Innovation as Part of the Management Control System

FABIO FREZATTI (UNIVERSITY OF SAO PAULO)

Co-author(s): Diogenes de Souza Bido (Universidade Prebiteriana Mackenzie) / **Ana Paula Capuano da Cruz** (Universidade Federal do Rio Grande) / **Maria José de Camargo Machado** (Universidade Metodista de Piracicaba)

Acknowledgements:
The authors want to recognize the support provided by CNPq, FAPESP and FIPECAFI during the research period.

Innovation as Part of the Management Control System

ABSTRACT

The objective of this research is to study the relationship between management control systems and the innovation process, taking into account the model from Simons (1995). The study is descriptive and quantitative and uses survey data that are analysed utilising structural equation modelling. The main contribution of this research is the identification of the influences exerted by the following: external stimuli and dynamic tensions on the direction of innovation strategies, dynamic tensions on the structure of the interactive control system, and the interactive control system on the structure of the diagnostic control system and on innovation intensity. No impact from the catalyst and obstructor elements on innovation process was confirmed. The influence of interactive system on the diagnostic was expected from literature but not confirmed. This find might consider that the efforts to maintain management control systems must be sensitive to the variables treated in the study.

1 INTRODUCTION

Periods of stability may seem to be good opportunities for developing the planning process in an organisation because decisions that are congruent with the goals and capabilities of the company may be made calmly; however, everyday reality is dynamic, requiring the continuous incorporation of additional variables into the analysis and the decision-making process. According to Simons (1995), the essence of management control is to provide support that enables management to balance the tension between innovative creation and the effort to meet expected targets, emphasising the need for the planning process to be dynamic and adaptive.

The findings of a survey conducted in 2009 by The Partners (a branding agency that sees creativity as a driver of organisational success and that develops ideas for brand designs, strategy and innovation for customers who require unusually creative solutions) indicate that innovation has not yet reached a stage of development that makes further innovation unnecessary (Mortimer, 2009). This agency's study also found that in many companies committed to innovation, i.e., those that consider it an element that must be included in their work plans, the need to innovate always exceeds innovative capacity; out of the 96% of executives who considered innovation essential to their business, only 23% of these executives perceived innovation as having successfully been made an integral element of their company's priorities.

Innovation planning and performance are closely related (Bes & Kotler, 2011). According to these authors, an organisation that does not have an innovation strategy ultimately squanders its efforts and makes mistakes that waste the organisation's time and resources, such as launching projects in categories and segments that are not priorities at a given time.

For Kumar (2004), the path to success in innovation involves a number of factors. According to this author, companies must be constantly aware of the external environment and the search for new opportunities and must develop a culture of innovation. When structured in this manner, Kumar (2004) believes that companies are able to develop planning processes that serve as the basis for the organisation to find untapped opportunities systematically and collaboratively, which is a feature that he considers fundamental to successful innovation.

This structuring requires a comprehensive framework with adjustments for inputs from various areas, such as market research, engineering, design, management control, branding, finance, and strategic planning (Kumar, 2004). Successful innovation therefore requires companies to plan innovation, and such planning must be supported by structured methods, tools and frameworks that allow integration between multidisciplinary teams and areas of multiple specificities. However, it has been noted that the role of management control with respect to its contribution to organisational innovation has rarely been demonstrated and has even been ignored altogether (Bisbe & Otley, 2004).

The urgent need to integrate innovation with management control systems has required many organisations to rethink their management models and direct their attention beyond short- and long-term goals, training their focus instead on other elements, such as organisational structure, information systems, the planning process, and definitions of governance. In fact, this period of organisational reflection provides an opportunity for revitalisation that is always relevant as a response to any type of crisis. In this sense, the concern with external stimuli increases because they are volatile and affect the maintenance of management stability and the model that assumes that stability is effective in such conditions.

Given this backdrop, the purpose of this study is to explore ways in which a management model can emphasise innovation in a proactively aware manner and at any level (corporate or within a sector). This investigation leads to the following research question:

how does the management control system relate to the innovation process?

The main contributions to the lacunae remaining from Simons' (1995) model are (i) questioning static posture, (ii) the relationship between stimuli external to the organisation and the management model, (iii) improving the relationship between dynamic tensions and the management model, and (iv) analysing the association between the diagnostic and interactive systems.

This article begins with an introduction that outlines the motivation behind the development of the study, the research question and the difficulties that certain organisations have been facing. Section 2 provides a literature review on the research topic, and Section 3 presents the theoretical model explored in this study and the hypotheses developed. The methodological design adopted in this research is described in Section 4. Section 5 presents the results of the study. Section 6 follows with a discussion that re-examines each of the tested hypotheses, and Section 7 presents conclusions drawn from the study.

2 LITERATURE REVIEW

For the development of this research, literature was reviewed that was related to the following themes: (i) management control systems, (ii) diagnostic and interactive control systems, (iii) dynamic tension, (iv) external stimuli, (v) catalyst or obstructor elements to innovation, and (vi) innovation.

2.1 MANAGEMENT CONTROL SYSTEM

The management control system of an organisation can be defined as a set of activities with the purpose of ensuring compliance with management plans (Anthony & Govindarajan, 2008). For a company to meet the challenge of realising its plans, an entire structure must be developed, and resources must be made available to support the desired actions. Otley (1994) presented a possible separation of the elements that may comprise management control, considering both strategic and operational planning.

Despite the breadth of Anthony and Govindarajan's (2008) approach to the concept of the management control system and that it is a classical definition, this research followed the more current definition of the management control system, which is the definition proposed by Berry, Broadbent and Otley (2005) that is more congruent with Simons (1995). Thus, for the purposes of this study, a management control system represents the process of guiding the organisation toward viable patterns of activity in a changing environment. Indeed, Simons (1995) considered that managerial control mechanisms were part of diagnostic control but were potentially not used in interactive control (Bisbe & Otley, 2004).

2.2 DIAGNOSTIC AND INTERACTIVE CONTROL SYSTEMS

The levers of control model developed by Simons (1995) is underpinned by the argument that command and control techniques are not sufficient for the successful implementation of strategy in a dynamic and competitive environment in which creativity and the initiative of the organisation's employees are important for its success.

