CONTROL SYSTEMS AND GOAL ORIENTATION IN ECO-DESIGN PERFORMANCE

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A R T I C L E I N F O

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A B S T R A C T

Research Purposes. *This study aims to examine how Management Control Systems (MCS), Learning Orientation (LO), and Performance-Prove Orientation (PPO) influence eco-friendly design performance, and whether their alignment improves sustainability-focused outcomes.*
Research Methods. *This study used a quantitative 2×2×2 experimental design with a LEGO-based eco-design task involving 117 accounting students. Participants were assigned to Diagnostic or Interactive MCS conditions and exposed to priming scenarios for Learning Orientation (LO) and Performance-Prove Orientation (PPO). Data were analysed using ANOVA (SPSS).*
Research Results and Findings. *The results show no significant main effects for MCS, LO, or PPO individually. However, a significant three-way interaction was found. Eco-design performance was highest when Interactive MCS aligned with low LO and low PPO, and when Diagnostic MCS aligned with high LO and low PPO. When PPO was high, differences between conditions became minimal. This study contributes to the behavioural accounting literature and managerial practice by highlighting the importance of aligning management control systems with individual goal orientations to support eco-design.*

A B S T R A K

Tujuan Penelitian. *Penelitian ini bertujuan untuk menguji bagaimana Management Control Systems (MCS), Learning Orientation (LO), dan Performance-Prove Orientation (PPO) memengaruhi kinerja eco-friendly design, serta apakah keselarasan di antara ketiganya dapat meningkatkan hasil yang berfokus pada keberlanjutan.*
Metode Penelitian. *Penelitian ini menggunakan desain eksperimen faktorial 2×2×2 dengan tugas eco-design berbasis LEGO yang melibatkan 117 mahasiswa akuntansi. Partisipan ditempatkan dalam kondisi MCS Diagnostic atau Interactive dan diberikan skenario pemicu untuk Learning Orientation (LO) dan Performance-Prove Orientation (PPO). Data dianalisis menggunakan ANOVA dengan bantuan SPSS.*
Hasil Penelitian dan Temuan Penelitian. *Hasil menunjukkan bahwa tidak terdapat pengaruh utama yang signifikan dari MCS, LO, maupun PPO secara individual. Namun, ditemukan interaksi tiga arah yang signifikan. Kinerja eco-design tertinggi muncul ketika Interactive MCS selaras dengan LO rendah dan PPO rendah, serta ketika Diagnostic MCS selaras dengan LO tinggi dan PPO rendah. Ketika PPO tinggi, perbedaan antar kondisi menjadi minimal. Penelitian ini memberikan implikasi bagi literatur akuntansi keperilakuan dan praktik manajerial dengan menekankan pentingnya keselarasan antara sistem pengendalian manajemen dan orientasi tujuan individu dalam mendukung eco-design.*

INTRODUCTION

In recent years, businesses have increasingly felt the pressure to adopt environmentally sustainable practices. This shift is largely driven by changing regulations, heightened consumer awareness, and the need to stay competitive. Companies are now encouraged to incorporate eco-design principles into their product development processes, enabling them to create environmentally friendly products that do not sacrifice performance or cost-effectiveness. Regulatory frameworks, particularly those rooted in Environmental, Social, and Governance (ESG) standards, mandate that organizations weave sustainability into their operations to ensure compliance and maintain their legitimacy in the market (Lestari et al., 2024; Wang et al., 2022). Furthermore, consumers today are more discerning than ever, seeking products that embody sustainable values. This growing expectation has prompted companies to innovate and set themselves apart through green design initiatives (Lestari et al., 2021).

In addition to the regulatory and reputational advantages, embracing eco-friendly design has become an urgent necessity amid the escalating global environmental crisis. Plastic pollution is among the most pressing threats to our planet, impacting nearly every marine and freshwater ecosystem worldwide (Borrelle et al., 2020). The scale of the problem is truly staggering: since the year 2000, global plastic waste generation has doubled, now reaching a staggering 353 million metric tons each year, yet a mere 9% of this waste is actually recycled (Ritchie et al., 2023). Alarmingly, it is estimated that between 19 and 23 million metric tons of plastic waste produced globally in 2016 found its way into our aquatic ecosystems (Borrelle et al., 2020). Even with ambitious efforts to tackle this issue, projections indicate that annual plastic emissions could soar to as high as 53 million metric tons by 2030 (Borrelle et al., 2020). This worrisome and anticipated surge in waste far exceeds our current mitigation efforts, underscoring the urgent need for proactive measures within organizations, such as eco-design, to fundamentally reshape the global plastics economy (Su, 2023).

Integrating eco-design into the complex world of New Product Development (NPD) is a significant challenge for managers, despite the clear benefits it offers. Unlike routine tasks, eco-design demands collaboration across different departments, continuous learning, and often disrupts established practices. As a result, leaders in organizations need strong Management Control Systems (MCS) to turn broad sustainability goals into specific actions that employees can take (Albertini, 2019; Traxler et al., 2023). This research draws on Simons' (1995) influential Levers of Control (LoC) framework to explore how Diagnostic Control Systems (DCS) and Interactive Control Systems (ICS) can serve as tools to guide employee behaviour toward sustainability. DCS helps monitor outcomes and ensure compliance, while ICS fosters discussions and learning about uncertainties related to strategies, such as new eco-design technologies and shifting consumer preferences (Anis et al., 2024).

