Green Leadership and Competence in Green Project Management: Roles of Awareness and Culture

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ABSTRACT

Objectives*: analyze the effects of green leadership and green competence on green project management, with environmental awareness as a mediating variable and green organizational culture as a moderating variable at PT Cipta Griya Semesta.*

Methodology*: Quantitative, causality design. Population: employees of PT Cipta Griya Semesta; sample: 125 purposively selected respondents (permanent and contract employees directly involved in projects). Analysis used SEM-PLS with SmartPLS 4.0*

Finding*: Six of eight hypotheses were supported. Green leadership and green competence had positive and significant direct effects on green project management and also significantly affected environmental awareness. Environmental awareness positively influenced green project management and mediated the relationship between green leadership and green project management (H6 accepted). However, environmental awareness did not mediate the effect of green competence on green project management (H7 rejected). Green organizational culture did not moderate the relationship between environmental awareness and green project management (H8 rejected).*

Conclusion*: Green competence appears to improve project outcomes directly without relying on environmental awareness as an intermediary, while green organizational culture functions as an independent predictor rather than a moderator.*

Keywords*: Green Project Management; Green Leadership; Green Competence; Environmental Awareness; Green Organizational Culture.*

INTRODUCTION

Environmental sustainability has become an increasingly critical issue in the construction sector, encouraging firms to adopt greener operational practices (Soemantri, 2025) and contribute to global decarbonization commitments such as the Paris (Schoolmedia, 2025). In the built environment, sustainability attention is particularly urgent because construction activities contribute substantially to resource consumption, energy use, and carbon emissions, making project-level sustainability integration increasingly necessary (Agyekum et al., 2025).

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In Indonesia, although policy direction and the green building agenda have expanded, implementation in construction remains limited and faces persistent barriers, particularly in human resource readiness and the strength of organizational culture (GBCI, 2025). In addition, the regulatory push for sustainable buildings has been reflected in national building regulations, yet field implementation still tends to lag due to capability gaps and organizational readiness (Susilo, 2022; PP No.16/2021; Permen PUPR No.21/2021).

Within PT Cipta Griya Semesta (CGS), this challenge is reflected in the inconsistent and suboptimal implementation of Green Project Management (GPM). Consequently, the research is directed to examine internal determinants that can strengthen GPM implementation, especially organizational and human factors that enable sustainability principles to be embedded in project execution.

Operational indicators at CGS show that environmental management issues remain unresolved. Waste-handling costs rose markedly from 2020 and peaked in 2023 (Rp99.810.000,-), and remained high in 2024 (Rp95.970.000,-), indicating that waste management has not yet stabilized as an efficient routine within project activities (CGS internal project management data, 2025). In parallel, KPI performance illustrates a persistent weakness in cleanliness as the lowest indicator across 2021–2024 (68.5% in 2021; 66.5% in 2022; 69% in 2023; 65% in 2024), reinforcing the need to investigate why green initiatives do not consistently translate into strong project-level environmental performance (CGS internal project management data, 2025).

GPM is positioned as a practical project approach that reduces negative environmental impacts through energy efficiency, responsible waste handling, environmentally friendly materials, and process control aligned with green design and regulatory expectations (Kibert, 2022). CGS has introduced several initiatives—such as segregated waste management, use of local materials to reduce carbon footprint, and electricity and water efficiency in project areas—but these efforts still face effectiveness constraints.

The literature also indicates that GPM effectiveness is shaped not only by technical arrangements but by organizational commitment, awareness, and the integration of sustainability values into daily project behavior (Magano et al., 2021). Therefore, an empirical model is needed to test which internal drivers most strongly influence GPM outcomes and through what mechanisms.

The study is grounded in several gaps identified from prior research. First, earlier studies frequently examined green leadership and green competence separately, leaving limited evidence about their combined role as antecedents of green project outcomes (Younis & Hussain, 2023). Second, mediation mechanisms in previous work often emphasize general constructs, while the role of Environmental Awareness as a specific pathway translating leadership direction and competence into consistent green project practices remains insufficiently examined (Mirhadian et al., 2023). Third, although green capabilities are linked to competitiveness in construction, the moderating role of Green Organizational Culture in strengthening the relationship between Environmental Awareness and GPM is still underexplored (Nguyen et al., 2023).

