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e-mail: matrik.fe@unud.ac.id



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DETERMINANTS OF FAMILY BUSINESS SUSTAINABILITY: EVIDENCE FROM INDONESIAN LISTED FIRMS

Herlina Yoka Roida¹⁾, Eugene Angelica Gunawan²⁾

^{1,2} Universitas Katolik Widya Mandala Surabaya, Surabaya, Indonesia
Email: yokaroida@ukwms.ac.id



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ABSTRACT

This study aims to investigate the impact of family ownership, family involvement, and family openness on the sustainability of family-owned businesses. The determinant factors are also explored, given the focus on the primary reasons why family businesses fail to survive from one generation to the next. The sample comprised family businesses listed on the Indonesia Stock Exchange from 2018 to 2022, comprising 119 companies and totaling 595 observations. The collected data were analyzed using binary logistic regression (logit). The study results indicate that family ownership, dual family involvement, and family openness can harm the sustainability of family businesses. However, family businesses will be more likely to survive if family members are represented on the Board of Commissioners and as Board Directors. This explains that the increasing concentration of families in the company will threaten the sustainability of family businesses. Moreover, the practical implications of this study are that family business managers must organize and develop strategies to maintain family involvement and control, while also reducing family domination within the company in order to sustain the long run and across generations.

Keywords: sustainability of family businesses; family ownership; family involvement; family openness.

INTRODUCTION

Hadi Cahyadi's book *Go Perpetuate: How to Beat the Third Generation Curse* (Cahyadi, 2023) claims that just 30% of Indonesian family firms can pass on their operations to the second generation, 13% to the third, and 3% to the third and beyond. This suggests that family businesses tend to decline in performance over time. It can be driven by the separation between ownership, management, and family identity (Family Firm Institute, 2018), which weakens governance, commitment, and strategic coherence in family firms. In Indonesia, if a company has at least 20% family ownership, it is considered a family business (PSAK 15, 2013), but Poza (2014) characterizes a family business as a special combination of the following: (1) at least 15% of the company is controlled by two or more family members or a family partnership; (2) Family members who serve on the executive board, advisory board, or as shareholders have a strategic impact on the company's management; (3) family members prioritize relationships; and (4) family members expect to keep the company going for generations. To maintain control of the business, family members typically have specific

management roles. Family firms typically concentrate more on their aspirations of transferring management and leadership to the following generation. La Porta et al. (1999) and Anderson and Reeb (2003) define a family firm as any company run by a founder, a member of the founding family, or a founding individual who either owns a share of the company or serves on the board.

One feature that distinguishes family businesses from other kinds of firms is transgenerational continuity. The goal of the intergenerational transfer procedure, known as transgenerational, is to guarantee the survival and continuation of family identity within the organization, including the family name. If a family firm can transfer ownership to the following generation, it is said to have survived. According to Jamil et al. (2025), sustainability is the capacity to maintain or improve the state and availability of desired resources or circumstances over a long period of time. Numerous elements that affect family sustainability have been documented in the literature, including long-term orientation, relationships with stakeholders, family involvement, and the size of family businesses (Ropega, 2016; Broccardo et al., 2019). Family businesses are compelled by long-term orientation to take into account both financial and non-financial variables, such as family identity, the ability to employ family influence, the company's longevity within the family dynasty, or socio-emotional wealth (Gómez-Mejía et al., 2007). One important aspect of family businesses is the interaction between the company and the family, which is included in the idea of socio-emotional wealth (SEW). It clarifies their strategic decision-making priorities through business openness, family ownership, and family involvement. Moreover, Pradeliana & Margaretha (2024) emphasize that effective succession planning is essential for the success of family-owned businesses. Therefore, the ability of the company to pass it on to the next generation and preserve the family identity within the company can be used to determine the sustainability of family businesses. Unfortunately, Waqar et al. (2020) and Ferreira et al. (2021) found that only 50% of the sustainability rate of family businesses exceeds five years.

Research on family-run enterprises, including Muttakin et al. (2014), Bensaadi (2023), and Gavana et al. (2023), generally employs agency theory and stewardship theory as approaches to analyze family business issues. The foundation of agency theory is the possibility that family management may act opportunistically to further their own interests at the detriment of the business. However, if the manager is pro-organization, as is usually the case in a family business, they will participate in developing the company. Since family businesses concern navigating their strategic decisions (Roida, 2020), SEW has a central theoretical framework to maintain its survival. The agency and stewardship approaches focus more on the potential for conflict within family businesses that could threaten business sustainability, while SEW emphasizes the long-term, non-economic goals of maintaining a family business. Empirically, there has been limited research into the SEW aspects and the sustainability of family businesses. Therefore, this study is crucial in interpreting the SEW dimensions (Berrone et al., 2012), such as family ownership, family involvement, and family openness, in maintaining a balanced role within the business. The SEW perspective would possibly alter predictions made about the family business's sustainability. In order to manage ownership and managerial engagement and increase the degree of sustainability of family enterprises, practical and policy consequences are proposed. Thus, there is a theoretical inconsistency of the previous empirical studies that this research can fill and set the prospects for a fruitful understanding of the conditions that lead to the maintenance of family business sustainability.

Family involvement can be seen from the family ownership concentration in a company. Family ownership refers to the percentage of shares held by family members in a company (La Porta et al., 1999). To be categorized as a family business, a firm must have at least 20% family ownership in Indonesia (PSAK 15, 2013). The highly concentrated ownership structure can result in a lack of separation within the family between family ownership and company management. This can happen because the family, as the owner, manages and runs the company. This implies that the family that runs and controls the business will determine its future. In order to strengthen the alignment of interests inside the company, family-owned businesses frequently employ family members as both owners and managers (Anderson & Reeb, 2003).

The non-financial purpose of socio-emotional wealth highlights the endowment effect associated with family ownership. When someone asks for more in exchange for something than they are willing to pay for it, it's known as the endowment effect (Thaler, 1980). However, in reality, managers can act opportunistically and make choices that, because of divergent preferences, are not in the best interests of the business owner (Jensen & Meckling, 1976). Owners who own and control the company will value their business more highly than their ownership stake. However, the endowment effect can seriously affect minority shareholders (Roida, 2020). As a result, power and information disparities between managers who are family members and minority shareholders can result in agency issues in family businesses. The long-term viability of the business is therefore adversely affected by family ownership.

However, from the perspective of stewardship theory, family members tend to have a greater emotional commitment and responsibility to maintain the company's sustainability (Donaldson & Davis, 1991). The SEW approach suggests that the family, as the owner, will make decisions that support the company's sustainability, even though it may not always be financially profitable. Thus, based on the stewardship perspective, there is no need to monitor managers, unlike the agency approach. This is in line with Williams et al. (2013), Muttakin et al. (2014), Zraig et al. (2018), and Razzak et al. (2019), who stated that family ownership can improve company performance in the long term and achieve transgenerational sustainability. The following interpretation of the hypothesis can be made in light of the aforementioned arguments:

H1: The likelihood of the family business surviving is increased when ownership is concentrated in the hands of family members.

Family engagement shows how family members with roles within the company make corporate decisions, which can affect the operations and long-term viability of the family business. Family participation is measured by the number of family members holding high leadership positions inside the company, such as the CEO (the board of directors) and the board of commissioners. Because family firms are typically diverse, they can hire experienced managers or appoint individuals they trust to important positions like the board of commissioners. One dimension of SEW is maintaining control and influence over the company's operational activities. This aims to ensure that families maintain and uphold their identity in the company. Roida, (2020) asserts that family members' participation in corporate decision-making signifies a sustained dedication to maintaining the company's viability for future generations.

Following the stewardship theory, which posits that managers act in line with the company owner's goals, family involvement is expected to enhance the company's operational decision-making process in harmony. In addition, agency tensions can also be lessened by family participation in the business (Madyan et al., 2021). Supported by the SEW approach, which states that family involvement in the board can strengthen SEW values because they frequently give more thought to the family's and the business's reputation, as it will be passed on to the following generation. Therefore, family involvement in the company board can be one factor that supports and ensures the company's sustainability. This is in line with Williams et al. (2013), Ine et al. (2019), and Bensaadi (2023), who have stated that family involvement has a positive influence on a company's sustainability.

However, the stronger the involvement and influence of family members in the company, the lower the value and perception of the company by the public and investors. This is because the company is perceived as being too dominated by the family. According to Roida (2020), companies with too strong family dominance tend to be worse at overcoming agency problems. This statement is supported by Gavana et al. (2023) and Poutziouris et al. (2015), who found that excessive family involvement through roles in management and monitoring has been shown to have a negative association with company performance from a market perspective, which in turn threatens the company's sustainability. Board members who are family members frequently struggle to strike a balance between their personal and business interests. In view of the above-described arguments, the second hypothesis can be understood as follows:

H2a: Family businesses will be more likely to survive if family members are represented on the Board of Commissioners.

H2b: The likelihood of family-owned businesses rises when family members are represented on the board of directors.

H2c: A family-owned business's chances of surviving are diminished when a family member serves on both the Board of Directors and the Board of Commissioners.

Regarding the external environment of family businesses, corporate transparency and openness are crucial to enhance investor and public trust. With increasing investor and public trust in the company, its value will also rise. Due to the company's increasing worth, the market may become more optimistic about its performance and prospects (Rohaeni et al., 2018). The number of independent commissioners on the company's board is one indicator of corporate transparency. The corporation appoints independent commissioners to the board, who are not connected to or actively participating in the business. For firms listed on the Indonesia Stock Exchange (IDX), board independence typically comprises at least 30% of the total number of commissioners.

From the stewardship perspective, the non-financial goals can offer a longer-term perspective for internal directors than independent directors, which means that independent boards will share the same goals as the company's owners. SEW believes that the family as the company owner will make the best decisions for the company because they act as stewards, not agents. Independent boards are selected and appointed by the family to oversee the company, and they may not have sufficient competence. Thus, independent boards seem unnecessary in the company. This is consistent with the findings of Gavana et al. (2023), Leung et al. (2014), and Kweh et al. (2019), who claimed that although independent boards share the owners' objectives, they do not enhance corporate success. However, excessive family engagement may harm the company's value and reputation (Patrisia et al., 2019).

This is because the family is perceived as having too much influence over the company. Therefore, the company's independent board of commissioners is expected to reduce family dominance and indicate family openness. An independent board can ensure that decisions align with and support the company's values and long-term goals. Following the agency perspective, an independent board can help reduce the potential for conflicts of interest in the company. According to Hu et al. (2022), independent boards can enhance the company's sustainability. Independent boards can transfer skills to balance family members who lack strong skills but are compelled to serve as directors or commissioners, ultimately positively impacting the company's sustainability. The following hypothesis can be interpreted in light of the aforementioned arguments:

H3: Family openness, as measured by board independence, increases the propensity for sustainability of a family-owned firm.

METHODS

This study aims to investigate the effects of SEW factors on the long-term sustainability of family businesses, including family ownership, family involvement, and family openness. Panel data analysis is used. Gujarati & Porter (2013) claim that because panel data is company-related and gathered over time, it can overcome heterogeneity. The financial reports of companies that are listed on the Indonesia Stock Exchange (IDX) provided the study's data. The company's website, which may be accessible through annual reports, and the Indonesia Stock Exchange website serve as the data sources.

The dependent variable is the success of family businesses. Family ownership, family involvement in the board of directors, family involvement in the board of commissioners, family involvement in both the board of directors and the board of commissioners, as well as family openness, are the independent variables utilized. Several firm characteristics, such as growth opportunities, profitability, and firm size, are the control variables.

The ability of a business to transfer its legacy to the following generation through transgenerational continuity is known as firm sustainability, or denoted as SUST. Company sustainability is measured by the presence or absence of cross-generational practices in the company as a binary variable, where 1 (one) is used if it has exceeded the age of 20 years and has carried out transgenerational practices, and 0 (zero) if it has not exceeded the age of 20 years and has not carried out transgenerational practices. The age used for 1 (one) generation in this study is 20 years (Poutziouris et al., 2015). According to Parada et al. (2019), a family council may also be established 20–30 years after a corporation is established. This implies that the company has outlived its founders.

Family ownership (denoted as FO) is the proportion of a company's total shares that are owned by family members (La Porta et al., 1999). According to Anderson and Reeb (2003), family share ownership is determined by dividing the total number of shares held by family members by the total number of outstanding shares, which is at least 20%.

