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What is the relationship between the interactive use and artifacts of management control?

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Abstract

Objective: This study examines the duality of management control system (MCS) use, as proposed by Simons (1995), by analyzing the relationship between the diagnostic and interactive uses of management controls, particularly in volatile contexts such as those found in emerging economies. The focus is on the relationship between each planning and control artifacts intended for diagnostic use and interactive use activation.

Method: The study was conducted with 146 organizations, which were segmented by size. Data were collected via SurveyMonkey and analyzed using structural equation modeling to assess the relationships between control artifacts and the different interactive uses of the MCS.

Results: The results indicate that interactive use does not occur in isolation, but rather depends on prior functional structuring of diagnostic use. The availability of the base forecast was associated with a greater potential for the interactive use of the control system within the budget control process. It was also central to stimulating and updating strategic thinking.

Contributions: The main contribution of this research lies in demonstrating empirically that traditional planning and control artifacts are prerequisites for interactive use. Furthermore, the specific association between artifacts and types of use fills a significant gap in the management control literature.

Impact: The results suggest that interactive use of controls requires a solid diagnostic foundation structured by strategic planning, budgeting, and investment control. Additionally, budget revisions based on the base forecast trigger strategic discussions and organizational learning.

Keywords: Management Control System; Diagnostic Use; Interactive Use, Forecast.

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Introduction

Organizational crises are unexpected events that are widely known to the public. They are characterized by high levels of uncertainty and the potential to disrupt business operations (Bundy et al., 2016; Klöckner et al., 2023). While many crises result from specific events affecting companies or regions, such as supply chain failures, data breaches, or environmental issues, the past few decades have been marked by global crises of great magnitude. Examples include the collapse of the dot-com bubble, which occurred between 1995 and 2000 (with the crash in March 2000); the September 11 attacks; the 2007–2009 financial crisis; Brexit; the climate crisis; and, more recently, the COVID-19 pandemic (Klöckner et al., 2023; Wenzel et al., 2020). These events have substantially increased the volatility of the business environment, requiring organizations to have greater perception, adaptability, and the ability to reconfigure resources.

In such contexts, pre-formulated strategies are insufficient, as evidenced by bankruptcies, market crashes, and value destruction (Hendershott, 2004; Shiller, 2006; Sylla, 2021). In order to perceive a crisis, assess its intensity, and respond in a structured manner, managers need a coordinated set of planning and control tools. These tools enable the management control system (MCS) to operate diagnostically by monitoring deviations and results and interactively by fostering dialogue, learning, and strategic adaptation (Simons, 1995).

The control levers model proposed by Simons (1995) provides a central framework for understanding this duality between diagnostic and interactive use. Diagnostic use emphasizes measurement, comparison, and correction of deviations, while interactive use is oriented toward continuous discussion of strategic uncertainties, managerial involvement, and organizational learning. Subsequent studies have shown that these uses are not distinct systems but rather modes of using control systems (Tessier & Otley, 2012), which are often complementary (Widener, 2007; Kruis et al., 2016).

Despite this conceptual advancement, the literature has explored this relationship in a fragmented manner. Most studies analyze diagnostic and interactive uses at an aggregate level without specifying the planning and control artifacts that underpin each mode of use or how the functional transition between them occurs (Simons, 1995; Widener, 2007; Tessier & Otley, 2012). Thus, although it is recognized that control systems can be used in distinct ways, the concrete role of artifacts in enabling interactive use remains unclear.

This gap is particularly evident in the context of the budgetary system. Budgeting is not a homogeneous practice (Mucci et al., 2021) but rather takes on multiple forms and integrates with more dynamic tools, such as the base and rolling forecasts (Sponem & Lambert, 2016; Sivabalan et al., 2009). While the literature acknowledges the relevance of these practices for dealing with uncertain environments (Welsch, 1996; Ekholm & Wallin, 2011), it tends to treat them as one and the same without empirically examining whether and how the base and rolling forecasts play distinct roles in the articulation between diagnostic and interactive use (Henttu-Aho, 2018; Frezatti et al., 2022).

Furthermore, there is a recurring implicit assumption that adopting practices considered more sophisticated, such as the balanced scorecard or the rolling forecast, would be associated with greater managerial interaction. However, classical literature warns that the effects of an artifact depend on how it is used (Simons, 1995), and there is limited empirical evidence of this direct association (Tuomela, 2005). This suggests a gap between the formal presence of artifacts and their effective incorporation into an organization's diagnostic and interactive routines.

In this scenario, the research problem lies in the need for a holistic understanding of the relationship between management control artifacts and their diagnostic and interactive uses, particularly in highly volatile contexts. Previous research indicates that the way artifacts are used is more relevant than their mere adoption in crisis situations (Becker et al., 2016). This reinforces the importance of understanding how these instruments function to support strategic responses.

Thus, this study investigates the duality of MCS use, as proposed by Simons (1995). Specifically, it examines how diagnostic and interactive uses manifest in organizations through the individualization and articulation of planning and control artifacts. The focus is on the association between artifacts traditionally linked to diagnostic use (e.g., strategic planning, budgeting, capital budgeting, and the balanced scorecard), dynamic budgeting tools (e.g., base and rolling forecasts), and interactive use.

The literature on MCSs extensively examines the duality between diagnostic and interactive uses of controls based on Simons' (1995) control levers model. From this perspective, diagnostic use is associated with performance monitoring and correction of deviations, while interactive use fosters managerial dialogue, organizational learning, and strategic adaptation. Subsequent studies have reinforced the idea that these uses should be understood as complementary modes of utilizing control systems rather than as independent systems (Tessier & Otley, 2012; Widener, 2007; Kruis et al., 2016).

Empirical research has examined the relationship between these modes of use and various organizational phenomena, including strategic change, innovation, and performance (Abernethy & Brownell, 1999; Su et al., 2015). These studies suggest that combining diagnostic discipline with managerial interaction helps address strategic uncertainties and organizational tensions.

In the Brazilian context, studies have also examined the role of MCSs in organizational and strategic processes. For example, Russo and Guerreiro (2017) discuss the sociomateriality of management accounting practices, and Almeida and Gasparetto (2022) analyze dynamic tensions in budgeting systems in family-owned firms. Additionally, Tavares et al. (2023) examine the relationship between MCSs and strategic alignment in Brazilian organizations. These studies broaden our understanding of how control systems are used in different organizational contexts.

Despite these advances in international and national literature, studies tend to analyze MCSs at an aggregate level. They emphasize the ways in which control is used, but do not specifically examine which planning and control artifacts underpin these uses in practice. Thus, the contribution of instruments such as strategic planning, budgeting, and forecasting mechanisms to the interactive use of MCSs remains unclear.

Given this limitation, it is important to understand how different control artifacts relate to the modes of use of MCSs. Therefore, this study addresses the following research question: What is the relationship between management control artifacts and the interactive use of MCSs?

The research addresses these gaps in the literature by shifting from an abstract analysis of control systems to a more operational approach. This approach highlights which artifacts matter, how they connect, and under what conditions they foster managerial interaction. Consequently, it strengthens the understanding of control as an effective strategy lever.

The study aims to investigate the duality in the use of MCSs, as proposed by Simons (1995), and analyze the relationship between the diagnostic and interactive uses of management controls, particularly in volatile contexts such as emerging countries.

2 Literature Review, Constructs, and Hypotheses

The following constructs are necessary for the development of the empirical research:
i. Management control system: diagnostic use and interactive use;
ii. Set of planning and control artifacts.

2.1 Management control system and diagnostic use

An MCS is a set of policies, practices, and procedures that managers implement to align organizational resource use with strategic objectives and priorities (Merchant & Van der Stede, 2007). However, similar management practices may have different uses (Tessier & Otley, 2012). Simons' (1995) Levers of Control model offers a lens through which the operationalization of management control can be viewed within an organization. This model provides a framework for understanding how these differences manifest (Al-Dhubaibi, 2026). The model proposes four "levers" of control: belief and value systems, constraint systems, diagnostic control systems, and interactive control systems (Simons, 1995).