Based on the CGS context and the theoretical logic in the literature, the research framework is constructed around human and organizational determinants of GPM. Implementation weaknesses are associated with differences in green leadership, limitations in

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green competence, uneven environmental awareness, and the extent to which green values are embedded as organizational culture—requiring a model that captures both direct effects and conditional mechanisms (Ahmed et al., 2023).

LITERATURE REVIEW

Grand Theory

Resource-Based View (RBV) posits that competitive advantage can be achieved through unique internal resources and capabilities that are valuable and difficult to imitate; in sustainability settings, green leadership and green competence can be positioned as strategic internal assets supporting effective green project management. This aligns with the Natural Resource-Based View (NRBV), which highlights environmentally oriented resources and capabilities as sources of long-term advantage (Bhandari et al., 2021).

Middle Theory

Dynamic Capabilities Theory extends RBV by emphasizing an organization's ability to sense, integrate, and reconfigure resources to remain competitive under change, and recent sustainability literature shows that dynamic (including green) capabilities help embed sustainability into organizational decisions and processes (Liang et al., 2022). Sustainability Leadership Theory also positions leaders as change agents who institutionalize sustainability values and encourage participation in green practices (Eustachio et al., 2023).

Moreover, contemporary studies using TPB and VBN frameworks confirm that attitudes, norms, perceived control, and value–belief structures shape pro-environmental intentions and behaviors (Li et al., 2025). Finally, recent institutional research explains how coercive, mimetic, and normative pressures influence sustainability/ESG-related practices, while sustainability culture research emphasizes shared values and assumptions as foundations for consistent environmental behaviors in organizations (Ketprapakorn & Kantabutra, 2022).

Applied Theory

Green Transformational Leadership (GTL) refers to leaders who inspire and mobilize followers toward environmental goals and encourage pro-environmental behavior beyond minimum expectations. In parallel, Green HRM embeds environmental objectives into HR functions—such as green recruitment and selection, green training and development, and green rewards/compensation—so that employees' capabilities and motivation for green behavior are systematically built and reinforced within the organization (Farrukh et al., 2022).

Value–Belief–Norm (VBN) logic explains pro-environmental actions as being driven by values and beliefs that activate personal norms, which then translate into intentions and behaviors. In organizational/project contexts, green organizational culture helps normalize sustainability-oriented assumptions and norms, while green/sustainable project management extends project success criteria beyond cost–time–scope by integrating sustainability considerations across the project life cycle and evaluating outcomes that include environmental and social impacts (Li et al., 2022).

Substance Theory

Green leadership is a leadership style embedding environmental sustainability into managerial practice and motivating pro-environmental behavior (Makhloufi et al., 2021), green competence is a set of knowledge, skills, and attitudes enabling sustainable work behavior and solutions (Agyekum et al., 2025), environmental awareness reflects knowledge–attitude–

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intention and is shaped through learning and organizational influence, green organizational culture is shared values/norms and structural reinforcement prioritizing environmental preservation, and green project management applies ssustainability across planning, execution, resources, monitoring, and closing (Ahmed et al., 2023).

Prior Research

Prior studies consistently support positive links between green leadership and environmental/green outcomes through psychological or organizational mechanisms (Younis & Hussain, 2023), show green competence contributes to environmental performance (Doghan et al., 2024) and provides operational guidance for competence measurement (Wegenberger & Ponocny, 2025), highlight the role of environmental awareness as a mediator across contexts (Tareke, 2024), and indicate culture/capabilities shape green implementation and competitiveness in construction-relevant settings (Susilo, D., 2022)

Hypothesis Development

Building on recent evidence that environmentally oriented leadership and green-related competencies strengthen green outcomes and project sustainability, green leadership and green competence are expected to positively influence green project management (H1, H2). Environmental awareness is also expected to directly enhance green project management (H3) and to be strengthened by green leadership and green competence (H4, H5) through behavioral and capability-building mechanisms (Ayzan et al., 2025).

Furthermore, environmental awareness is expected to mediate the effects of green leadership and green competence on green project management (H6, H7), consistent with contemporary empirical applications of planned-behavior and value–belief–norm logics showing that awareness-related beliefs and norms translate into pro-environmental intentions and behaviors. Finally, green organizational culture is expected to strengthen the influence of environmental awareness on green project management (H8), aligning with recent institutional/culture research indicating that shared green values and organizational norms amplify the translation of individual awareness into consistent environmental practice (Shen et al., 2022).

