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INFLUENCE OF INFORMATION SHARING AND ENVIRONMENTAL UNCERTAINTY ON THE RELATIONSHIP BETWEEN THE USE OF THE BUDGETING SYSTEM AND INNOVATIVE PERFORMANCE IN BRAZILIAN STARTUPs

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ABSTRACT

This research analyzes the effect of information sharing and environmental uncertainty on the relationship between the use of the budgeting system and innovative performance. A survey was conducted with Brazilian startups, resulting in 121 respondents. The data were analyzed using structural equation modeling through partial least squares. The findings demonstrate that the relationship between the use of the budgeting system and innovative performance is significant, showing that budgeting mechanisms play a fundamental role as a managerial foundation in the innovation processes of startups. The use of the budgeting system contributes to innovative performance in different degrees of environmental uncertainty, providing support for decision-making and the generation of business opportunities. The study has implications that highlight the critical role of budgeting mechanisms in the innovation processes of startups and emphasize the importance for managers to consider environmental uncertainty when fostering planning and controls to sustain an environment conducive to innovation. For future research, we suggest including organizational variables, such as knowledge sharing and organizational effectiveness, to enhance the use of the budget and innovative performance.

Keywords: Information sharing. Environmental uncertainty. Budgeting system. Innovative performance. Startups.

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1 INTRODUCTION

Startups play a prominent role in the innovation processes, benefiting from the flexibility and agility that drive creativity and innovation (Valaei, Ismail & Rezaei, 2017). However, in the context of business innovation processes, management control assumes an indispensable role (Müller-Stewens et al., 2020; Mancebo et al., 2024). In recent years, the relationship between management control systems and innovation has received significant attention in academic literature (Müller-Stewens et al., 2020; Henri & Wouters, 2020; Gomez-Conde et al., 2023). Management control systems play a crucial role in the effective allocation of resources in startups (Samagaio et al., 2018; Crespo et al., 2019; Frare & Akroyd, 2023).

Among the various management control mechanisms, budgeting has been widely studied due to its crucial role in organizational planning and control, resource allocation, and performance evaluation (Van der Stede, 2011; Becker et al., 2016). Its use exerts a positive influence on the value of startups, particularly those in the development phase and operating in uncertain environments (Davila et al., 2015; Kim et al., 2021; Santos et al.,2023).

owever, there are gaps in obtaining evidence regarding the relationship between the use of the budgeting system and innovative performance (Laitinen et al., 2016; Beuren et al., 2021; Zeng et al., 2023). Thus, the variable 'information sharing' is emphasized to strengthen the discussion about the use of the budgeting system and planning among management members, favoring the creation of business opportunities (Lunardi et al., 2020; Mucci et al., 2021). The moderating role of environmental uncertainty, which influences managers' decisions and the relevance of information from the budgeting system in the innovation process, is also highlighted (Grabner et al., 2018; Beuren et al., 2021). In complex environments, budgeting information can enhance the creative process and promote innovation (Santos et al., 2023; Mancebo et al., 2024). Therefore, the study aims to analyze the effect of information sharing and environmental uncertainty on the relationship between the use of the budgeting system and innovative performance.

The research is relevant as it prompts discussions and reflections about the influence of budgeting system use, information sharing, and environmental uncertainty perception on innovative performance. The purpose is to foster an understanding of the importance of training managers in budgeting processes, as well as in planning and control mechanisms related to innovation processes in startups (Samagaio et al., 2018; Crespo et al., 2019; Beuren et al., 2021).

The study offers contributions in two areas: theoretical and practical. First, from a theoretical perspective, it provides new evidence on the use of budgeting systems in relation to innovative performance. The study emphasizes that different levels of environmental uncertainty give distinct degrees of relevance to information from the budgeting system in the context of the innovation process in organizations.

From a practical contribution standpoint, it emphasizes to managers that the lack of information sharing related to the budgeting process can lead to difficulties in planning and resource allocation. Finally, it highlights the importance for managers to consider the environmental uncertainty of the sector, as its increase implies a growing need to promote planning and controls to sustain an environment conducive to innovation.