The diagnostic control system corresponds to formal information systems that monitor alignment between achieved results and strategic objectives (Simons, 1995). It is used to monitor manager and employee performance (Kimura & Mourdoukoutas, 2000), communicate key performance indicators (Tessier & Otley, 2012), and monitor the success of the current strategy, enabling potential interventions (Ruiter et al., 2022).

Three characteristics distinguish the MCS and the diagnostic use of control artifacts: (i) the ability to measure results; (ii) the existence of benchmarks to compare planned results with actual results; and (iii) the ability to correct deviations from these benchmarks (Simons, 1995). While this characterization of diagnostic use exists, the literature uses concepts of control systems that directly emphasize this property. For example, Kimura and Mourdoukoutas (2000) define an MCS as one that implements techniques to monitor and evaluate performance in relation to organizational goals.

Although the mechanisms of the MCS and the presence of control levers are complementary, the literature has treated these constructs separately. Empirical research and theoretical discussions have investigated the interaction dynamics among different levers (Al-Dhubaibi, 2026; Bedford, 2015; Kimura & Mourdoukoutas, 2000) and how to coordinate them for various purposes. These purposes include increasing management control effectiveness (Al-Dhubaibi, 2026), developing environmental capabilities and competencies (Albertini, 2019), stimulating innovation (Ruiter et al., 2022), and improving performance (Bedford, 2015).

In general, control levers are considered exogenous predictor constructs in empirical models (Al-Dhubaibi, 2026; Anees et al., 2025; Bedford, 2015). The present study empirically analyzes the aforementioned complementarity, proposing that the diagnostic use system is anchored in the presence and use of various management control artifacts (e.g., strategic planning, capital budgeting, and the balanced scorecard). These control artifacts provide informational support for diagnostic use.

The proposed relationship aligns with theoretical premises concerning management control artifacts and levers. Tessier and Otley (2012) argue that diagnostic and interactive use systems should be considered based on how they are used rather than as control systems. Tavares et al. (2023) highlight that strategic planning and budgeting are artifacts and models that enable the "tracking" of strategic objectives. Tuomela (2005), in turn, illustrates that performance measurement systems (e.g., the balanced scorecard) are generally considered consistent with the diagnostic use system in the literature.

Previous research has suggested an association between the use of planning and control artifacts, such as strategic planning (Oro & Lavarda, 2020; Tavares et al., 2023), budgeting (Oro & Lavarda, 2020; Kuruppu et al., 2024), the balanced scorecard (Barros & Ferreira, 2022; Kuruppu et al., 2024), and other forms of performance measurement (Oro & Lavarda, 2020; Pilonato & Monfardini, 2020), and the diagnostic use system. This empirical support corroborates the theoretical prediction. In this study, we will consider all of these artifacts.

Consequently, we have:

H1+: The greater the use of planning and control artifacts, the greater the use of the diagnostic system.

2.2 Set of planning, control, and interactive use artifacts

The interactive use system corresponds to formal systems that engage managers and subordinates in decision-making processes to promote dialogue, discussion of strategic uncertainties, and organizational learning (Simons, 1995). This system has three main functions: (i) signaling preferences, (ii) monitoring, and (iii) ratifying decisions (Simons, 1995).

The complementarity between diagnostic and interactive use has both theoretical and empirical foundations. From a theoretical perspective, the diagnostic use system aligns with the mechanistic view of control systems (Bedford & Malmi, 2015; Burns & Stalker, 1961). While the diagnostic system proposes monitoring, it can also limit creativity and innovation (Kimura & Mourdoukoutas, 2000), constituting the "restrictive force" of control (Simons, 1995; Tessier & Otley, 2012).

To allow for adaptation and creativity, Simons (1995) emphasizes the importance of interactive control, which departs from these characteristics. Interactive control seeks answers to management elements that were not considered in the strategic planning process up to the point of diagnostic analysis. Thus, the interactive control system (one of the "positive force" levers) offsets the restrictive forces of diagnostic control by facilitating dialogue and learning, creating a dynamic balance between the different forms of control (Simons, 1995; Tessier & Otley, 2012). Thus, the literature emphasizes integrating different levers to achieve greater operational effectiveness (Kimura & Mourdoukoutas, 2000).

According to Chenhall and Morris (1995), a management control structure, or diagnostic control system, is necessary to ensure an innovative approach to strategy that is aligned with an interactive control perspective. Tuomela (2005) states that the interactive use of performance measures can improve strategic management quality and commitment to strategic goals. Therefore, he emphasizes that strategic performance measurement systems can be used both diagnostically and interactively.

Similarly, Widener (2007) shows that the diagnostic system provides the necessary structure for the interactive control system to be effective. Thus, the premise of this study is that organizations need a basic management control structure that managers can use from diagnostic and interactive control perspectives, or even both in a complementary manner.

This study predicts that greater use of the diagnostic system predicts the use of the interactive control system. Using diagnostic control artifacts can lead to using the interactive control system (Al-Dhubaibi, 2026; Asiaei et al., 2023; Pilonato & Monfardini, 2020; Kuruppu et al., 2024). Using the interactive control system tends to improve an organization's internal communication processes (Pilonato & Monfardini, 2020), enhance the effectiveness of the artifacts used (Asiaei et al., 2023), and provide a more holistic and integrated view of different business areas (Kuruppu et al., 2024). Other empirical studies support the complementary relationship between diagnostic and interactive control systems using quantitative (Bellora-Bienengraber et al., 2023) and qualitative (Oro & Lavarda, 2020; Barros & Ferreira, 2022) approaches.

Consequently, we have:

H2+: The greater the use of the diagnostic system, the greater the interactive use of the control system.

In the literature, forecasting mechanisms are often treated as tools that adjust performance expectations throughout the planning cycle (Hansen, 2011). However, different forecasting approaches incorporate distinct management control logics. Specifically, the base and rolling forecasts differ in their operational characteristics and in how they structure managerial attention and interaction.

A base forecast is a periodic review of original budget assumptions that is generally focused on updating expectations for the remainder of the period (Hansen, 2011; Sivabalan et al., 2009). In this sense, the base forecast operates within the time limits defined by the budget cycle and maintains a direct connection with previously established targets. Because it requires managers to reassess deviations from planned performance and discuss revised expectations, the base forecast stimulates interaction among managers regarding the causes of deviations and possible strategic responses.

However, it can be developed without executive involvement in updating the data; therefore, doubts about commitment to meeting the targets often arise (Merchant & Van der Stede, 2007). This type of forecast is useful because it provides a more accurate view of the expected result.

Conversely, the rolling forecast involves constantly extending the planning horizon through successive updates of projections (Hansen, 2011). Rather than revisiting the assumptions of an existing budget cycle, the rolling forecast shifts the focus to future periods, emphasizing forward-looking planning and long-term expectations. Consequently, its primary role is to support adaptive planning rather than trigger discussions about current deviations from planned performance.

From a management control perspective, this distinction implies that the base forecast triggers the interactive use of controls, facilitating structured discussions about performance variances. In contrast, rolling forecasts primarily support continuous planning and future-oriented coordination.

Thus, the availability of base and rolling forecasts generally depends on the prior use of management control artifacts, particularly budgetary control processes (Sivabalan et al., 2009; Frezatti et al., 2022). The effective application of these forecasts requires up-to-date informational inputs generated by other control artifacts to analyze variations between simulated and actual results, their causes, evaluations, and future projections. This, in turn, calls for greater contributions from the diagnostic control system (Frezatti et al., 2022).