Conceptual Framework

The conceptual framework integrates green leadership and green competence as antecedents of green project management, with environmental awareness as a mediator and green organizational culture as a moderating context.

Figure 1. Conceptual Framework

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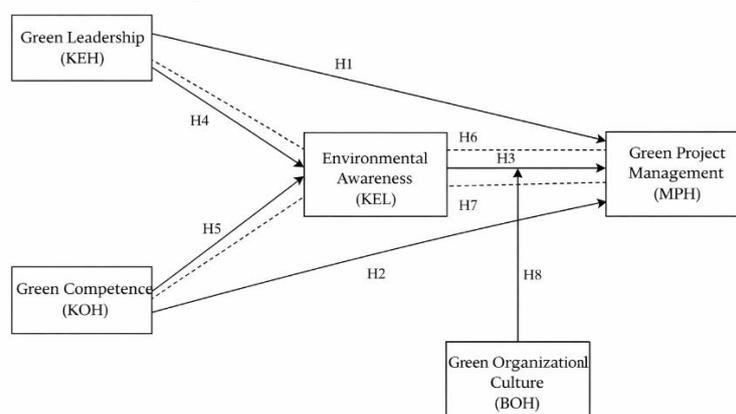
METHOD

This study applies a quantitative approach with a causality design to test the relationships among green leadership, green competence, environmental awareness (mediator), green organizational culture (moderator), and green project management, using employees of PT Cipta Griya Semesta as the population frame. The sampling strategy uses **non-probability purposive sampling** to select respondents who best understand and are directly involved in project activities, with inclusion criteria such as employment status and relevant project involvement. The analysis strategy employs **SEM-PLS** because it is suitable for complex predictive models and theory development (Hair et al., 2022).

Data collection uses a **survey method** with **primary data** gathered directly from respondents through an **electronic questionnaire**. The procedure includes formal research permission from company management, coordination with relevant departments (e.g., HR or Project Management) to distribute the questionnaire link via internal communication channels, and the use of **informed consent** to ensure anonymity and confidentiality. Data collection was planned for approximately **four weeks**, supported by periodic reminders to increase response rates.

The instrument is a **Google Forms** questionnaire containing items adapted from validated prior studies, measured using a **5-point Likert scale** (Robinson, 2023). Instrument quality is assessed within **SmartPLS (SEM-PLS)** through **CFA in the Measurement Model (Outer Model)**, evaluating convergent validity via outer loadings and AVE thresholds. Discriminant validity is examined using Fornell–Larcker/cross-loading logic and **HTMT ≤ 0.90**.

RESULTS AND DISCUSSION

The measurement model met the recommended criteria for PLS-SEM: all indicators showed strong convergent validity with outer loadings above the accepted threshold (Hair et al., 2022), and all constructs achieved AVE values above 0.50, confirming that each latent variable adequately explained its indicators' variance. Discriminant validity was also supported using Fornell–Larcker and related criteria (Robinson, 2023).

Respondents Descriptive

Table 1. Details of Research Sample Acquisition

Description	Number
Number of questionnaires distributed (Total population)	150
Number of questionnaires not returned / not completed	(20)
Number of questionnaires returned (Response rate)	130
Number of incomplete questionnaires / not meeting criteria (outliers)	(5)
Final sample used (Usable sample)	**125**

A total of **150 questionnaires** were distributed to the target respondents (representing the study's total population). From these, **20 questionnaires** were **not returned or were left uncompleted**, resulting in **130 returned questionnaires** as the initial response set. After the responses were collected, the data were screened for completeness and eligibility; **5 questionnaires** were found to be **incomplete or did not meet the research criteria** (classified as outliers) and were therefore excluded from analysis. As a result, the study

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proceeded with a **final usable sample of 125 respondents**, and only these valid questionnaires were included in the statistical analysis.

Outer Model Evaluation Results

Table 2. Outer Loadings Values

	KEH	KOH	KEL	BOH	MPH	BOH x KEL
KEH.1	0,809					
KEH.2	0,791					
KEH.3	0,797					
KEH.4	0,846					
KEH.5	0,822					
KEH.6	0,749					
KOH.1		0,814				
KOH.2		0,804				
KOH.3		0,871				
KOH.4		0,800				
KOH.5		0,800				
KOH.6		0,743				
KEL.1			0,805			
KEL.2			0,786			
KEL.3			0,735			
KEL.4			0,856			
KEL.5			0,838			
KEL.6			0,816			
BOH.1				0,826		
BOH.2				0,794		
BOH.3				0,818		
BOH.4				0,815		
BOH.5				0,844		
BOH.6				0,766		
MPH.1					0,788	
MPH.2					0,774	
MPH.3					0,825	
MPH.4					0,848	
MPH.5					0,771	
MPH.6					0,729	
MPH.7					0,749	
MPH.8					0,752	
BOH x KEL						1,000

Convergent validity is met based on **outer loadings** and **AVE**. All indicators load strongly on their constructs (each meets the >0.70 rule), so no items needed to be removed.