A management control system (MCS) does not function in isolation; its success largely depends on the psychological traits of the people it aims to guide. This is especially true in creative fields like eco-design, where the designer's goal orientation plays a significant role. For instance, individuals with a Learning Orientation (LO) are inclined to focus on enhancing their skills and gaining new insights, viewing setbacks as valuable lessons rather than failures. On the other hand, those with a Performance-Prove Orientation (PPO) tend to prioritize showcasing their current abilities and seeking approval from others, which can make them hesitant to take risks in innovative projects (Yang et al., 2020; Zhou, 2021). Recognizing these psychological tendencies is crucial for understanding how designers will respond to various MCS designs, particularly when they face the challenging demands of eco-innovation, which often involve high risks and potential rewards.

Despite the growing emphasis on eco-friendly design, integrating sustainability principles into organizational processes remains a significant managerial challenge. From a management control perspective, eco-design often disrupts established routines and control mechanisms that were originally designed to prioritize efficiency, cost minimization, and short-term financial performance. The integration of sustainability objectives into traditional business models introduces additional layers of complexity, as managers must balance environmental considerations with existing performance targets and operational constraints (Johnstone, 2024). This complexity can weaken the effectiveness of conventional control systems, which may not be sufficiently flexible to accommodate the exploratory and cross-functional nature of eco-design activities.

Beyond structural challenges, the implementation of eco-design is also shaped by behavioural factors. Employees may resist sustainability-driven changes due to entrenched work habits, uncertainty about new expectations, or limited understanding of the strategic importance of environmental initiatives (Haryanto et al., 2025). Moreover, traditional accounting and performance measurement systems often struggle to capture the long-term and intangible benefits of eco-design, such as reduced environmental impact or improved sustainability reputation. As a result, sustainability efforts may be undervalued or misaligned with formal performance indicators, weakening employee motivation to engage in eco-friendly practices. These limitations highlight the relevance of behavioural accounting perspectives, which emphasize how individual motivation, perception, and interpretation of control systems influence organizational outcomes (Harris et al., 2025). By focusing on the interaction between control structures and human behaviour, behavioural accounting provides a useful framework for understanding why sustainability initiatives succeed or fail within organizations (Dayani & Budiasih, 2024; Soares et al., 2024). However, little is known about how management control structures interact with individual goal orientations to shape eco-design outcomes, particularly from a behavioural accounting perspective.

This study highlights an important gap in the literature surrounding behavioural accounting and sustainability. While earlier research has examined how Management Control Systems (MCS) impact sustainability outcomes and how goal orientation can drive innovation, there has been little exploration of how these two elements interact, particularly in eco-design. Importantly, the effectiveness of diagnostic or interactive systems may depend on whether designers possess high or low learning orientation and whether they are motivated by performance-prove tendencies. Although prior research generally assumes that flexible and interactive systems support creativity, this may not always be the case. In some contexts, designers with a high learning orientation may benefit more from the structure and measurable feedback provided by diagnostic systems. In contrast, those with a lower learning orientation, especially those with a lower performance-prove orientation, may perform better in the exploratory environment of interactive systems. This aligns with the Contingency Theory perspective, which argues that the success of a management control system depends on how well it fits behavioural and contextual characteristics (Chenhall, 2003; Otley, 1980). Despite this relevance, the literature has not yet examined how different control structures align with combinations of learning and performance-prove motivations in sustainability-focused design tasks (Khural et al., 2022; Quesado et al., 2024).

This study builds on established theories to explore how different types of Management Control Systems (MCS), specifically, Diagnostic versus Interactive systems, interact with designers' goal orientations, such as Learning and Performance-Prove. The focus is on understanding how these dynamics influence the success of new eco-friendly product development. In particular, it examines whether a designer's goal orientation affects the relationship between the type of control system used and the quality of eco-design outcomes. To fill this research gap, the study combines Simons (1995) framework on Management Control Systems with Goal Orientation Theory and Contingency Theory. This integration helps to clarify how the relationship between organizational control mechanisms and individual motivations can drive sustainable innovation. Notably, Contingency Theory plays a crucial role here, suggesting that the effectiveness of management controls depends on how well they align with specific contextual and behavioural factors (Chenhall, 2003; Otley, 1980).

This research employs a 2x2x2 experimental design involving accounting students as proxy participants for designers. The primary aim is to investigate how different combinations of management control systems (MCS) types, specifically, diagnostic versus interactive systems, interact with varying levels of learning orientation (high versus low) and performance-prove orientation (high versus low). This exploration seeks to understand how these factors influence outcomes in eco-friendly design. By integrating both structural and behavioural elements within an experimental framework, the research aims to enhance the comprehension of how internal organizational systems and individual motivations collaboratively foster sustainable innovation. Based on this objective, this study examines whether MCS, individual goal orientations, and their alignment influence eco-friendly design outcomes. This study is novel in integrating behavioural accounting perspectives with management control systems research by examining how individual goal orientations interact with diagnostic and interactive controls to influence eco-design outcomes in an experimental setting.

LITERATURE REVIEW

Management Control Systems (MCS)

Management Control Systems (MCS) are mechanisms used by organizations to direct behaviours, make strategic decisions, and ensure performance aligns with organizational objectives (Simons, 1995). MCS can include both formal systems, such as budgets, performance measurement tools, and reporting procedures, and informal elements, such as cultural and social controls.

Simons (1995) introduced two widely adopted MCS types:

1. Diagnostic Control Systems: These systems emphasize monitoring, variance analysis, and evaluation against predetermined performance standards. Diagnostic controls typically use structured indicators to ensure efficiency, consistency, and compliance with established objectives (Le et al., 2023). They are designed to maintain stability and reduce risks by relying on measurable targets and accountability structures (Albertini, 2019).
2. Interactive Control Systems: Interactive controls emphasize communication, strategic dialogue, and learning. These systems involve frequent management attention, continuous feedback, and cross-functional discussions that support adaptability and responsiveness in dynamic environments (Anwar, 2024; Lewis et al., 2024).