These functions are directly related to the fundamental characteristics of the diagnostic control system (e.g., measuring results, comparing forecasts to observations, and correcting deviations). The base forecast is triggered when a mismatch is identified between actual and budgeted figures. This process can be initiated through the diagnostic use of the control system (Frezatti et al., 2022) and comes into play when unfavorable budgetary concerns arise (Almeida & Gasparetto, 2022).

The diagnostic control system monitors the organization’s results and corrects deviations from expected outcomes (Simons, 1995; Heggen & Sridharan, 2021; Frezatti et al., 2023). This function is achieved by using tools such as budgets and forecasts because they are expected to increase the predictability of objectives and goals. The base and rolling forecasts depend on information processed in the budgeting system and the identification of unfavorable variations, which can be identified through the diagnostic system (Almeida & Gasparetto, 2022).

More dynamic forms of budgeting or forecasting can synergistically combine with control tools for diagnostic purposes. These tools include the traditional budget (Ekholm & Wallin, 2011; Henttu-Aho, 2018), operational planning (Hansen & Van der Stede, 2004), and planning quality (Jordan & Messner, 2020). This reinforces the concept of complementarity among these tools and between the diagnostic system and more dynamic forms of budgeting (Henttu-Aho, 2018).

As a result, we have:

H3+: The greater the use of the diagnostic system, the greater the use of the base forecast.

H4+: The greater the use of the diagnostic system, the greater the use of the rolling forecast.

The base and rolling forecasts are budgeting system practices derived from budget information. They are generally used when there is concern about budget execution volatility (Almeida & Gasparetto, 2022; Frezatti et al., 2022). Managers at different hierarchical levels tend to become involved on an individual and regular basis in light of this concern. They use mechanisms of the interactive control system to discuss, learn, and intervene in the decisions of managers from other business units. They also establish accurate measures in response to identified opportunities and threats (Heggen & Sridharan, 2021; Almeida & Gasparetto, 2022).

During times of crisis, it is expected that the interactive use of MCS artifacts will increase due to the need for enhanced organizational learning and rapid, appropriate responses, thereby facilitating coordination quality (Asel et al., 2011). Conversely, during crises, managers' autonomy is often restricted (Asel et al., 2011), increasing the demand for evidence of potential outcomes. Crisis situations are associated with a higher level of uncertainty; the greater the uncertainty, the greater the importance of forecasts (Bhimani et al., 2018). Furthermore, developing new ideas becomes more important in these scenarios since identifying and applying corrective actions alone is insufficient to overcome the challenges faced (Henri, 2006).

Within Simons' (1995) theoretical framework of control levers, the interactive use of the control system integrates the aforementioned elements. It performs important functions in scenarios marked by strategic uncertainty (Simons, 1995), is future-oriented (Widener, 2007), enables direct engagement among managers at different hierarchical levels within the organizational structure (Rathnasekara & Gooneratne, 2020), and fosters dialogues that trigger new approaches, opportunities, and strategies in response to identified threats (Heggen & Sridharan, 2021). This facilitates knowledge generation and learning within the organization.

Despite their different purposes, the diagnostic and interactive control systems are positively related (Widener, 2007; Kruis et al., 2016). This means that, despite the tensions resulting from their use (e.g., the predictability of goal attainment and innovation), the systems complement each other and work together to support strategic control (Simons, 1995; Kruis et al., 2016). Within this complementarity, elements of the budgeting system can be identified, as it can be used to compare budgeted and actual results (i.e., the diagnostic system) and facilitate discussions on future performance (i.e., the interactive system), particularly in unfavorable scenarios (Almeida & Gasparetto, 2022). This is evident during the implementation of both systems.

Thus, the potential for using the budget as an interactive tool exists even within more rigorous budget structures (Van der Stede, 2001). According to Van der Stede, the budget exhibits this characteristic when it facilitates discussions between senior management and other managers, regardless of the organization's performance. This study argues that this property is emphasized when more dynamic forms of budgeting are used, such as base and rolling forecasts, since they are generally used in response to an uncertain and dynamic environment (Oro & Lavarda, 2020). These forms of budgeting provide more accurate information and foster the emergence of ideas arising from interactive discussions (Henttu-Aho, 2018).

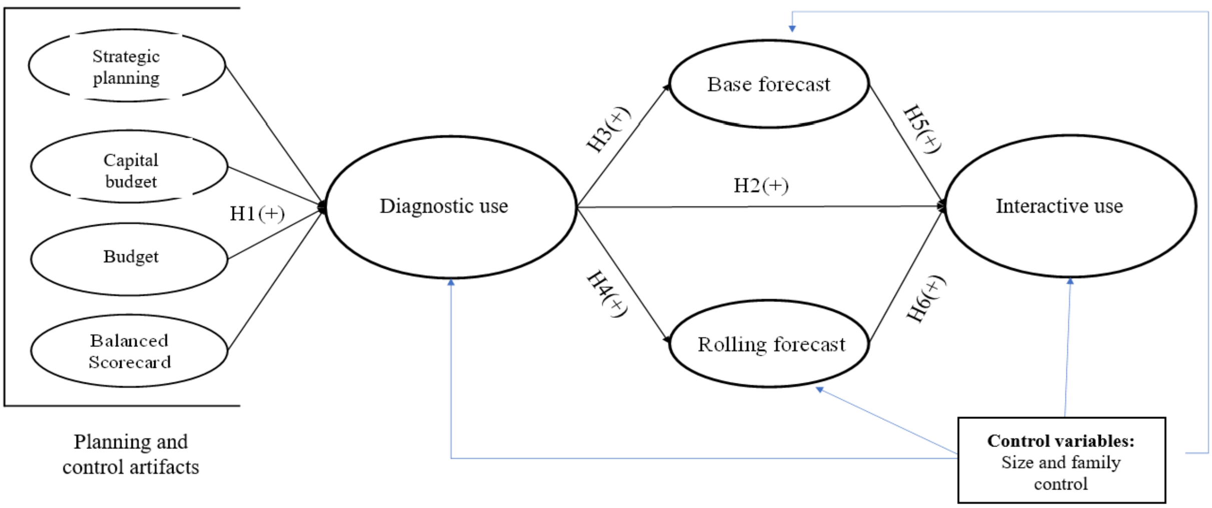
Consequently, we have:

H5+: The greater the use of the base forecast, the greater the interactive use of the control system.

H6+: The greater the use of the rolling forecast, the greater the interactive use of the control system.

Figure 1 shows the conceptual model and the research hypotheses.

Figure 1. Conceptual model of the research



3 Methodology

3.1 Population and sample

The research was conducted with managers of Brazilian companies of various sizes. Sampling was segmented by organizational size, operationalized by number of employees according to the European Commission's (2020) classification: small (up to 49), medium (50 to 249), large A (250 to 999), large B (1,000 to 4,999) and large C (more 5,000). Although the European definition classifies companies with more than 250 employees as large, this subdivision was retained to capture greater heterogeneity among large organizations.

Taking ownership structure into account, the questionnaire was administered to managers of companies divided into three categories: (1) multinational corporations operating in Brazil, (2) family-owned or non-family-owned companies that are publicly traded, and (3) family-owned companies that are not publicly traded. We also considered the sector in which the company operates (manufacturing, retail, or services), company size, and ownership structure. The final sample consists of 146 companies. The research ethics committee approved the project, and an informed consent form was attached to the questionnaire.

3.2 Descriptive statistics of the sample

Table 1 presents the descriptive statistics of the sample. We observed reasonable homogeneity in company size (number of employees) across the aforementioned size groups. Companies with 10 to 49 employees, 50 to 249 employees, 250 to 1,000 employees, 1,000 to 5,000 employees, and more than 5,000 employees represent 24.7%, 19.2%, 18.5%, 19.2%, and 6.8% of the sample, respectively. There is an unidentified segment of 11.6%.

