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# Adapting Internal Control Systems as Governance Mechanisms to Enhance Higher Education Institutions' Sustainable Performance

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**ABSTRACT**

*The objective of this study is to examine the role of adaptive internal control systems as a governance tool for improving the implementation of sustainability-oriented innovation and sustainable performance of higher education institutions, moderated by leadership commitment. The study employs a quantitative explanatory design based on a survey of university leaders, unit heads, internal auditors, and quality assurance system managers in the Special Region of Yogyakarta, Indonesia. Data analysis was conducted using Structural Equation Modeling based on Partial Least Squares (SEM-PLS). The findings indicate that adaptive internal control systems positively affect the implementation of sustainability-oriented innovation and the sustainable performance of higher education institutions. However, sustainability-oriented innovation does not directly improve institutional performance without leadership support. Leadership commitment was found to strengthen the relationship between internal control systems and innovation, as well as the effect of innovation on university performance. These findings underscore that the integration of adaptive control systems and committed leadership is a key factor in achieving sustainable and accountable governance in higher education.*

**Keywords:** Internal control systems, Sustainable innovation, University performance, Leadership commitment, Governance.

## Introduction

Higher education institutions play a strategic role in advancing sustainable development through education, research, and community engagement. Over time, expectations placed on universities have expanded beyond accountability and good governance to include meaningful contributions to social, economic, and environmental dimensions. Thus, internal control systems must be adjusted to effectively guide the attainment of sustainability targets (Mio *et al*., 2022). In the past two decades, global awareness of sustainability issues has expanded exponentially, leading many organizations, including universities, to adjust their strategies and operations to the principles of sustainable development (Öztaş *et al*., 2023; Meissner *et al*., 2024). Universities are no longer seen just as institutions of education and research but as agents of social change with a moral responsibility to lead the way to greater sustainable communities (Caeiro *et al*., 2020; Bautista-Puig *et al*., 2022; Svensson & Lindberg, 2026).

The literature points to the need for systems that integrate financial and non-financial dimensions to assess and control sustainable performance. The levers of control (LOC) concept clarifies how control systems can be used diagnostically and interactively to encourage learning, innovation, and attainment of strategic goals (Asiaei *et al*., 2023; Hao *et al*., 2025). In the sustainability environment, management control serves not only as a compliance instrument but also as a vehicle for organizational learning (Asiaei *et al*., 2023; Dharmayanti *et al*., 2023). Nevertheless, research on internal

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control in higher education institutions has mostly been confined to audit, compliance, and fraud prevention (Aryawati *et al*., 2024), with quantifiable empirical evidence on the adoption of internal control as a driver of sustainable innovation still lacking.

Sustainability practices in the globalization of higher education are not just a social duty, but also a means to reinforce institutional reputation and competitiveness. Participation in worldwide rankings has become an important tool for the construction of the legitimacy and the global visibility of universities (Estrada-Real & Cantu-Ortiz, 2022; Morgan *et al*., 2025). Rankings such as the Times Higher Education World University Rankings (THE WUR) and the QS World University Rankings have become important markers of institutional performance worldwide.

There are also sustainability-based rankings such as the UI GreenMetric World University Ranking that provide a precise measure of campus sustainability policies and practices (Calderon, 2023). UI GreenMetric assesses six main characteristics: setting and infrastructure; energy and climate change; waste; water; transportation; and education and research. With the rising participation of universities worldwide, this rating is gaining more and more recognition as a framework to assess sustainability in higher education institutions. Although the literature on sustainable universities is still growing, most of the research is still focused on descriptive analyses of indicators or on a single rating system (Boiocchi *et al*., 2023). Studies on the combination of sustainability metrics and institutional performance in mainstream global rankings are still somewhat few. A paper in the International Journal of Sustainability in Higher Education also underscores the importance of gaining a better understanding of how the configuration of sustainability metrics affects university performance across different worldwide rankings. This discrepancy shows that the link between sustainability practices and institutional performance is still not fully understood, either in its configuration or in its effects.

## *Literature Review*

### *University Sustainability Performance*

Sustainable university performance is the systematic measurement, management, and reporting of economic, social, and environmental impacts by a higher education institution using standardized Sustainability Performance Indicators (SPIs) and Embedded Public Responsibility (EPR) indicators, which measure the integration of sustainability into teaching, research, and policy. Such performance is subject to coercive, normative, and resource-dependence pressures, which makes sustainability reporting an institutionalized practice that aims to establish public legitimacy and universities' contributions to the Sustainable Development Goals (Damaševičius *et al*., 2025; Nagesh *et al*., 2025; Hsiao *et al*., 2026).