Interactive controls are often used when tasks involve uncertainty, innovation, or evolving stakeholder expectations. Together, these two control types represent different approaches to steering behaviour, implementing strategy, and managing complex tasks.

Goal Orientation Theory

Goal Orientation Theory explains how individuals differ in their motivational tendencies when approaching tasks, learning opportunities, and performance situations. Two orientations are commonly discussed:

1. Learning Goal Orientation (LGO): Individuals with learning orientation seek mastery, skill development, and long-term improvement. They tend to be curious, open to feedback, and willing to engage in experimentation and knowledge-building activities (Park et al., 2022). Learning-oriented individuals are often persistent and receptive to challenges that require deep thinking or innovative solutions.
2. Performance-Prove Goal Orientation (PPO): Performance-prove orientation reflects the desire to demonstrate competence and gain positive evaluations from others (Chae & Shin, 2024). Individuals with this orientation are more focused on appearing capable, outperforming peers, and meeting explicit expectations or standards. Their motivation tends to be driven by external validation and social comparison.

Both orientations influence how individuals approach problem-solving, feedback, uncertainty, and work tasks that require creativity or structure.

Eco-Friendly Design

Eco-design represents an integrated, systemic approach to innovation that embeds environmental considerations throughout the product development process. It aims to reduce lifecycle impacts through material efficiency, recyclability, and energy optimization (Iluyomade & Okwandu, 2024). Recent research shows that successful eco-design implementation depends on cross-functional collaboration, creative problem-solving, and sustainability-oriented organizational cultures (Subono & Kurnisa, 2024). Moreover, developing employees' "green competences" such as systems thinking and environmental awareness enhances innovation capacity and the integration of circular economy principles (Sulich & Kozar, 2024). Thus, eco-design not only constitutes a technical challenge but also a behavioural and strategic one, requiring alignment between organizational values, employee skills, and regulatory pressures (Tyagi et al., 2024).

In this study, eco-design success is understood as the ability to develop product designs that balance environmental sustainability and resource efficiency within given constraints. Successful eco-design is therefore reflected in decisions that minimise environmental impact, such as material waste and resource intensity, while maintaining functional feasibility and cost awareness. From a behavioural accounting perspective, eco-design performance is not solely a technical outcome but the result of how individuals interpret and respond to sustainability-related goals within organisational control contexts.

Contingency Theory

Contingency Theory posits that no single management system or organizational practice is universally effective. Instead, the effectiveness of a system depends on how well it aligns with contextual factors, such as the task environment, individual characteristics, organizational culture, or strategic priorities (Otley, 1980; Chenhall, 2003).

Contingency Theory emphasizes that the interaction between organizational controls and individual traits significantly shapes outcomes. Different types of tasks or individuals may require different control mechanisms for optimal performance. This theoretical foundation supports examining how MCS types may function differently depending on personal goal orientations or task demands, although the actual relationships between these variables are developed later in the hypothesis section.

Hypotheses Development

Management Control Systems and Eco-friendly Design

Management Control Systems (MCS) play a vital role in helping organizations align their activities with strategic goals, both through formal and informal means (Simons, 1995). When it comes to sustainability, these systems become essential tools for turning broad environmental strategies into concrete, measurable outcomes (Albertini, 2019; Fernandes et al., 2023). There are two primary types of MCS: diagnostic controls, which focus on performance measurement, and interactive controls, which foster dialogue and learning. While they serve different purposes, both are crucial in driving eco-friendly product innovation. In recent years, the push for sustainability-oriented innovation has taken centre stage in corporate strategies. As Tchanturia & Getashvili (2024) highlight, principles of eco-design and practices rooted in the circular economy are now fundamental for ensuring that innovation aligns with environmental responsibility. Their research outlines a pathway for sustainable product development, stressing that incorporating ecological considerations into the innovation process not only minimizes waste and emissions but also enhances a firm's long-term competitiveness.

Diagnostic controls serve as the vital monitoring systems within a business, ensuring that operations run smoothly and efficiently while keeping potential risks in check and maintaining accountability. These controls function by comparing actual outcomes to predefined targets (Le et al., 2023). In the context of eco-design, they are particularly important because they help standardize processes, ensure compliance with environmental standards, and promote the wise use of resources. For instance, diagnostic systems track key metrics such as material usage, waste reduction, and compliance with regulatory standards. This form of oversight creates a fundamental sense of environmental responsibility throughout the organization (Albertini, 2019). However, it is important to recognize that an overemphasis on control and compliance can sometimes hinder creativity and exploration (Kaveski & Beuren, 2020; Pazetto & Beuren, 2022). Despite this potential drawback, the structured approach provided by diagnostic controls is essential for effectively integrating eco-design features and managing the financial and operational risks associated with non-compliance.

On the contrary, interactive controls play a crucial role in driving strategic renewal within organizations by promoting open dialogue, feedback, and ongoing learning across different teams. These controls are adaptable and help manage the strategic uncertainties that often come with innovation and the need for sustainable practices (Anwar, 2024; Lewis et al., 2024). In the context of sustainable design, interactive controls are particularly important. They enable collaboration among design, engineering, and supply chain teams, which is essential for developing innovative, environmentally friendly solutions (Delaney et al., 2022). Moreover, the continuous conversations encouraged by these controls help integrate complex, non-financial data, like environmental, social, and governance (ESG) metrics, into managerial decision-making. This integration is vital for successful eco-innovation (Anis et al., 2024; Traxler et al., 2023).