2 THEORETICAL FRAMEWORK

2.1 Use of the Budgeting System and Innovative Performance

The budgeting system is primarily characterized by mechanisms applied in the context of control, planning, and resource allocation functions (Emmanuel et al., 1990; Van der Stede, 2011; Becker et al., 2016). In this regard, when the budget is used as a control and planning device, the chances of contributing to the improvement of product innovation performance are increased (Dunk, 2011).

Merchant (1984) emphasizes that the budget, as a planning mechanism, exposes the available options to managers, supporting the decision-making process. In this way, the budget as a planning tool is developed and discussed across various management levels, favoring the forecasting of results in order to identify the most advantageous solutions and mitigate environmental uncertainties (Samuelson, 1986; Zeng et al., 2023). Therefore, the use of the budgeting system as a planning mechanism tends to contribute to product innovation (Samagaio et al., 2018; Crespo et al., 2019; Beuren et al., 2021; Gomez-Conde et al., 2023).

In a study, Laitinen et al. (2016) demonstrate that the use of interactive budgeting is positively related to product innovation. The authors emphasize that the relationship between product innovation and performance changes depending on the defensive and prospecting strategies adopted by the companies. Beuren et al. (2021) highlight that the use of interactive budgeting intensifies the effects of innovation as creative processes that enhance business performance.

Zeng et al. (2023) present that the adoption of interactive budgeting has a positive impact on innovation performance, providing managers with essential information and resources for their active participation in innovative processes. In this context, they highlight that in entrepreneurial environments, the implementation of flexible budgeting mechanisms provides significant support for innovative activities (Chtioui & Dubuisson, 2020). Based on this, the first hypothesis of the research is formulated:

H1. The use of the budgeting system positively influences innovative performance.

2.2 Budgeting System Use, Information Sharing, and Innovative Performance

The budgeting process is an essential resource for product innovation, representing a crucial approach for managers to ensure the proper allocation of budgetary resources (Cheng et al., 2013; Henri & Wouters, 2020). Comerford and Abernethy (1999) add that the benefits derived from involving managers in the budgeting process are mainly associated with sharing and disseminating relevant information, thereby facilitating the decision-making process.

Thus, the practice of information sharing enables the exchange of information among organizational members on relevant topics. It refers to the communication established between senior managers, subordinates, and other members of the organization, aiming to foster cooperation through a better understanding of the organization's expectations and capabilities (Parker & Kyj, 2006). To achieve organizational objectives, it is necessary to increase the sharing of information within the workplace, allowing a more comprehensive understanding of what is needed to achieve better performance (Parker & Kyj, 2006; Lunardi et al., 2019).

Mucci et al. (2021) emphasize that budget alignment, integration, learning, and information sharing are relevant elements for improving the effectiveness of budgeting systems within organizations. Information sharing between superiors and subordinates plays a crucial role in enhancing budgetary discussions, enabling more accurate resource allocation (Lunardi et al., 2020). The discussion presented suggests the second hypothesis of this research:

H2. The sharing of information positively influences the use of the budgeting system and innovative performance.

2.3 Use of the Budgeting System, Environmental Uncertainty, and Innovative Performance

The perception of environmental uncertainty plays a fundamental role in consolidating the use of control mechanisms and in the managers' understanding of the influence of uncertainty in the environment that impacts organizations. This leads to assigning relevance to different procedures, managerial controls, and the need for information to face market changes (Hoque, 2004). In this context, the use of budgeting systems by organizations facilitates the structuring of

information for decision-making, helping to reduce uncertainty with the aim of improving stability and security in the face of risks in the market environmen (Bourmistrov & Kaarbøe, 2017).