Our sample shows heterogeneity in terms of net revenue levels. Large companies, for example, those with annual revenue exceeding US$75 million, account for 36.9% of the sample. Regarding family control, 43.2% of the companies are family-controlled, while 45.2% have less than 50% of their shares held by family members and are classified as non-family-owned (e.g., publicly traded companies and government-owned entities). Regarding the age of the companies, 28.1% were founded in the last 10 years, 43.2% are between 10 and 49 years old, and 17.2% are over 50 years old. The respondents include CEOs or principal owners (24.7%), executives who report directly to the CEO (52.1%), executives who report to senior management (6.8%), and middle managers (4.8%).

Table 1. Descriptive statistics of the sample

Panel A. Size (number of employees)	n	%	Panel C. Family control	n	%
Between 10 and 49 employees	36	24.7%	100% of the shares	48	32,9%
Between 50 and 249 employees	28	19.2%	Between 50% and less than 100% of the shares	15	10,3%
Between 250 and 999 employees	27	18.5%	Less than 50% of the shares	9	6,2%
Between 1,000 and 4,999 employees	28	19.2%	Non-family-owned company	57	39,0%
More than 5,000 employees	10	6.8%	Did not respond	17	11,6%
Did not respond	17	11.6%			
Panel B. Size (net revenue in US$)			**Panel D. Years in business**		
Less than 12.5 million	51	34.9%	Less than 10 years	41	28.1%
Over 12.5 million up to 25 million	8	5.5%	Between 11 and 49 years	63	43.2%
Over 25 million up to 75 million	16	11.0%	Between 50 and 99 years	22	15.1%
Over 75 million up to 125 million	14	9.6%	Over 100 years	3	2.1%
Over 125 million up to 250 million	10	6.8%	Did not respond	17	11.6%
Over 250 million up to 1,250 million	19	13.0%			
Over 1,250 million	11	7.5%	**Panel E. Hierarchical level**		
Did not respond	17	11.6%	CEO or principal owner	36	24.7%
			Level 1	76	52.1%
			Level 2	10	6.8%
			Level 3	7	4.8%
			Did not respond	17	11.6%

Note 1: Panel B uses an exchange rate of US$1.00 = BRL4.00.

3.3 Instruments

All survey items were measured using a 5-point Likert scale ranging from "strongly disagree" to "strongly agree." The instruments used to measure planning and control artifacts (strategic planning, budget, capital budget, balanced scorecard, forecast, and rolling forecast) and the diagnostic control system were based on previous studies (Frezatti et al., 2022). These variables were measured using three to five items, which are shown in Appendix A (e.g., Abernethy & Brownell, 1999; Merchant & Van der Stede, 2007; Hansen & Van der Stede, 2004). Use of the interactive control system was measured using six items inspired by previous studies and presented in Appendix B (Su et al., 2015).foram mensuradas por meio de 3 a 5 itens demonstrados no Apêndice A (e.g., Abernethy & Brownell, 1999; Merchant & Van der Stede, 2007; Hansen & Van der Stede, 2004). O uso do sistema de controle interativo foi mensurado a partir de 6 itens inspirados em estudos anteriores e apresentado no apêndice B (Su et al., 2015).

3.4. Data analysis

For the analysis of the data and testing of the research hypotheses, structural equation modeling (SEM) was used via the partial least squares (PLS) method with

SmartPLS® version 4 software. SEM is suitable for estimating complex models and models with mediators without imposing distribution assumptions on the data. This technique is widely used in management accounting studies and studies examining control levers.

A power analysis conducted using G*Power 3.1.9.2 software showed that the sample size is sufficient to detect a small effect size ($f^2 \geq 0.08$) as statistically significant, given a statistical power of 0.8 (20% type II error) and a significance level of 5% (type I error), with four predictors (Nitzl, 2016).

While no single strategy can eliminate the possibility of bias in survey research entirely, combining validated scales, qualified respondents, statistical tests for common method bias (CMB), and an assessment of multicollinearity significantly reduces this risk and strengthens the results obtained.

In addition to statistical tests, certain methodological precautions were adopted to reduce potential biases associated with the study design. First, the measurement instruments were based on previously validated scales in MCS literature, reducing ambiguities in interpretation and potential measurement biases (Abernethy & Brownell, 1999; Hansen & Van der Stede, 2004; Su et al., 2015). Second, the respondents held managerial positions directly involved in planning and control processes, increasing the likelihood that they possessed adequate knowledge about the artifacts under investigation and the use of control systems in their organizations.

Additionally, the analyzed constructs represent relatively objective organizational practices, such as strategic planning, budgeting, and forecasting mechanisms. This tends to reduce the problems associated with excessive subjectivity that are tied to respondents' individual perceptions.

To assess the possibility of CMB, we performed Harman's single-factor test and the total collinearity test. Non-rotated exploratory factor analysis revealed four factors with eigenvalues greater than one, explaining 64.4% of the total variance. The first factor accounts for 46.1% of the explained variance, which remains below 50%. This suggests that CMB does not threaten the validity of the results (Castillo et al., 2025). Harman's test assesses CMB using indicators (measurement model), while the total collinearity test focuses on the constructs of the structural model (Castillo et al., 2025).

Total collinearity was obtained from a model derived from the original model, in which all constructs were measured by factor scores and used as predictors of any dependent variable solely to obtain the variance inflation factor (VIF) values. If the VIF values are less than 3.3, CMB is not considered a problem (Castillo et al., 2025). This was the case in this model: base forecast and strategic planning had a VIF of 3.2, and the remaining constructs had a VIF below 2.9.

4 Results

This quantitative study is based on a survey. The application of SmartPLS yielded the following results.

4.1 Evaluation of the measurement model

Figure 2 and Table 2 present the results of the measurement model evaluation at the construct level. These results confirm convergent and discriminant validity and reliability (above 0.7). Regarding convergent validity, the results meet the thresholds defined by Hair Jr. et al. (2017) for Cronbach's alpha (above 0.7) and average variance extracted (AVE) (above 0.5). Regarding discriminant validity, we observe that the square root of the AVE (diagonal) is greater than the correlations between latent variables, and the heterotrait-monotrait (HTMT) values (in gray) are less than 0.85.

Table 2. Assessment of discriminant validity: Fornell-Larcker and HTMT matrix

	1	2	3	4	5	6	7	8
1. SP	0.823	0.573	0.752	0.738	0.766	0.582	0.566	0.733
2. BSC	0.530	0.928	0.578	0.482	0.410	0.594	0.416	0.448
3. Capex	0.681	0.546	0.878	0.718	0.708	0.677	0.575	0.522
4. Budget	0.667	0.453	0.661	0.864	0.823	0.658	0.517	0.562
5. Diagnostic Use	0.673	0.365	0.627	0.727	0.877	0.643	0.611	0.587
6. Bforecast	0.539	0.567	0.632	0.610	0.580	0.945	0.777	0.529
7. Rforecast	0.523	0.398	0.536	0.480	0.547	0.729	0.942	0.415
8. Interactive Use	0.660	0.424	0.475	0.515	0.528	0.490	0.387	0.836
Cronbach's alpha	0.880	0.967	0.925	0.915	0.848	0.939	0.937	0.913
Composite reliability (rho_c)	0.913	0.974	0.944	0.936	0.909	0.961	0.960	0.933
Average variance extracted (AVE)	0.678	0.861	0.771	0.746	0.770	0.892	0.888	0.700

Note: The values on the main diagonal correspond to the square root of the AVE. The values below the diagonal are the correlations between constructs. Since these values are smaller than those on the main diagonal, there is discriminant validity. The values above the diagonal (in gray) are the unadjusted correlations (HTMT matrix). Since these values are less than 0.85, discriminant validity is present (Hair Jr., et al., 2022, p. 122).

The measurement of the constructs was evaluated in two stages. First, we examined the constructs at the construct level using Table 2. Then, we examined the constructs at the indicator level using Table 3 (Hair Jr. et al., 2022). One item from Strategic Planning (SP_1) was excluded due to a lack of discriminant validity.