Based on the need to seek the best adjustment between different tensions, Simons (1995) proposes a lever system that helps to control strategy. In the author's view, there are four levers of control: (i) beliefs systems, (ii) boundary systems, (iii) diagnostic control systems, and (iv) interactive control systems. One of the greatest challenge for business management lies in balancing these different tensions, particularly with respect to understanding the use of these systems to manage tensions.

The beliefs system includes definitions that senior management use to communicate formally and strengthen the basic values, purpose and direction of the organisation (Simons, 1995). In this system, formalisation plays a vital role in the organisation, acting to reduce the

ambiguity that often confounds organisational actions and enabling a quick and clear identification of what is (or should be) undertaken by the company.

The boundary system outlines what is acceptable for the organisation's participants. This system does not specify what should be undertaken but clarifies the limitations of risks to be taken in the pursuit of opportunities (Simons, 1995). In general, it is assumed that individuals are looking for opportunities and managers are unable to identify all of the possible problems, leading to the necessity for guidance and a focus on delegation of authority. Moreover, standardising processes most likely will have a negative effect on creativity and flexibility (Simons, 1995); combining the beliefs and boundary systems leads to the demarcation of a "window of opportunity" to which managers should apply their energies.

The diagnostic control system seeks to ensure that decisions are aligned with the goals of the organisation (Simons, 1995). Without being specific, when authors refer to management control, they typically are only referring to the diagnostic information system. The diagnostic control system is the formal system of organisational information that monitors results and corrects deviations from expected performance standards. This system should provide conditions for negotiation and goal setting and receive developmental information for management self-assessment and monitoring. The operationalisation of diagnostic control occurs through such artefacts as strategic planning, capital budgets, annual budgets, the Balanced Scorecard, rolling forecasts, and budgetary control.

Once structured and standardised, the diagnostic control system illustrates what can be accomplished and simultaneously limits creativity and innovation. Because of these limitations, Simons (1995) reinforces the importance of the interactive system, which circumvents these problems and aims to provide answers to management elements that were not considered in the strategic planning process previously developed. Thus, the interactive control system refers to the formal systems that involve managers in the decisions of subordinates; this system's focus of attention is on aspects of control that do not routinely appear in information systems. Indeed, the interactive system assumes that strategic planning does not create or provide strategy but merely provides its implementation and control (Simons, 1995).

The diagnostic control system limits innovation and opportunities because its function is to ensure that plans are achieved (Simons, 1995). This system's action should increase the predictability of achieving goals. Nonetheless, among the dynamic tensions in the conflict between focussing on established goals and having the freedom to innovate, the pressure for cooperation is the driving force of innovation. Thus, the management control system plays a critical role in pressuring the organisation to adapt and innovate. The operationalisation of management by integrating these two systems (interactive and diagnostic) is not addressed in the literature. Thus, this study explores the process of association between these two systems, which have different specific purposes but both aim at contributing to its occurrence with respect to innovation generally.

2.3 DYNAMIC TENSION

Dynamic tension is an expression used by Simons (1995) to characterise antagonistic situations that must be defined (e.g., old vs. new, maintenance vs. change, freedom vs. restriction, and empowerment vs. accountability) and are, in a way, part of organisational life and management. Mundy (2010) believes that management control acts on dynamic tensions by both creating and balancing them and that this constitutes the central concept in any discussion regarding dynamic tension. This author further argues that finding the correct balance between control and freedom of action is not easy when optimising available resources and tools (Mundy, 2010).

Henri (2006) proposes the following three distinct types of dynamic tension: (i)

unlimited opportunities *versus* limited attention, (ii) intended strategy *versus* emergent strategy, and (iii) self-interest *versus* desire to contribute. Different examples of dynamic tension have been discussed by several authors, including the following: (i) flexibility *versus* control (Davila & Wouters, 2005), which indicates the degree of freedom that managers have to act, and consistency in management would lead the organisation to structure its management control system to operate according to the desired balance, (ii) competition *versus* cooperation (Etherington & Tjosvold, 1998), which implies the stimulation of internal competition in the organisation while simultaneously aiming to achieve collaboration between managers, and an important means of achieving this goal may be to act strongly in structuring individual and shared indicators, (iii) growth *versus* risk (Porter, 1989; Sutton, 1998), which is the permanent conflict inherent in structuring organisational strategy and internal balance according to the strategic vision for the planned period, and (iv) long-term *versus* short-term (Sitkin, 1996), which emphasises the actions and allocation of resources. What seems to be absent in the literature is any discussion about the complementarity or exclusivity of the relationship between the alternatives.

2.4 External stimuli

The approach of Groot and Lukka (2000) is used to include elements external to the organisation in the analysis because these can explain occurrences and dynamics within the management model. Consistently with the proposal of Simons (1995), while recognising external elements, the model is geared toward a relatively static perspective or one not oriented towards change and the effect of external stimuli. The following factors are considered external stimuli (Groot & Lukka 2000): (i) the dynamics of international competition when it ceases to be an option and becomes compulsory (Gupta & Govindarajan, 2001), (ii) governmental regulation and deregulation, (iii) customer increases and demands, (iv) restrictions on the availability of scarce resources, and (v) advances of competition that threaten current and future products.

From an epistemological point of view, the approach of Groot and Lukka (2000) is consistent and has similarities with Simons (1995) when dealing with business reorientation, for example, which consists of the definition and implementation of strategies, for Simons (1995). By suggesting and including restructuring and changes in organisational arrangements, Groot and Lukka's (2000) approach is thus complementary to Simons' (1995) model. In certain aspects, however, the former approach is more restrictive in terms of what is considered – adjustments in accounting, for example – and in other aspects, it is more complementary and dynamic – addressing change, for example – even when they relate to changes identified in organisational arrangements.

2.5 Catalyst and Obstructor Elements of Innovation

Naranjo-Gil, Maas, and Hartmann (2009) suggest that innovation can be affected simultaneously by stimulating factors and factors that determine organisational skills and the capacity to address change. Additionally, these authors consider that organisational strategy should be treated as a precursor to the design of the management control system.