More generally, sustainable university performance can be defined as the ability of higher education institutions to produce, manage, and report measurable social and environmental results as elements of their institutional responsibility for sustainable development. In the higher education setting, sustainability is conceived not just in terms of the environmentally friendly practice of operation but also as the university's impact on values, behaviors, and social norms through its education, research, and community engagement. De Villiers *et al*. (2025); Kowalski *et al*. (2024) state that sustainability performance involves measurable successes in social and environmental efforts as judged through sustainability rankings. Moreover, sustainable performance of the university also implies the integration of the Sustainable Development Goals (SDGs) in the management system of the institution. De Villiers *et al*. (2025) also note that sustainability performance comprises the implementation of goals associated with the SDGs through teaching, research, and community engagement.

Furthermore, internal and external factors (institutional resources, academic prestige, and the geopolitical backdrop) influence sustained university performance. Thus, sustainability is a function of the mix of organizational capacity and external constraints such as regulation, public legitimacy, and higher education stakeholders' needs (Novak & Dvorak, 2025; Sato *et al*., 2025). The sustainability values institutionalization is also reflected in sustainable university performance. Universities educate and study to form public perception of sustainability and frame it as the right thing to do. In this way, universities foster social change toward more ecologically and socially responsible behavior and policy. Therefore, sustainable university performance acts as not just an internal metric but also a driver for wider social change (Huber *et al*., 2025; Salem *et al*., 2025; Anwar *et al*., 2026).

### *University sustainable innovation*

University sustainable innovation is the capacity of a university to develop and utilize environmentally friendly goods, processes, technologies, and learning techniques with the purpose of reducing ecological impacts, improving resource efficiency, and supporting long-term sustainability. The present article considers sustainable innovation as green innovation that involves product and process innovation and is an important mediating factor between green human resource management (GHRM) practices and green culture and improved university environmental performance (Rotondo *et al*., 2023; Kajanova & Badrov, 2024).

University sustainable innovation is a sort of innovation generated by higher education institutions to produce products, processes, services, and technology which contribute to social, environmental, and economic objectives. We define innovation as the creation of new technologies and services that enhance human and institutional well-being without exceeding the regeneration capacity of nature, following Gonzalez-Urango *et al*. (2025); Novak and Jelic (2025). Sustainability innovation in the university context can be understood from three viewpoints: an internal managerial perspective, an external relational perspective, and a performance evaluation perspective. Together, these perspectives form a sustainability-oriented innovation ecosystem. Universities are agents of transformation, acting through Technology Transfer Offices, as they transfer research outputs to society, while keeping the integration of social and environmental values and ensuring that technology diffusion helps to sustainable development goals.

### *Adaptation of Internal Control Systems and Leadership Commitment*

Recent research has shown that measurement and control systems for sustainable performance have moved away from traditional compliance-oriented approaches to more integrative, strategic and sustainability-oriented systems (Kwatra *et al*., 2024; Zoni & Wainer Bustamante, 2025). In this context, the levers of control (LOC) approach is increasingly employed to understand how management control can help to accomplish social responsibility and integrate sustainability into the organizational strategy (Asiaei *et al*., 2023; Parveen & Ghosh, 2025; Zoni & Wainer Bustamante, 2025). A growing body of empirical research also suggests that management control systems function as mediating mechanisms linking organizational resources to improved sustainable performance, particularly through diagnostic and interactive controls that promote innovation and organizational learning (Bellora-Bienengräber *et al*., 2023; Altowijri, 2024).

On the other hand, studies on internal control in higher education institutions remain dominated by issues such as internal audit, oversight quality, and fraud prevention, including bibliometric mapping studies that highlight research trends on internal control in university settings (Aryawati *et al*., 2024). Meanwhile, research on university performance emphasizes the roles of quality culture and the internal auditor's perspective as important factors in determining institutional performance effectiveness (Yazid *et al*., 2025). However, research that directly links the adaptation of internal control systems to sustainability-oriented innovation as a mediating mechanism for improving university performance remains limited.

### *Hypothesis*

**H1:** Internal control system adaptation has a positive effect on the implementation of sustainability-oriented innovation in higher education institutions. Adaptive and interactive control systems have been shown to promote the integration of sustainability and organizational innovation through levers of control and sustainability management control systems (Asiaei *et al*., 2023; Dharmayanti *et al*., 2023; Zoni & Wainer Bustamante, 2025).

**H2:** Internal control system adaptation has a positive effect on sustainable performance in higher education institutions. Prior research indicates that sustainable performance measurement and control systems contribute to the achievement of strategic goals and to long-term organizational performance improvement, including in the higher education sector (Mio *et al*., 2022; Nguyen *et al*., 2025; Yazid *et al*., 2025).

**H3:** Sustainability-oriented innovation implementation has an effect on sustainable performance in higher education institutions. Empirical studies suggest that sustainable innovation serves as a key mechanism through which control systems influence sustainable performance (Beusch *et al*., 2022; Akankunda, 2024; Aksoy & Akaydin, 2024).