Table 3. Cross-tabulated factor loadings

Item	1. SP	2. BSC	3. Capex	4. Budget	5. Diagnostic Use	6. Bforecast	7. Rforecast	8. Interactive Use
SP_2	0.744	0.454	0.445	0.434	0.418	0.294	0.264	0.553
SP_3	0.846	0.462	0.560	0.588	0.632	0.446	0.428	0.559
SP_4	0.783	0.358	0.559	0.538	0.511	0.415	0.457	0.491
SP_5	0.899	0.508	0.570	0.594	0.618	0.578	0.514	0.647
SP_6	0.835	0.399	0.656	0.568	0.554	0.444	0.456	0.469
BSC_1	0.460	0.851	0.460	0.371	0.321	0.455	0.287	0.342
BSC_2	0.483	0.941	0.506	0.406	0.329	0.532	0.356	0.375
BSC_3	0.467	0.951	0.488	0.421	0.311	0.468	0.331	0.371
BSC_4	0.529	0.943	0.508	0.436	0.368	0.537	0.379	0.434
BSC_5	0.509	0.952	0.530	0.430	0.352	0.564	0.430	0.416
BSC_6	0.492	0.923	0.542	0.455	0.343	0.590	0.422	0.411
Capex_1	0.654	0.476	0.914	0.627	0.624	0.621	0.482	0.412
Capex_2	0.653	0.476	0.857	0.568	0.484	0.568	0.460	0.470
Capex_3	0.594	0.441	0.890	0.562	0.564	0.513	0.525	0.384
Capex_4	0.570	0.541	0.891	0.641	0.546	0.562	0.465	0.368
Capex_5	0.517	0.469	0.835	0.499	0.521	0.506	0.419	0.466
Budget_1	0.607	0.362	0.560	0.885	0.702	0.525	0.440	0.405
Budget_2	0.488	0.399	0.613	0.896	0.623	0.557	0.398	0.414
Budget_3	0.554	0.421	0.589	0.875	0.619	0.559	0.433	0.502
Budget_4	0.612	0.343	0.508	0.842	0.572	0.473	0.412	0.406
Budget_5	0.621	0.436	0.586	0.820	0.612	0.516	0.387	0.501
Diagnostic_1	0.575	0.277	0.514	0.662	0.915	0.530	0.462	0.505
Diagnostic_2	0.669	0.317	0.593	0.672	0.935	0.583	0.544	0.530
Diagnostic_3	0.518	0.384	0.549	0.576	0.773	0.395	0.426	0.333
Bforecast_1	0.507	0.498	0.617	0.589	0.560	0.961	0.675	0.438
Bforecast_2	0.518	0.507	0.585	0.556	0.548	0.959	0.709	0.488
Bforecast_3	0.501	0.604	0.588	0.582	0.535	0.913	0.682	0.462
Rforecast_1	0.460	0.377	0.523	0.473	0.513	0.703	0.934	0.343
Rforecast_2	0.538	0.391	0.520	0.469	0.533	0.686	0.942	0.384
Rforecast_3	0.477	0.358	0.472	0.413	0.499	0.673	0.952	0.366
Interactive_1	0.388	0.296	0.352	0.322	0.323	0.407	0.251	0.699
Interactive_2	0.488	0.332	0.370	0.500	0.439	0.434	0.307	0.800
Interactive_3	0.567	0.329	0.462	0.428	0.413	0.369	0.326	0.864
Interactive_4	0.584	0.365	0.376	0.406	0.453	0.401	0.341	0.884
Interactive_5	0.602	0.401	0.396	0.426	0.460	0.391	0.307	0.867
Interactive_6	0.652	0.392	0.428	0.480	0.533	0.451	0.393	0.888

Source: Prepared by the authors.
Note: The items are detailed in Appendix A according to their numbering.

Table 3 shows that all items have higher factor loadings within their own constructs than in the other constructs (cross-loadings). This leads to the conclusion that there is discriminant validity at the indicator level (Hair Jr., et al., 2022).

Three main aspects of Table 3 should be noted. First, the correlation matrix reveals associations consistent with the theoretical framework of the study, without showing excessively high correlations between constructs. This alleviates concerns about multicollinearity. Second, these results provide initial support for the discriminant validity of the constructs and justify conducting the structural analyses presented in the following sections.

4.2 Evaluation of the structural model

The structural model was estimated with and without the control variables (size and family control). The results are presented in Table 4. Hypothesis testing was performed using structural coefficients and effect sizes. No significant effects of the control variables were found.

The results of the hypothesis tests (Table 4) show that the presence of planning and control artifacts is positively related to diagnostic system use with regard to strategic planning ($\beta = 0.304$, $p = 0.012$, $f^2 = 0.101$), capital budgeting ($\beta = 0.173$, $p = 0.043$, $f^2 = 0.032$), and budgeting ($\beta = 0.454$, $p \leq 0.001$, $f^2 = 0.249$). These results partially support H1. Together, the constructs representing management control artifacts and control variables explained 59.5% of the variance observed in the diagnostic control system construct. Conversely, the existence of the diagnostic system was positively related to interactive use, thus validating H2 ($\beta = 0.374$, $p = 0.001$, $f^2 = 0.132$).

Hypotheses H3 ($\beta = 0.580$, $p \leq 0.001$, $f^2 = 0.507$) and H4 ($\beta = 0.547$, $p \leq 0.001$, $f^2 = 0.426$) related to the relationship between the diagnostic control system and forecasting practice also received statistical support given that the p-value was less than 0.05. These results suggest that greater contributions from the diagnostic system are associated with increased use of

Table 4. Direct effects (standardized structural coefficients)

	H	β	P-value	f^2	β	P-value	f^2	Adjusted R^2
SP -> Diagnostic Use	H1a	0.304	0.012	0.101	0.298	0.013	0.098	0.595
Capex -> Diagnostic Use	H1b	0.173	0.043	0.032	0.198	0.025	0.041	
Budget -> Diagnostic Use	H1c	0.454	0.000	0.249	0.454	0.000	0.250	
BSC-> Diagnostic Use	H1d	-0.096	0.135	0.015	-0.101	0.127	0.017	
Size_Emp -> Diagnostic_Use					-0.158	0.403	0.006	
Family_Control -> Diagnostic_Use					-0.091	0.421	0.004	
Diagnostic Use -> Bforecast	H3	0.580	0.000	0.507	0.581	0.000	0.487	0.324
Size_Emp -> Bforecast					-0.064	0.829	0.001	
Family_Control -> Bforecast					-0.076	0.619	0.002	
Diagnostic Use -> Rforecast	H4	0.547	0.000	0.426	0.524	0.000	0.381	0.298
Size_Emp -> Rforecast					0.362	0.163	0.019	
Family_Control -> Rforecast					-0.022	0.888	0.000	
Diagnostic Use -> Interactive Use	H2	0.374	0.001	0.132	0.364	0.001	0.123	0.312
Bforecast -> Interactive Use	H5	0.299	0.004	0.056	0.301	0.006	0.056	
Rforecast -> Interactive Use	H6	-0.036	0.732	0.001	-0.044	0.697	0.001	
Size_Emp -> Interactive Use					0.143	0.641	0.003	
Family_Control -> Interactive Use					-0.144	0.350	0.007	

Note: The results remain significant when size and family control are included as control variables.

the base and rolling forecasts, explaining 32.4% and 29.8% of the variance in these constructs, respectively.

Regarding the influence of the base and rolling forecasts on interactive control system use (H5 and H6, respectively), the results in Table 4 provide statistical support for H5 (β = 0.299, p = 0.004, f^2 = 0.132) but not H6 (β = -0.036, p = 0.732, f^2 = 0.056). These results suggest that greater availability of the base forecast is associated with a higher potential for interactive use of the control system, while there is no statistical evidence regarding the association between the availability of the rolling forecast and interactive use of the control system. Together, the independent variables explain 31.2% of the variance observed in the interactive control system construct.