Taras et al. (2017) state that family engagement on the board of commissioners (denoted as BC) is quantified by the presence or absence of family in the post as a binary variable, where 1 (one) indicates the presence and 0 (zero) if there is not. The presence or absence of family members in the board of directors' position is a binary variable that measures involvement on the board of directors (denoted as BD), with 1 (one) representing the presence of family members and 0 (zero) representing their absence. The number of family members holding positions on the board of directors and commissioners (referred to as DUALITY) is a

measure of family participation, as a dummy variable, where 1 (one) represents the presence of family members and 0 (zero) if there is not.

Family openness (denoted as BI) refers to a company's ability to inform and disclose its activities and outcomes to outside parties, such as investors and the general public. According to Lestari and Harindayani (2017), corporate transparency is measured using the percentage of independent commissioners over the entire board.

Firm size (denoted as SIZE) is a measurement scale that characterizes the operational activities of businesses and classifies them according to their size (big or small). The size of the corporation is calculated using the natural logarithm of its total assets (Setia-Atmaja et al., 2009). Profitability, denoted as PROFIT, is the capacity of a business to generate profit using its capital. Profitability is measured using the Return on Assets (ROA) ratio, which is calculated by dividing net profit by total assets. Growth potential, denoted as GROWTH, is the capacity of a business to increase its size and make profitable investments (Muttakin et al., 2014). Growth opportunity is calculated by dividing the market value of stock by its book value, according to research by Roida, (2020).

The study's population consists of all family firms that are listed on the Indonesia Stock Exchange (IDX) and have observation years between 2018 and 2022. Family businesses that meet certain requirements and are registered on the IDX make up the sample. Purposive sampling is the method used for sampling. This technique chooses samples according to specific standards, which are at least 20% owned by the company (PSAK 15, 2013) and/or took an active role in strategic decision-making via executive or board roles. These standards align with previous literature on family businesses (Anderson & Reeb, 2003). The sample was chosen through purposive sampling to ensure that only companies meeting the family ownership criteria and having comprehensive financial and governance data throughout the observation period were included. Although this method enhances data uniformity, it could introduce selection bias by omitting companies with partial disclosures or varying ownership structures. Thus, the results need to be understood in relation to the chosen sample, and care should be taken when extending the findings. Table 1 provides specifics about the sample selection procedure and the final sample size.

Table 1. Number of Observations

	Number
Population	
Family Firms listed on IDX during 2018-2022	226
Does not meet criteria	
During the observation years, family businesses that lacked a comprehensive annual report	(107)
Final sample size	119
Final data observations (5 years)	595

Source: Authors, 2026

The logistic regression (logit) method is used in a panel data analysis. The value of one element will be predicted using this connection based on the value of the other factor. Given that the dependent variable is binary, logistic regression serves as a suitable estimation technique. Despite the dataset containing repeated firm-year observations, pooled logistic regression is utilized, as the focus of the study is to determine the average relationship between governance variables and the probability of the outcome across different firms. A logistic estimator was examined; however, the restricted within-firm variation in numerous explanatory variables would significantly decrease the effective sample by omitting firms

lacking variation in the dependent variable. Robust standard errors clustered at the firm level are utilized to address potential dependence within firms. The panel data regression equation utilized in this study is as follows:

$$\text{SUST} = \alpha + \beta_1\text{FO} + \beta_2\text{BC} + \beta_3\text{BD} + \beta_4\text{DUALITY} + \beta_5\text{BI} + \beta_6\text{SIZE} + \beta_7\text{PROFIT} + \beta_8\text{GROWTH} + \varepsilon \dots \dots \dots (1)$$

In this study, classical assumption tests, including multicollinearity, will be conducted. Binary logistic regression testing will include the Hosmer-Lemeshow goodness-of-fit test and model accuracy. In addition, hypothesis testing will encompass pseudo-R-squared, simultaneous R-squared, and partial R-squared. Finally, the marginal effect test will be performed to evaluate the alteration in probability caused by a one-unit increment in the predictor variable.

RESULT AND DISCUSSION

The descriptive statistics are presented in Table 2. It shows that the average Indonesian family business has an 82.35% survival rate. This implies that Indonesian family enterprises are typically strong and capable of transferring ownership to the following generation. The average number of shares owned by the family in the research sample was 64.97%. Ownership above 50% can be interpreted as controlling the company. This implies that family members have a strong desire to keep control of the business within the family. This is consistent with Indonesian businesses' propensity to endure, implement transgenerational succession, and uphold family control within the organization, as recommended by the SEW approach.

Table 2. Descriptive Statistics for Variable Measures

Variable	Mean	Median	Max	Min	SD	N
Dependent Variable						
Firm Sustainability (SUST)	0.8235	1.0000	1.0000	0.0000	0.3815	595
Independent Variables						
Family Ownership (FO)	0.6497	0.6638	1.0000	0.0582	0.1852	595
Family on the Board of Commissioners (BC)	0.8437	1.0000	1.0000	0.0000	0.3634	595
Family on the Board of Directors (BD)	0.7899	1.0000	1.0000	0.0000	0.4077	595
Duality (DUALITY)	0.6840	1.0000	1.0000	0.0000	0.4653	595
Family Openness (BI)	0.4125	0.4000	0.7500	0.0000	0.1209	595
Control Variables						
Firm Size (SIZE)	28.7723	28.6824	34.8124	0.0042	2.2062	595
Profitability (PROFIT)	0.0327	0.0280	0.8564	-1.1222	0.1220	595
Growth Opportunity (GROWTH)	2.1138	1.1298	38.8821	-7.6027	3.3840	595

Source: Data processed using EViews, 2026

The research sample indicated that, on average, 84.37% of the board of commissioners and 78.99% of the board of directors were family members. Additionally, 68.4% of individuals were involved in both boards. These figures indicate a considerable degree of family participation in the companies, with family members frequently serving on the boards. It is also implied that family members occupy over half of the management positions within these family-owned businesses.

According to the percentage of independent commissioners in the board structure, the average number of board members in the research sample was 41.25% in terms of family openness. The Financial Services Authority Regulation (POJK) Number 57/POJK.04/2017, which mandates a minimum percentage of independent commissioners of 30% of the total number of board members, has thus been complied with by Indonesian family-owned firms.

The multicollinearity test is used to ensure that there is no correlation between the independent variables used. More precisely, since the correlations between independent variables are less than 0.80, it may be concluded that multicollinearity does not exist. Family ownership (FO) and business sustainability (SUST) are negatively correlated. Furthermore, the relationships between family involvement, both in management and control, show a positive correlation. Interestingly, board independence (BI) shows a negative association with sustainability. The highest correlation occurs between family representation in the board of directors (BD) and DUALITY variables, at 0.7588, while the lowest correlation is found between the DUALITY and SIZE variables, at -0.2033. In general, the matrix correlations indicate that there are no multicollinearity issues with our model or estimations. The multicollinearity test results are displayed in Table 3 as follows.

Table 3. Correlation Coefficients between Variables

	SUST	FO	BC	BD	DUAL	BI	SIZE	PROFIT	GRO
SUST	1.0000								
FO	-0.1169	1.0000							
BC	0.2257	-0.0620	1.0000						
BD	0.0318	0.0783	0.1189	1.0000					
DUALITY	0.1121	0.0272	0.6333	0.7588	1.0000				
BI	-0.1393	-0.0288	-0.1791	0.0573	-0.0930	1.0000			
SIZE	0.0462	-0.1121	-0.0880	-0.1423	-0.2033	0.1567	1.0000		
PROFIT	0.0672	0.1581	0.0618	0.0010	0.0076	0.0494	0.1405	1.0000	
GROWTH	0.0282	0.0951	-0.0433	-0.1304	-0.0318	-0.0952	-0.0566	0.1202	1.0000

Source: Data processed using EViews, 2026

Finding out if the model is appropriate for use in this investigation is the goal of the model fit test. The Hosmer-Lemeshow Goodness of Fit Test can be used to ascertain it. The regression model is fit, according to the Hosmer test findings, which show a probability value over 0.05 (0.6781). The Hosmer test results are shown in Table 4 as follows. The coefficient of determination test is then used to determine how much variation in the independent variable may account for variance in the dependent variable. The McFadden R-squared value in the logistic regression test results can be used to determine this test. The McFadden R-squared score is 0.0936 based on the findings of the logistic regression test's coefficient of determination test. According to Table 5, family business sustainability may be explained by differences in the variables of board independence, duality, family ownership, and family involvement in management and control by 9.36%.

Table 4. Hosmer- Lemeshow Test

H-L Statistic	29.9972	Prob. Chi-Sq(8)	0.6781
Andrews Statistic	38.9040	Prob. Chi-Sq(10)	0.5897

Source: Data processed using EViews, 2026

Table 5. Coefficient Determination Test

McFadden R-squared	0.0936
S.D. dependent var	0.3815
Akaike info criterion	0.8750
Schwarz criterion	0.9414
Hannan-Quinn criterion	0.9009
Restr. Deviance	554.5391
Likelihood Ratio (LR) statistic	51.8981
Prob (LR statistic)	0.0000

Source: Data processed using EViews, 2026

Finally, the classification matrix is used to determine the estimated percentage of correct and incorrect cases for the dependent variable (the model accuracy test). It can also be used to indicate the percentage match rate between correctly classified cases and incorrectly classified cases. The higher the model match rate, the better the prediction accuracy of the regression model. Table 6 presents the results, showing that the percentage of model accuracy that can be predicted accurately is 73.92%.

To test the hypotheses, finding out how every independent variable concurrently affects the dependent variable is the goal of the simultaneous influence test. This test can be determined through the probability Likelihood Ratio Statistic value (LR statistic) from the logistic regression test results. If the LR statistic value is below 0.05, then all independent variables simultaneously significantly influence family business sustainability. Table 5 shows that the p-value (LR statistic) is below 0.05 (0.000). indicating that the likelihood of family company longevity is influenced concurrently by family ownership, family participation in management and control, duality, and board independence.

Table 6. The Expectation Prediction (Accuracy of Model) Test

	Estimated Equation		
	Dep=0	Dep=1	Total
E(# of Dep=0)	27.41	77.59	105.00
E(# of Dep=1)	77.59	412.41	490.00
Total	105.00	490.00	595.00
Correct	27.41	412.41	439.82
% Correct	26.10	84.17	73.92
% Incorrect	73.90	15.83	26.08
Total Gain*	8.46	1.81	2.99
Percent Gain**	10.27	10.27	10.27

Source: Data processed using EViews, 2026

Next, the potential influence of family ownership, family involvement, and family openness on the tendency toward family business sustainability is presented in Table 7. The coefficient results show that the sustainability of family enterprises in Indonesia is statistically significantly impacted by family ownership, involvement, and company openness. The magnitude of family representation on the board of commissioners on family business survival are approximately three times in magnitude. While the magnitudes of family ownership, family in board of directors, duality, and board independence are approximately similar, at

about two times in magnitude, respectively. Meanwhile, the three control variables used, namely, company size, profitability, and growth opportunity do not have a statistically significant effect on the sustainability of family businesses.

Family ownership has a significantly negative impact on the probability to survive. It indicates that being too concentrated in the family reduces the tendency of family business sustainability, and thus, hypothesis 1 is not supported. The high concentration of ownership indicates strong incentives to seize wealth from minority shareholders as well as individual advantages of control. Consequently, the tendency of family company sustainability in Indonesia decreases with increasing family ownership. These results suggest that family ownership can threaten company sustainability.

Family involvement on the board of commissioners to control the company or the board of directors to lead the company may increase the sustainability of family businesses. Consistent with prior studies, (Williams et al., 2013; Ine et al., 2019; Bensaadi, 2023), family involvement in management can increase the sustainability of the company due to the alignment of goals in running the business. Therefore, hypotheses 2a and 2b are supported. However, family involvement, if it is too prominent in the company, by placing family members who may not have managerial abilities on the board of commissioners and directors, reduces the tendency to sustain family businesses. This is supported by the results of family ownership tests, which indicate that the more concentrated the company is within the family, the greater the threat it poses to the company's sustainability. This finding supports research by Gavana et al. (2023), which states that having more families in company management will threaten sustainability and reduce company performance. Therefore, hypothesis 2c is supported.