**H4:** Leadership commitment moderates the relationship between internal control system adaptation and sustainability-oriented innovation implementation. Leadership support and commitment strengthen the effectiveness of control

systems as learning tools and drivers of sustainability strategy (Bellora-Bienengräber *et al*., 2023; Elango & Govindaraju, 2025; Zoni & Wainer Bustamante, 2025).

**H5:** Leadership commitment moderates the relationship between sustainability-oriented innovation implementation and sustainable performance in higher education institutions. Leadership committed to sustainability enhances the impact of sustainable innovation on institutional performance (Bezuidenhout *et al*., 2023; Jannath *et al*., 2024; Yazid *et al*., 2025).

### *Research Model*

The detailed theoretical review and empirical studies, as well as the hypothesis development presented earlier, allow the research framework to be illustrated as a model where internal control system adaptation is the independent variable that influences sustainability-oriented innovation implementation and sustainable university performance. The adoption of sustainability-oriented innovation functions as a mediator in the effect of the control system on performance. Furthermore, leadership commitment acts as a moderating variable that increases the correlations among the key factors. Accordingly, **Figure 1** presents the research framework, which reflects the structural relationships among governance, innovation, leadership, and stakeholder performance within the higher education environment.

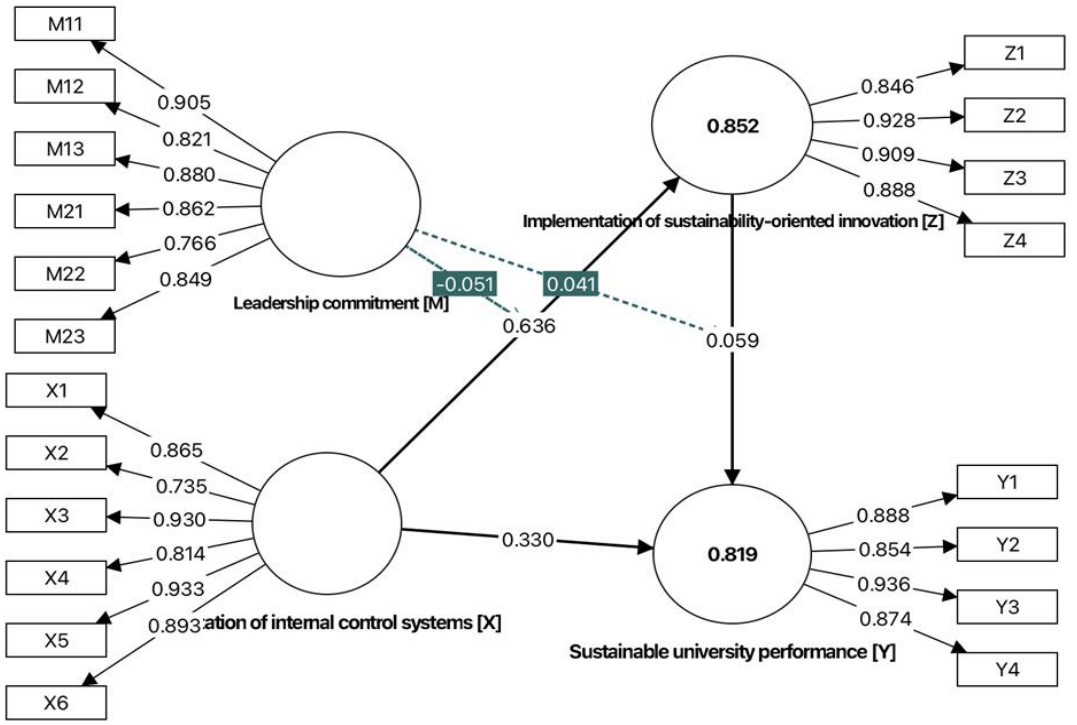


**Figure 1.** Conceptual framework of the research [Source: Authors' calculation using Smart-PLS 4.1]

## Materials and Methods

### *Research Procedures*

This study employed a quantitative explanatory design aimed at testing the causal relationships among internal control system adaptation, sustainability-oriented innovation implementation, and sustainable university performance, including the mediating and moderating roles within these relationships. A quantitative approach was selected as it is suitable for assessing complicated theoretical models and simultaneous interactions between latent components, particularly using structural equation modeling (SEM) based on partial least squares (Hair & Alamer, 2022; Bellora-Bienengräber *et al*., 2023; Chandrasekhar *et al*., 2025).

The organization is the unit of analysis in this research undertaken in higher education institutions in the Special Region of Yogyakarta. The respondents were university leaders, unit heads, internal auditors, and quality assurance system managers who had a good enough awareness of the application of internal control and the policies of institutional sustainability. The total sample included 149 respondents. The higher education setting was deemed relevant due to the growing expectations for governance, accountability, and institutional sustainability in the higher education sector (Bezuidenhout *et al*., 2023; Sutoyo *et al*., 2023; Benhmida & Trabelsi, 2024).