Although Management Control Systems can be distinguished into diagnostic and interactive controls (Simons, 1995), this study conceptualises MCS at an aggregate level when examining its direct relationship with eco-friendly design. This approach reflects the view that control systems function as a contextual framework that shapes decision-making rather than as isolated mechanisms producing uniform effects across individuals. In sustainability-oriented tasks such as eco-design, both diagnostic and interactive controls may support performance by providing structure, guidance, and strategic focus through different behavioural pathways. Accordingly, the direct effect of MCS is hypothesised at a general level, while differences between diagnostic and interactive controls are examined through interaction effects with individual goal orientations. This perspective acknowledges potential trade-offs between diagnostic and interactive controls but prioritises their contingent effectiveness, consistent with Contingency Theory, rather than assuming the universal superiority of one control type.

H_1: Management Control Systems positively influence eco-friendly design**.**

Learning Goal Orientation and Eco-friendly Design

Goal Orientation Theory explains how individuals approach challenges and learning situations. A learning goal orientation reflects a person's desire to develop new skills, improve competence, and embrace challenges as opportunities for growth (Park et al., 2022). Individuals with a strong learning orientation are motivated by curiosity and intrinsic satisfaction rather than external rewards.

In the context of design and innovation, individuals with a learning-oriented mindset are more inclined to experiment, seek feedback, and engage in creative thinking. These traits are essential for developing eco-friendly products (Kilic & Dursun, 2023; Vikas et al., 2022). Rather than viewing environmental challenges as hurdles, these individuals see them as opportunities to discover innovative solutions. Research indicates that a strong learning orientation drives exploratory innovation by encouraging designers to challenge existing assumptions and adopt sustainable practices (Zhou, 2021). Recent studies by Miron-Spektor et al. (2022) shed light on how goal orientation impacts creative performance over time. Their longitudinal research involving manufacturing employees revealed that those with a robust learning orientation consistently enhanced the quality of their ideas, maintaining their creativity over several years. In contrast, performance-oriented individuals tended to generate a higher volume of ideas initially but quickly lost momentum. These insights suggest that a learning orientation not only promotes deeper cognitive engagement but also supports continuous improvement, both of which are crucial for eco-design processes that demand iterative experimentation and a long-term commitment to sustainability.

H_2: Learning goal orientation has a significant positive effect on eco-friendly design.

Performance-Prove Goal Orientation and Eco-friendly Design

Performance-prove goal orientation is an important motivational pathway that differs significantly from learning orientation. While learning orientation is all about mastering new skills, performance-prove orientation is centered on the desire to showcase one's abilities to others and receive positive feedback (Chae & Shin, 2024; Zhou, 2021). Individuals with a performance-prove mindset tend to view tasks as chances to affirm their capabilities. They actively seek out favorable judgments and aim to outperform their peers or meet set standards. This pursuit of validation often results in a structured, deliberate, and cautious approach to tackling tasks (Yang et al., 2020).

Recent evidence shows that individuals with a performance-prove orientation can achieve mixed results on innovation-related tasks. Lindfors et al. (2021) found that students with either a performance-approach or performance-avoidance mindset often experienced fatigue, uncertainty, and declining engagement while working on product innovation projects. Their motivation hinges more on seeking external validation than on a genuine interest in the work itself. This led to achieving short-term goals but limited their ability to sustain creativity over time. Similarly, Miron-Spektor et al. (2022) found that while performance-oriented individuals might generate more ideas initially, they often struggle to maintain the quality of those ideas as their drive to "prove" their abilities diminishes once they receive initial recognition. These insights suggest that, although a performance-prove orientation can boost measurable success in structured environments, it may not foster the long-term creative engagement necessary for ground-breaking eco-innovation.

In the context of sustainable design, having a clear focus on environmental goals can significantly enhance our ability to meet specific targets. Eco-friendly design, especially when guided by Management Control Systems (MCS), often relies on clear and measurable criteria. This can include tracking how much material is used, meeting certification standards, or aiming for specific reductions in waste. Designers who are motivated by a strong desire to prove their performance tend to thrive in this environment, as they are driven to meet these established benchmarks (Alia et al., 2025). Their dedication stems from a commitment to showcase their skills as professionals who can successfully navigate complex regulations and help their organizations achieve their environmental objectives. Consequently, the pursuit of external recognition and tangible accomplishments directly supports their engagement and success in initiatives aimed at promoting eco-friendly design.

H_3: Performance-prove goal orientation has a significant positive effect on eco-friendly design.

The Alignment Between MCS and Goal Orientation

Management Control Systems (MCS) influence sustainability-oriented tasks by shaping how individuals interpret goals, manage uncertainty, and engage with eco-design work. Consistent with Contingency Theory (Otley, 1980), the effectiveness of any control system depends on how well it aligns with individual characteristics and task demands. Diagnostic controls provide structure, clear targets, and procedural discipline, whereas interactive controls encourage dialogue, problem-solving, and the exploration of alternative design pathways (Chenhall, 2003; Simons, 1995; Widener, 2007). Eco-friendly design often requires both creativity and adherence to environmental standards, meaning that the effectiveness of each control system depends on how well it aligns with the designer's motivation and working style.

Learning goal orientation guides how individuals approach complex design challenges. Those with strong learning orientation tend to seek mastery, feedback, and continuous improvement, enabling them to work productively within structured environments that provide clear expectations and measurable progress (Kilic & Dursun, 2023; Park et al., 2022). Diagnostic controls emphasize targets, disciplined processes, and performance indicators, which can reinforce mastery-driven behaviour by providing high-learning-oriented designers with the structure needed to channel their curiosity and problem-solving into environmentally effective outcomes. Conversely, individuals with lower learning orientation often rely more on external cues, guidance, and collaborative processes, making the open communication and iterative discussions facilitated by interactive controls more suitable for supporting their contribution to eco-friendly design (Barros & Ferreira, 2022; Lewis et al., 2024).