Table 7. Logit Regression Results on Family Firms' Sustainability

Variable	Logistic Regression	
Family Ownership	-1.9929***	(-2.9269)
Board Commissioners	2.1113***	(3.9797)
Board of Directors	1.1881**	(2.3205)
Duality	-1.3802**	(2.3205)
Board Independence	-2.9219***	(-2.9784)
Size	0.0663	(1.3731)
Profit	1.3584	(1.4375)
Growth	0.0464	(1.1904)
Intercept	0.3838	(0.2479)
McFadden R-square	0.0936	
Prob > LR stat	51.8981***	
Number of observations	595	

Source: Data processed using EViews, 2026

Significant at * $p < 0.10$, ** $p < 0.05$, and *** $p < 0.01$, according to the legend. Parentheses are used to display t-statistics.

The performance and sustainability of the business are not enhanced by the existence of board independence as a gauge of family business openness. This can happen because, in a family business, the independent board of commissioners is usually the most trusted member of the family and is frequently appointed by the family itself; however, they may not possess the necessary competence to supervise the company effectively. The family business may appoint this independent board of commissioners solely to comply with OJK regulations. This finding is consistent with prior studies, (Gavana et al., 2023; Leung et al., 2014; Kweh et al.,

2019), that independent boards have similar objectives to the family; they do not improve the viability of family firms. Thus, the presence of an independent board in the company does not impact the sustainability tendency of family businesses; therefore, hypothesis 3 is not supported.

In addition, the company's sustainability tendency is not significantly impacted by the control variables, growth opportunity, profitability, and company size. This implies that corporate sustainability is not determined by firm attributes like size, profitability, and company growth. This is consistent with the SEW approach, which emphasizes non-economic goal orientation as a crucial aspect of family companies.

Lastly, we examine the marginal effect, which indicates the change in probability resulting from a one-unit increase in the predictor or independent variable, as shown in Table 8. The coefficient of -0.2584 means that family firms with larger ownership have a 25.84 percent lower probability of survival, as overly concentrated ownership may disrupt voting rights in decision-making for company development. However, if family involvement on the board of commissioners increases by 1%, then the probability of family firms surviving is 19.26% higher. Additionally, since the family still makes all of the decisions, having family members on the board of directors raises the likelihood that family businesses will survive by more than 100%. On the contrary, excessive involvement of the family in the roles of the board of commissioners and the board of directors (duality) increases the probability that the company will not survive by more than 100%. This implies that agency disputes between family and non-family shareholders may result from decision-making that is family-centric.

Meanwhile, in terms of openness, a 1% increase in the proportion of board independence will reduce the probability of the company surviving by 37%. This implies that the high percentage of board independence reduces family influence and authority within the company, even if family businesses must be more receptive to the participation of non-family board members. All the results confirm the significant influence of family ownership, family involvement, and family openness of the family firm in Indonesia.

Table 8. The Marginal Effect

Variables	dy/dx	Std.Error	z	P> z	95%	
					Confidence Level	
Family Ownership	-0.2584	0.0861	(-3.00)	0.003	-0.4272	-0.0897
Board Commissioners	0.1926	0.1185	(3.40)	0.001	0.1705	0.6349
Board of Directors	1.0437	0.0991	(1.94)	0.052	0-.0016	0.3868
Duality	-1.1528	0.0608	(-2.51)	0.012	-0.2720	-0.0337
Board Independence	-0.3790	0.1252	(-3.03)	0.002	-0.6243	-0.1337
Size	0.0086	0.0062	(1.38)	0.168	-0.0036	0.0208
Profit	0.1761	0.1220	(1.44)	0.149	-0.0629	0.4152
Growth	0.0086	0.0050	(1.38)	0.233	-0.0039	0.0159

y = Pr(SUST) (predict) = 0.8469

Source: Data processed using EViews, 2026

Robustness and Specification Checks. In this section, we estimate the robustness and specification tests to confirm that biases do not affect our results. First, we perform the regressions using various proxies for the board of directors and independent board variables to see if the previous results are responsive to alternative measurements. These variables are calculated using the percentage of board directors from families (Roida, 2020) and the ratio of independent board members to the family members on the board. Table 8 shows that, except

for the beneficial effects of family participation, the results are comparable to those reported, and serving as board commissioners (board independence) on a firm's sustainability becomes insignificant using this measurement.

Second, we employ the firm's age as a dependent variable in measuring family business survival using the instrumental variable approach, considering that performance in surviving is likely to change over the firm's lifecycle. The average age of companies in Indonesia indicates that they are in the maturity category, necessitating continuous innovation to survive in the business environment and compete with new companies that can innovate. The firms' age is only partially a guarantee of their survival. Firms get more extensive and complicated as they mature, implying that agency issues could increase. As a result, firm performance may decrease, and the rate of survival will decrease, as well. The findings align with previous analyses.

Table 9. The Estimation Methodology I

Variable	(1)		(2)	
Family Ownership	-0.0002***	(-2.3526)	-0.0002***	(-2.8272)
Board Commissioners	3.0686***	(5.1096)	1.3739***	(3.0259)
Board of Directors	1.0437**	(2.1021)		
%Board of Directors			1.43E-05	(0.2567)
Duality	-1.1466**	(-1.8279)	-0.2485	(-0.5849)
Board Independence			-0.0003***	(-2.7377)
Board Indep/Fam on Board	-8.57E-05***	(-3.5461)		
Size	2.14E-06	(0.3887)	7.41E-06	(1.5495)
Profit	0.0001	(1.2825)	0.0002*	(1.2825)
Growth	7.03E-06	(1.6211)	2.19E-06	(0.6193)
Intercept	0.0989	(0.0574)	0.7798	(0.5075)
McFadden R-square	0.0998		0.0838	
Prob > LR stat	55.3198***		46.4799***	
Number of observations	595		595	

Source: Data processed using EViews, 2026

Significant at * $p < 0.10$, ** $p < 0.05$, and *** $p < 0.01$, according to the legend. Parentheses are used to display t-statistics.

Finally, we consider the possible impact of family ownership concentration on a firm's age since family ownership handles the implications of various family holding levels (Setia-Atmaja et al., 2009), including the propensity for survival. As the previous result shows that family ownership harms business sustainability, the proportion of family ownership, the percentage of family ownership squared (designated as *ownership*²), and the percentage of family ownership cubed (designated as *ownership*³) are all recalculated. The correlations between a company's survival and the degree of family ownership concentration are shown in Table 9. As can be seen, if the ownership concentration is less than the tipping point of 0.2459 (approximately 24%), the chances of survival are reduced. After that, the probability of survival will increase if the ownership levels are between 0.2459 and 0.6358. However, if the ownership level reaches 0.6358 or higher, the change required to survive will decrease accordingly. These results are consistent with the fact that the mean of family ownership in Indonesia is about 0.6497. This suggests that the dispersion of ownership may result in a non-linear relationship between survivability and its dispersion. Family ownership concentration may affect the ability to survive if it is not too concentrated (approximately more than 63%)

or too dispersed (approximately less than 24%), which falls within the optimal range of 24% to 63%. The results are similar to those reported in the earlier analyses.

Table 10. The Estimation Methodology II

Variable	OLS (Age)	
Family Ownership	-89.9945*	(-1.86)
Family Ownership ²	182.9915**	(2.01)
Family Ownership ³	-95.9411*	(-1.80)
Board Commissioners	8.1193***	(2.82)
Board of Directors	13.0556***	(4.23)
Duality	-10.5469***	(-3.05)
BI	-11.0524**	(-2.36)
Size	1.5319***	(5.87)
Profit	3.5029	(0.75)
Growth	-0.5880***	(-3.43)
Intercept	-16.8914	(-1.44)
Adjusted R-square	0.1769	
Prob > F stat	13.75***	
Number of observations	595	

Source: Data processed using EViews, 2026

Significant at * $p < 0.10$, ** $p < 0.05$, and *** $p < 0.01$, according to the legend. Parentheses are used to display t-statistics.

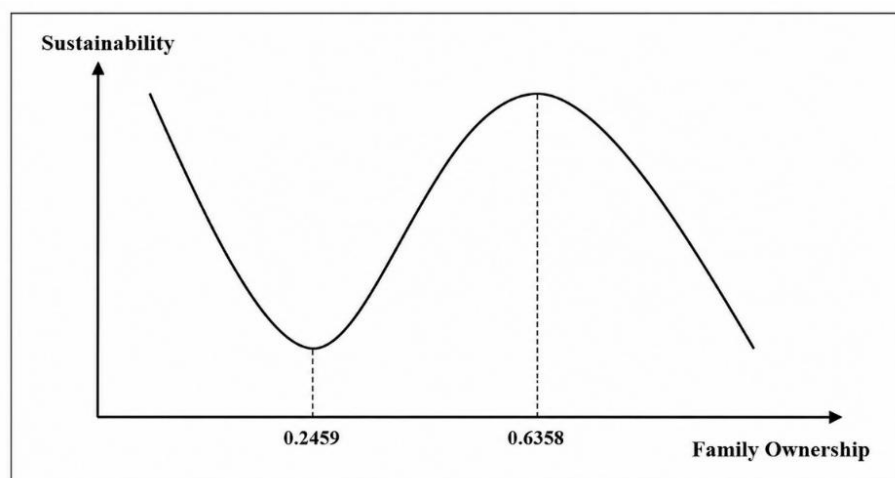


Figure 1. The Nonlinearity of the Ownership and Sustainability Relationship

Source: Data processed using EViews, 2026

CONCLUSIONS

Based on the SEW aspects, this study investigates the effects of family ownership, family involvement, and family openness on the sustainability of family-owned firms in the Indonesian capital market context, which is marked by substantial private advantages of control. According to the study's findings, family firms are more likely to maintain their long-term orientation goals and pass the business down through the generations if they have non-economic aims. By taking into account the distinctive features of family businesses that set

them apart from non-family businesses, SEW seems to broaden the application of agency and stewardship theory. SEW can determine the connection between the inclination toward family ownership, involvement, and openness and the tendency toward sustainability. Family ownership contributes significantly to the viability of family businesses as long as families retain control over the enterprise. The degree of ownership concentration appears to have distinct effects on the sustainability of businesses. Family representation on the board of directors (management) or commissioners (controller) greatly increases the likelihood of family company sustainability, while duality involvement has a severe negative effect. In Indonesia, family openness through the existence of an independent board of commissioners has a significant negative impact on the propensity of family business sustainability, as well. This study demonstrates that the more concentrated a company is on the family, the greater the threat it poses to the sustainability of the family business. The higher the family ownership and the more families are in company management positions, the easier it is for the family to act opportunistically and prioritize family interests over business interests. The results of this study indicate the existence of an agency dimension that occurs when the family is too dominant in family ownership and involvement (duality). However, the stewardship dimension also appears to be a pro-organization family, as evidenced by family involvement in managerial (families on the board) and monitoring roles (families on the board commissioner). Since the independent board is suspected of being affiliated with the executive director, it is not truly independent (Nguyen et al., 2021; Ogabo et al., 2021). As a result, the outcomes are often contrasted with those of the previous investigation. These results can be an indication of how important families are to the company. Increased family control over the company could indicate a possibility of disputes between families, management, institutional investors, and minority shareholders, which could jeopardize the company's viability.

This study contributes to the literature, especially to strengthen the position of the SEW approach by emphasizing the sustainability of business through a multidimensional view of SEW. As researchers, business survivability is a process of intergenerational transfer that aims to maintain family identity within the organization. Therefore, it is transferable to the following generation. The interaction between the business and the family is included in the notion of socio-emotional wealth. By analyzing strategic decision-making through family ownership, family involvement (as managers and controllers), and business openness (through board independence), especially in the context of maintaining the socio-emotional wealth of families, our findings shed light on this topic.

This research has various theoretical and practical ramifications. For investors, the findings suggest that family involvement can bring negative incentives if it is too centralized, potentially leading to families expropriating the wealth of minority shareholders. For family business management, the results suggest that family firms should consider certain aspects, as long-term-oriented investors perceive them as more attractive in maintaining business for the long run. For policymakers, the findings that certain factors significantly influence a family firm's propensity to survive could serve to justify specific actions, particularly encouraging greater family openness and reducing family centralization in decision-making.