### *Data Collection Technique*

The primary data were acquired by a structured questionnaire survey utilizing a five-point Likert scale. This technique is frequently employed in studies of control systems and performance because it captures managerial perceptions of control practices and organizational innovation successfully (Asiaei *et al*., 2023; Bellora-Bienengräber *et al*., 2023; Liedekerke *et al*., 2025). The data analysis was completed using Structural Equation Modeling-Partial Least Squares (SEM-PLS) with the aid of SmartPLS software. SEM-PLS was selected because it is suitable for predictive research models involving latent constructs and medium-sized samples, and because it allows the simultaneous testing of mediation, moderation, and moderated mediation (Hair & Alamer, 2022; Bellora-Bienengräber *et al*., 2023; Dobrzynski *et al*., 2024; Lutfi *et al*., 2024).

The tests included validity, reliability, path coefficients, bootstrapping, and conditional indirect effects analysis as part of the mediation and moderation assessment (Hair & Alamer, 2022; Akankunda, 2024; Zoni & Wainer Bustamante, 2025). The independent variable was internal control system adaptation, measured through the four levers of control dimensions: belief, boundary, diagnostic, and interactive control (Beusch *et al*., 2022; Bellora-Bienengräber *et al*., 2023). The mediating variable was the implementation of sustainability-oriented innovation, which includes innovation in education, research, community engagement, and university governance (Beusch *et al*., 2022; Dharmayanti *et al*., 2023). The dependent variable was sustainable university performance, measured through academic performance, governance, institutional reputation, and sustainability indicators (Mio *et al*., 2022; Yazid *et al*., 2025). The moderating variables were leadership commitment and external pressure, representing organizational contextual elements that may reinforce or diminish the correlations among the key dimensions (Bedford *et al*., 2022; Hair & Alamer, 2022; Zoni & Wainer Bustamante, 2025).

## Results and Discussion

This research recruited 147 respondents consisting of university leaders, unit heads, internal auditors, and quality assurance system managers from higher education institutions in the Special Region of Yogyakarta, Indonesia. All respondents had enough knowledge of the implementation of internal control systems and policies for institutional sustainability, so the data collected was representative for testing the research model. The analysis was performed by utilizing Structural Equation Modeling based on Partial Least Squares (SEM-PLS) to examine the measurement model (outer model) and the structural model (inner model), including tests of validity, reliability, coefficient of determination, goodness of fit, and hypothesis testing.

### *Respondent Characteristics*

**Table 1.** Respondent characteristics

| Variable | Category | Frequency (n=49) | Percent (100%) |
|---|---|---|---|
| **Gender** | Male | 29 | 59 |
| | Female | 20 | 41 |
| **Age [years]** | >50 | 38 | 78 |
| | 41 - 50 | 7 | 14 |
| | 31 - 40 | 3 | 6 |
| **Position** | Rector/ Vice Rector | 6 | 12 |
| | Dean/Vice Dean | 13 | 27 |

| | | | |
|---|---|---|---|
| | Head of Study Program/ Secretary of Study Program | 11 | 22 |
| | Internal Audit Unit | 10 | 20 |
| | Quality Assurance Unit | 4 | 8 |
| | Finance Unit | 1 | 2 |
| | Head of Unit/ Head of Section | 4 | 8 |
| **Length of work [years]** | 5 - 10 | 4 | 8 |
| | 11 - 20 | 10 | 20 |
| | >20 | 33 | 67 |
| **PT Status** | State | 26 | 53 |
| | Private | 23 | 47 |
| **Source: Authors' calculation using Excel** | | | |

**Table 1** shows the descriptive characteristics of the respondents. The majority of respondents were male, with 29 persons (59%) compared to 20 respondents (41%) who were female. The largest age group was above 50 years old with 38 respondents (78%), followed by the age range 41–50 years (7 respondents, 14%) and 31–40 years (3 respondents, 6%). The respondents' jobs were rectors/vice rectors and deans/vice deans, and the biggest percentage of work experience was more than 20 years (33 respondents, 67%). The mix of the respondents means that they had enough expertise and strategic positions to analyze the internal control and sustainability procedures of the institutions.

### *Construct Validity & Reliability Test*

The initial phase in Partial Least Squares-Structural Equation Modeling (PLS-SEM) analysis is to assess the measurement model (outer model) prior to testing the structural model. The objective of this assessment is to guarantee that the indicators of the latent construct in the study are valid and reliable measures. Validity testing is carried out to determine how far the indicators are able to represent the construct to be measured. In this study, convergent validity was measured using outer loading and Average Variance Extracted (AVE) with an outer loading ≥ 0.70 and AVE ≥ 0.50 as the usual criterion. Furthermore, discriminant validity was assessed by utilizing the Fornell–Larcker criterion and Heterotrait–Monotrait Ratio (HTMT) to confirm that each concept is empirically distinct from the others. Reliability testing, meanwhile, was intended to ensure the internal consistency among indicators within the same construct. Reliability was assessed using Cronbach's Alpha and Composite Reliability (CR), with the recommended minimum threshold of 0.70. Through these steps, it can be confirmed that the research instrument has good measurement quality, allowing the structural model results to be interpreted validly and scientifically.