H_4: Eco-friendly design outcomes will be higher among individuals with high learning orientation when using diagnostic MCS, and among individuals with low learning orientation when using interactive MCS.

Performance-prove orientation introduces a different motivational mechanism. Individuals with low performance-prove orientation tend to experience less evaluation pressure, lower self-presentation concerns, and greater willingness to participate in open discussions, conditions that align naturally with the communicative and exploratory nature of interactive MCS (Chae & Shin, 2024; Zhou, 2021). Interactive control systems encourage cross-functional dialogue, experimentation, and adaptive responses to sustainability challenges (Anis et al., 2024; Traxler et al., 2023). These settings require individuals to share ideas, revisit assumptions, and engage in uncertainty. Low performance-prove individuals are better positioned to contribute effectively in such environments, as they are less influenced by anxiety about external judgment and more able to participate authentically in collaborative eco-design efforts. In contrast, individuals with high performance-prove orientation may hesitate to seek help or expose incomplete ideas, making interactive systems less supportive of their performance in sustainability-driven design work (Lindfors et al., 2021; Miron-Spektor et al., 2022).

H5: Interactive Management Control Systems produce stronger eco-friendly design outcomes among individuals with low learning orientation and low performance-prove orientation.

RESEARCH METHODS

This study adopts a quantitative experimental approach designed to analyze the influence of Management Control Systems (MCS), Learning Goal Orientation, and Performance-Prove Goal Orientation on eco-friendly design outcomes. The experiment employs a 2x2x2 factorial between-subjects design, combining two types of MCS (diagnostic vs. interactive) with four goal-orientation conditions (high/low learning and high/low performance-prove). This factorial framework provides the conceptual foundation for examining both main and interaction effects among variables. It illustrates the possible combinations of control system types and designer goal orientations, thereby providing a basis for hypothesis testing.

Table 1. Factorial Design of Management Control Systems and Designer Goal Orientations

	Designer's Goal Orientations			
	LO		PPO	
	High	Low	High	Low
Diagnostic MCS	Cell 1	Cell 2	Cell 3	Cell 4
Interactive MCS	Cell 5	Cell 6	Cell 7	Cell 8

Research Subjects

The research involved 117 undergraduate accounting students from the Faculty of Economics and Business at Universitas Muhammadiyah Yogyakarta. These participants were chosen because they had completed Management Accounting and Cost Accounting courses, providing them with the foundational understanding needed to perform the experimental tasks. Students were used as substitutes for professional designers following the argument of Elliott et al. (2007), who state that non-professionals can serve as valid experimental subjects when tasks are adjusted to their competency level. Participants were randomly assigned to one of eight experimental conditions representing the full combination of MCS types and goal orientation levels.

Participants were undergraduate students recruited via convenience sampling. Participation was voluntary, and participants were randomly assigned to one of the experimental conditions. Although the number of participants across experimental cells was not perfectly balanced, this imbalance resulted from random assignment and participant availability rather than systematic selection. The overall sample size remained adequate for factorial ANOVA, as each experimental cell met minimum requirements for statistical analysis.

Experimental Design and Procedure

This study employed a laboratory experimental design conducted in a controlled classroom environment. Participants were tasked with building an eco-friendly dollhouse prototype using LEGO blocks, which served as the physical medium for the design exercise. The experiment aimed to test the influence of three independent variables on the single dependent variable, Eco-Friendly Design Performance.

Each experimental session began with a short briefing, followed immediately by the experimental manipulations. The independent variables included the Management Control System (MCS), which was manipulated to be either diagnostic or interactive in its operational mode, alongside two psychological variables: Learning Goal Orientation (LGO) and Performance-Prove Goal Orientation (PPGO). The MCS manipulation was implemented using distinct scripts and settings that explicitly represented either a diagnostic control environment (structured, target-oriented) or an interactive control environment (flexible, feedback-based). Goal orientations were concurrently induced through short priming scenarios designed to activate either a learning-oriented or a performance-proving mindset, based on a validated psychological framework.

Learning goal orientation refers to an individual's motivation to develop competence, acquire new skills, and view challenges as opportunities for learning rather than evaluation (Vandewalle, 1997). In this experiment, learning goal orientation was operationalised through a priming scenario presented prior to the eco-design task. Participants in the high learning orientation condition were instructed to focus on improving their understanding of eco-design principles, experimenting with alternative solutions, and learning from trial-and-error during the task. In contrast, participants in the low learning orientation condition were guided to prioritise task completion, with little emphasis on learning or skill development. This manipulation was designed to activate different motivational mindsets while keeping the task structure constant across conditions.

Following the manipulations, participants executed the design task, after which a post-task questionnaire was administered to ensure manipulation validity and collect demographic information. The dependent variable, Eco-Friendly Design Performance, was measured by evaluating the resulting LEGO block prototype, which used blocks with varying environmental impact and cost; the eco-friendly design score was calculated as a trade-off between sustainability and cost efficiency, with lower scores indicating a more sustainable and efficient design. All materials and task instruments were adapted from previously validated studies and modified for the eco-design context to enhance realism and comprehension. The study assumptions are grounded in Simons' (1995) Levers of Control Framework, Goal Orientation Theory, and Contingency Theory, which collectively explain how system–individual alignment affects design outcomes.

Data Processing and Analysis

Data were processed and analyzed using IBM SPSS Statistics software (version 25). Given the 2x22 experimental design, a factorial Analysis of Variance (ANOVA) was employed to examine the main and interaction effects among the variables. All statistical analyses were conducted using SPSS. Post-hoc analyses were then conducted to examine specific group differences. The experimental design, variable manipulations, and analytical methods were documented carefully to ensure the study can be replicated under similar conditions in future research.