We acknowledge that this study has certain limitations and areas for improvement. Although we utilize pooled data, we must examine how governance mechanisms evolve. The cross-generational issue is a significant concern in family businesses, and therefore, it is sensitive to how families perceive it. Future research can investigate how family businesses define their ability to survive, which impacts not only the companies themselves but also the sustainability of the family. Next, although we have successfully integrated family ownership,

family involvement, and family openness to assess firm sustainability, future research can examine and contrast the cross-national and cultural aspects to provide additional viewpoints.

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EMOTIONAL LABOR AS MEDIATOR AND SELF-EFFICACY AS MODERATOR IN WORK-RELATED BURNOUT AMONG HEADS OF STUDY PROGRAMS

Hamam Zaki¹⁾, Rahayu Setianingsih²⁾, Sri Rahmayanti³⁾

^{1,2,3} Universitas Muhammadiyah Riau, Pekanbaru, Indonesia

Email: hammamzaki@umri.ac.id



SINTA 2

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ABSTRACT

Work-related burnout among Heads of Study Programs is an increasing concern due to growing academic, administrative, and managerial responsibilities in higher education. Although burnout has been widely examined among lecturers and other professionals, evidence focusing on Heads of Study Programs remains limited, particularly regarding the mediating role of emotional labor and the moderating role of self-efficacy. This study examines the effects of job demands and emotional intelligence on work-related burnout, with emotional labor as a mediator and self-efficacy as a moderator. Data were collected from 249 Heads of Study Programs at Muhammadiyah universities in Indonesia established less than ten years ago and analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS 4.0. The findings show that job demands increase work-related burnout, while emotional intelligence influences emotional labor. Emotional labor increases burnout and mediates the relationship between emotional intelligence and burnout. However, self-efficacy does not moderate the relationship between job demands and burnout. These findings extend the Job Demands-Resources (JD-R) perspective by identifying emotional labor as an important psychological mechanism and highlighting the need for organizational support to reduce burnout and promote sustainable academic leadership.

Keywords: job demands; self-efficacy; emotional intelligence; emotional labor; work-related burnout.

INTRODUCTION

Work-related burnout has emerged as a significant occupational health challenge affecting employees and organizational leaders across various sectors, including higher education. Increasing organizational complexity, rapid digital transformation, and expanding administrative responsibilities have intensified the psychological demands placed on individuals in the workplace. The Gallup State of the Global Workplace 2026 report indicates that global manager engagement declined from 31% in 2022 to 22% in 2025, highlighting growing concerns about the well-being and sustainability of individuals occupying managerial roles. Given their responsibility for simultaneously managing organizational performance, employee expectations, and increasingly complex workplace demands, managers represent an important occupational group in understanding vulnerability to work-related burnout.

Similar challenges have become increasingly evident in the higher education sector. Recent studies suggest that excessive administrative responsibilities, escalating workloads, and inadequate institutional support are among the key factors contributing to burnout among

university academics. These pressures are particularly concerning because academic work increasingly involves responsibilities that extend beyond traditional teaching and research functions to include administrative duties, quality assurance, accreditation requirements, and institutional performance expectations (Koster & McHenry, 2023). Consequently, burnout in higher education should no longer be viewed solely as an individual psychological problem but as a broader organizational challenge with potential implications for leadership effectiveness, employee well-being, educational quality, and institutional performance.

In Indonesia, Heads of Study Programs hold strategic positions because they are responsible for ensuring curriculum quality, achieving accreditation standards, overseeing lecturer performance, providing student services, and maintaining institutional governance. Unlike managerial positions in many corporate organizations, they simultaneously serve as academic leaders, administrative managers, curriculum coordinators, quality assurance officers, human resource supervisors, and intermediaries between university management, lecturers, students, and external stakeholders. Balancing these multiple responsibilities requires continuous emotional regulation, effective leadership, and sustained professional commitment, while they often operate under conditions of limited organizational resources. These challenges are expected to be even greater in relatively young universities, where governance systems, organizational resources, and quality assurance mechanisms are still developing (Bowo & Hendro, 2023; Kurniadewi et al., 2022). According to the Job Demands–Resources (JD-R) Theory, prolonged exposure to excessive job demands without sufficient organizational and personal resources gradually depletes employees' psychological energy. It ultimately leads to work-related burnout (Bakker & Demerouti, 2017). Therefore, work-related burnout among Heads of Study Programs should be viewed not only as an individual psychological problem but also as an organizational issue that may undermine leadership effectiveness, lecturer performance, educational quality, and institutional sustainability.

Several studies have examined burnout in higher education settings, particularly among students and academic staff (A'yunin et al., 2023; Burns et al., 2021). Burnout among managers has also been investigated across various corporate settings and among healthcare professionals (Membrive-Jiménez et al., 2020). Although the existing literature has extensively examined burnout across a wide range of professions, research specifically addressing burnout among Heads of Study Programs remains notably limited. Heads of Study Programs are required to balance academic autonomy with organizational accountability, which may intensify psychological strain and emotional exhaustion (Mandefro et al., 2025). Despite the complexity of these responsibilities, empirical studies specifically investigating burnout among Heads of Study Programs remain scarce, particularly in developing countries where institutional transformation and resource constraints are more pronounced (Ghamrawi et al., 2025; Islam et al., 2025). Recent studies have also predominantly examined work-related burnout among lecturers, teachers, healthcare professionals, and corporate employees, highlighting the adverse effects of excessive workloads, emotional demands, and organizational pressures on psychological well-being (Koster & McHenry, 2023). Therefore, understanding burnout within the context of leadership among Heads of Study Programs remains an important research priority.

Academic work is often characterized by substantial responsibilities and limited resources, conditions that may increase the risk of burnout. High job demands tend to increase stress and trigger emotional exhaustion, which is widely recognized as a core dimension of work-related burnout (Ekore et al., 2020). Supporting this view, Golu et al. (2022) reported that job demands are an important determinant of work-related burnout. A growing body of

research, conducted predominantly in Western countries, has further confirmed the positive relationship between job demands and work-related burnout (Fouquereau et al., 2019). Nevertheless, studies examining this relationship in non-Western contexts, such as Indonesia, remain limited, particularly those focusing on work-related burnout among Heads of Study Programs.

The responsibilities of Heads of Study Programs are closely associated with emotional labor, which may contribute to work-related burnout when not managed effectively. This argument is supported by evidence indicating that academic supervisors often experience difficulties in regulating their emotions, thereby increasing their vulnerability to work-related burnout. In emotionally demanding work environments, particularly in service-oriented professions, a high level of emotional intelligence is essential for managing emotional experiences appropriately (Ezekiel & Nanfa, 2023). This study examines the relationship between emotional labor and work-related burnout, as previous research has demonstrated that excessive emotional labor significantly increases employees' risk of experiencing work-related burnout. Employees who are consistently required to control, suppress, or modify their emotions in demanding work situations are more vulnerable to emotional exhaustion and psychological distress (Humphrey, 2023). Recent empirical studies have also consistently reported a positive relationship between emotional labor and work-related burnout across various professional settings, including academia (Davis & Stazyk, 2022). Individuals with high emotional intelligence are generally better able to regulate their emotions and transform them into constructive psychological responses, enabling them to adapt more effectively to complex social and occupational environments (Fteiha & Awwad, 2020).

In behavioral studies, mediating and moderating variables play important roles in explaining psychological processes, although each serves a distinct function (Igartua & Hayes, 2021). Previous empirical research on emotional labor has predominantly examined its relationship with organizational outcomes, particularly emotional exhaustion and work-related burnout (Ardanty et al., 2023). Nevertheless, relatively limited attention has been devoted to the role of emotional labor as a mediating variable. Choi et al. (2019), for instance, explored the relationship between emotional intelligence and work-related burnout by incorporating several mediating and moderating factors into their analysis. In the present study, emotional labor is proposed as a mediator that explains the underlying mechanism linking emotional intelligence to work-related burnout (Nurochim et al., 2022). Effective management of emotional labor may minimize adverse psychological consequences and reduce the likelihood of work-related burnout, whereas ineffective emotion regulation may exacerbate burnout symptoms (Nam & Kabutey, 2021; Wang et al., 2023).

Despite the growing body of literature on work-related burnout, several important research gaps remain. Recent studies have predominantly examined burnout among lecturers, teachers, healthcare professionals, and corporate employees, highlighting the adverse effects of excessive workloads, emotional demands, and organizational pressures on psychological well-being (Rinfret et al., 2025). However, empirical evidence specifically focusing on Heads of Study Programs remains limited, despite their strategic responsibilities for academic quality, accreditation, curriculum implementation, and institutional performance. Existing research has also largely examined the independent effects of job demands, emotional intelligence, or emotional labor on work-related burnout (Humphrey, 2023), while relatively limited attention has been devoted to examining emotional labor as the underlying psychological mechanism through which emotional intelligence influences work-related burnout, or self-efficacy as a moderating factor that may mitigate the adverse effects of job

demands. Furthermore, much of the existing empirical evidence originates from developed countries and well-established universities.

In contrast, studies conducted in private higher education institutions—particularly relatively young Muhammadiyah universities operating within evolving governance systems, limited organizational resources, and increasing institutional demands—remain scarce (Kurniadewi et al., 2022). Consequently, existing evidence has yet to provide a comprehensive explanation of how organizational demands, emotional processes, and personal resources interact to shape work-related burnout among Heads of Study Programs. To address these gaps, the present study develops an integrated conceptual model that simultaneously examines the relationships among job demands, emotional intelligence, emotional labor, self-efficacy, and work-related burnout, thereby providing new empirical evidence from an underexplored higher education context.

This study makes both theoretical and practical contributions. Theoretically, it extends the application of the JD-R framework to Heads of Study Programs and integrates emotional intelligence and emotional labor into the explanation of work-related burnout. The study also examines whether self-efficacy plays a moderating role in the relationship between job demands and work-related burnout. Practically, understanding these mechanisms may help higher education institutions shift from individually oriented burnout interventions toward strategies that simultaneously address workload, organizational support, leadership resources, and emotion regulation. This is particularly important because the well-being of Heads of Study Programs may influence leadership effectiveness, academic quality, decision-making, and the sustainability of study program management.

Academic work is characterized by considerable responsibilities and limited resources, conditions that may increase vulnerability to burnout. Higher education employees experience multiple demands, including workload, publication pressure, competing time demands, technology-mediated work, student support responsibilities, and insufficient structural resources (Naidoo-Chetty & Du Plessis, 2021). The Job Demands–Resources Theory explains that job demands requiring sustained physical, cognitive, or emotional effort consume employees' psychological resources and may initiate a health-impairment process that eventually results in exhaustion and burnout (Bakker et al., 2023).

Previous studies have similarly demonstrated that high job demands increase stress and emotional exhaustion (Golu et al., 2022). However, evidence concerning this relationship among academic leaders remains limited, particularly in non-Western higher education contexts. Because Heads of Study Programs simultaneously manage academic, administrative, managerial, and interpersonal responsibilities, sustained job demands may progressively exhaust the resources required to maintain effective functioning. Therefore:

H1: Job demands have a positive effect on work-related burnout among Heads of Study Programs.

The responsibilities of Heads of Study Programs also involve substantial interpersonal and emotional interactions. They are expected to communicate with lecturers and students, resolve conflicts, respond to institutional demands, and maintain professional emotional expressions under challenging circumstances. Emotional intelligence enables individuals to perceive, understand, and regulate emotions, facilitating more effective management of emotionally demanding situations (Fteiha & Awwad, 2020).

From an emotional regulation perspective, individuals with higher emotional intelligence are better able to recognize their own and others' emotions and adapt their emotional expressions to situational demands. This capability is particularly relevant to emotional labor, which requires individuals to regulate emotional expressions in accordance with organizational expectations. Thus, emotional intelligence provides the psychological capacity through which academic leaders manage the emotional requirements embedded in their leadership roles.

H2: Emotional intelligence has a positive effect on emotional labor among Heads of Study Programs.

Emotional labor represents the effort required to regulate, suppress, or modify emotional expressions in accordance with occupational expectations. Although such regulation is often necessary for effective interpersonal interaction, persistent emotional regulation can consume psychological resources, particularly when displayed emotions differ from those actually experienced. This discrepancy may generate emotional dissonance and psychological strain, thereby increasing vulnerability to burnout.

Recent studies continue to identify emotional labor as an important occupational demand associated with psychological exhaustion and burnout across professional settings (Davis & Stazyk, 2022; Humphrey, 2023). For Heads of Study Programs, the need to remain professional and emotionally composed when addressing conflicts, complaints, performance pressures, and competing stakeholder expectations may create sustained emotional demands. Therefore:

H3: Emotional labor has a positive effect on work-related burnout among Heads of Study Programs.