When dealing with occurrences that are directly linked to the onset of change, catalyst drivers contain factors directly linked to the timing of the change. Groot and Lukka (2000) believe that an action may be demanded at a particular point in time, such as when an alliance is broken or when profitability decreases. Thus, certain moments may act as catalysts for organisational change. While motivation is a broad concept, a catalyst is something more specific, urgent and pressing.

In turn, facilitator drivers comprise elements that are conducive to change and are necessary but not sufficient to bring about change, such as top management support and availability of information systems. Conversely, obstructor drivers, such as complex decision-

making processes and structural inertia, inhibit and prevent change.

2.6 INNOVATION

Innovation is a process that includes technical activity, design, development and management that results in the commercialisation of new (or improved) products or the first use of new (or improved) processes (Freeman, 2004). Operationally, it can also be defined as doing more with fewer resources by enabling efficiency gains in service delivery or in processes, whether productive, administrative, or financial. Innovation can occur in processes, products, or in the organisation (Rogers, 1995). With regard to intensity, innovation may be incremental, radical or disruptive (Arcand, Grisales, Facal, & Dupuis, 2010).

3 THEORETICAL MODEL AND HYPOTHESES

The theoretical model (Figure 1) takes into account precursors of managerial control (external stimuli, innovation strategies and dynamic tensions), the management control system itself (diagnostic and interactive control systems), and the innovation process (catalysts, obstructors and innovation intensity).

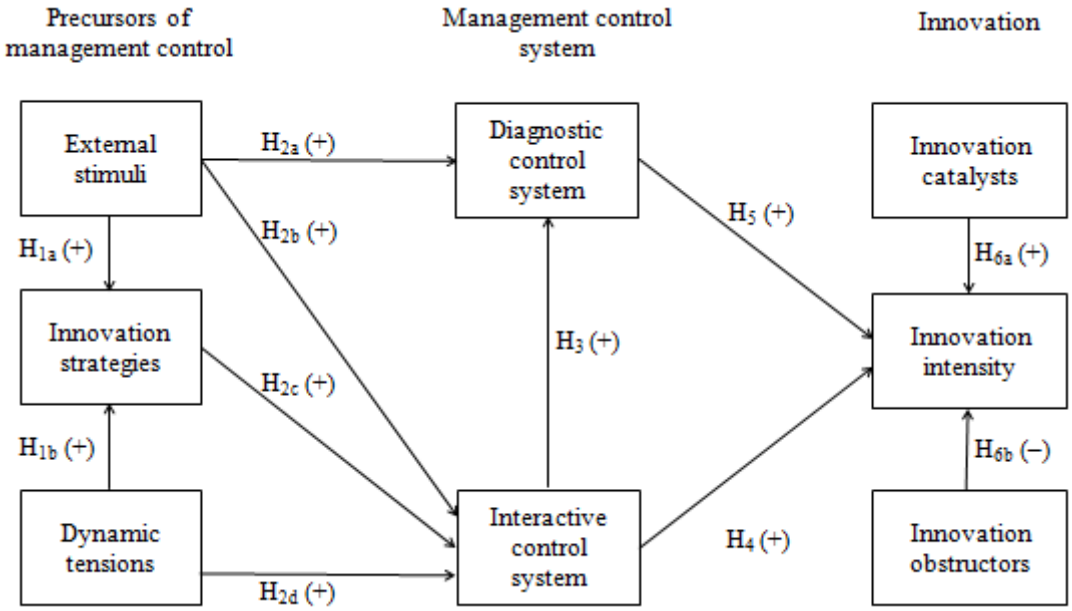

Figure 1. Hypothetical model of the Levers of Control as Innovation Mediators

3.1 RELATIONSHIP BETWEEN MANAGEMENT CONTROL SYSTEM PRECURSORS

Organisations exist in a given environment and constantly interact with that environment. Within these interactions, external stimuli occur that can affect the company's activities, which makes them complex (Kaplan & Norton, 1996). Thus, in the hypothetical model of this study, it is assumed that there are precursors to control systems; in this case, those precursors are external stimuli, innovation strategies, and dynamic tensions.

When the organisation develops its plans and innovation strategies, the environment in which it exists is changing. The relationship between external stimuli and innovation strategies (e.g., the prioritisation of actions focused on processes, products, and organisation) is particularly relevant to understanding its model as a whole (Kaplan & Norton, 1996). This effect tends to be observed, for example, when an organisation under a great deal of competitive pressure is motivated to re-structure in a different manner such that it is less affected by this factor (Simons, 1995). Similarly, movements by competitors toward the company's products and services can provide significant incentives to the innovation process and lead to new product launches (Groot & Lukka, 2000).

Additionally, dynamic tensions also exert influence on innovation strategies, complementing the effect of external elements. This tension can be observed, for example, when the organisation realises that competitors are directing their efforts to lower-priced products (external stimulus), and because of dynamic tensions, the organisation begins to do the same – although not in the short term. The main point regarding this tension is that this dynamic can be structured and organised (Mundy, 2010).

This leads to the formulation of the first group of **hypotheses**:

(H_{1a}) External stimuli have a positive influence on the direction of innovation strategies.

(H_{1b}) Dynamic tensions have a positive influence on the direction of innovation strategies.

3.2 Relationship between Precursors and Interactive and Diagnostic Control Systems

In addition to influencing strategic direction, external stimuli influence interactive and diagnostic control systems. For interactive control, the influence of these stimuli can be observed in exerting pressure to find answers to generate new strategies; in diagnostic control, their influence is observed in terms of providing information that enables monitoring and redirecting activities. Thus, external stimuli cannot be overlooked as precursors because they are important in the structuring process of interactive and diagnostic control systems.

Dynamic tension, in turn, affects the design of the interactive control system. Although recognising that dynamic tension influences the organisation's strategies to a certain degree, Simons (1995) is not concerned with operationalization or with identifying the effect of these strategies.

In addition to external stimuli and dynamic tensions, the profile of the innovation strategy of the organisation itself has an effect on the design of the management control system. Directing the innovation strategy for a product, process or organisation creates demands on the interactive control system. The importance of these elements refers mainly to the complexity that they bring to structuring the management control system.