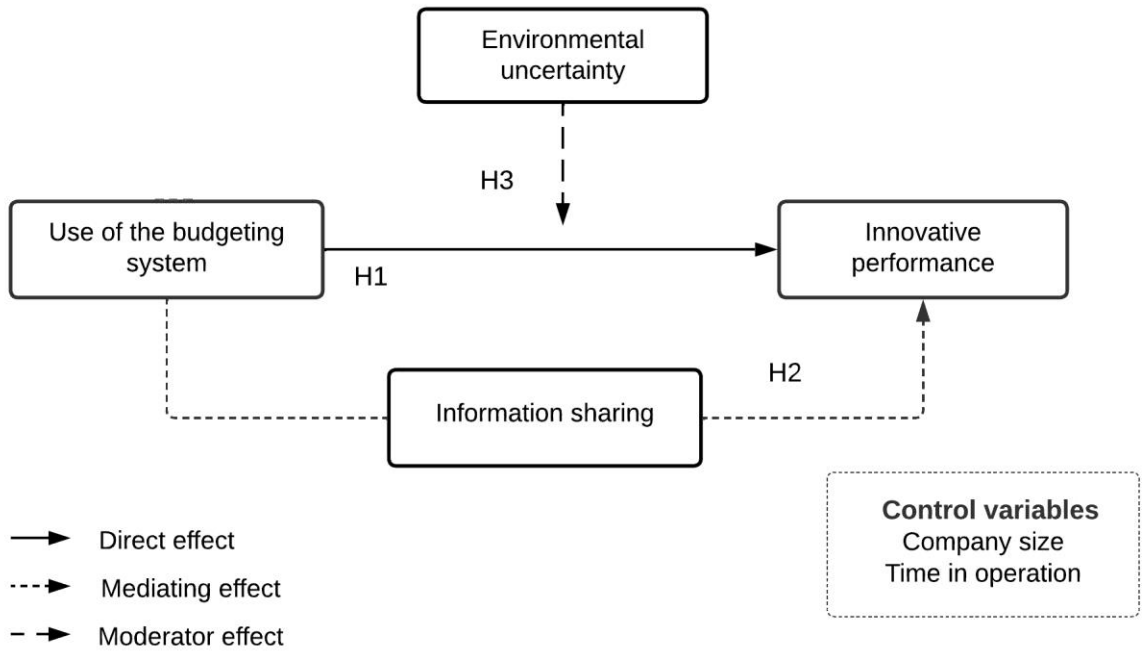
Thus, the budget supports supervision to mitigate uncertainty and promote efficiency (Samagaio et al., 2018; Crespo et al., 2019; Beuren et al., 2021). Hassan & Basiruddin (2023) emphasize that increased environmental uncertainty implies the need to make future projections and acquire accurate and comprehensive information during the budgeting process. In line with this, Grabner et al. (2018) indicate that employees exposed to environments characterized by uncertainty, such as in the context of innovation, require greater direction and guidance. This suggests that environmental uncertainty acts as a contingency factor influencing the demand for information processin.

In this context, it is clear that environmental factors have the intrinsic ability to influence the attractiveness and viability of innovation activities (Kim et al., 2021). Therefore, it becomes imperative to concurrently use information from the budgeting system, cost modeling, and performance measurement systems to support the development and implementation of innovations, especially in situations of high environmental uncertainty (Davila et al., 2015; Henri & Wouters, 2020). Santos et al. (2023) highlight that as technological turbulence increases, budgetary information becomes more relevant to the innovation process of organizations. Based on such evidence, the third hypothesis of this research can be formulated:

H3. Environmental uncertainty moderates the relationship between the use of the budgeting system and innovative performance.

Figure 1 illustrates the conceptual model of the research. Additionally, two control variables are included in the model: size and time of operation in the market..

Figure 1
Theoretical Model of Analysis and Research Hypotheses



Source: Prepared by the authors.

From the analysis of such interactions, the purposes of this research can be inferred.

3 METHOD AND RESEARCH PROCEDURES

3.1 Population, Data Collection, and Sample

The methodology used in this research is characterized as descriptive research, survey-based, with a quantitative approach to the data. The population of the study consists strictly of startups, from which 2.000 startups registered and listed on Startupbase were randomly selected. Of these, 1.129 startups were contacted and located on the LinkedIn® platform. Data collection took place from April 2023 to November 2023 and resulted in 121 respondents, representing the final sample, corresponding to a response rate of 6.05% (sample/population).