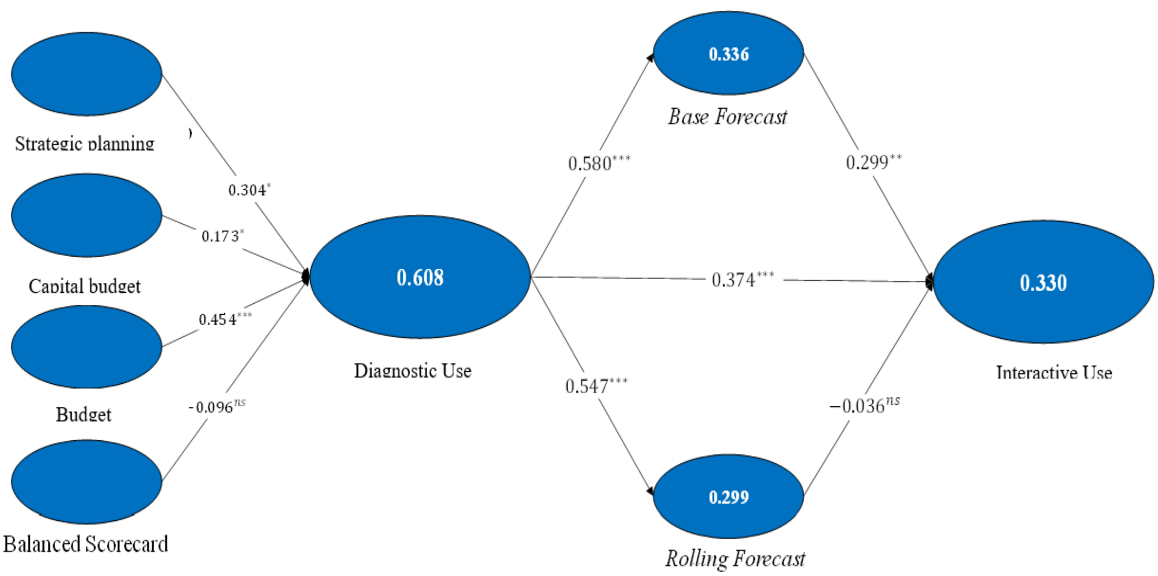
Table 5. Total indirect effects

	β	T-statistic	P-value
SP -> Bforecast	0.176	2.356	0.018
SP -> Rforecast	0.166	2.325	0.020
SP -> Interactive Use	0.160	2.095	0.036
BSC -> Bforecast	-0.056	1.488	0.137
BSC -> Rforecast	-0.053	1.448	0.148
BSC -> Interactive Use	-0.051	1.500	0.134
Capex -> Bforecast	0.100	1.861	0.063
Capex -> Rforecast	0.094	1.855	0.064
Capex -> Interactive Use	0.091	1.948	0.051
Budget -> Bforecast	0.263	3.462	0.001
Budget -> Rforecast	0.248	3.567	0.000
Budget -> Interactive Use	0.240	3.502	0.000
Diagnostic Use -> Interactive Use	0.154	2.488	0.013

Table 5 shows the indirect effects of planning and control artifacts on interactive use. The balanced scorecard (BSC) did not show a significant effect in the first direct relationship (H1d), which explains why its indirect effect on the other constructs was also not statistically significant. All other constructs showed statistically significant relationships with the interactive use of the control system.

Figure 2 summarizes the results of the structural model, the coefficients, the statistical significance of the direct relationships, and the R^2 of the dependent variables.

Figure 2. Model estimated in SmartPLS 4



Legend: ns = not significant; * = p ≤ 0.05; ** = p ≤ 0.01; *** = p ≤ 0.001.

5 Discussion of Findings

The idea that control system uses are related to the artifacts that structure them is well-established in the literature. However, the relationship between these systems and the interactive use of the MCS has not been addressed. The following results were obtained in this study:

H1+: The greater the use of planning and control artifacts, the greater the use of the diagnostic system.

The budget was found to be the artifact with the highest coefficient, as expected, because budgetary control enables diagnostic use and depends directly on formal routines for monitoring, identifying, and explaining variances, as well as their eventual linkage to managerial evaluation (Merchant & Van der Stede, 2007; Scapens, 2006; Sponem & Lambert, 2016; Abernethy & Brownell, 1999). Furthermore, the literature recognizes that budgeting is not a homogeneous practice; it assumes different roles and configurations. A significant part of its diagnostic power stems from its design and use in disciplining the "plan–execute–compare–correct" cycle (Sponem & Lambert, 2016; Simons, 1995). The results align with the idea that mechanistic controls (associated with diagnosis) are useful for maintaining predictability and coordination, especially when an organization needs to keep performance "under control" (Burns & Stalker, 1961; Bedford & Malmi, 2015).

Strategic planning also showed a positive association, reinforcing the idea that the diagnostic function depends on a certain level of prior definition of objectives and priorities, allowing for the establishment of benchmarks for comparison and accountability (Simons, 1995). In practice, strategic planning and budgeting appear as complementary pairs: strategic planning provides direction and criteria, while budgeting operationalizes these criteria and allows for the monitoring of execution and deviations (Tavares et al., 2023; Merchant & Van der Stede, 2007). Thus, the findings suggest that budgetary control gains substance when an organization has minimally structured strategic references (Simons, 1995; Tessier & Otley, 2012).

Regarding the capital budget, the positive effect (albeit smaller) aligns with its role in supporting decisions requiring a comparison of expectations and results, as well as a systematic evaluation of trade-offs. This reinforces the ability of the diagnostic system to monitor goal achievement and economic discipline (Merchant & Van der Stede, 2007). Capex tends to "anchor" relevant decisions in assumptions, metrics, and formal reviews, aligning with its diagnostic use as a monitoring and correction mechanism (Simons, 1995).

The statistical insignificance of the BSC is a point that deserves attention. Although it is classically proposed as a mechanism for translating strategy into measures and goals (Kaplan & Norton, 1992) and is often assumed to be consistent with the diagnostic use of performance measurement systems in the literature (Tuomela, 2005), our results suggest that its presence does not necessarily result in greater contributions to budget control. Two interpretations consistent with the framework of the article help contextualize this finding:

1. Functional independence from budget control: Budget control can operate robustly based on budget/variance analysis and monitoring routines without relying on the BSC. In other words, the BSC may exist, but it is not the "engine" of diagnosis when diagnosis is operationally represented by the budget (Simons, 1995; Merchant & Van der Stede, 2007).

2. Adoption that is more symbolic than operational ("ceremonial" use): The mere presence of the artifact does not guarantee its effective incorporation into monitoring and correction routines. If the BSC is misaligned with the budget cycle or is used more as a strategic language than as a device for accountability and correction, it tends to have no effect on budget control. This interpretation aligns with the warning in the manuscript that certain artifacts may exist without impacting practice, referencing ceremonial use (Russo & Guerreiro, 2017). Despite these contributions, Brazilian literature has only explored the relationship between specific control artifacts and MCS use to a limited extent.

In summary, empirical evidence suggests that the observed use of the BSC in diagnostics is structured around tools with a strong capacity to "close the loop" of goals, execution, variances, and correction (Simons, 1995), particularly budgeting and, to a lesser extent, strategic planning and capex. While the BSC is theoretically powerful as a strategy translator (Kaplan & Norton, 1992), it did not prove to be a precursor to budget control in the way the diagnostic was operationalized in this study. This signals that future research should distinguish more precisely between the "presence" versus "integration" of the BSC in the control package and in the diagnostic routines actually practiced (Tessier & Otley, 2012; Sponem & Lambert, 2016).