Therefore, based on these arguments, the following hypotheses can be formulated:

(H_{2a}) External stimuli positively affect the structuring of the diagnostic control system.

(H_{2b}) External stimuli positively affect the structuring of the interactive control system.

(H_{2c}) Innovation strategies positively affect the structuring of the interactive control system.

(H_{2d}) Dynamic tensions positively affect the structuring of the interactive control system.

3.3 Relationship between the Management Control System and Innovation Intensity

For Simons (1995), the interactive control system should stimulate the demand and learning that make the organisation's new or emerging strategies viable, unlike the diagnostic control system. This author believes that the innovation process must be stimulated. Essentially, the interactive control system focuses on the entire organisation, thus forcing the establishment of a dialogue between different parts of the company in the author’s words. The search for these dialogues provides the basis for demanding the establishment of a specific agenda for debates of this nature and thus motivates the search for information that circulates in channels other than those that normally attract the organisation’s attention (Simons, 1995).

While focusing on something out of the ordinary, creative and futuristic, the maintenance of this supposed agenda of dialogues that touch on any type of innovation

implies a degree of positioning and decision-making, which, in turn, requires a level of diagnostic system structure to generate support for its existence. In this sense, integration is relevant, and the interactive system becomes conditional upon the support of the diagnostic system. Thus, although it is focussed on stimulating innovation, would there be an influence of one type of effect (or even control) over the other? This possibility leads to the following hypothesis:

(H_3) The interactive control system positively affects the structuring of the diagnostic control system.

If a diagnostic control system is structured and standardised to show only what can be followed, it places limitations on creativity and innovation. An interactive system does not have these characteristics and seeks answers to management elements that were not previously considered. Otley (2003) believes that the interactive system exists to challenge the organisation, thereby stimulating questions about its adopted strategies.

Managerial control artefacts such as strategic planning, budgeting, Balanced Scorecard, rolling forecast, capital budgeting, and budgetary control are usually understood as related to the diagnostic control system. However, these artefacts can be used to stimulate the actions of the interactive system (Bisbe & Otley, 2004).

From a rational perspective, Galbraith (1977) emphasises that uncertainty stems from the difference between information required and information provided. Thus, strategic information, even though not necessarily structured, can reduce uncertainty and is demanded by the organisation to support the identification and management of new opportunities and innovation. The interactive control system corresponds to formal and informal systems involving managers in the decisions of subordinates (Naranjo-Gil & Hartmann, 2007), thus drawing the focus of attention towards features that do not routinely appear in information systems.

Indeed, Simons (1995) emphasises that the interactive system assumes that strategic planning does not provide strategy but implements and controls it instead. This author also believes that the diagnostic control system limits innovation and opportunities (Simons, 1995) because its function is to ensure that plans are achieved. The system's action should increase the predictability of achieving goals. Among dynamic tensions – the conflict between focussing on established goals and having the freedom to innovate – the pressure for cooperation is the driving force of innovation.

Bisbe and Otley (2004) were unable to confirm an association between greater interactive use and greater product innovation. Thus, the management control system plays a critical role in creating pressure on the organisation to adapt and innovate. This effect leads to the formulation of the following hypothesis:

(H_4) The interactive control system positively affects innovation intensity.

Although the diagnostic control system is designed to ensure that what was planned is executed (Henri, 2006), its effect on the innovation process can nonetheless be observed. Henri (2006) recognises that the diagnostic control system can be used interactively. When studying the use of the diagnostic system, Kober, Ng and Paul (2007) found that meetings to discuss budgets, a typical diagnostic control system tool, influenced organisational strategy. Although such artefacts are not intended for use in discussing strategy, their use inspires reflection on that strategy. Similarly, Naranjo-Gil and Hartmann (2007) also examined the subject of artefacts moderating the relationship between strategy and innovation.

Agbejule (2011) discussed the combined effect of the diagnostic and interactive use of management control artefacts and found that less frequent use of diagnostic instruments and more frequent use of interactive tools generate a positive effect on performance. While the diagnostic control system is designed to improve efficiency and not to emphasise innovation (Davila, 2005), the system's use in tracking critical performance variables and monitoring and

coordinating strategies is conducive to successful innovation. Thus, the benefits of innovation are perceived as important and occur in organisations. These benefits lead to the formulation of the following hypothesis*:*

***(*H_5) The diagnostic control system positively affects the intensity of previously planned innovation.**

3.4 Relationship between the Catalyst and Obstructor Elements and Innovation Intensity

Obstructors of innovation are elements that prevent, delay, or hinder the innovation process (Groot & Lukka, 2000), whereas catalysts are elements that trigger that process. Simons (1995) found that competitive pressure is a catalyst for innovation and adaptation in the organisation. Porter (1989) also suggests that an environment of domestic competition exerts more pressure to innovate than less competitive environments. Consequently, the following hypotheses can be formulated:

(H_{6a}) Catalyst elements are positively associated with innovation intensity.

(H_{6b}) Obstructor elements are negatively associated with innovation intensity.

4 METHODOLOGY

This section describes the methodological procedures in the development of this research, particularly those that help in the understanding of its operationalisation. The following information is provided: (i) the instrument used for data collection, (ii) the process of data collection itself, and (iii) the resources used to process and analyse data.

4.1 Data collection tool

This research was conducted with the use of a questionnaire consisting of closed questions, divided into blocks (see Appendix), seeking to map information concerning the following: (i) the external stimuli that affect the innovation process, (ii) innovation strategies used by the studied organisations, (iii) the dynamic tensions found in these organisations, (iv) diagnostic control systems, (v) interactive control systems, (vi) catalysts, (vii) obstructors to innovation, and (viii) innovation intensity.

The scales used are shown in the Appendix and content validity (Netemeyer, Bearden, & Sharma, 2003) was obtained by developing indicators in accordance with the definitions of the constructs and by the pre-test conducted with potential respondents.