Although job demands are important predictors of burnout, their effects may vary depending on individuals' personal resources. The JD-R Theory proposes that personal resources can influence how employees respond to demanding work environments (Bakker et al., 2023). Among these resources, self-efficacy reflects an individual's belief in their ability to manage challenging situations and accomplish work-related goals.

Individuals with stronger self-efficacy may perceive demanding situations as more manageable and may demonstrate greater persistence when confronting occupational difficulties. Accordingly, self-efficacy may function as a psychological buffer that reduces the extent to which high job demands translate into burnout. This potential buffering mechanism is particularly relevant to Heads of Study Programs because they regularly face multiple and simultaneous organizational demands. Therefore:

H4: Self-efficacy moderates the relationship between job demands and work-related burnout.

In behavioral research, mediation explains the mechanism through which one variable influence another (Igartua & Hayes, 2021). Previous emotional labor research has predominantly examined its direct association with outcomes such as exhaustion and burnout (Ardanty et al., 2023). However, emotional labor may also represent an important psychological process through which emotional intelligence influences work-related burnout.

Individuals with stronger emotional intelligence are better able to recognize and regulate emotional experiences, which can shape how they perform emotional labor in demanding interpersonal situations. Adaptive management of emotional labor may reduce psychological strain, whereas ineffective emotional regulation may intensify emotional exhaustion and burnout (Wang et al., 2023). Therefore, rather than assuming that emotional intelligence influences burnout independently, this study proposes that its influence operates

partly through the way academic leaders regulate emotions in performing their roles.

H5: Emotional labor mediates the relationship between emotional intelligence and work-related burnout among Heads of Study Programs.

Based on the theoretical arguments and hypotheses developed above, this study proposes an integrated research framework incorporating job demands, emotional intelligence, emotional labor, self-efficacy, and work-related burnout. Emotional labor is positioned as a mediating mechanism, while self-efficacy is examined as a moderator of the relationship between job demands and work-related burnout. The proposed framework is presented in Figure 1

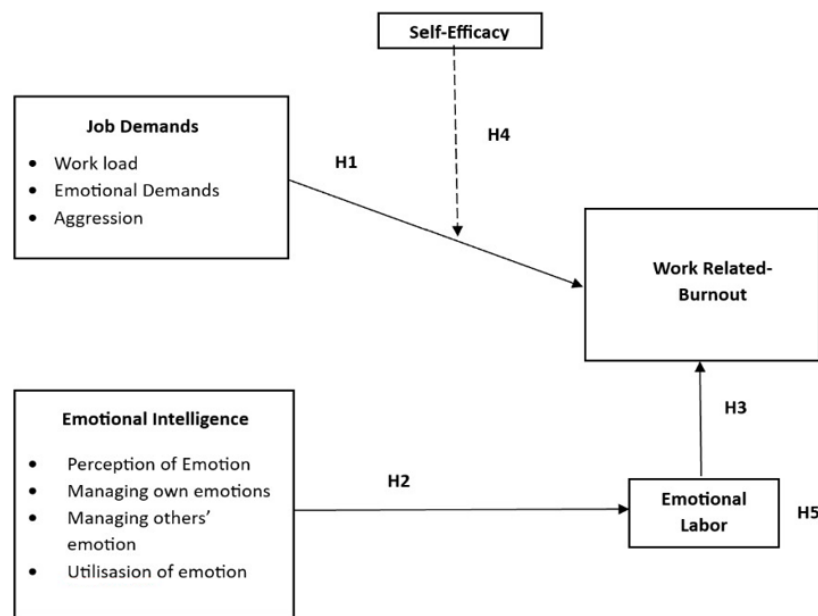


Figure 1. Research Framework

Source: Authors, 2026

METHODS

This study employs a quantitative approach to examine and describe the relationship between variables, identifying their cause-and-effect relationships. The population in this study consisted of all heads of study programs at D3, D4, Professional, Vocational, and S1 levels of Muhammadiyah Universities throughout Indonesia, comprising 22 universities with an institutional age of less than 10 years and a total population of 290 heads of study programs. This study employs a saturated or census sampling technique because it aims to make generalizations with minimal errors (Sugiyono, 2011). For this reason, the entire population was used as the sample in this study, comprising 290 heads of study programs.

This study employed a cross-sectional research design, as data collection was conducted at one specific point in time to investigate the relationships among the proposed variables. A quantitative approach was selected because the study sought to examine hypotheses and assess causal associations among latent variables through statistical procedures. Furthermore, the survey method allowed the researchers to gather standardized information from respondents representing various Muhammadiyah universities in Indonesia, thereby enhancing the consistency and comparability of the data obtained.

Job demands were measured using a 9-item instrument developed by Vander Elst et al. (2016). Emotional intelligence was evaluated through a 16-item instrument adapted from the Wong and Law Emotional Intelligence Scale (WLEIS), which has been extensively validated and utilized in recent organizational and educational research (Extremiera et al., 2018). Emotional labor was assessed using a 6-item scale introduced by Brotheridge and Lee and has been widely implemented in contemporary studies examining emotional labor within organizational and educational contexts (Jeung & Chang, 2021). Furthermore, self-efficacy was measured using an 8-item scale (Shoji et al., 2016), while work-related burnout was assessed through a 7-item instrument adapted from the Copenhagen Burnout Inventory (Salvagioni et al., 2017), which has frequently been applied in occupational burnout research.

All responses were recorded using a five-point Likert scale ranging from 1 (“strongly disagree”) to 5 (“strongly agree”). Approval to use the original measurement instruments was obtained from the respective developers. In addition, the finalized questionnaire was reviewed by three experts to ensure the clarity, relevance, and completeness of the survey items. Data collection in this cross-sectional study was conducted through an online questionnaire distributed directly via official university email addresses. The questionnaire consisted of 46 items in total, and the study successfully obtained 249 valid responses, yielding a response rate of 85.86%.

Before conducting the main data collection, a pilot study was carried out with a small group of respondents to evaluate the clarity, readability, and overall understanding of the questionnaire items. Several minor modifications were subsequently implemented to improve the wording and sentence structure while preserving the original intent of the measurement instruments. In addition, respondents were assured of the confidentiality and anonymity of their responses in order to reduce potential response bias and encourage more accurate and honest participation during the survey process.

To analyze the relationships among the constructs, this study utilized the Partial Least Squares Structural Equation Modeling (PLS-SEM) technique through SmartPLS 4. This analytical approach is considered suitable for modeling latent variables, particularly when dealing with relatively limited sample sizes and data that may not satisfy normal distribution assumptions (Hair Jr et al., 2023). The proposed research model consisted of multi-item constructs representing reflective measurement models rather than formative ones. The constructs demonstrated strong intercorrelations, adequate unidimensionality, and satisfactory internal consistency. Furthermore, the analysis followed a two-stage procedure, beginning with the evaluation of the measurement model and followed by the assessment of the structural model.

The evaluation of the measurement model involved examining internal consistency reliability, convergent validity, and discriminant validity. Reliability was considered satisfactory when the values of Cronbach’s Alpha (CA) and Composite Reliability (CR) exceeded the recommended threshold of 0.70. Convergent validity was established when the Average Variance Extracted (AVE) values were greater than 0.50, indicating that the constructs adequately explained the variance of their indicators. In addition, discriminant validity was assessed using the Heterotrait–Monotrait Ratio (HTMT) approach. Following the assessment of the measurement model, the structural model was analyzed by evaluating path coefficients, coefficients of determination (R^2), effect sizes (f^2), and predictive relevance. Bootstrapping analysis was also performed to examine the statistical significance of both direct and indirect relationships among the proposed constructs.

RESULT AND DISCUSSION

Of the total survey participants, 114 were male (46%), and 135 were female (54%), reflecting a slight dominance of female heads of the study program in Muhammadiyah universities. The most significant proportion of respondents was in the 31-40 age group ($n=139$; 56%), followed by those aged 25-30 years ($n=82$; 33%) and those aged 41-50 years ($n=28$; 11%). All program chairpersons had attained higher education qualifications, including master's degrees, PhDs, and professional certifications. Regarding work experience as program chairpersons, the majority of participants had been employed in this role at their current universities for a significant period, ensuring well-informed survey responses. A small number of program chairpersons had less than one year of experience, while 136 had served for 1 to 2 years. In addition, 113 program chairpersons had worked at the institution for 3 to 4 years.

The assessment of construct validity demonstrated that all measurement requirements were satisfactorily fulfilled. In this study, indicator loadings above 0.70 were regarded as acceptable for confirming the adequacy of the measurement model. The results indicated that all nine indicators of Job Demands, 16 indicators of Emotional Intelligence, six indicators of Emotional Labor, eight indicators of Self-Efficacy, and seven indicators of Work-Related Burnout (WBO) met the recommended criteria, as presented in Table 1. Therefore, all questionnaire items were retained in the PLS-SEM analysis without the need for item elimination.

Discriminant validity was evaluated using the Heterotrait–Monotrait Ratio (HTMT) criterion. Compared with the traditional Fornell–Larcker criterion, HTMT is considered a more rigorous approach for detecting discriminant validity issues among latent constructs. As shown in Table 1, all HTMT values were below the recommended threshold of 0.90, indicating that the discriminant validity requirements were successfully achieved.

Moreover, the reliability assessment indicated that all constructs within the proposed research model possessed adequate internal consistency. Both Cronbach's Alpha (CA) and Composite Reliability (CR) values for each latent construct surpassed the recommended cutoff value of 0.70, reflecting strong consistency and reliability among the measurement indicators. In addition, all Average Variance Extracted (AVE) values exceeded 0.50, thereby demonstrating satisfactory convergent validity for every construct included in the study. These results suggest that the instruments applied in this research were sufficiently reliable and valid for examining the relationships among job demands, emotional intelligence, emotional labor, self-efficacy, and work-related burnout. Consequently, the measurement model fulfilled the necessary statistical criteria, allowing the analysis to proceed to the evaluation of the structural model using the PLS-SEM method.

The assessment of construct validity was performed to confirm that all measurement indicators satisfied the required standards of reliability and validity. In the present study, indicator loadings greater than 0.70 were regarded as acceptable, suggesting that each indicator had a strong relationship with its corresponding construct. As shown in Table 1, all indicators measuring Job Demands (JD), Emotional Intelligence (EI), Emotional Labor (EL), Self-Efficacy (SE), and Work-Related Burnout (WBO) achieved the recommended threshold criteria. The final model consisted of nine indicators for Job Demands, sixteen indicators for Emotional Intelligence, six indicators for Emotional Labor, eight indicators for Self-Efficacy, and seven indicators for Work-Related Burnout. Since all indicators met the required statistical standards, no items were removed from the analysis. These results demonstrate that

the measurement indicators adequately represented and explained their respective latent constructs.

Table 1. Results of Constructs Reliability, Convergent and Discriminant Validities

Construct	Reliability (CA & CR) Convergent Validity (AVE)				Discriminant Validity: Heterotrait Monotrait Ratio (HTMT)				
	Loadings	A	R	AVE	JD	SE	EI	EL	WBO
JD	0.863	0.976	0.978	0.745	0.863	0.807	0.828	0.834	0.879
SE	0.828	0.962	0.966	0.652					
EI	0.853	0.971	0.974	0.686					
EL	0.807	0.961	0.967	0.732					
WBO	0.823	0.946	0.958	0.698					

Note: CA= Cronbach's Alpha; CR=Composite Reliability; AVE=Average Variance Extracted;

HTMT=Heterotrait–Monotrait Ratio

Source: Data processed, 2026

In addition, the reliability analysis indicated that all constructs demonstrated strong internal consistency, as evidenced by Cronbach's Alpha (CA) and Composite Reliability (CR) values that exceeded the recommended threshold of 0.70. The CA values ranged between 0.946 and 0.976, while the CR values varied from 0.958 to 0.978, reflecting a high degree of reliability among all constructs incorporated in the research model. Convergent validity was also examined using the Average Variance Extracted (AVE) criterion. The AVE values for all constructs were above the recommended minimum value of 0.50, ranging from 0.652 to 0.745, indicating that each construct was capable of adequately explaining the variance of its respective indicators. These findings confirm that the constructs employed in this study possessed satisfactory statistical reliability and conceptual validity in measuring the proposed variables.