RESULTS AND DISCUSSION

Results

Assumption Testing

Before conducting the ANOVA, the assumption of equal error variances was examined. As shown in Table 2, the Levene's Test result was non-significant ($p = 0.469 > 0.05$), indicating that the variances among the experimental groups were statistically homogeneous. Therefore, the assumption of homogeneity of variance was satisfied.

Table 2. Homogeneity Test Result (Levene's Test of Equality of Error Variances)

F	df1	df2	Sig.
0.953	7	109	0.469

Descriptive Statistics

The descriptive statistics for eco-friendly design performance (dependent variable) are presented in Table 3. The table shows the mean scores, standard deviations, and number of participants for each experimental condition. Participant distribution across the eight groups ranged from 3 to 42 individuals.

Table 3. Descriptive Statistics

Dependent Variable: Eco-Friendly

	LO	PPO	Mean	Std. Deviation	N
Diagnostic MCS	Low	Low	5.333	1.15470	3
		High	4.6667	0.81650	6
	High	Low	3.8571	1.21499	7
		High	4.7381	1.20563	42
Interactive MCS	Low	Low	3.7500	1.70783	4
		High	5.0909	1.81409	11
	High	Low	6.2500	0.95743	4
		High	4.5750	1.29867	40
Total					117

Hypothesis Testing

The ANOVA results presented in Table 4 show a statistically significant three-way interaction among Management Control System (MCS), Learning Orientation, and Performance-Prove Orientation ($F = 10.104$, $p = 0.002$). This finding indicates that the impact of MCS on eco-friendly design performance depends on the combination of the two designer goal orientations. The significant three-way interaction supports the contingency-based assumption that the effectiveness of control systems depends on contextual alignment between organizational mechanisms and individual motivations (Barros & Ferreira, 2022; Chenhall, 2003; Otley, 1980).

Table 4. ANOVA Results

Dependent Variable: Eco Friendly			
	Mean Square	*F-Stat*	*p-value*
Factors			
MCS	0.894	0.556	0.457
LO	0.262	0.163	0.687
PPO	0.011	0.007	0.934
MCS * LO	8.954	5.572	0.020
MCS * PPO	0.234	0.146	0.703
MCS * LO * PPO	16.237	10.104	0.002

Interaction Effects

Figures 1A and 1B illustrate the two-way interaction between MCS and Learning Orientation at different levels of Performance-Prove Orientation. Under low performance-prove orientation (Figure 1A), a strong cross-over pattern emerged: designers with low learning orientation performed best under interactive MCS (M = 3.75), while those with high learning orientation performed best under diagnostic MCS (M = 3.86). This shows that eco-design outcomes are contingent upon the congruence between system type and intrinsic motivation. Under high performance-prove orientation (Figure 1B), however, differences between experimental groups were minimal, and lines appeared nearly parallel. This suggests that strong external motivation to demonstrate competence neutralizes the differential effects of MCS and learning orientation.

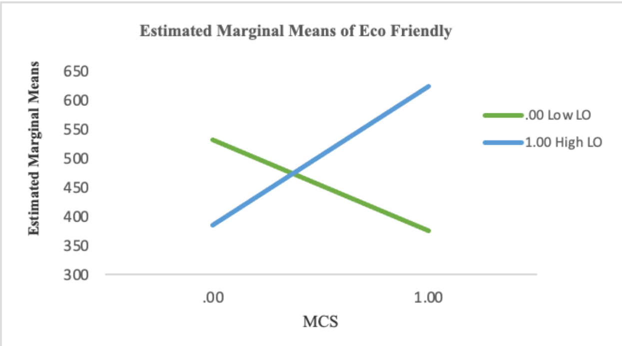

Figure 1. Estimated Marginal Means of Eco-Friendly Design at Low Performance-Prove Orientation

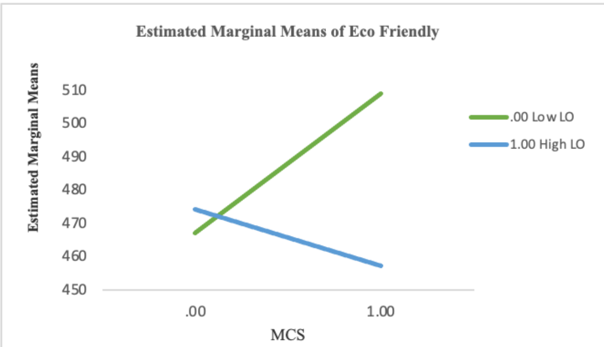

Figure 2. Estimated Marginal Means of Eco-Friendly Design at High Performance-Prove Orientation

Discussion

The Effect of Management Control Systems on Eco-Friendly Design

The results reveal that the type of Management Control System (MCS) by itself does not have a statistically significant direct effect on eco-friendly design outcomes ($F = 0.556$, $p = 0.457$). This finding suggests that whether a diagnostic or interactive control system is adopted, the overall mean differences in eco-design performance remain minimal across experimental groups. This aligns with prior research emphasizing that control systems, on their own, are not inherently enabling or constraining; their effectiveness depends on how they interact with contextual and behavioural variables (Hall, 2016; Simons, 1995).

In this study, the mean eco-design performance under diagnostic systems ($M = 4.64$) and interactive systems ($M = 4.83$) showed only marginal variation. This outcome reinforces the contingency-based assumption that management control mechanisms influence performance primarily through *fit* rather than form(Chenhall, 2003; Otley, 1980). In other words, control systems gain significance when they complement the motivational and cognitive orientations of the individuals applying them.