H2+: The greater the use of the diagnostic system, the greater the interactive use of the control system.

The results provide consistent empirical support for H2, indicating that interactive use does not emerge autonomously, but rather, is conditioned by prior functional structuring of diagnostic use. This finding strengthens the main idea of the manuscript, which is that control systems should be viewed as modes of use rather than as isolated artifacts (Simons, 1995; Tessier & Otley, 2012).

From a theoretical perspective, this finding directly aligns with the logic of control levers. By providing formal routines for measurement, comparison, and correction of deviations, diagnostic use establishes the informational foundation necessary for interactive use to operate effectively (Simons, 1995; Widener, 2007). Without this foundation, strategic dialogue tends to become diffuse, excessively subjective, or disconnected from the organization's operational reality.

The literature maintains that diagnostic use plays a structuring role, especially in contexts of uncertainty, by reducing informational ambiguity and creating common performance benchmarks (Chenhall & Morris, 1995; Widener, 2007). Thus, the diagnostic system enables interactive use by offering a concrete starting point for discussions, questioning, and organizational learning (Simons, 1995; Tuomela, 2005).

The results also align with the complementarity view of mechanistic and organic systems. While diagnostic use is associated with a mechanistic logic of control focused on predictability and discipline (Burns & Stalker, 1961; Bedford & Malmi, 2015), interactive use introduces organic elements by stimulating cross-functional communication, strategic vigilance, and continuous managerial involvement (Simons, 1995). Acceptance of H2 indicates this transition occurs through functional linkage, not substitution: diagnostic control creates conditions for interactive control activation.

From an empirical perspective, the positive, statistically significant correlation between diagnostic and interactive use suggests that organizations with greater monitoring and identification capacities are most likely to engage their managers in strategic discussions. This finding aligns with prior research indicating that interactive use is more effective when supported by structured formal control systems (Widener, 2007; Kruis et al., 2016; Bellora-Bienengräber et al., 2023).

H2 was tested independently of the presence of the base and rolling forecasts, indicating that interactive use can be activated in contexts where formal budget revisions are not necessary. In relatively stable environments or when variations are considered insignificant, interactive use can rely directly on the information produced by the traditional diagnostic system without requiring more dynamic budget artifacts at that time. This result reinforces the idea that interactive use is more associated with the quality of the diagnostic framework that underpins the decision-making process than with the specific type of artifact (Tessier & Otley, 2012).

In summary, the findings associated with H2 corroborate the central premise of the study: interactive use is a consequence, not an alternative, to diagnostic use. An organization's ability to foster strategic dialogue, learning, and adaptation directly depends on diagnostic systems that provide reliable, comparable, and actionable information. These results help to overcome fragmented approaches in the literature and reinforce the need to analyze control systems in an integrated manner that considers their functional linkages, rather than just their isolated characteristics.

H3+: The greater the use of the diagnostic system, the greater the use of the base forecast.

This hypothesis was accepted, and the results provide strong empirical support for H3. This indicates that the availability of the base forecast is directly associated with the existence of a functional, structured diagnostic system. This finding reinforces the notion that the base forecast is not an autonomous artifact but rather an operational extension of the budgeting system. The activation of this extension depends on the organization's ability to measure results, compare performance, and identify deviations, which are central properties of diagnostic use (Simons, 1995).

From a theoretical perspective, the result aligns with literature conceiving of control artifacts as mechanisms that reduce the gap between necessary and available information in contexts of change and uncertainty (Galbraith, 1973; Smart & Vertinsky, 1977). The diagnostic use system acts as informational infrastructure, allowing managers to perceive relevant discrepancies between actual and planned performance. This creates conditions for activating the base forecast as a tool for updating budgetary expectations for the remainder of the period (Welsch, 1996; Sivabalan et al., 2009).

The primary function of the base forecast is to provide a more accurate projection of the expected outcome by incorporating observed results and adjusting for future months (Welsch, 1996). However, this functionality only materializes when there is a diagnostic process capable of identifying significant variations and generating reliable information. Thus, the empirical findings support the premise that greater diagnostic use increases the utility and availability of the base forecast as a managerial tool (Merchant & Van der Stede, 2007; Frezatti et al., 2022).

Literature on budget control also indicates that budget revisions, including the base forecast, are used when concerns arise about budget execution, particularly when faced with unfavorable variations (Almeida & Gasparetto, 2022). This process is diagnostic by definition: identifying the mismatch between the forecast and actual results triggers revising future estimates. Thus, the base forecast can be interpreted as a structured managerial response to signals emitted by the diagnostic system rather than as an independent or merely technical practice (Frezatti et al., 2022).

Furthermore, the magnitude of the observed effect (high f^2) suggests that the diagnostic use system plays a central role in explaining the availability of the base forecast rather than a marginal one. This finding aligns with studies indicating that more dynamic budgeting methods rely heavily on the quality of budget information processing and performance monitoring discipline (Ekholm & Wallin, 2011; Henttu-Aho, 2018). Without this diagnostic foundation, the base forecast tends to lose practical relevance or become merely formal.

In summary, the findings related to H3 reinforce the idea of a functional linkage between the control systems proposed in this study. The base forecast emerges as an artifact conditioned by diagnostic use and employed to update expectations and support decisions in dynamic environments. These results contribute to the literature by demonstrating that adopting more flexible planning tools does not replace diagnostic control; rather, it depends directly on the existence and effectiveness of diagnostic control, which reinforces the idea of complementarity among the different uses of MCSs.

H4+: The greater the use of the diagnostic system, the greater the use of the rolling forecast.

This hypothesis was accepted, and the results provide robust empirical support for H4. This indicates that the availability of the rolling forecast is positively associated with the degree to which the diagnostic system contributes. This finding reinforces the idea that the rolling forecast does not exist in isolation or as a purely technical practice. Rather, it depends on a structured diagnostic infrastructure that can provide reliable information on performance, deviations, and trends (Simons, 1995; Sivabalan et al., 2009; Frezatti et al., 2022).

While the rolling forecast shares similarities with the base forecast in that it combines actual results with future projections, it is distinguished by its extended planning horizon, which can span 12, 18, 24, or more months (Ekholm & Wallin, 2011; Hansen, 2011; Henttu-Aho, 2018). This characteristic enhances its utility as a tool for anticipating trends and preparing subsequent budgets but also increases its reliance on a diagnostic system that can ensure consistency, comparability, and informational discipline over time.

From a theoretical perspective, this is consistent with literature linking flexible, continuous planning to budget information quality (Ekholm & Wallin, 2011; Henttu-Aho, 2018). A rolling forecast requires an organization to transform historical data and variance analyses into reliable forward-looking projections. This is only feasible when the diagnostic system fulfills its core functions of measuring, comparing, and correcting deviations (Simons, 1995; Frezatti et al., 2022).

H5+: The greater the use of the base forecast, the greater the interactive use of the control system.

The results provide consistent empirical support for H5, indicating a positive association between greater availability of the base forecast and interactive use of the control system. This finding reinforces the idea that the base forecast plays a distinct role in the budgeting system by acting as a link between diagnostic monitoring and interactive management processes.

Conceptually, the base forecast is a revision of the budget throughout the period that incorporates actual results and updates expectations for the remaining months (Welsch, 1996; Sivabalan et al., 2009). This continuous updating creates conditions conducive to managerial engagement by highlighting discrepancies, risks, and emerging opportunities requiring interpretation, discussion, and coordinated action – functions central to the interactive use of the control system (Simons, 1995).

The literature indicates that budget revisions tend to be triggered when concerns arise regarding budget execution, especially in the face of unfavorable variations or volatile scenarios (Almeida & Gasparetto, 2022; Frezatti et al., 2022). In these circumstances, managers at different hierarchical levels are mobilized to discuss causes, alternatives, and responses, thus intensifying cross-functional dialogue and organizational learning, which are elements characteristic of interactive use (Simons, 1995; Widener, 2007). Thus, the base forecast provides up-to-date information and structures an agenda for interaction, functioning as a catalyst for interactive use.