Table 3. Average Variance Extracted (AVE) Values

Variables	AVE	Description
Environment Awareness (KEL)	0,645	Valid
Green Leadership (KEH)	0,650	Valid
Green Competence (KOH)	0,651	Valid
Green Project Management (MPH)	0,657	Valid
Green Organizational Cultural (BOH)	0,609	Valid

The AVE values are all above 0.50 (**KEL 0.645; KEH 0.650; KOH 0.651; MPH 0.657; BOH 0.609**), confirming that each construct explains more than half of its indicators' variance.

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Table 4. Reliability Testing Results

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average Variance Extracted (AVE)	Description
KEH	0,889	0,891	0,916	0,645	Reliable
KOH	0,892	0,894	0,918	0,650	Reliable
KEL	0,892	0,897	0,918	0,651	Reliable
BOH	0,896	0,898	0,920	0,657	Reliable
MPH	0,908	0,910	0,925	0,609	Reliable

Construct reliability is also strong. Cronbach's Alpha for all variables falls in the range **0.889–0.908**, and Composite Reliability ranges **0.916–0.925**, all above the >0.70 threshold, supporting internal consistency and instrument reliability.

Table 5. Cross Loadings Testing Results

	KEH	KOH	KEL	BOH	MPH	BOH x KEL
KEH.1	0,809	0,511	0,562	0,620	0,621	-0,567
KEH.2	0,791	0,512	0,481	0,481	0,560	-0,459
KEH.3	0,797	0,597	0,538	0,571	0,630	-0,563
KEH.4	0,846	0,645	0,587	0,570	0,612	-0,488
KEH.5	0,822	0,533	0,533	0,593	0,574	-0,536
KEH.6	0,749	0,557	0,523	0,561	0,603	-0,521
KOH.1	0,617	0,814	0,550	0,524	0,630	-0,569
KOH.2	0,537	0,804	0,572	0,427	0,590	-0,463
KOH.3	0,566	0,871	0,606	0,554	0,628	-0,570
KOH.4	0,471	0,800	0,524	0,457	0,544	-0,508
KOH.5	0,602	0,800	0,625	0,568	0,613	-0,560
KOH.6	0,566	0,743	0,450	0,521	0,571	-0,581
KEL.1	0,504	0,517	0,805	0,527	0,501	-0,554
KEL.2	0,480	0,550	0,786	0,534	0,472	-0,597
KEL.3	0,533	0,544	0,735	0,533	0,507	-0,526
KEL.4	0,606	0,592	0,856	0,630	0,613	-0,516
KEL.5	0,540	0,526	0,838	0,602	0,536	-0,626
KEL.6	0,572	0,608	0,816	0,556	0,533	-0,584
BOH.1	0,573	0,513	0,557	0,826	0,612	-0,490
BOH.2	0,580	0,517	0,600	0,794	0,582	-0,529
BOH.3	0,598	0,520	0,527	0,818	0,593	-0,482
BOH.4	0,569	0,517	0,606	0,815	0,535	-0,585
BOH.5	0,626	0,547	0,612	0,844	0,631	-0,557
BOH.6	0,488	0,469	0,505	0,766	0,553	-0,492
MPH.1	0,620	0,520	0,453	0,515	0,788	-0,438
MPH.2	0,617	0,602	0,537	0,515	0,774	-0,549
MPH.3	0,610	0,592	0,457	0,564	0,825	-0,500
MPH.4	0,651	0,639	0,578	0,632	0,848	-0,528
MPH.5	0,552	0,551	0,470	0,505	0,771	-0,453
MPH.6	0,492	0,545	0,480	0,541	0,729	-0,570
MPH.7	0,566	0,578	0,546	0,635	0,749	-0,540
MPH.8	0,556	0,591	0,566	0,584	0,752	-0,481
BOH x KEL	-0,652	-0,675	-0,700	-0,644	-0,651	1,000

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Discriminant validity is supported through multiple checks: cross-loadings show each indicator loads higher on its own construct than on others.