In relation to the profile of the respondents, the average age is 34 years, with the majority of respondents being male (87) and having a postgraduate level of education, including an MBA or master's degree (67). Regarding the profile of the startups, it was found that the time in the market ranged from 9 months to 15 years, with an average of 6 years in the market. The size of the startups was proportionally assessed based on the number of employees, resulting in an average of 22 employees.

3.2 Measurement of Variables

The research instrument was divided into three blocks, all on a seven-point scale with the options "1 strongly disagree" and "7 strongly agree," as shown in Table 1.

Table 1
Measurement of Variables

Variables		Description	Items	Scale	Source
Use of the budgeting system	Planning	Structured process of defining and organizing financial and operational goals for a future period	8 items	1 - 7	Becker et al. (2016) e Pavlatos e Kostakis (2021)
	Resource Allocation	Process of distributing available financial resources among the organization's projects			
	Performance Evaluation	Process of analyzing and monitoring the fulfillment of financial and operational goals defined in the budget			
Information sharing		Process of exchanging information and insights between individuals, teams, or departments within an organization	3 items	1 - 7	Parker e Kyj (2006)
Innovative performance		Refers to the ability of an organization to introduce products and processes that add value	7 items	1 - 7	Schultz et al. (2013) e Bedford, Bisbe e Sweeney (2019)
Environmental uncertainty		Refers to the degree of unpredictability and complexity of external conditions that affect an organization	4 items	1 - 7	Becker et al. (2016)

Source: Prepared by the authors.

We incorporated two control variables, size and years of operation. The company size was considered as a control variable because the number of employees can directly influence the capacity for innovation (Damanpour, 2020). On the other hand, the years of operation were chosen as a control variable to better understand the impact of experience and market stability on organizations (Tippins & Sohi, 2003).

During the research design, measures were taken to mitigate potential issues arising from Common Method Bias (CMB), which can occur when data collection is performed through a

single method (survey) directed by the respondent, and to ensure that all items related to the case study are independent or unbiased (Podsakoff & Organ, 1986). In this regard, the questionnaire was designed with criteria that include instructional guidelines and an emphasis on anonymity (Podsakoff et al., 2003). After data collection, the Harman single-factor test was conducted, indicating that a single factor accounted for 34.85% of the variance in the questionnaire, demonstrating that CMB did not affect the results of this research.

3.3 Data Analysis Techniques

For data analysis, PLS-SEM was used due to its applicability in management research, robustness regarding the absence of data normality, and its ability to model with certain degrees of complexity (Hair et al., 2019). Next, we used the G*Power 3.1 software to demonstrate the sample power based on the medium effect size (f^2) of 0.15. α error probability of 0.05. power (1 - β error probability) of 0.90. and three predictors, which requires a minimum of 99 cases (Faul et al., 2009). Thus, a power level above 0.80 is considered satisfactory (Cohen, 1988; Hair et al., 2017). Therefore, the sample of 121 respondents is satisfactory for the application of PLS-SEM in the assumed conceptual model.

4 RESEARCH RESULTS

4.1 Quantitative Approach: PLS-SEM

The PLS-SEM approach begins with the evaluation of the measurement model (Table 1), which demonstrates the reliability and validity of the constructs. During this stage, the second-order construct modeling of the use of the budgeting system was carried out using a type I higher-order structure, applying the repeated indicators approach (Sarstedt et al., 2019). The results regarding the measurement of the research are detailed in Table 2.

Table 2

Modelo de mensuração

Variables	**Mean**	**SD**	**α**	**CR**	**AVE**
1. Information Sharing	6.16	1.08	0.849	0.929	0.868
2. Innovative Performance	6.02	1.40	0.894	0.925	0.757
3. Environmental Uncertainty	5.56	1.39	0.793	0.862	0.629
4. Use of Budgeting System	5.07	1.57	0.885	0.908	0.625

Discriminant Validity - Fornell-Larcker Criterion						
Variable	1	2	3	4	5	6
1.CI	**0.932**					
2.DI	0.188	**0.870**				
3.IA	0.049	0.466	**0.793**			
4.USO	0.288	0.487	0.173	**0.791**		
5.Size	0.084	0.092	0.108	0.123	-	
6. Time	0.119	0.129	0.012	0.149	0.511	-

Note. The bold values on the diagonal represent the square root of the average variance extracted (AVE), α = Cronbach's alpha; CR = composite reliability. USO = Use of the budget system; CI = Information sharing; IA = Environmental uncertainty; DI = Innovative performance.
Source: Prepared by the authors.