Furthermore, discriminant validity was evaluated through the Heterotrait–Monotrait Ratio (HTMT) criterion, which is regarded as a more rigorous method than the conventional Fornell–Larcker criterion for assessing discriminant validity within PLS-SEM analysis. The HTMT values reported in Table 1 were all below the recommended cut-off value of 0.90, demonstrating that each construct was empirically distinguishable from the others. This result indicates that the latent variables in the study did not exhibit substantial overlap and were able to capture distinct conceptual dimensions. Overall, the measurement model showed adequate reliability, convergent validity, and discriminant validity, thereby supporting the suitability of proceeding to the structural model evaluation.

The coefficient of determination (R^2) was analyzed to assess the explanatory and predictive capacity of the endogenous latent variables within the structural model. Hair et al. (2017) further suggested that R^2 values of 0.75, 0.50, and 0.25 may be interpreted as substantial, moderate, and weak levels of explanatory power, respectively. The R^2 results obtained in this study are summarized in Table 2. The findings showed that Job Demands (JD) and Emotional Labor (EL) together accounted for 70.2% of the variance in Work-Related Burnout (WBO), indicating that the proposed model possessed substantial predictive capability. This result implies that job demands and emotional labor play a major role in explaining burnout among study program leaders.

In contrast, the R^2 value for the relationship between Emotional Intelligence (EI) and Emotional Labor (EL) was 0.269, suggesting that Emotional Intelligence explained 26.9% of the variance in Emotional Labor. Although this value may be interpreted as weak to moderate, it still indicates that emotional intelligence contributes meaningfully to the way study program

leaders manage emotional labor. Furthermore, the structural model assessment also incorporated effect size analysis using the f^2 criterion to evaluate the relative influence of each predictor construct. Based on established guidelines, f^2 values of 0.02, 0.15, and 0.35 represent small, medium, and large effect sizes, respectively. As reported in Table 2, Job Demands showed a substantial effect on Work-Related Burnout, while Emotional Intelligence exerted a strong influence on Emotional Labor. Emotional Labor also demonstrated a meaningful contribution to Work-Related Burnout, highlighting its important role within the proposed conceptual model. Collectively, these findings indicate that the structural model developed in this study has satisfactory explanatory and predictive strength in explaining burnout among study program leaders at Muhammadiyah universities in Indonesia.

Table 2. Results of Structural Model Evaluation

Endogenous Construct	Predictive Power (R ²)	Predictor	Standardised beta	Effect size	f^2 inference
JD	0.702	WBO	0,623	0.837	Large
EL		WBO	0.211	0.087	Medium
EI	0.269	EL	0,521	0.373	Large

Source: Data processed, 2026

The coefficient of determination (R^2) was used to evaluate the predictive power of the endogenous constructs in the proposed structural model. The results indicate that Job Demands (JD) and Emotional Labor (EL) jointly explain 70.2% of the variance in Work-Related Burnout (WBO), demonstrating substantial predictive accuracy of the model. This finding suggests that the combination of excessive job demands and emotional labor plays a significant role in influencing burnout among study program leaders. Meanwhile, Emotional Intelligence (EI) explains 26.9% of the variance in Emotional Labor (EL), indicating a moderate predictive contribution. Furthermore, the effect size analysis (f^2) demonstrates that the relationship between JD and WBO has a large effect size, while the relationship between EI and EL also shows a substantial effect. In contrast, the effect size of EL on WBO is categorized as medium, suggesting that emotional labor contributes meaningfully to burnout, although its influence is relatively lower compared to job demands. Overall, these findings confirm that the proposed model possesses satisfactory explanatory and predictive capabilities in understanding work-related burnout among study program heads.

Prior to examining the direct and indirect effects, an assessment of multicollinearity among the predictor constructs was performed to ensure the stability and robustness of the structural model. The Variance Inflation Factor (VIF) values for all constructs were found to be below the recommended cut-off value of 5.0, indicating that multicollinearity did not pose a problem in this study. These findings suggest that the predictor variables were not excessively correlated and therefore did not bias the estimation of the structural path coefficients. Table 3 displays the structural relationships identified in the model along with their respective VIF values, supporting the suitability of the model for subsequent hypothesis testing.

In addition, a bootstrapping analysis with 5,000 resamples was conducted to determine the significance of both direct and indirect effects within the structural model. The findings revealed that the confidence intervals, including both the lower limit (LL) and upper limit (UL), did not contain zero for the statistically significant paths, thereby confirming the significance of the proposed relationships. This result provides empirical evidence supporting the existence of both direct and mediating effects among the variables examined in this study.

Moreover, the application of the bootstrapping procedure strengthened the robustness and reliability of the statistical estimates by reducing potential sampling bias and enhancing the precision of standard error calculations. Consequently, the results summarized in Table 3 offer comprehensive evidence regarding the relationships among job demands, emotional intelligence, emotional labor, self-efficacy, and work-related burnout.

Table 3. Results of Direct and Indirect Effects

Path Relationship			Std. Beta (β)	σ	t-value	p-value	LL	UL	Decision
Direct Effects									
JD	WBO		0.211	0.055	3.805	0.000	0.101	0.316	Accept
EI	EL		0.521	0.055	9.472	0.000	0.402	0.620	Accept
EL	WBO		0.606	0.056	10.895	0.000	0.497	0.713	Accept
Indirect effects									
JD	SE	WBO	0.077	0.039	1.987	0.047	-0.002	0.147	Reject
EI	EL	WBO	0.316	0.048	6.642	0.000	0.229	0.409	Accept

Source: Data processed, 2026

The results presented in Table 3 indicate that all direct relationships in the proposed model are statistically significant, as evidenced by t-values exceeding the recommended threshold of 1.96 and p-values below 0.05. Specifically, job demands significantly increase work-related burnout, suggesting that excessive academic and administrative responsibilities contribute to emotional exhaustion among study program leaders. Furthermore, emotional intelligence significantly influences emotional labor, indicating that individuals with higher emotional intelligence are better able to regulate and express emotions effectively in professional settings. Emotional labor was also found to significantly increase work-related burnout, implying that continuous emotional regulation in leadership roles may intensify psychological strain over time.

Regarding the indirect effects, emotional labor was found to successfully mediate the relationship between emotional intelligence and work-related burnout. This finding suggests that emotional intelligence indirectly affects burnout through emotional management processes in the workplace. In contrast, the moderating effect of self-efficacy on the relationship between job demands and work-related burnout was not supported. Although the p-value was below 0.05, the confidence interval approached zero, indicating that the interaction effect was not statistically robust. Therefore, H4 was not supported. Overall, these findings confirm the robustness of the proposed structural model and provide empirical support for the theoretical framework developed in this study.

This study sought to provide a deeper understanding of how job demands contribute to work-related burnout among Heads of Study Programs at Muhammadiyah universities in Indonesia. The empirical support for H1 confirms RQ1, indicating that job demands constitute a significant antecedent of work-related burnout among academic leaders. More importantly, the findings suggest that burnout is not merely the consequence of a heavy workload; rather, it emerges through the cumulative effect of multiple organisational, managerial, and academic responsibilities that must be managed concurrently over an extended period.

Unlike lecturers whose responsibilities are primarily centred on teaching, research, and community engagement, Heads of Study Programs occupy a multifaceted leadership role that requires balancing strategic and operational responsibilities simultaneously. They are expected to coordinate curriculum implementation, ensure compliance with accreditation

standards, supervise academic staff, oversee administrative operations, monitor programme performance, and respond to expectations from university executives and external stakeholders. The convergence of these responsibilities creates persistent cognitive, emotional, and managerial demands that continuously consume psychological energy. Over time, this sustained resource depletion is likely to increase vulnerability to work-related burnout, particularly when institutional support is insufficient to offset escalating job demands.

These findings provide strong empirical support for the Job Demands–Resources (JD-R) Theory, which proposes that burnout develops when employees are exposed to prolonged job demands without sufficient organizational or personal resources to maintain psychological functioning (Bakker et al., 2023). From the perspective of the JD-R framework, excessive job demands activate the health impairment process, whereby continuous physical, cognitive, and emotional effort gradually exhausts employees' energetic resources and ultimately results in burnout. Recent developments of the theory further emphasize that burnout is driven not solely by workload intensity but by the imbalance between increasing organizational demands and the availability of supportive resources, particularly among individuals occupying complex leadership positions (Bakker et al., 2023). Consequently, the present findings reinforce the theoretical proposition that organizational demands represent a fundamental mechanism through which burnout develops among academic leaders.

The institutional context of Muhammadiyah universities provides an important explanation for these findings. As many of these institutions are relatively young and continue to strengthen their governance systems, quality assurance mechanisms, administrative procedures, and organizational infrastructure, Heads of Study Programs frequently assume responsibilities beyond their formal job descriptions. Such circumstances are likely to intensify role overload, increase psychological strain, and accelerate the depletion of personal resources, thereby creating favorable conditions for the emergence of work-related burnout.

The present findings are broadly consistent with previous studies conducted in higher education settings. Naidoo-Chetty and Du Plessis reported that increasing workloads, administrative responsibilities, and limited institutional resources significantly diminished academics' psychological well-being while increasing their susceptibility to burnout (Naidoo-Chetty and Du Plessis, 2021). Similarly, administrative burden and institutional demands as key predictors of burnout among academic personnel (Frintner et al., 2021). Persistent organizational demands contribute to emotional exhaustion and reduced work engagement in higher education institutions (Weber et al., 2023). Collectively, these studies support the argument that excessive organizational demands represent a consistent risk factor for burnout across academic environments.

Nevertheless, the present study extends the existing literature in several important ways. Previous research has predominantly focused on lecturers or academic staff, whereas empirical evidence concerning Heads of Study Programs remains limited. By examining academic leaders who simultaneously perform managerial, academic, and administrative functions, this study broadens the application of the Job Demands–Resources Theory within higher education leadership. Specifically, the findings demonstrate that the health impairment process is equally applicable to middle-level academic leaders working in relatively young private universities in developing countries, thereby extending the contextual boundary of the JD-R framework beyond traditional employee populations.

From a practical standpoint, these findings suggest that reducing burnout among Heads of Study Programs should not depend solely on individual resilience or personal coping

strategies. Instead, universities need to implement systemic organizational interventions that directly address the underlying sources of excessive job demands. Such interventions may include establishing a more equitable distribution of managerial responsibilities, strengthening administrative support, streamlining bureaucratic and accreditation processes, providing structured leadership development programs, and offering accessible psychological support services. These initiatives are expected not only to safeguard the well-being of academic leaders but also to enhance leadership effectiveness, maintain academic quality, and strengthen long-term institutional sustainability.

Overall, this study provides evidence supporting the applicability of the Job Demands–Resources Theory in explaining work-related burnout among academic leaders. The findings highlight that burnout should be understood as the cumulative consequence of prolonged exposure to excessive organizational demands in the absence of sufficient organizational resources. Consequently, promoting sustainable academic leadership requires universities to move beyond individual-level interventions and adopt organizational strategies that balance job demands with adequate structural, administrative, and psychological support. Such an approach is essential for preserving leaders' well-being while simultaneously sustaining institutional performance in an increasingly demanding higher education environment.

The next finding concerns the role of emotional intelligence in explaining emotional labour among Heads of Study Programs. The empirical results demonstrate that emotional intelligence has a significant positive effect on emotional labour among Heads of Study Programs at Muhammadiyah universities in Indonesia. This finding suggests that academic leaders with higher levels of emotional intelligence are better able to regulate, manage, and appropriately express their emotions when confronted with the complex demands of their professional roles. Within the context of academic leadership, this capability is particularly important because Heads of Study Programs are expected not only to fulfil administrative and academic responsibilities but also to cultivate effective interpersonal relationships with lecturers, students, university management, and various external stakeholders. Accordingly, emotional intelligence should not be viewed merely as an individual competency but as a critical leadership capability that enables academic leaders to maintain professionalism, emotional stability, and constructive interpersonal relationships across a wide range of challenging workplace situations.