From a behavioural accounting perspective, this finding reflects the inherent complexity of eco-design tasks, which require designers to balance cost efficiency, environmental impact, and regulatory compliance simultaneously. Traditional management control mechanisms, when applied uniformly, may fail to capture the nuanced trade-offs embedded in sustainability-oriented decision-making (Harris et al., 2025). As a result, the effectiveness of MCS cannot be assessed independently of how individuals cognitively process environmental objectives. This supports the argument that eco-design outcomes are less a function of control intensity and more a function of how controls are interpreted and enacted by decision-makers within a given behavioural context (Johnstone, 2024).

At the individual level, management control systems influence eco-design behaviour by shaping how participants cognitively and motivationally interpret the control environment, rather than through direct behavioural enforcement (de Costa et al., 2025). Diagnostic control systems frame performance information around explicit targets, evaluation criteria, and accountability, which can heighten perceived performance pressure and encourage risk-averse decision-making. In contrast, interactive control systems emphasise dialogue, strategic context, and flexibility, leading participants to interpret control information as supportive and learning-oriented (Andersen & Young, 2023; Anwar, 2024). However, because both control conditions in the experiment operated under identical task constraints and performance expectations, these differences in perceived pressure or support were not sufficiently strong to independently alter eco-design behaviour. Consequently, individual goal orientation played a central role in shaping behavioural responses to the control context, explaining why the effects of management control systems emerged primarily through interaction patterns rather than as direct main effects.

The experimental context also provides an important lens for interpreting the non-significant main effects observed in this study. The eco-design task was conducted within a short-term laboratory setting, with student participants completing a single design exercise under time-limited conditions. Unlike organizational settings in which management control systems operate over extended periods and carry material career or performance consequences (Hammouch et al., 2024), the experimental task involved limited personal stakes. As a result, differences between diagnostic and interactive control systems may not have been perceived as meaningfully distinct by participants. Furthermore, the short task duration and standardized performance outcomes may have constrained the full expression of learning and performance-prove goal orientations, as participants had limited opportunity to adapt their strategies, accumulate feedback, or experience repeated evaluation. These contextual features likely attenuated the direct impact of both management control systems and goal orientations, helping to explain why their effects emerged primarily through interaction patterns rather than as robust main effects.

The Effect of Learning Orientation on Eco-Friendly Design

The ANOVA results also indicate that learning orientation has no significant main effect on eco-friendly design outcomes ($F = 0.163$, $p = 0.687$). Participants with a high learning orientation ($M = 4.78$) did not substantially outperform those with a low learning orientation ($M = 4.59$). This suggests that having a strong intrinsic drive to acquire knowledge and improve skills does not automatically translate into better eco-design performance unless supported by an appropriate control environment.

This finding contrasts with several prior studies that link learning orientation with innovative behaviour and sustainability outcomes (Yokoyama & Miwa, 2021). However, the absence of a significant main effect here underscores that motivation alone is insufficient to drive eco-innovation; structure and situational alignment remain crucial. The finding aligns with the argument of Henri (2006),that learning orientation must interact with enabling control systems to activate creativity and sustainable innovation.

The Effect of Performance-Prove Orientation on Eco-Friendly Design

Similarly, performance-prove orientation does not exhibit a significant direct impact on eco-friendly design outcomes (F = 0.007, p = 0.934). Participants with high performance-prove motivation (M = 4.73) performed comparably to those with low performance-prove motivation (M = 4.68). This outcome indicates that external motivation to demonstrate competence does not meaningfully affect sustainable design quality when considered in isolation.

This result supports earlier behavioural studies (Vandewalle, 1997) showing that performance-driven motivation can diminish exploratory learning behaviours, which are crucial for creative design. Consequently, while performance-prove orientation may encourage short-term efficiency or compliance-driven innovation (Yang et al., 2020; Zhou, 2021) it lacks the intrinsic cognitive depth required for eco-innovation unless supported by compatible managerial structures.

Moreover, the absence of a main effect suggests that performance-prove orientation may function more as a contextual amplifier rather than a direct driver of eco-design quality. In sustainability-oriented tasks, where outcomes are multidimensional and not immediately observable, external validation may provide insufficient guidance for decision-making. Consequently, individuals motivated primarily by performance demonstration may rely more heavily on formal cues and benchmarks, which limits the independent influence of their motivational orientation on design outcomes.

The Interaction Between MCS and Learning Orientation

The two-way interaction between Management Control Systems (MCS) and learning orientation is statistically significant (F = 5.572, p = 0.020), indicating that the effectiveness of a control system depends on the designer's motivational profile. At low levels of learning orientation, participants performed better under interactive MCS (M = 3.75) than under diagnostic MCS (M = 5.33). Interactive systems stimulate dialogue, provide external prompts, and offer iterative feedback, which are helpful for individuals who are not naturally inclined to explore or self-direct their learning (Ahn et al., 2021).

In contrast, at high levels of learning orientation, the pattern reverses. Individuals with strong intrinsic motivation performed better under diagnostic MCS (M = 3.86) than under interactive systems (M = 4.58–6.25, depending on performance-prove level). Diagnostic controls offer clear targets, structured expectations, and measurable indicators of improvement, conditions that help high-learning-oriented individuals channel their motivation productively (Bedford, 2015; Hall, 2011).

This crossover interaction supports H4, which proposes that eco-friendly design outcomes are highest when diagnostic controls are paired with high learning orientation, and when interactive controls are paired with low learning orientation. The finding reinforces the contingency perspective that the effectiveness of MCS lies not in the control design itself, but in the alignment between system characteristics and individual motivation (Chenhall, 2003; Otley, 1980).