With the use of confirmatory factor analysis, items with factor loadings below 0.60 were excluded: USO4, CI2, IA2, and IA4. The remaining items demonstrated adequacy with factor loadings above 0.60 (Hair et al., 2017). The internal consistency shows reliability with Cronbach's alpha (α) for the constructs above 0.70, while composite reliability (CR) presents satisfactory values (> 0.7) (Hair et al., 2019). The convergent validity of the model is confirmed, as the AVE is above the adequate threshold (> 0.5) (Hair et al., 2019).

Discriminant validity was confirmed using the Fornell-Larcker criterion, where the values on the diagonal, highlighted in bold, represent the square root of the average variance extracted (AVE) and should be higher than the correlations between the constructs (Hair et al., 2017). Once the validity of the measurement model was confirmed, the structural model analysis was performed as shown in Table 3. For this analysis, a bootstrapping procedure with 5,000 resamples was used, employing the bias-corrected and accelerated (BCA) method with a two-tailed test.

Table 3
Structural model

Relationship	Beta (*β*)	*t*-value	*p*-value	F^2	Decision
USO → DI	0.370	4.334	0.000***	0.212	H1 supported
Tamanho → DI	0.153	1.392	0.197	0.012	
Tempo → DI	0.144	1.843	0.293	0.006	
USO→ CI →DI	0.018	0.447	0.306	-	H2 not supported
USO * IA →DI	0.139	1.670	0.065*	0.048	H3 supported

Note. USO = Budget system usage; CI = Information sharing; IA = Environmental uncertainty; DI = Innovative performance. IC 90% = 90% confidence interval. * p < 0.1; ** p < 0.05; *** p < 0.01.
Source: Prepared by the authors.

In the context of the explained variance (R^2) related to innovative performance (39.70%), a significant proportion of the variation is explained by the exogenous variables, as guided by Cohen (1988). Therefore, it can be stated that the model does not exhibit multicollinearity, since the highest variance inflation factor (VIF) among the independent variables is below 3.5 (Hair et al., 2019). Regarding the two control variables incorporated into the model (size and time of operation), it was found that they did not reach statistical significance, indicating that they do not play a determining role in innovative performance.

The predictive relevance, expressed by the Q^2 in relation to innovative performance (29.30%), is considered acceptable, as it presents a value greater than zero, confirming the predictive accuracy of the model (Hair et al., 2019). The assessment of the effect size (f^2) was conducted following Cohen's (1988) guidelines, which define a value of 0.02 for small effects, 0.15 for medium effects, and 0.35 for large effects. In the proposed relationships, the effects were identified as small (0.048) and medium (0.212).

4.2 Discussion of Results

H_1 suggests that the use of the budgeting system has a significant and positive relationship with innovative performance. The hypothesis was supported ($\beta = 0.370$; $p < 0.01$). Evidence was found that the use of the budgeting system as a mechanism contributes to innovative performance, enabling startups to have planning and controls for forecasting results with the aim of mitigating risks and identifying business opportunities. Thus, the use of the budgeting system as a planning tool, discussed with management members, favors business opportunities and mitigates environmental uncertainties in organizations (Zeng et al., 2023).

It is demonstrated that budgeting mechanisms intensify the impacts on innovative performance, acting as a managerial foundation for innovation processes that contribute to the enhancement of business performance (Samagaio et al., 2018; Crespo et al., 2019; Beuren et al., 2023). In this context, it is emphasized that in entrepreneurial environments, the adoption of budgeting mechanisms represents a significant support for innovative activities (Chtioui & Dubuisson, 2020). Thus, using the budget as a control and planning tool increases the likelihood of contributing to the enhancement of product innovation performance. Organizational strategy

can highlight the relevance of the budget in the interconnection between product innovation and innovative performance (Dunk, 2011; Laitinen et al., 2016; Santos et al., 2023).