### *Outer Loading Test Results (Convergent Validity)*

**Table 2.** Outer Loading Values

| Construction | Indicator | Loading Factor |
|---|---|---|
| **Adaptation of internal control systems [X]** | X1 | 0,863 |
| | X2 | 0,732 |
| | X3 | 0,930 |
| | X4 | 0,805 |
| | X5 | 0,935 |
| | X6 | 0,902 |
| **Implementation of sustainability-oriented innovation [Z]** | Z1 | 0,844 |
| | Z2 | 0,934 |
| | Z3 | 0,914 |
| | Z4 | 0,878 |
| **Sustainable university performance [Y]** | Y1 | 0,883 |
| | Y2 | 0,859 |

| | | |
|---|---|---|
| | Y3 | 0,931 |
| | Y4 | 0,877 |
| **Leadership commitment [M]** | M11 | 0,890 |
| | M12 | 0,811 |
| | M13 | 0,864 |
| | M21 | 0,870 |
| | M22 | 0,794 |
| | M23 | 0,860 |
| **Source: Authors' calculation using SmartPLS 4.1** | | |

The **Table 2** All loading values are above 0.70, although indicators X2 and M22 are only slightly above the threshold. Thus, all indicators can be considered to have satisfactory convergent validity.

*Reliability Testing Results (Cronbach's Alpha, Composite Reliability, AVE)*

**Table 3.** Reliability Test

| Construction | Conbrach Alpha | CR | AVE | √AVE |
|---|---|---|---|---|
| **Adaptation of internal control systems [X]** | 0,931 | 0,946 | 0,747 | 0,864 |
| **Implementation of sustainability-oriented innovation [Z]** | 0,916 | 0,940 | 0,798 | 0,893 |
| **Sustainable university performance [Y]** | 0,907 | 0,937 | 0,789 | 0,888 |
| **Leadership commitment [M]** | 0,921 | 0,939 | 0,720 | 0,849 |
| **Source: Authors' calculation using SmartPLS 4.1** | | | | |

Based on the **Table 3** criteria applied, Cronbach's Alpha and Composite Reliability (CR) values at or above 0.70 indicate that the constructs are reliable. In addition, AVE values at or above 0.50 show that convergent validity has been adequately established. Accordingly, the four constructs, namely X, Z, Y, and M, can be considered highly reliable and to have very strong convergent validity. If all AVE values are above 0.70, this further indicates exceptionally strong measurement quality.

*Discriminant Validity Uses Latent Correlation and Fornell–Larcker*

**Table 4.** Correlation Matrix Between Constructs

| Construction | X | Z | Y | M |
|---|---|---|---|---|
| **Adaptation of internal control systems [X]** | 1,000 | 0,905 | 0,867 | 0,881 |
| **Implementation of sustainability-oriented innovation [Z]** | 0,905 | 1,000 | 0,821 | 0,867 |
| **Sustainable university performance [Y]** | 0,867 | 0,821 | 1,000 | 0,883 |
| **Leadership commitment [M]** | 0,881 | 0,867 | 0,883 | 1,000 |
| **Source: Authors' calculation using SmartPLS 4.1** | | | | |

According the **Table 4** to the Fornell–Larcker criterion, the square root of the AVE for each construct should be greater than its correlations with other constructs. However, in this dataset, inter-construct correlations, such as X–Z = 0.905 and M–Y = 0.883, are higher than the corresponding square roots of AVE. Thus, discriminant validity based on the Fornell–Larcker criterion has not been established. This finding indicates that the constructs are highly similar or may even overlap.

*Discriminant Validity Using HTMT (Heterotrait–Monotrait Ratio)*

**Table 5.** Heterotrait–Monotrait Ratio

| Construction | X | Z | Y | M |
|---|---|---|---|---|
| **Adaptation of internal control systems [X]** | 1,000 | 0,976 | 0,943 | 0,954 |
| **Implementation of sustainability-oriented innovation [Z]** | 0,976 | 1,000 | 0,901 | 0,944 |
| **Sustainable university performance [Y]** | 0,943 | 0,901 | 1,000 | 0,960 |
| **Leadership commitment [M]** | 0,954 | 0,944 | 0,960 | 1,000 |

**Source: Authors' calculation using SmartPLS 4.1**

According to the **Table 5** Heterotrait–Monotrait Ratio (HTMT) criterion, discriminant validity is generally considered acceptable when the values are below 0.85 under a strict threshold or below 0.90 under a more lenient threshold. However, in this dataset, all construct pairs have HTMT values of 0.90 or higher, and some even exceed 0.95. Accordingly, discriminant validity can be regarded as weak. Statistically, this indicates that respondents perceived the constructs as highly similar. Methodologically, this suggests the need to revise the indicators so that they are more specific, or to consider estimating a model with fewer constructs and clearer distinctions among them.