4.2 Data Collection

To delimit the study population, companies were taken from those listed in the publication "Best and Biggest 2010" (*Melhores & Maiores 2010*). Thus, from the 1,825 organisations listed in this publication (the target population), a sample of 121 large companies was obtained and defined for convenience. Data collection was conducted via email between June and August 2011 with technological support from the Formsite system.

The companies were contacted by telephone to confirm receipt of the message, present the research to respondents and request their cooperation in completing the questionnaire. Information regarding academic training, the time elapsed since such training, and the professional occupation of respondents in the organisation indicated adequate professional maturity and an appropriate hierarchical level and degree of training for the research topic. The data showed that 75% of respondents had been in the company for over five years, and 71% had been in their current position for over five years, with 63% holding the office of director or superintendent and 24% that of manager.

4.3 Data Analysis

In addition to univariate descriptive analysis, structural equation modelling (SEM) was

used with estimation by partial least squares (PLS-PM - Partial Least Squares Path Modelling), which was considered the most appropriate method for this research because of the non-normality of data, the small sample made available for SEM estimation based on covariance (LISREL, AMOS, EQS, etc.), and the exploratory nature of the research (Henseler, Ringle, & Sinkovics, 2009; Ringle, Sarstedt, & Straub, 2012), on the one hand, and because it enables the measurement and structural models to be estimated with a complexity that would not be possible with multiple regression models, on the other. The software used was SmartPLS 2.0.M3 (Ringle, Wende, & Will, 2005).

5 RESULTS

5.1 ASSESSMENT OF THE MEASUREMENT MODEL

Before testing the hypotheses, it was necessary to ascertain whether the measurement of constructs was adequate. Convergent validity, discriminant validity and reliability were used for this purpose.

Regarding convergent validity, it could be observed that all indicators showed significant factor loadings ($p < 0.01$, Appendix) and average variance extracted from the eight latent variables was greater than 45% (Table 1).

It is noteworthy that values above 50% have been recommended for average variance extracted (Henseler et al., 2009; Ringle et al., 2012), and the values could be increased by the elimination of indicators with smaller factor loadings, in this case. However, because eliminating this would undermine the content validity and replicability of the study (Devellis, 2003, Little, Lindenberger, & Nesselroade, 1999), the decision was made to keep all indicators.

Discriminant validity was evaluated at the level of the indicators that could be observed to all have greater factor loadings in their respective latent variables than in any other (the cross loadings table was not included for lack of space but is available from the first author) and was also evaluated at the latent variable level, as can be observed in Table 1, where the square root of the average variance extracted was greater than the correlations between latent variables (Henseler et al., 2009; Ringle et al., 2012). Therefore, discriminant validity is adequate.

Table 1: Matrix of correlations between latent variables

Latent variables	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1. External stimuli	**0.670**							
2. Dynamic Tension	0.214	**0.711**						
3. Innovation Strategies	0.352	0.312	**0.688**					
4. Diagnostic System	0.263	0.266	0.214	**0.724**				
5. Interactive System	0.304	0.473	0.343	0.332	**0.795**			
6. Catalysts	0.365	0.175	0.066	0.059	0.234	**0.710**		
7. Obstructors	0.123	-0.003	-0.063	-0.091	-0.067	0.247	**0.676**	
8. Innovation Intensity	0.211	0.183	0.408	0.223	0.333	0.177	-0.127	**0.684**
Mean	4.0	3.9	4.3	3.4	3.8	3.5	3.2	4.0
Standard Deviation	0.70	0.65	0.64	0.65	0.91	0.88	0.93	0.79
Coefficient of Variation	17%	17%	15%	19%	24%	25%	30%	20%
Scale	(a)	(a)	(a)	(b)	(b)	(b)	(b)	(a)
Average Variance Extracted	0.45	0.51	0.47	0.52	0.63	0.50	0.46	0.47
Composite Reliability	0.76	0.80	0.82	0.88	0.90	0.75	0.80	0.77

Note 1: Correlations greater than | 0.180 | are significant at 5% and greater than | 0.230 | are significant at 1%.
Note 2: On the diagonal the square root of the average variance extracted is in bold.
Legend: (a) = 5, 4, 3, 2, 1, 0 = Strongly Agree, PA; NAND, PD; Totally disagree, Do not know
(b) = 4, 3, 2, 1, 0 = Exists and is used to measure and monitor the effect of innovation; Exists and is

used in a general way, not to monitor innovation; Exists but is not really used for management; Does not exist in the organisation; Do not know.

The composite reliability of all latent variables was higher than 0.7, a value that is considered adequate by Hair Jr., Black, Babin, and Anderson (2010).

5.2 Evaluation of the Structural Model

The evaluation of the structural model took into account the results of structural coefficients (Figure 2) that were, in turn, compared with the correlations (Table 1) when the possible occurrence of non-significant results because of multicollinearity was suspected (J. Cohen, Cohen, West & Aiken, 2002).