H_2 suggests that the sharing of information mediates the relationship between the use of the budgeting system and innovative performance. This hypothesis was not supported ($\beta = 0.018$; $p < 0.306$). The study suggests that there may be inadequate involvement of managers in the budgeting process in startups, which may result in difficulties in planning and resource allocation decisions. Therefore, it is emphasized that the practice of information sharing enables exchanges between senior managers, subordinates, and other members of the organization, aiming to foster cooperation through understanding the organization's expectations and capabilities (Parker & Kyj, 2006).

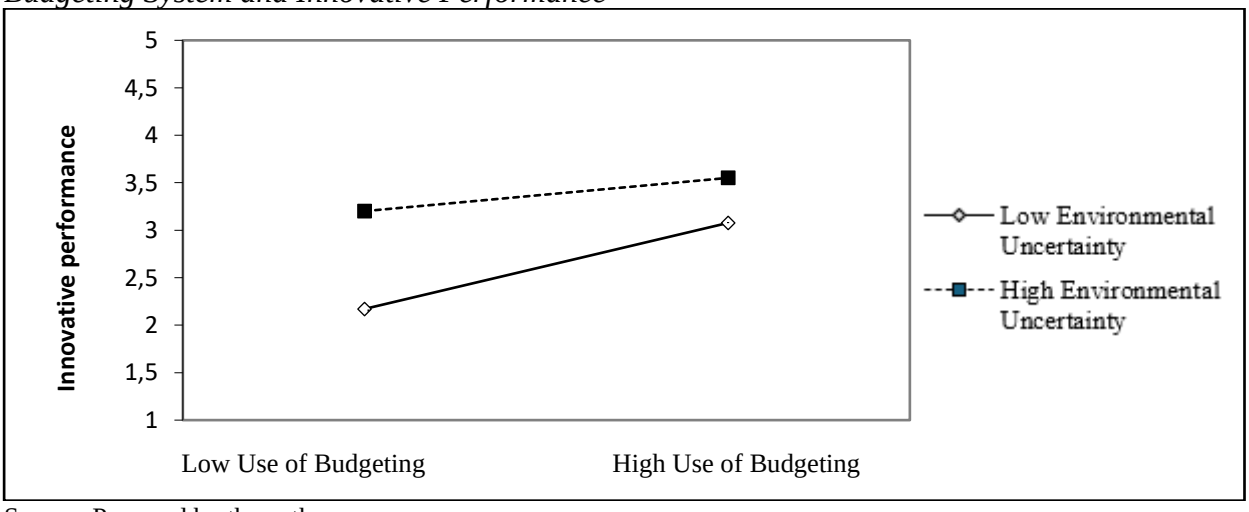
Lunardi et al. (2020) add that sharing information between superiors and subordinates plays a favorable role in enhancing budgeting discussions in organizations, enabling more precise resource allocation. In this context, the importance of budgeting alignment, manager development, and information sharing are highlighted as key elements for improving the effectiveness of budgeting systems used by organizations (Mucci et al., 2021).

Thus, managers' participation in the budgeting process is linked to sharing and disseminating relevant information to facilitate and promote assertive decision-making (Comerford & Abernethy, 1999). This shows that the budgeting process is an indispensable resource for product innovation, representing an essential approach through which managers ensure the allocation of budgets that indicate how decisions made during the development of products and services impact costs (Davila et al., 2015; Henri & Wouters, 2020; Frare & Akroyd, 2023).

H_3 demonstrates that the perception of environmental uncertainty can moderate the relationship between the use of the budgeting system and innovative performance. The hypothesis was supported ($\beta = -0.139$; $p = 0.065$). It suggests that managers' perception of uncertainty in startups influences the relationship between the use of the budgeting system and innovative performance, which results in budgeting system information becoming more relevant for the innovation process in organizations. Thus, environmental uncertainty implies that startups use the budget as a control and planning tool, increasing the likelihood of contributing to the enhancement of product innovation performance (Henri & Wouters, 2020; Santos et al., 2023). Figure 2 explores the moderating effect of H_3 in more detail.