### *Model Fit Test*

#### *$R^2$ Test (Coefficient of Determination)*

The endogenous variables in this model are Z and Y. The $R^2$ value for Z, predicted by X and M, is 0.841. This indicates a very strong explanatory power, as X and M account for 84.1% of the variance in sustainability-oriented innovation implementation. Meanwhile, the $R^2$ value for Y, predicted by X, Z, and M, is 0.815. This also indicates very strong explanatory power, as these three variables explain 81.5% of the variance in sustainable university performance. Accordingly, both $R^2$ values fall into the high category because they are above 0.75.

#### *Goodness of Fit (GoF)*

The average AVE is 0.764, while the average $R^2$ value for the endogenous variables Z and Y is 0.828.

$$GoF = \sqrt{\bar{AVE} \times \bar{R}^2} \approx \sqrt{0{,}764 \times 0{,}828} \approx 0{,}795 \quad (1)$$

Overall, the model demonstrates very good measurement quality in terms of reliability and convergent validity. All indicators have loadings above 0.70, the Cronbach's alpha and composite reliability values for all constructs exceed 0.90, and the AVE values are above 0.70. However, discriminant validity is not yet adequate because inter-construct correlations are very high and the HTMT values for all construct pairs exceed 0.90. This finding indicates a very strong proximity among the constructs, so differences between them should be interpreted with great caution.

#### *Hypothesis Testing (Structural Model)*

In the structural model, internal control system adaptation and leadership commitment were found to have a positive and significant effect both on the implementation of sustainability-oriented innovation and directly on sustainable university performance. In contrast, sustainability-oriented innovation did not show a significant direct effect on performance. The model has very strong explanatory power, with an $R^2$ value of 0.841 for sustainability-oriented innovation implementation and 0.815 for sustainable university performance, as well as a GoF value of 0.795, indicating a high level of model fit.

**Table 6.** Hypothesis testing

| Relationships | Beta | t-hitung | p-value | Decision |
|---|---|---|---|---|
| **Adaptation of internal control systems → implementation of innovation-oriented** | 0,631 | 5,074 | 0,000*** | H1-Accepted |

| | | | | |
|---|---|---|---|---|
| **Implementation of innovation-oriented →performance** | –0,005 | –0,032 | 0,975 | H2-Rejected |
| **Adaptation of internal control systems → Performance** | 0,402 | 2,377 | 0,022** | H3-Accepted |
| **Leadership commitment moderates the Internal control system adaptation relationship → implementation of innovation-oriented** | 0,311 | 2,500 | 0,016** | H4 - Accepted |
| **Leadership commitment moderates the implementation-oriented innovation relationship → Performance** | 0,534 | 3,701 | 0,001*** | H5 – Accepted |
| *****sig<0,01 (1%), **sig<0,05 (5%) *sig<0,1(10%)** **Source: Authors' calculation using SmartPLS 4.1** | | | | |

The **Table 6** hypothesis testing results indicate that internal control system adaptation has a positive and significant effect on sustainability-oriented innovation implementation (β = 0.631; t = 5.074; p < 0.001***), so H1 is supported. This finding is consistent with recent literature showing that control system adaptation can foster sustainability-oriented innovation through more strategic and flexible control adjustments. In contrast, sustainability-oriented innovation implementation does not have a significant effect on performance (β = -0.005; t = -0.032; p = 0.975), so H2 is rejected. This suggests that sustainability innovation does not immediately translate into performance outcomes, as its effects may require time and stronger institutional integration. Internal control system adaptation also has a positive effect on sustainable university performance (β = 0.402; t = 2.377; p = 0.022**), so H3 is supported, indicating that adaptive internal control functions as a governance mechanism that strengthens accountability and institutional sustainability. Furthermore, leadership commitment strengthens the relationship between internal control system adaptation and sustainability-oriented innovation (β = 0.311; t = 2.500; p = 0.016**), so H4 is supported, as well as between sustainability-oriented innovation and sustainable university performance (β= 0.534; t = 3.701; p = 0.001***), so H5 is supported underscoring the importance of leadership in transforming control into organizational outcomes.