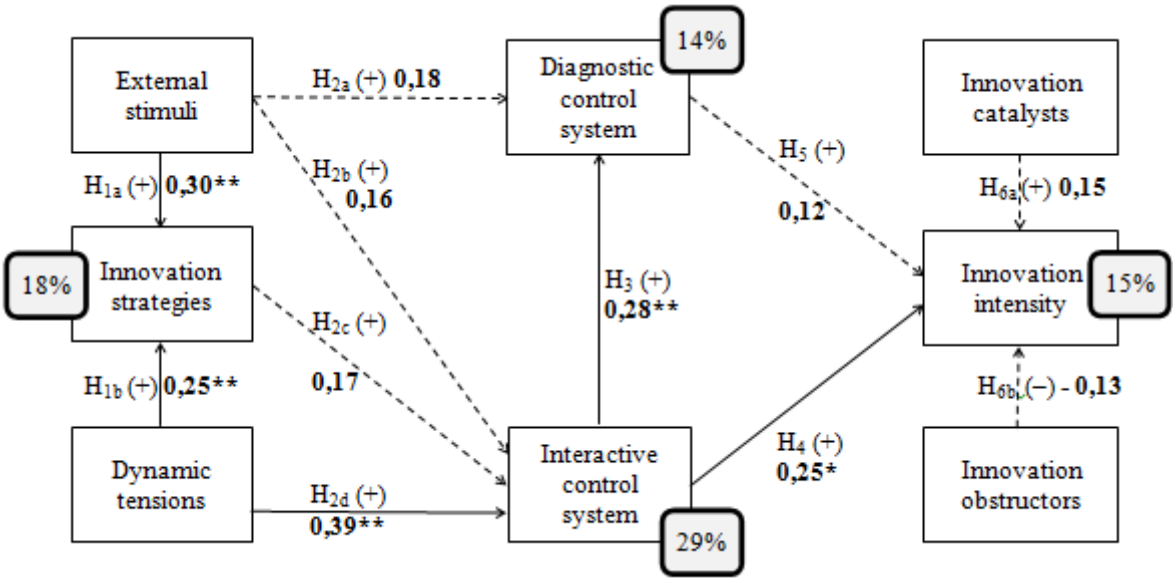

Figure 2. Results of the structural model

Legend: ** p <0.01, two-tailed. * p <0.05, two-tailed. (dashed arrow) = not significant (p >0.05)
Note: Model estimated using SmartPLS 2.0.M3 software with path weighting scheme.
Significances estimated by bootstrap with 121 cases and 1000 resamplings.
Source: Research data

The coefficients of determination (R^2) of the endogenous latent variables were analysed; the total effects (sum of direct and indirect effects) were also analysed.

Despite the fact that the structural coefficient (Figure 2) was not significant for H_{2a} and H_{2b}, the correlation between the external stimuli and the interactive control system was 0.30 ($p < 0.01$) and the correlation between external stimuli and the diagnostic control system was 0.26 ($p < 0.01$). This result is low but suggests that the non-significant structural coefficient may be observed because of the effect of multicollinearity, even if this effect is low (J. Cohen et al., 2002).

Confirming the low effects of external stimuli, it can be observed that their total effect (direct plus indirect) was 0.21 on the interactive control system and 0.24 on the diagnostic control system.

The same was true for H_{2c}, where the structural coefficient is not significant, but the correlation is 0.34 ($p < 0.01$) between innovation strategies and the interactive control system.

6 DISCUSSION

This subsection presents a discussion of the hypotheses tested:

(H_{1a}) External stimuli have a positive influence on the direction of innovation strategies.

(H_{1b}) Dynamic tensions have a positive influence on the direction of innovation

strategies.

Both hypotheses were validated, corroborating previous studies (Groot & Lukka, 2000; Kaplan & Norton, 1996; Simons, 1995). The elements selected to analyse and validate these hypotheses were the dynamics of international competition, increased customer demand and competitor advances that bring threats to current and future products.

The organisations have low levels of control over these elements, and the elements have a major effect on the organisations' survival. This finding indicates that relevant changes in these variables require alterations to the organisation's direction in terms of innovations in processes, products, in the organisation itself, or the manner in which products and/or services are delivered.

(H_{2a}) External stimuli positively affect the structuring of the diagnostic control system.

(H_{2b}) External stimuli positively affect the structuring of the interactive control system.

(H_{2c}) Innovation strategies positively affect the structuring of the interactive control system.

(H_{2d}) Dynamic tensions positively affect the structuring of the interactive control system.

Of these factors, only hypothesis H_{2d} was validated, which corroborates the results found in the previous literature (Henri, 2006; Simons, 1995). Dynamic tensions therefore have a significant effect on interactive control structuring, but no influence of precursor variables could be confirmed on the structuring of the diagnostic system. In other words, an influence of the external environment on both diagnostic and interactive control systems could not be confirmed. This finding indicates that neither the diagnostic nor the interactive control systems are adjusting because of changes occurring outside the organisation. Even changing innovation strategies did not affect control systems.

(H_3) The interactive control system positively affects the structure of the diagnostic control system.

This hypothesis was validated. The existence and development of the interactive control process feeds and challenges diagnostic control, causing it to be changed in accordance with the organisation's activities. Thus, interactive control leads to improvements in diagnostic control.

(H_4) The interactive control system positively affects innovation intensity.

This hypothesis was validated. The finding supports the approach of Simons (1995) and is inconsistent with the findings of Bisbe and Otley (2004), who did not obtain evidence that this occurs. In one sense, the flexibility provided by the interactive system has an effect on innovation intensity. In more objective terms, an organisation that is limited to incremental innovation or other types of progress, regardless of its industry sector and type of business, is more connected in terms of internal structure to the interactive control system than the diagnostic one.

(H_5) The diagnostic control system positively affects previously planned innovation intensity.

This hypothesis was not validated. Consistent with Simons' (1995) proposal, there was no evidence that diagnostic control provides a significant contribution to an organisation's innovation process as a result of its rigidity and demanding structure.

(H_{6a}) Catalyst elements are positively associated with the innovation intensity.
(H_{6b}) Obstructor elements are negatively associated with innovation intensity.

Neither of these hypotheses was validated. Although the literature indicates that there are elements that prevent, hinder, and/or delay the innovation process (Groot & Lukka, 2000) and that there are also elements that accelerate the process of innovation in the organisation, no evidence to that effect was found in this study.

7 CONCLUSIONS

The first general conclusion of this study is that the development of diagnostic and interactive control systems depends on precursors comprising distinct elements, such as external stimuli, innovation strategies, and dynamic tensions. However, there is a "path" traversed by these variables, and they are filtered in stages, beginning with external stimuli, passing through innovation strategies, and proceeding via the balancing of dynamic tensions before reaching the interactive control system.

No effect of the diagnostic system could be verified concerning innovation intensity, although it influenced control. This conclusion is important because it shows that the design of control systems, known to be contingently adapted for the organisational management model, is indirectly influenced by variables over which the company has little control (external stimuli), variables that are induced by the management control model (dynamic tensions), and by variables that constitute internal decisions, although they are affected by others (innovation strategies).

The interactive system's influence on the diagnostic system and on innovation intensity was demonstrated. This finding indicates that the rites and informal paths that the interactive system employs to meet organisational demands, including identification of emerging strategies, also influence the diagnostic control system. This result supports the idea that the diagnostic system should at any point incorporate elements that had previously passed through the interactive system.