Figure 2

Moderating Effect of Environmental Uncertainty on the Relationship Between the Use of the Budgeting System and Innovative Performance



Source: Prepared by the authors.

In this way, it is evident that high levels of budget usage are associated with improved innovative performance, both in contexts of high and low perceived environmental uncertainty. This highlights that the mechanisms of the budgeting system (planning, control, and resource allocation) employed by startup managers enable innovation activities, favoring innovative performance. The application of budgeting systems by organizations facilitates the structuring of information for decision-making and enhances the generation of business opportunities (Bourmistrov & Kaarbøe, 2017; Kim et al., 2021; Mancebo et al., 2024).

The results indicate that high levels of budgeting system usage and the perception of environmental uncertainty positively influence innovative performance, providing managerial information to address market changes, mitigate risks, and create business opportunities. Hassan and Basiruddin (2023) emphasize that increased environmental uncertainty necessitates future projections and obtaining accurate and comprehensive information regarding the use of budgeting systems in organizations. In this context, it becomes essential to utilize information from the budgeting system to support the development and implementation of innovations, especially in situations of high environmental uncertainty (Henri & Wouters, 2020).

5 FINAL CONSIDERATIONS

The empirical results of the study allow for several conclusions. Initially, it is observed that budgeting mechanisms intensify the impacts on innovative performance, playing a key role as a managerial foundation in the innovation processes of startups. The lack of information sharing among managers in the budgeting process within startups can lead to difficulties in planning and defining resource allocations for the organization's present and future actions. Finally, it is evident that high levels of budget usage are correlated with improved innovative performance, both in contexts of high and low environmental uncertainty. Overall, it is concluded that the use of the budgeting system contributes to innovative performance in varying degrees of environmental uncertainty, supporting decision-making and the generation of business opportunities.

Implications for the literature are involved in the study. Theoretical implications: the study contributes by adding new evidence on the use of the budgeting system in relation to innovative performance, corroborates previous studies that found a positive relationship (Laitinen et al., 2016; Beuren et al., 2021; Zeng et al., 2023), and highlights the fundamental role of budgeting mechanisms in the innovation processes of startups. Additionally, it adds new findings to the research flow exploring the moderating role of environmental uncertainty (Grabner et al., 2018; Kim et al., 2021; Hassan & Basiruddin, 2023), demonstrating that different levels of environmental uncertainty provide varying degrees of relevance to the information from the budgeting system in the context of the organizational innovation process.

The research also contributes to the managerial practice of organizations, especially startups. Initially, it offers guidance for managers to align the use of the budgeting system (involving planning, control, and resource allocation) with the innovative performance of startups. The study emphasizes that the lack of information sharing related to the budgeting process in startups can lead to difficulties in planning and defining resource allocations. Finally, it highlights the importance for managers to consider the environmental uncertainty of the sector, as it increases the need to foster planning and controls to sustain an environment conducive to innovation.

Finally, some limitations should be noted. The generalization of the results should be done cautiously, given the research design, which adopted a cross-sectional approach, and its specific application in the context of Brazilian startups. Therefore, it is suggested that future research consider implementing longitudinal studies in the context of startups, explore different variables or approaches related to the use of the budgeting system and its impact on innovative performance, and include organizational variables such as knowledge sharing and organizational effectiveness.

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CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest regarding this submitted work.

CONTRIBUTIONS OF THE AUTHORS

Roles	1ª author	2º author	3º author
Conceptualization	♦	♦	
Data Curation	♦	♦	
Formal Analysis	♦	♦	♦
Funding Acquisition			
Investigation	♦	♦	
Methodology	♦		
Project Administration			♦
Resources			
Software	♦		
Supervision			♦
Validation	♦	♦	
Visualization	♦	♦	♦
Writing – Original Draft	♦	♦	
Writing – Review & Editing	♦	♦	♦