The bootstrapping results are presented in the following figure to strengthen the understanding of the data, as described in detail in **Table 6**. **Figure 2** provides a clearer visual representation of the distribution and pattern of the bootstrapping process, thereby facilitating the interpretation of the analytical results in the discussion. Furthermore, this representation complements the studied data, and it also confirms the robustness and trustworthiness of the research findings in compliance with the current requirements for academic publication. The **Figure 2** is displayed below:

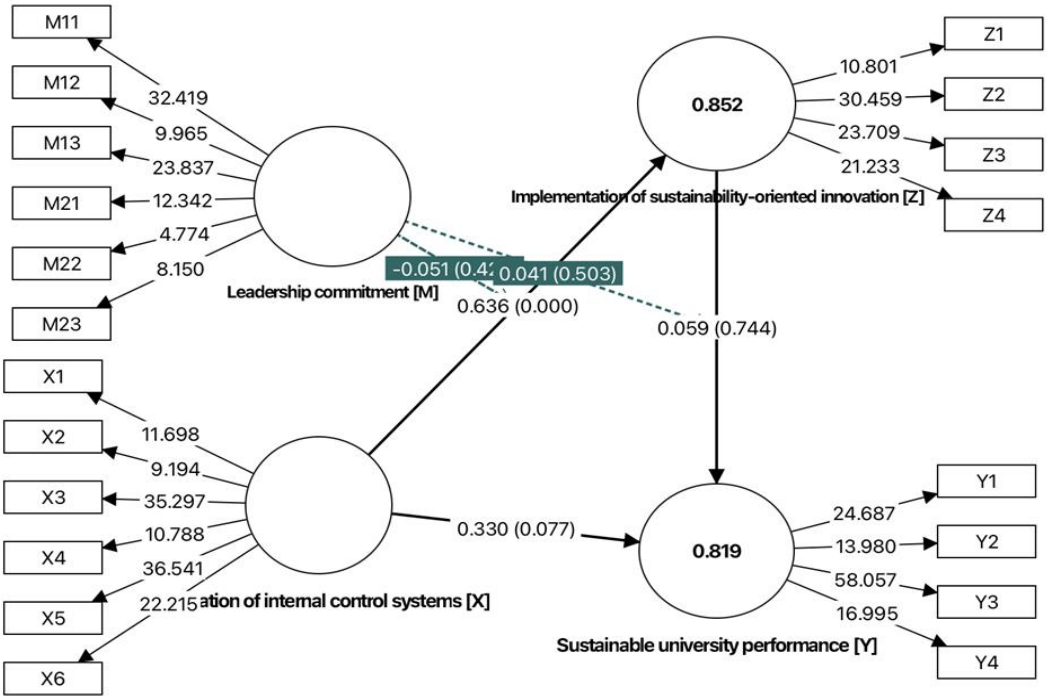


**Figure 2.** Model Structure Bootstrapping [Source: Authors' calculation using SmartPLS 4.1]

Overall, the findings of this study support the concepts of control theory within the framework of higher education by demonstrating that adapting the internal control system is a strategic governance instrument for promoting innovation and sustainable performance. But sustainability-driven innovation does not inevitably translate to improved performance without a commitment from leaders. Hence, the combination of adaptive control systems and committed leadership is the key to sustainable institutions.

H1: Internal control system adaptation → sustainability-oriented innovation implementation (supported).

The results reveal that the adaptation of the internal control system has a positive and substantial effect on the realization of sustainability-oriented innovation ($\beta = 0.631$; p-value < 0.001***). This research suggests that the more adaptable the use of control systems, through belief systems, boundary systems, diagnostic control, and interactive control, the higher the integration of sustainable innovation in university operations. This result is consistent with the levers of control theory, which posits that control systems are not merely compliance instruments, but also learning and strategic exploration processes (Asiaei *et al*., 2023; Zoni & Wainer Bustamante, 2025). In the sustainability context, interactive management control has been demonstrated to foster innovation exploration and sustainability value embedding in organizational practices (Dharmayanti *et al*., 2023). Hence, the adoption of internal control systems plays a vital role in creating a sustainability-oriented innovation environment in higher education institutions.

H2: Sustainability-oriented innovation implementation → sustainable university performance (not supported).

The test results show that the deployment of sustainability-oriented innovation has no significant effect on sustainable university performance ($\beta = -0.005$; p-value = 0.975). The result indicates that sustainability-oriented innovation has not yet been directly transformed into improved indices of institutional performance. In theory, sustainability-oriented innovation should be a mechanism that mediates the effect of control systems on performance (Beusch *et al*., 2022; Akankunda, 2024). But in higher education, innovation may take longer to produce quantitative performance outcomes, especially in the area of reputation, governance, and social contribution. Moreover, significant inter-construct correlations in the model suggest possible conceptual overlap, which may influence the relevance of the direct path. Sustainability-oriented innovation seems to work more as a long-term transformational process rather than a direct determinant of institutional performance.

H3: Internal control system adaptation → sustainable university performance (supported).