These findings can be interpreted through the Ability Model of Emotional Intelligence (Mayer et al., 2016), which conceptualises emotional intelligence as a set of cognitive abilities involving the perception, understanding, utilisation, and regulation of emotions. According to this model, individuals with higher emotional intelligence are more capable of selecting adaptive emotion regulation strategies when faced with emotionally demanding situations. Rather than reacting impulsively to workplace pressures, they can recognise emotional cues, regulate their own emotional responses, and respond in ways that facilitate effective interpersonal interactions. Within academic leadership, these abilities become increasingly important because Heads of Study Programs are expected to demonstrate composure, empathy, fairness, and professionalism despite operating in environments characterised by high workloads, competing institutional priorities, and continuous organisational change. Consequently, emotional intelligence serves as a fundamental psychological resource that enables academic leaders to perform emotional labour more effectively.

The institutional context of this study provides further insight into this relationship. Heads of Study Programs at relatively young Muhammadiyah universities operate within institutions that continue to strengthen their governance systems, quality assurance

mechanisms, and organizational capacity. As a result, they are required to manage a broad range of responsibilities, including curriculum implementation, accreditation compliance, human resource development, and the achievement of institutional performance targets. These responsibilities necessitate continuous interaction with individuals and groups who possess diverse expectations, interests, and professional backgrounds. Under such circumstances, the ability to regulate personal emotions, understand the emotional states of others, and display appropriate emotional responses becomes essential for maintaining leadership effectiveness and fostering a positive organizational climate. Therefore, academic leaders with higher emotional intelligence are more likely to engage in emotional labor successfully than those with less developed emotion regulation capabilities.

The present findings are consistent with previous empirical research. Han et al. (2022), reported that emotional intelligence plays a crucial role in enabling academics to manage emotional demands through more adaptive emotional labor strategies. Similarly, (Buzova et al., 2023) found that individuals with higher emotional intelligence are better able to regulate their emotional expressions, thereby maintaining positive interpersonal relationships in the workplace. Knežević et al. demonstrated that emotional intelligence enhances individuals' capacity to align their emotional expressions with organizational expectations without generating excessive psychological strain (Knežević et al., 2021). Collectively, these studies support the proposition that emotional intelligence facilitates more effective emotion regulation in professional settings. Nevertheless, most previous investigations have focused on lecturers, service employees, or business professionals. By contrast, the present study extends this body of knowledge by demonstrating that the positive relationship between emotional intelligence and emotional labor also applies to Heads of Study Programs, a group of middle-level academic leaders whose managerial responsibilities and leadership demands differ substantially from those of other occupational groups.

From a theoretical perspective, these findings reinforce the view that emotional intelligence represents an essential psychological resource that facilitates effective emotion regulation within the workplace. More importantly, this study extends the application of the Ability Model of Emotional Intelligence by demonstrating that emotional intelligence contributes not only to interpersonal effectiveness but also to the development of more adaptive emotional labor strategies among academic leaders. This finding broadens the contextual applicability of emotional intelligence theory by providing empirical evidence from higher education leadership in developing-country universities, where organizational complexity and leadership demands continue to evolve.

From a practical perspective, the findings suggest that universities should recognize emotional intelligence as a strategic leadership competency rather than merely an individual characteristic. Accordingly, higher education institutions should integrate emotional intelligence development into leadership development initiatives by providing training in emotion regulation, interpersonal communication, conflict management, empathetic leadership, and self-awareness. Such initiatives are expected to strengthen the capacity of Heads of Study Programs to cope with the emotional demands of academic leadership while fostering healthier, more collaborative, and more sustainable working environments that ultimately support institutional effectiveness.

The subsequent finding highlights the importance of emotional labor as a psychological mechanism underlying work-related burnout among Heads of Study Programs. The empirical results indicate that emotional labor has a significant positive effect on work-related burnout among Heads of Study Programs at Muhammadiyah universities in Indonesia.

This finding suggests that the greater the expectation for academic leaders to regulate, suppress, or modify their emotional expressions to conform to organizational expectations, the greater their susceptibility to work-related burnout. Within the context of academic leadership, Heads of Study Programs are expected not only to make sound managerial and academic decisions but also to consistently demonstrate composure, empathy, and emotional support toward lecturers, students, university management, and other stakeholders, even when operating under considerable organizational pressure. The continuous discrepancy between genuinely experienced emotions and those that must be displayed in accordance with professional expectations may generate emotional dissonance, which progressively depletes psychological resources and increases the likelihood of burnout.

These findings can be explained through Emotional Labor Theory, originally proposed by (Hochschild Arlie, 1983) and further developed by (Grandey and Melloy, 2017), which argues that employees frequently regulate their emotional expressions to comply with organizational display rules. According to this perspective, the strategy of surface acting, whereby individuals display emotions that do not genuinely reflect their internal emotional state, is particularly taxing because it requires the continuous suppression or modification of authentic feelings. Such emotional regulation creates psychological tension and accelerates the depletion of emotional resources. In contrast, deep acting enables individuals to modify their internal emotional state so that it becomes more congruent with the emotions they are expected to express, thereby reducing emotional dissonance and lowering the risk of burnout (Grandey & Melloy, 2017). Accordingly, the present findings suggest that burnout is influenced not only by the intensity of emotional demands but also by the emotion regulation strategies individuals employ in responding to those demands.

The institutional context examined in this study provides additional insight into this relationship. As academic leaders, Heads of Study Programs occupy positions that require them to balance institutional performance objectives with maintaining positive interpersonal relationships. They are simultaneously responsible for resolving conflicts among lecturers, responding to students' concerns, fulfilling expectations from university management, and ensuring compliance with academic quality standards. These diverse responsibilities frequently require them to display emotions consistent with organizational expectations, even when those expressions differ from their genuine feelings. When such conditions persist over an extended period without sufficient organizational support, the cumulative emotional burden is likely to intensify psychological exhaustion and ultimately develop into work-related burnout.

The present findings are consistent with previous empirical evidence. A meta-analysis conducted by (Yin et al., 2023), demonstrated that emotional labor, particularly surface acting, is strongly associated with burnout across a wide range of occupational settings. Similarly, (Han et al., 2022) reported that academics who relied more frequently on surface acting experienced significantly higher levels of emotional exhaustion than those who predominantly adopted deep acting strategies. (Jeung and Chang, 2021), likewise found that high emotional labor demands substantially increased burnout, particularly when organizations failed to provide adequate psychological support. Collectively, these studies suggest that ineffective emotion regulation represents a critical pathway through which emotional labor contributes to burnout. Nevertheless, previous studies have largely focused on service employees, healthcare professionals, or lecturers. The present study extends this literature by demonstrating that the positive relationship between emotional labor and work-related burnout also applies to Heads of Study Programs, a group of middle-level academic leaders who must simultaneously

manage emotional demands while performing strategic leadership responsibilities within higher education institutions.

From a theoretical perspective, these findings reinforce the proposition that emotional labor constitutes a key psychological mechanism through which emotional demands in the workplace evolve into burnout. More importantly, this study extends the application of Emotional Labor Theory within the context of academic leadership by demonstrating that leaders' ability to cope with emotional demands is shaped not only by individual emotional competencies but also by the characteristics of their work roles and the level of organizational support available to them. This finding broadens the contextual applicability of Emotional Labor Theory by providing empirical evidence from middle-level academic leaders working in developing-country higher education institutions.

From a practical perspective, the findings suggest that universities should adopt organizational strategies that help academic leaders manage emotional demands in healthier and more sustainable ways. Such initiatives may include providing training in emotion regulation, offering professional counseling services, strengthening social support networks, and cultivating an organizational culture that promotes open communication, psychological safety, and employee well-being. By implementing these interventions, higher education institutions can reduce the risk of work-related burnout among Heads of Study Programs while simultaneously enhancing leadership effectiveness, organizational resilience, and the long-term sustainability of institutional performance.

The next finding concerns the moderating role of self-efficacy in the relationship between job demands and work-related burnout. Contrary to the proposed hypothesis, the findings reveal that self-efficacy does not significantly moderate the relationship between job demands and work-related burnout among Heads of Study Programs at Muhammadiyah universities in Indonesia. This result suggests that confidence in one's ability to perform work-related tasks successfully is insufficient to buffer the detrimental effects of excessive job demands on burnout. In other words, even academic leaders who possess high levels of self-efficacy remain vulnerable to work-related burnout when they are continuously exposed to persistent organizational demands that exceed the resources available to cope with them.

These findings can be interpreted through the Job Demands–Resources (JD-R) Theory, which proposes that burnout develops when job demands consistently exceed the personal and organizational resources available to employees (Bakker et al., 2023). Within the JD-R framework, self-efficacy is conceptualized as an important personal resource that enhances individuals' confidence in managing challenging work situations. However, the protective value of self-efficacy is not unconditional. Its effectiveness depends largely on the nature, intensity, and duration of job demands, as well as the availability of organizational resources that enable individuals to perform their roles effectively. When organizational demands become chronic, multidimensional, and increasingly complex, personal psychological resources alone may no longer be sufficient to prevent the health impairment process that ultimately leads to burnout. Accordingly, the present findings suggest that work-related burnout among Heads of Study Programs is influenced more strongly by structural and organizational characteristics than by individual beliefs regarding personal capability.

The organizational context of this study provides further insight into the absence of the moderating effect. Heads of Study Programs at relatively young Muhammadiyah universities are required to manage responsibilities that extend beyond conventional academic leadership. They are expected to oversee accreditation processes, improve academic quality, achieve institutional performance indicators, coordinate curriculum development, supervise

human resource management, and ensure compliance with increasingly complex regulatory requirements, often under conditions of limited organizational support. These responsibilities create a work environment in which stress originates primarily from structural and institutional pressures rather than from deficiencies in individual capability. Consequently, even leaders with strong self-efficacy may experience burnout when organizational systems fail to provide adequate administrative support, balanced workload allocation, effective leadership, and sufficient institutional resources.

The present findings differ from several previous studies that identified self-efficacy as a protective factor capable of reducing or moderating the relationship between work stress and burnout (Consiglio et al., 2023). One possible explanation for this inconsistency lies in differences in occupational context and respondent characteristics. Most earlier studies were conducted among healthcare professionals, school teachers, or employees working in relatively stable organizational environments. In contrast, the present study focuses on Heads of Study Programs serving in developing private universities characterized by continuous institutional transformation and increasing organizational demands. Conversely, the findings are consistent with more recent evidence suggesting that personal resources do not always protect employees from burnout when organizational demands become excessively high or when organizational support is insufficient (Bakker et al., 2023). Collectively, these findings imply that the protective function of self-efficacy is context-dependent and may diminish under conditions where organizational pressures substantially outweigh available resources.

From a theoretical perspective, this study contributes to the growing body of literature by demonstrating that self-efficacy does not invariably function as a moderator in the relationship between job demands and work-related burnout. This finding refines the application of the Job Demands–Resources Theory by suggesting that the effectiveness of personal resources is contingent upon organizational conditions. Specifically, the buffering role of self-efficacy appears to weaken when organizational demands become overwhelmingly dominant and are not accompanied by sufficient structural or institutional support. Consequently, the findings highlight the importance of adopting a more contextual perspective when examining the role of personal resources in preventing burnout among academic leaders.

From a practical perspective, the findings indicate that efforts to reduce burnout among Heads of Study Programs should not rely solely on interventions designed to enhance self-efficacy, such as motivational programs or individual leadership development initiatives. Instead, universities should simultaneously strengthen organizational resources by improving administrative support, redistributing managerial responsibilities more equitably, simplifying bureaucratic and accreditation procedures, reinforcing quality assurance systems, and enhancing leadership support at both faculty and university levels. By addressing the structural sources of occupational stress alongside individual capacity development, higher education institutions are more likely to establish sustainable strategies for preventing burnout and promoting the long-term effectiveness of academic leadership.

The final finding extends the preceding discussion by examining whether emotional labor functions as the underlying psychological mechanism linking emotional intelligence to work-related burnout among Heads of Study Programs. The empirical results indicate that emotional labor significantly mediates the relationship between emotional intelligence and work-related burnout among Heads of Study Programs at Muhammadiyah universities in Indonesia. This finding suggests that emotional intelligence does not reduce burnout directly; rather, its protective effect operates through individuals' ability to regulate and manage their

emotional expressions in response to workplace demands. In other words, academic leaders with higher levels of emotional intelligence are more likely to adopt adaptive emotion regulation strategies when performing their leadership responsibilities. These strategies enable them to cope more effectively with the emotional challenges inherent in academic leadership, thereby reducing their vulnerability to work-related burnout.