Table 6. Heterotrait-Monotrait (HTMT) Ratio Testing Results

	KEL	KEH	KOH	MPH	BOH	KEL x BOH
KEL						
KEH	**0,749**					
KOH	0,771	**0,779**				
MPH	0,725	0,831	**0,821**			
BOH	0,782	0,789	0,706	**0,798**		
KEL x BOH	0,745	0,690	0,712	0,683	**0,681**	

HTMT values are within the safe range (**0.681–0.831**, all <0.90 and even below the stricter 0.85 standard), and Fornell–Larcker is satisfied (each AVE on the diagonal exceeds inter-construct correlations).

Inner Model Evaluation Results

Table 7. Coefficient of Determination Testing Results

	R-square	**R-square adjusted**	**Category**
KEL	0,694	0,682	Strong
MPH	0,540	0,532	Moderate

The inner (structural) model shows strong–moderate explanatory power based on **R²**. **Environmental Awareness (KEL)** has **R² = 0.694 (strong)** and **Green Project Management (MPH)** has **R² = 0.540 (moderate)**, indicating that the exogenous variables explain **69.4%** of KEL and **54.0%** of MPH.

Table 8. Q-Square (Q^2) Testing Results

	SSO	**SSE**	**Q² (=1-SSE/SSO)**	**Description**
KEL	750,000	488,689	0,348	Consisting Predictive Relevance
MPH	1000,000	587,729	0,412	Consisting Predictive Relevance

Additional inner-model diagnostics confirm the model's predictive quality. Predictive relevance (blindfolding) produced **Q² > 0** for both constructs (**KEL = 0.348; MPH = 0.412**), supporting good predictive relevance.

Table 9. Effect Size (f^2) Testing Results

	KEL	KEH	KOH	MPH	BOH	BOH x KEL
KEL				**0,000**		
KEH				0,101	0,298	
KOH				0,131	0,084	
MPH						
BOH				0,089		
BOH x KEL				**0,007**		

Effect size (f²) shows **small but meaningful** contributions of **KEH → MPH (0.101)** and **KOH → MPH (0.131)**, while the interaction **BOH × KEL** is **very weak (0.007)** and **KEL → MPH is 0.000**, consistent with the weak/non-significant interaction role.

Table 10. Model Fit SRMR Testing Results

	Saturated model	Estimated model
SRMR	0,067	0,073

Model fit using SRMR is acceptable **(0.067 saturated; 0.073 estimated)** and within recommended cutoffs (<0.08; and still acceptable <0.10 in PLS-SEM).

Multicollinearity Results

Table 11. Variance Inflation Factor (VIF) Testing Results

	KEL	KEH	KOH	MPH	BOH	BOH x KEL
KEL				2,776		
KEH				2,674	1,946	
KOH				2,545	1,946	
MPH						
BOH				2,556		
BOH x KEL				2,442		

Multicollinearity was assessed using **VIF** with conservative guidance that **VIF < 3** indicates the model is free from collinearity and potential common method bias concerns. Based on the reported results, all VIF values fall between **1.946 and 2.776**, with the highest VIF on **KEL (2.776)** and the lowest on the relationship involving **KEH and KOH toward BOH (1.946)**. Because all values are below both **VIF < 5.0** and the stricter **VIF < 3.0** benchmark, the model is concluded to have **no multicollinearity problem**, meaning each exogenous variable contributes uniquely in explaining the endogenous variables.

Table 12. Direct Effect Hypothesis Testing Results

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	Tstatistics (|O/STDEV|)	P-values	Description
KEH → MPH	0,287	0,283	0,093	3,095	0,002	Positive Significant
KOH → MPH	0,320	0,322	0,096	3,320	0,001	Positive Significant
KEL → MPH	0,264	0,262	0,090	2,930	0,003	Positive Significant
KEH → KEL	0,516	0,509	0,109	4,729	0,000	Positive Significant
KOH → KEL	0,274	0,281	0,109	2,519	0,012	Positive Significant
BOH → MPH	0,008	0,012	0,077	0,108	0,914	Not Significant
BOH x KEL→ MPH	-0,044	-0,044	0,038	1,162	0,245	Not Significant

However, not all effects were supported. **Green organizational culture (BOH)** did not show a meaningful direct influence on **green project management (MPH)** (p=0.914), suggesting that cultural conditions alone were not sufficient to explain differences in project-level green practices. Likewise, the interaction term **BOH × KEL → MPH** was not significant (p=0.245), meaning that green organizational culture did not strengthen (or weaken) the effect of environmental awareness on green project management as initially expected.