The modification of the internal control system was found to have a favorable and substantial effect on sustained university performance (β = 0.402; p-value = 0.022**). This means that adaptive control systems may increase the effectiveness of governance, transparency, and attainment of institutional sustainability goals. This finding is in agreement with Mio *et al*. (2022), who argue that sustainable performance assessment systems contribute to achieving organizational strategic goals. Moreover, Yazid *et al*. (2025) highlight that quality governance and quality culture are major drivers of university performance. Thus, adaptive internal control functions are not just a tool for monitoring, but also a strategic instrument for improving accountability and legitimacy of institutions of higher education.

H4: Leadership commitment moderates the relationship between internal control system adaptation and sustainability-oriented innovation implementation (supported).

The results reveal that leadership commitment enhances the association between the adaptation of the internal control system and the implementation of sustainability-oriented innovation (β = 0.311; p-value = 0.016). This implies that the success of control systems in promoting innovation is highly contingent on leadership support and commitment. This result supports the idea that leadership is crucial in activating control systems as organizational learning tools (Bellora-Bienengräber *et al*., 2023). Zoni and Wainer Bustamante (2025) further state that sustainable integration in management strategy demands leadership commitment to foster conversation and cross-unit learning. Thus, leadership commitment is a lever to improve the role of control systems in supporting sustainable innovation.

H5: Leadership commitment moderates the relationship between sustainability-oriented innovation implementation and sustainable university performance (supported).

The results also showed that leadership commitment enhances the influence of sustainability-oriented innovation on university performance (β = 0.534; p-value = 0.001). This result suggests that the performance impact of sustainability-oriented innovation is more significant when embedded within consistent and visionary leadership of the sustainability agenda. The outcome is in line with Bezuidenhout *et al*. (2023), who stress that integrated control and reporting systems need leadership support to generate long-term benefit. Moreover, Yazid *et al*. (2025) identify quality culture and managerial commitment as significant drivers of higher education institutional performance. Leadership is thus a contextual factor enhancing the transition of innovation into sustainable institutional performance.

## Conclusion

The purpose of this study is to investigate the effect of internal control system adaptation as a governance mechanism for sustainability-oriented innovation implementation and sustainable university performance with the moderating function of leadership commitment. The results indicate that modification of the internal control system positively and significantly affects the implementation of sustainability-oriented innovation and the sustainable performance of the university. The findings revealed that leadership commitment reinforced the association between adaptation of internal control systems and sustainability-oriented innovation and the relationship between sustainability-oriented innovation and institutional performance.

However, it has no meaningful direct effect on university performance. Thus, the achievement of tangible performance outcomes for sustainable innovation requires both leadership support and strategy alignment. Overall, the interaction between adaptive internal control mechanisms and leadership commitment is a significant aspect in creating sustainable governance in higher education institutions.

### *Contribution*

#### *Theoretical Contribution*

This study contributes to the development of levers of control theory in higher education settings, where it has mostly been tested in corporate environments. The results contribute to the knowledge that internal control systems serve not only as compliance and fraud prevention instruments, but also as strategic mechanisms to promote innovation and institutional sustainability. In addition, this study adds to the literature on sustainability management control systems by demonstrating the considerable impact of contextual factors, especially leadership commitment, on the effectiveness of sustainability-oriented innovation. Thus, the study underlines the importance of systems, strategy, and leadership in the governance of sustainable universities.

*Practical Contribution*

The findings show that university leaders and quality assurance managers are able to adjust internal control systems without developing new systems practically. The dimensions of belief system enhancement and interactive control are more effective in promoting sustainability-oriented innovation. Furthermore, leadership commitment has been identified as the critical determinant in translating innovation into institutional performance. Therefore, institutional strategy should explicitly incorporate internal control and sustainability policies to promote the attainment of SDG 4 (Quality Education) and SDG 16 (Peace, Justice and Strong Institutions).

*Research Limitations*

This study has several limitations. First, the research was conducted in higher education institutions in the Special Region of Yogyakarta, so generalizing the findings to other regions should be done with caution. Second, the study used a cross-sectional design, which does not capture the long-term dynamics between sustainability-oriented innovation and institutional performance. The impact of innovation may also require a longer period to become significantly observable. Third, the discriminant validity test results showed high inter-construct correlations, indicating a possible conceptual overlap. This condition may affect the interpretation of relationships among variables in the structural model.

*Suggestions for Further Research*

Based on these limitations, several suggestions for future research are proposed. First, longitudinal studies should be conducted to examine the long-term impact of sustainability-oriented innovation on university performance. Second, the scope of the research should be expanded to different regions, or public and private universities should be compared in greater depth, to strengthen the generalizability of the findings. Third, the model should be extended by integrating other contextual variables such as external demand, organizational culture, or resource capacity as additional moderators or mediators. Fourth, the measurement tools should be improved to enhance discriminant validity and to clarify the conceptual boundaries among constructs. Fifth, the combination of quantitative approaches with qualitative methods (mixed methods) should be used to understand better the implementation process of internal control and sustainable innovation in higher education settings.

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