Finally, no effect of catalyst and obstructor variables could be found on the development of innovation. In this study, these two elements did not influence innovation.

Although no generalization is possible, due to the design of the field research, the implications of this research are that the structuring and maintenance of management control systems should be sensitive to the influences of the variables identified; otherwise, these systems would be detached from actual events and the needs of the organisation. This perspective is important in various aspects of management, particularly in monitoring the innovation process.

REFERENCES

Agbejule, A. (2011). Organizational culture and performance : the role of management accounting system. *Journal of Applied Accounting Research*, *12*(1), 74-89. doi:10.1108/09675421111130621

Anthony, R. N., & Govindarajan, V. (2008). *Sistemas de controle gerencial* (12th ed., p. 769). São Paulo: McGraw- Hill.

Arcand, S., Grisales, R. M., Facal, J., & Dupuis, J. P. (2010). *Sociología de la empresa: del marco histórico a las dinámicas internas*. Bogota: Siglo del Hombre.

Berry, A. J., Broadbent, J., & Otley, D. (2005). *Management control: theories, issues and performance* (2nd ed.). Basingstoke: Palgrave Macmillan.

Bes, F. T. de, & Kotler, P. (2011). *A bíblia da inovação* (p. 332). Sao Paulo: Leya.

Bisbe, J., & Otley, D. (2004). The effects of the interactive use of management control systems on product innovation. *Accounting, Organizations and Society*, *29*, 709-737. doi:10.1016/j.aos.2003.10.010

Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2002). *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*. *Cases in Management Accounting* (p. 736). New Jersey: Routledge Academic.

Davila, T. (2005). The promise of management control systems for innovantion and strategic change. In C. S. Chapman (Ed.), *Controlling strategy: management, accounting, and performance measurementmeasurement* (1st ed., pp. 37-61). Oxford University Press.

Davila, T., & Wouters, M. (2005). Managing budget emphasis through the explicit design of conditional budgetary slack. *Accounting, Organizations and Society*, *30*, 587-608. doi:10.1016/j.aos.2004.07.002

Devellis, R. F. (2003). *Scale development: theory and applications* (2nd ed.). Thousand Oaks: Sage Publications.

Etherington, L., & Tjosvold, D. (1998). Managing budget conflicts: contribution of goal interdependence and interaction. *Revue Canadienne des Sciences de l'Administration*, *15*(2).

Freeman, C. (2004). The "national system of innovation in historical perspective." *Revista Brasileira de Inovação*, *3*(1), 15-34.

Galbraith, J. R. (1977). *Organization design*. Reading: Addison Wesley Longman.

Groot, T., & Lukka, K. (2000). *Cases in Management Accounting*. (Prentice Hall, Ed.). Harlow.

Gupta, A. K., & Govindarajan, V. (2001). Converting global presence into global competitive advantage. *Academy of Management Executive*, *15*(2), 45-58.

Hair Jr., J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate Data Analysis*. Upper Side River: Prentice Hall.

Henri. (2006). Management control systems and strategy: A resource-based perspective. *Accounting, Organizations and Society*, *31*(6), 529-558. Elsevier. doi:10.1016/j.aos.2005.07.001

Henseler, J., Ringle, C. M., & Sinkovics, R. R. (2009). The use of partial least squares path modeling in international marketing. *Advances in International Marketing*, *20*, 277-319.

Kaplan, R. S., & Norton, D. P. (1996). *Balanced Scorecard: translating strategy into action*. Boston: Harvard Business School Press.

Kober, R., Ng, J., & Paul, B. J. (2007). The interrelationship between management control mechanisms and strategy. *Management Accounting Research*, *18*, 425-452. doi:10.1016/j.mar.2007.01.002

Kumar, V. (2004). Innovation planning toolkit. *Futureground International Conference* (Vol. 8785, pp. 17-21). Melbourne.

Little, T. D., Lindenberger, U., & Nesselroade, J. R. (1999). On selecting indicators for multivariate measurement and modeling with latent variables: when "good" indicators are bad and "bad" indicators are good. *Psychological Methods*, *4*(2), 192-211.

Mortimer, R. (2009). Turn creativity into strategy for success. *Marketing Week*, (16).

Mundy, J. (2010). Creating dynamic tensions through a balanced use of management control systems. *Accounting, Organizations and Society*, *35*(5), 499-523. Elsevier Ltd. doi:10.1016/j.aos.2009.10.005

Naranjo-Gil, D., & Hartmann, F. (2007). Management accounting systems , top management team heterogeneity and strategic change. *Accounting, Organizations and Society*, *32*, 735-756. doi:10.1016/j.aos.2006.08.003

Naranjo-Gil, D., Maas, V., & Hartmann, F. (2009). How CFOs determine management accounting innovation: an examination of direct and indirect effects. *European Accounting Review*, *18*(4), 667-695. doi:10.1080/09638180802627795

Netemeyer, R. G., Bearden, W. O., & Sharma, S. (2003). *Scaling procedures: issues and applications* (1st ed., p. 224). Sage Publications.

Otley, David. (1994). Management control in contemporary organizations: towards a wider framework. *Management Accounting Research*, *5*(3-4), 289-299. doi:10.1006/mare.1994.1018

Otley, David. (2003). Management control and performance management : whence and whither? *The British Accounting Review*, *35*, 309-326. doi:10.1016/j.bar.2003.08.002

Porter, M. (1989). *Vantagem competitiva*. Rio de Janeiro: Campus.

Ringle, C. M., Sarstedt, M., & Straub, D. W. (2012). A critical look at the use of PLS-PM in MIS Quarterly. *MIS Quarterly*, *36*(1), iii-xiv.

Ringle, C. M., Wende, S., & Will, A. (2005). *SmartPLS 2.0 M3 (beta)*. Germany: University of Hamburg.

Rogers, E. M. (1995). *Diffusion of innovations*. New York: The Free Press.

Simons, R. (1995). *Levers of Control: How managers use innovative control systems to drive strategic renewal* (p. 232). Boston: Harvard Business Press.