Table 13. Indirect Effect Hypothesis Testing Results

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T-statistics (|O/STDEV|)	P-values	Description
KEH → KEL → MPH	0,136	0,135	0,057	2,389	0,017	Positive Significant
KOH → KEL → MPH	0,072	0,073	0,038	1,905	0,057	Not Significant

Table 14. Hypothesis Testing Results

Hypotehsis	Realtionship (path)	P-Values	Decision
H1	(KEH) → (MPH)	0.002	Supported
H2	(KOH) → (MPH)	0.001	Supported
H3	(KEL) → (MPH)	0.003	Supported
H4	(KEH) → (KEL)	0.000	Supported
H5	(KOH) → (KEL)	0.012	Supported
H6	KEH → KEL → MPH (Mediation)	0.017	Supported
H7	KOH → KEL → MPH (Mediation)	0.057	Not Supported
H8	BOH × KEL → MPH (Moderation)	0.245	Not Supported

Discussion

Hypothesis testing was carried out using the bootstrapping procedure, and statistical significance was determined using the standard criterion of **p-value < 0.05**. The results indicate that most of the proposed direct relationships were supported: **green leadership (KEH)** significantly improved **green project management (MPH)** (β=0.287; p=0.002) and also significantly increased **environmental awareness (KEL)** (β=0.516; p=0.000). Similarly, **green competence (KOH)** showed significant positive effects both on **green project management** (β=0.320; p=0.001) and on **environmental awareness** (β=0.274; p=0.012). In addition, **environmental awareness (KEL)** itself contributed significantly to improving **green project management (MPH)** (β=0.264; p=0.003), confirming its role as an important behavioral driver in project implementation.

However, not all effects were supported. **Green organizational culture (BOH)** did not show a meaningful direct influence on **green project management (MPH)** (p=0.914), suggesting that cultural conditions alone were not sufficient to explain differences in project-level green practices. Likewise, the interaction term **BOH × KEL → MPH** was not significant (p=0.245), meaning that green organizational culture did not strengthen (or weaken) the effect of environmental awareness on green project management as initially expected.

CONCLUSION

The results show that the proposed model performs well in explaining green project outcomes at PT Cipta Griya Semesta. The structural model indicates that the predictors account for a strong proportion of variance in **Environmental Awareness (KEL)** ($R^2=0.694$) and a moderate proportion in **Green Project Management (MPH)** ($R^2=0.540$). Predictive relevance is also supported because Q^2 values are greater than zero for both endogenous variables, meaning the model has meaningful predictive capability. Overall, these statistics

confirm that the framework is empirically adequate for explaining GPM performance in this context.

At the measurement level, the instrument is statistically sound and supports interpretation of the structural relationships. Convergent validity is achieved as indicators meet the outer loading standards and each construct records AVE above 0.50. Reliability is also strong because Cronbach's Alpha and Composite Reliability values exceed recommended thresholds across constructs. Discriminant validity is supported through Fornell–Larcker, cross-loadings, and HTMT values remaining within acceptable limits, indicating the variables are empirically distinguishable.

In terms of direct effects, the findings confirm that both **Green Leadership (KEH)** and **Green Competence (KOH)** significantly strengthen **Green Project Management (MPH)**, and both variables also significantly increase **Environmental Awareness (KEL)**. Environmental awareness itself significantly improves green project management, showing that awareness contributes to more consistent green project practices. These results suggest that effective green leadership and strong green competencies operate not only through technical execution but also by building environmentally oriented attitudes and attention among employees.

The mediation and moderation tests clarify how and when these drivers matter. Environmental awareness significantly mediates the influence of green leadership on green project management (KEH → KEL → MPH), indicating leadership promotes better green implementation partly by shaping awareness. However, environmental awareness does not mediate the effect of green competence on green project management (KOH → KEL → MPH not significant), implying competence translates into outcomes primarily through direct application rather than through awareness. Finally, green organizational culture shows neither a significant direct effect on GPM nor a moderating effect on the awareness–GPM link, meaning culture did not strengthen the pathway from awareness to implementation in this setting.

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