Furthermore, unlike the traditional annual budget, which is often associated with rigid, mechanistic routines, the base forecast combines diagnostic discipline with operational flexibility. It maintains the logic of comparing planned versus actual results while incorporating forward-looking adjustments that require managerial judgment and negotiation across departments (Merchant & Van der Stede, 2007; Frezatti et al., 2022). This duality explains why the base forecast is particularly well-suited for interactive use by creating an institutionalized space for ongoing debate about future performance.

The positive and statistically significant coefficient observed for H5 suggests that the base forecast is perceived as a directly actionable tool for day-to-day management, especially in uncertain contexts. This finding aligns with evidence indicating that volatile environments increase the importance of mechanisms that facilitate frequent communication and alignment among managers due to the need for rapid and coordinated responses (Asel et al., 2011; Bhimani et al., 2018). The base forecast meets this demand more immediately by operating on short-term horizons and being strongly connected to current performance.

In summary, the findings related to H5 indicate that the base forecast acts as an operational trigger for interactive use by transforming diagnostic information into inputs for strategic dialogue and collective decision-making. These results reinforce the logic of complementarity between control systems, as proposed by Simons (1995), by showing that interactive use emerges from the availability of artifacts that continuously update the vision of the future and require joint interpretation. Thus, the base forecast establishes itself as the primary functional link between diagnostic and interactive use in the empirical model of this study.

H6+: The greater the use of the rolling forecast, the greater the interactive use of the control system.

The results do not provide empirical support for H6, indicating that the availability of the rolling forecast is not statistically significantly associated with interactive control system use. This finding is particularly relevant because it contrasts with the evidence obtained for H5 (base forecast → interactive use), suggesting that not all forms of continuous forecasting activate interactive control in the same way.

Conceptually, the rolling forecast is described in the literature as a tool that continuously extends the planning horizon. It is frequently used to anticipate future scenarios and support subsequent budget preparation (Ekholm & Wallin, 2011; Hansen, 2011; Henttu-Aho, 2018). While this increases its strategic utility, it also shifts the focus away from the short term and immediate operational decisions. This reduces its potential to generate the managerial tension necessary to stimulate frequent interactions, intense debates, and cross-functional involvement. These are central elements of interactive use, according to Simons (1995).

The results suggest that, in the context analyzed, the rolling forecast is predominantly used as a technical forecasting tool associated with medium- and long-term predictability rather than the continuous discussion of emerging problems. This interpretation aligns with literature indicating that the rolling forecast does not replace or intensify managerial dialogue and may play a more analytical and less relational role, particularly when detached from immediate decisions or short-term performance pressures (Ekholm & Wallin, 2011; Henttu-Aho, 2018).

Another relevant aspect is that the rolling forecast requires greater analytical sophistication and informational stability to operate effectively since it relies on historical data, consistent assumptions, and periodic comprehensive reviews. In such cases, it may be used more centrally in specific areas, such as controllership or planning. This limits its role as a platform for broad interaction among managers at different levels and with different functions. This helps explain why its availability does not necessarily lead to greater interactive use of the control system.

Rejecting H6 also reinforces the functional distinction between the base and rolling forecasts, as the empirical model of the study had already suggested. While the base forecast is strongly anchored in current performance and variations in the current period – elements that demand an immediate managerial response and stimulate interaction – the rolling forecast appears to operate as a more distant mechanism from daily decision-making routines with lesser capacity to trigger intense interactive processes (Simons, 1995; Frezatti et al., 2022).

In summary, the findings associated with H6 suggest that the mere availability of the rolling forecast is insufficient to intensify interactive use of the control system. These results contribute to the literature by demonstrating that advanced continuous planning practices should not be automatically interpreted as inducing managerial interaction. Rather, their impact depends on proximity to current performance, manner of use, and integration with other control mechanisms. Thus, the study emphasizes the importance of analyzing the effects of forecasting artifacts in a differentiated manner, respecting their specific functions within MCSs.

6 Conclusions, Limitations, and Agenda for Future Research

This research advances our understanding of how MCSs are used in organizations, particularly in regard to the relationship between diagnostic and interactive use. The main contribution is the empirical demonstration that interactive use is not isolated but is influenced by the prior structuring of the diagnostic system, which gives traditional planning and control artifacts a central role.

Theoretically, the study progresses by proposing a logical sequence linking artifacts (e.g., strategic planning, capital budgeting, and budgeting), diagnostic use (e.g., budgetary control), and more dynamic artifacts (e.g., base and rolling forecasts), ultimately leading to interactive use. This chain enables us to transcend fragmented and prescriptive approaches to control system uses by illuminating how the integration of artifacts influences managerial practices, particularly in unstable contexts.

Empirically, the findings show that the base forecast primarily links diagnostic and interactive uses by continuously updating the future outlook based on changes, fostering cycles of learning and strategic action. However, the rolling forecast, despite being associated with long-term planning, proved to be disconnected from interactive use, suggesting that its technical adoption does not imply greater coordination or strategic dialogue.

The results of this research have important implications for managers responsible for designing and using MCSs. First, the findings suggest that interactive use of the control system is neither autonomous nor dependent on the adoption of more sophisticated artifacts. Rather, it is conditioned by the existence of a previously established diagnostic framework. Tools such as strategic planning, budgeting, and capital budgeting provide the information necessary for structured, evidence-based strategic dialogue.

These results suggest that organizations seeking to foster greater managerial interaction, especially in volatile environments, should prioritize the quality and consistency of their diagnostic mechanisms before introducing new control instruments. Without formal routines for monitoring, comparing, and analyzing variances, managerial interaction tends to become diffuse or subjective.

A second relevant aspect concerns the role of the base forecast. The results indicate that this artifact plays a specific role in activating the interactive use of the control system. By updating performance expectations throughout the budget period, the base forecast creates opportunities for managers to discuss trends, risks, and possible strategic responses. Thus, systematic budget reviews improve the quality of projections and function as institutional mechanisms that foster cross-functional communication and organizational learning.

Conversely, the rolling forecast showed no significant correlation with interactive use. This suggests that extending the planning horizon alone does not guarantee greater managerial interaction. Rather, interaction appears to depend more on routines for reviewing and discussing the generated information than on the temporal extension of the projections.

Taken together, the findings indicate that interactive use of the control system is an organizational phenomenon emerging from the interplay of artifacts, routines, and management processes. For managers, this implies recognizing that the ability to promote strategic learning and organizational adaptation depends less on the adoption of individual tools and more on the structure and utilization of planning and control systems in day-to-day operations.

While not the focus of this research, the study also raises questions about the ceremonial use of certain artifacts (Russo & Guerreiro, 2017). The balanced scorecard, for example, is widely touted in the literature as a strategy integrator but did not have a significant impact on the diagnostic system. This underscores the need to investigate not only the presence of these instruments, but also how they are effectively incorporated into organizational practice.

Among the limitations are the convenience sample and focus on Brazilian companies, which may affect the generalizability of the results to other contexts. Nevertheless, these choices are consistent with the research objective, given the volatile environments of emerging countries, which are fertile ground for analyzing interactive use.

For future research, we recommend investigating the role of organizational culture, leadership, and digitalization in strengthening interactive use. Additionally, we suggest exploring the transition mechanisms between diagnostic and interactive use at different hierarchical levels and decision cycles.

In summary, this research broadens our understanding of the complementarity of MCSs. It shows that the interactive use of these systems is not a choice, but rather a result of how the artifacts are configured, activated, and aligned with the organization's reality. It offers theoretical, empirical, and practical contributions to redesigning control models that are more responsive, coherent, and connected to the complexity of the contemporary organizational environment.

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