Sitkin, S. B. (1996). Learning through failure: the strategy of small losses. In M. D. Cohen & L. S. Sproull (Eds.), *Organizational Learning* (pp. 541-578). Thousand Oaks: Sage Publications.

Sutton, C. (1998). *Strategic concepts*. Macmillan, Basingstoke.

APPENDIX

		S	M	SD	FL
External stimuli	Answer the questions below according to your level of agreement. As a general rule, in your organisation, external stimuli for INNOVATION come from:				
	Q251 dynamics of international competition	(a)	3.4	1.56	0.64
	Q252 governmental regulation and deregulation	(a)	3.9	1.13	X
	Q253 increases in customer demands	(a)	4.5	0.87	0.76
	Q254 restrictions on the availability of scarce resources	(a)	3.7	1.22	0.50
	Q255 competitor advances that threaten current and future products	(a)	4.0	1.19	0.75
	Q256 other external stimulus (stimuli) [please identify below]	(a)	1.3	1.91	X
Dynamic tensions	Dynamic tension in a company is something that creates a conflict in its management. Indicate your level of agreement with the specified types of dynamic tension more relevant to innovation opportunities:				
	Q511 unlimited opportunities (worth any innovation opportunity)	(a)	3.2	1.15	X
	Q512 limited attention (the focus is clearly defined as is the time used to make the focus viable)	(a)	3.7	1.02	0.64
	Q521 current strategies (previously decided in the formal planning process)	(a)	4.0	0.96	0.84
	Q522 emerging (not yet observed in the formal planning process)	(a)	3.7	0.94	0.65
	Q531 manager self-interest	(a)	3.6	1.18	X
	Q532 desire to contribute to the organisation	(a)	4.2	0.76	0.70
Innovation Strategy	Answer the questions below according to your level of agreement. As a general rule, in your organisation INNOVATION encompasses changes (in business dimensions):				
	Q221 in processes	(a)	4.4	0.75	0.74
	Q222 in technologies	(a)	4.5	0.74	0.69
	Q223 in products	(a)	4.3	1.06	0.52
	Q224 in the organisation	(a)	3.9	1.21	0.64
	Q225 in the manner in which products and services are marketed/offered	(a)	4.0	1.08	0.81
	Q226 other alternative(s) [please identify below]	(a)	1.2	1.79	X
Control System	Answer the questions below according to your level of agreement.				
	Q111. there is formalised strategic planning in the company	(b)	3.2	0.97	0.79
	Q112. the company has an annual budget	(b)	3.7	0.74	0.67
	Q113. the budget is aligned with and derives from strategic planning	(b)	3.1	1.05	0.87
	Q114. there is a rolling forecast (projections aimed at providing financial results)	(b)	3.2	1.13	0.67
	Q115. there is a capital budget (plan of investment projects)	(b)	3.4	0.99	0.77
	Q116. the company has budgetary control	(b)	3.7	0.52	0.72
	Q117. individual performance explained by budgetary control affects the variable remuneration of the executive	(b)	2.5	1.39	0.51
Interactive Control System	To what extent do you agree that the organisation has the characteristics described below for identifying projects and actions that involve INNOVATION?				
	Q411. information on innovation is an important element for the highest level of managers	(b)	4.0	1.20	0.77
	Q412. regular and frequent attention is devoted to the analysis and discussion of innovation by managers at all levels	(b)	3.6	1.26	0.84
	Q413. data generated by the system are interpreted and discussed in meetings with superiors, subordinates and peers	(b)	3.7	1.24	0.84
	Q414. the system is a way to catalyse the ongoing challenge and subsequent debates about information, expectations and plans	(b)	3.5	1.37	0.80
	Q415. the innovation project is monitored after implementation	(b)	3.8	1.38	0.72
Catalysts	Answer the questions below according to your level of agreement. In your opinion, in your organisation, the following are catalysts and stimulators of INNOVATION:				
	Q271. broken alliances	(b)	2.6	1.45	0.69
	Q272. established alliances	(b)	3.9	1.14	0.75
	Q273. decrease in profitability	(b)	3.8	1.32	0.69
	Q274.others	(b)	1.5	2.04	X
Obstructors	Answer the questions below according to your level of agreement. In your opinion, in your organisation, the following elements obstruct INNOVATION:				
	Q261. complex processes to be developed	(b)	3.7	1.13	X
	Q262. inertia of the organisation in finding answers	(b)	3.5	1.35	0.68
	Q263. speed of competitors in creating a barrier	(b)	3.0	1.37	0.57
	Q264. financial resources for project development	(b)	3.2	1.37	X
	Q265. lack of professionals	(b)	3.4	1.36	0.87
	Q266. non-availability of technology	(b)	3.0	1.33	0.64
	Q267. rigidity of the planning process	(b)	2.8	1.27	0.59
	Q268. other	(b)	1.1	1.72	X
Innovation Intensity	When talking about INNOVATION in your organisation, in terms of emphasis on project development, which of the following types of innovation occur:				
	Q211. incremental: changes (continuous or not) to improve what already exists. Example: an improved product, an improved process, etc.	(a)	4.6	0.78	0.49
	Q212. disruptive: changes that introduce alterations. Example: new product, new process aligned with the tendency of the company	(a)	4.26	1.04	0.75
	Q213. radical: revolutionary changes. Example: a product outside the previous focus of the company, a completely different production process for the business, etc.	(a)	3.2	1.61	0.82
	Q214. perception: may not necessarily be something created or recently changed, but is perceived as a change	(a)	3.6	1.24	0.63

X = Indicators removed from the measurement model as a result of presenting low factor loading values.
S = scale; **M** = mean; **SD** = standard deviation; **FL** = factor loading.

Note 1: Scales developed by the authors based on the theoretical model.
Note 2: All factor loadings are significant at 1%.
Legend: **(a)** 5 (strongly agree), 4 (partially agree), 3 (neither agree nor disagree), 2 (partially disagree), 1 (strongly disagree), 0 (do not know). / **(b)** 4 (exists and is used to measure and monitor the effect of innovation), 3 (exists and is used in a general way, not to monitor innovation), 2 (exists but is not really used by management), 1 (does not exist in the organisation), 0 (do not know).