The Interaction Between MCS and Performance-Prove Orientation

The interaction between MCS and performance-prove orientation was not statistically significant (F = 0.146, p = 0.703). Eco-design outcomes remained relatively stable regardless of whether individuals were high or low in performance-prove orientation, suggesting that a desire to demonstrate competence does not meaningfully shape how designers respond differently to diagnostic or interactive controls.

This pattern is consistent with prior behavioural findings that performance-prove motivation often directs attention toward impression management rather than the deeper exploratory thinking required for sustainability-driven design tasks (Boiral et al., 2020; McFarland et al., 2023). As a result, individuals with high performance-prove orientation may engage in similar behaviours across different control environments, focusing on producing acceptable outcomes rather than adapting their approach to the affordances of the control system.

Because this effect does not correspond to any of the hypotheses, it is interpreted as an auxiliary finding rather than a direct test of a hypothesis. It suggests that performance-prove motivation alone does not shape how designers react to differences between diagnostic and interactive systems.

The Three-Way Interaction Among MCS, Learning Orientation, and Performance-Prove Orientation

The most important result of this study is the significant three-way interaction among MCS, learning orientation, and performance-prove orientation ($F = 10.104$, $p = 0.002$). This finding shows that eco-design performance is determined not by any single factor, but by the joint configuration of structural controls and individual motivations.

When performance-prove orientation is low, the MCS × learning orientation interaction becomes highly pronounced. Under these conditions, individuals with low learning orientation achieved their best outcomes under interactive MCS ($M = 3.75$), where dialogue and iterative feedback compensate for their limited intrinsic motivation. Meanwhile, individuals with high learning orientation performed best under diagnostic MCS ($M = 3.86$), where clear targets and structured evaluation help focus their mastery-oriented drive toward environmental goals. This pattern aligns closely with H5, which proposes that interactive MCS are particularly effective for individuals with low learning orientation and low performance-prove orientation. In contrast, diagnostic systems align more effectively with high-learning, low-performance-prove profiles.

However, when performance-prove orientation is high, differences between MCS conditions narrow substantially (means range from 4.58 to 5.10). This suggests that once individuals become highly motivated to prove their competence, they tend to adopt similar patterns of behaviour regardless of the control system or their learning orientation. The desire for external validation appears to override contextual cues, weakening the influence of structural–motivational alignment.

This three-way interaction highlights the importance of configurational thinking in behavioural accounting and management control research. Rather than assuming linear relationships, the findings demonstrate that eco-design performance emerges from specific combinations of control systems and motivational traits. This supports recent calls for moving beyond single-factor explanations in sustainability research and adopting a systems-oriented perspective that recognizes the interdependence between structure, cognition, and motivation (Hall, 2016; Widener, 2007). By empirically demonstrating how misalignment weakens eco-design outcomes, this study contributes to a more nuanced understanding of how organizations can design control environments that effectively support sustainability-driven innovation.

This supports recent calls to move beyond single-factor explanations in sustainability research and to adopt a systems-oriented perspective that recognizes the interdependence among structure, cognition, and motivation (Hall, 2016; Widener, 2007) by showing that eco-friendly design is not merely the outcome of environmental standards or resource availability but is deeply shaped by the interplay between managerial structure and human motivation.

Overall, the results provide partial support for the proposed hypotheses. The direct effect of Management Control Systems on eco-friendly design (H1) is not supported. Similarly, learning goal orientation (H2) and performance-prove goal orientation (H3) do not show significant direct effects on eco-friendly design. However, the interaction hypotheses receive support. Eco-friendly design outcomes are higher among individuals with high learning orientation when using diagnostic MCS, and among individuals with low learning orientation when using interactive MCS, supporting H4. In addition, interactive Management Control Systems produce stronger eco-friendly design outcomes among individuals with low learning orientation and low performance-prove orientation, supporting H5. These findings indicate that eco-friendly design performance depends on the alignment between Management Control Systems and individual goal orientations rather than on their independent main effects.

CONCLUSION

This study examined the influence of Management Control Systems (MCS) and designer goal orientations on eco-friendly design performance, using an experimental 2×2×2 factorial design involving 117 accounting students. The results reveal that while no main effects were observed for MCS, learning orientation, or performance-prove orientation individually, a significant three-way interaction among these variables emerged. This finding confirms that the effectiveness of management control systems depends on their alignment with individual motivational orientations, consistent with Contingency Theory. These results extend the theoretical understanding of how structural (system-level) and psychological (individual-level) factors jointly influence sustainable innovation. They provide empirical evidence that achieving eco-friendly design performance requires a match between organizational control mechanisms and designers' motivational traits, rather than relying on a single dominant control approach.

The findings of this study offer several important implications for both practice and theory. From a managerial perspective, the results reinforce the need for a contingency-based approach to management control, in which the design and use of Management Control Systems (MCS) are aligned with employees' motivational characteristics rather than applied uniformly. These insights encourage managers to consider motivational profiling when assigning tasks, designing teams, or implementing sustainability initiatives. In addition, the results highlight the importance of employee development programs that enhance learning motivation and reduce excessive performance-prove tendencies, such as training that rewards experimentation, long-term learning, and sustainable problem-solving rather than only visible achievements. Despite its contributions, this study is not without limitations. The use of student participants and LEGO-based design tasks may limit external validity, and future research should incorporate professional designers or real-world organizational settings. The experimental design also captures behaviour at a single point in time, suggesting that longitudinal or field studies may be beneficial for examining how the alignment between MCS and motivation evolves across the innovation cycle. Future studies may also explore additional psychological factors, such as performance-avoidance orientation or creative self-efficacy, as well as other control system elements, such as beliefs or boundary controls, to deepen understanding of how structural and behavioural variables jointly shape sustainable innovation outcomes.

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