These findings can be interpreted by integrating the Ability Model of Emotional Intelligence (Mayer et al., 2016) with Emotional Labor Theory (Grandey & Melloy, 2017). According to the Ability Model, emotionally intelligent individuals possess the cognitive abilities required to perceive, understand, utilize, and regulate emotions effectively. These competencies provide the psychological foundation for selecting more adaptive emotional labor strategies, particularly deep acting, which involves aligning one's internal emotional state with the emotional expressions required by the work role. By contrast, individuals with lower emotional intelligence are more likely to rely on surface acting, whereby displayed emotions differ from genuinely experienced feelings. Prolonged reliance on surface acting may generate emotional dissonance a discrepancy between experienced and expressed emotions—which progressively depletes psychological resources, increases emotional exhaustion, and ultimately contributes to work-related burnout. Accordingly, the findings suggest that emotional intelligence protects academic leaders from burnout not because it directly eliminates emotional demands, but because it enables them to regulate those demands through healthier and more adaptive emotional labor strategies.

The organizational context of this study provides further insight into this mediating mechanism. Heads of Study Programs occupy leadership positions that require continuous interaction with lecturers, students, university administrators, professional staff, and external stakeholders. In fulfilling these diverse responsibilities, they are expected to demonstrate professionalism, empathy, emotional composure, and effective interpersonal communication, even when confronted with interpersonal conflict, administrative pressures, and demanding institutional performance expectations. Under such circumstances, successful emotional management depends not only on possessing high emotional intelligence but also on the ability to translate that emotional competence into appropriate emotional labor strategies that fit specific workplace situations. Consequently, emotional labor represents the critical psychological process through which emotional intelligence influences the level of work-related burnout experienced by academic leaders.

The present findings are consistent with previous empirical evidence. (Han et al., 2022), reported that academics with higher emotional intelligence were more likely to employ adaptive emotion regulation strategies, resulting in lower levels of burnout. Similarly, (Hong and Lee, 2016), demonstrated that emotional intelligence plays a pivotal role in enhancing the effectiveness of emotional labor while reducing the adverse consequences of emotional demands on psychological well-being. More recently, (Geng et al., 2025) found that effective emotion regulation contributes to professional well-being through the adoption of more adaptive emotional labor strategies. Collectively, these studies support the proposition that emotional labor constitutes an important mechanism through which emotional intelligence influences employees' psychological outcomes. Nevertheless, previous research has primarily focused on lecturers, healthcare professionals, or service employees. The present study extends this literature by demonstrating that the mediating role of emotional labor also applies to Heads of Study Programs, a group of middle-level academic leaders who simultaneously navigate academic, administrative, and strategic leadership responsibilities within higher education institutions.

From a theoretical perspective, this study makes an important contribution by demonstrating that emotional labor serves as the primary psychological mechanism linking emotional intelligence to work-related burnout. The findings extend the application of both the Ability Model of Emotional Intelligence and Emotional Labor Theory within the context of academic leadership while simultaneously enriching the Job Demands–Resources (JD-R) Theory. Specifically, the results suggest that personal psychological resources do not necessarily reduce burnout through a direct pathway; instead, their protective influence operates through emotion regulation processes manifested in adaptive emotional labor strategies. This integrated perspective provides a more comprehensive understanding of the psychological processes underlying work-related burnout among academic leaders. It highlights the importance of considering both personal competencies and behavioral regulation mechanisms when explaining burnout in higher education leadership.

From a practical perspective, the findings indicate that enhancing emotional intelligence alone may not be sufficient to reduce burnout unless academic leaders are also equipped with the skills required to implement adaptive emotional labour strategies. Accordingly, universities should integrate emotional intelligence development with training programmes focusing on emotion regulation, interpersonal communication, conflict management, empathetic leadership, and reflective leadership practices. In addition, providing leadership coaching, professional counselling services, peer support mechanisms, and sustained organisational support can strengthen the capacity of Heads of Study Programs to manage emotional demands more effectively. Such integrated interventions are expected to minimise the risk of work-related burnout while promoting sustainable academic leadership, psychological well-being, and long-term institutional effectiveness.

CONCLUSIONS

This study provides a deeper understanding of work-related burnout among Heads of Study Programs at relatively young Muhammadiyah universities in Indonesia by integrating organizational demands, personal resources, and emotional regulation processes. Rather than viewing burnout solely as an individual problem, the findings indicate that it emerges from the interplay between demanding organizational conditions and how academic leaders manage the emotional requirements of their roles. Emotional labor represents an important psychological mechanism linking emotional intelligence to burnout, while self-efficacy alone appears insufficient to protect academic leaders when job demands remain substantial. These findings extend the application of the Job Demands–Resources (JD-R) framework to middle-level academic leadership and highlight the importance of considering both organizational and psychological mechanisms in understanding burnout. Practically, universities should not rely solely on individual resilience or coping strategies to prevent burnout. Organizational interventions should include more balanced workload allocation, stronger administrative support, streamlined bureaucratic processes, emotional intelligence and emotion-regulation development, and accessible psychological support to create healthier working conditions while sustaining leadership effectiveness and institutional performance.

Several limitations should be acknowledged. First, the cross-sectional design limits causal interpretation, as all variables were measured at a single point in time; therefore, future studies should employ longitudinal designs to examine how job demands and psychological resources influence burnout over time. Second, the reliance on self-reported questionnaire

data may introduce perceptual, social desirability, and common method biases despite the anonymity and confidentiality provided to respondents. Future research could incorporate multiple data sources, such as institutional workload records or assessments from other organizational members. Third, the study was restricted to Heads of Study Programs at Muhammadiyah universities in Indonesia established for less than ten years, limiting the generalizability of the findings to older universities, public institutions, other private universities, and different cultural contexts. Future studies could conduct comparative research across institutional types and countries. Finally, the model included only selected organizational and psychological factors, while other potentially relevant demands and resources, such as organizational support, role conflict, autonomy, leadership support, and work–family conflict, were not examined. Despite these limitations, the study demonstrates that sustainable academic leadership requires a balance between organizational demands and adequate personal and organizational resources, suggesting that universities should move beyond exclusively individual-focused interventions toward organizational practices that foster more supportive and sustainable working conditions for academic leaders.

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WHEN INVESTMENT UNDERMINES SUSTAINABILITY: THE MODERATING ROLE OF CAPEX IN THE ESG–ENVIRONMENTAL INNOVATION RELATIONSHIP



SINTA 2

Umi Murtini¹⁾, Afnei Ngan Billy Tumba²⁾

¹⁾ Universitas Kristen Duta Wacana, Yogyakarta, Indonesia

²⁾ Universitas Gadjah Mada, Yogyakarta Indonesia

Email: umimt@staff.ukdw.ac.id

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ABSTRACT

Environmental innovation is increasingly important as firms face growing pressure to translate sustainability commitments into tangible environmental outcomes. This study examines the effects of Environmental, Social, and Governance (ESG) performance and the Environmental Pillar on environmental innovation and investigates whether Capital Expenditure (CAPEX) moderates the relationship between ESG performance and environmental innovation among publicly listed firms in Indonesia, Malaysia, and Singapore. Using secondary panel data comprising 250 firm-year observations from 2020 to 2024, this study employs random effects panel regression. The results indicate that ESG performance and the Environmental Pillar have positive and statistically significant effects on environmental innovation. However, CAPEX does not exhibit a statistically significant direct effect in the moderation models, and the interaction between ESG and CAPEX is not statistically significant. Significant cross-country differences in environmental innovation are also observed. These findings highlight the importance of ESG and environmental performance in promoting environmental innovation, while providing no evidence that CAPEX moderates this relationship.

Keywords: environmental innovation; ESG; environmental pillar; CAPEX; ASEAN.

INTRODUCTION

The ASEAN region faces substantial challenges in implementing environmental sustainability and promoting environmental innovation across countries with different regulatory, economic, and institutional conditions. While countries such as Singapore have made considerable progress in ESG practices and environmental performance, Indonesia and Malaysia continue to face challenges in environmental regulation and its implementation (Aulia et al., 2023). These differences may result in varying degrees of ESG integration into corporate strategies, particularly in firms' efforts to develop environmental innovation. Consequently, understanding how firms translate ESG commitments into environmental innovation is particularly important in the ASEAN context.

An increase in ESG performance does not necessarily correspond to a proportional increase in green investment, as capital expenditure may be allocated across various types of corporate assets and investments with different implications for environmental innovation

(Nsiah et al., 2025). This condition suggests that Capital Expenditure (CAPEX) does not necessarily represent a direct commitment to sustainability because corporate investments may primarily support production capacity and economic expansion. Therefore, the allocation of CAPEX is important for understanding whether corporate resources are directed toward environmental objectives. The strategic direction of investment may consequently determine whether ESG commitments are effectively translated into environmental innovation.

Recent empirical studies also report inconsistent relationships between ESG performance and environmental innovation (Dicuonzo et al., 2022). Several studies identify a significant positive relationship between ESG and environmental innovation (Alodat et al., 2025; Pinheiro et al., 2024), whereas other studies indicate that the relationship may become insignificant or weaker when financial factors such as investment and capital structure are considered (Vierescu et al., 2025). This inconsistency suggests that the relationship between ESG and environmental innovation may depend on additional organizational and financial conditions. CAPEX is therefore considered an important contingency factor because corporate investment decisions determine how resources are committed to productive and sustainability-related activities.

This relationship can be explained primarily through Resource Allocation Theory, which emphasizes that organizational outcomes depend on how available resources are allocated among competing strategic priorities (Helfat & Maritan, 2024). From this perspective, strong ESG performance establishes a strategic orientation toward sustainability, but its implementation requires adequate allocation of corporate resources. CAPEX can support environmental innovation when it is directed toward green technologies, environmentally efficient production systems, and other assets that facilitate environmental improvements (Casciello et al., 2024). Conversely, when CAPEX is primarily allocated to conventional assets, the resources available for environmental innovation may be constrained. Thus, CAPEX can function as an important mechanism through which ESG commitments are translated into environmental innovation.

The role of CAPEX becomes particularly relevant when examining its moderating effect on the ESG–environmental innovation relationship. ESG performance may create organizational commitments and strategic priorities related to sustainability, but these commitments do not automatically generate environmental innovation without appropriate resource allocation. When CAPEX is aligned with environmental objectives, investment resources can facilitate the implementation of ESG strategies and potentially strengthen their contribution to environmental innovation. However, the extent to which CAPEX supports environmental objectives may depend on how investment resources are allocated across different corporate activities. Consequently, higher levels of CAPEX may weaken the extent to which ESG performance is translated into environmental innovation when capital investments are not sufficiently aligned with environmental objectives. This mechanism suggests that the effect of ESG performance on environmental innovation may vary according to firms' investment allocation decisions.

Previous studies have predominantly examined the direct role of ESG in promoting environmental innovation, with comparatively limited attention to the interaction between ESG performance and corporate investment decisions (Li et al., 2023). At the same time, the effectiveness of ESG strategies depends on the availability and allocation of resources necessary for their implementation (Aich et al., 2021). This limitation leaves an important gap in understanding how CAPEX influences the relationship between ESG and environmental innovation, particularly in emerging ASEAN markets. Examining this relationship may

therefore provide additional insight into why firms with similar ESG commitments can generate different environmental innovation outcomes.

ESG integration, as a means to corporate sustainable development, is now gaining popularity. However, empirical studies show that its effectiveness in driving environmentally-oriented innovation is still mixed (Cervino & Mendi, 2024). One rationale for ESG fostering environmental innovation is the regulatory demands and expectations of stakeholders (Nagriwum et al., 2025). However, the reality of ESG is more complex; it's not uncommon for the necessary investment to be misdirected or insufficiently aligned with strategic sustainability priorities, resulting in a discrepancy between a company's sustainability commitments and its innovation capabilities (David et al., 2024). This issue becomes more complex when CAPEX reflects firms' investment behavior. Theoretically, CAPEX should support innovation, including environmental innovation, by providing a sufficient resource base (O'Connell et al., 2025). However, in practice, CAPEX is seldom a channel through which sustainability-related spending is made, and therefore it has the potential to decouple or even reverse the link between ESG and environmental innovation (Erdoğan et al., 2025). This condition creates an ironic situation: an increase in corporate investment does not necessarily correspond to an increase in environmental innovation.

In the context of Indonesia, Malaysia, and Singapore (ASEAN-3), differences in economic characteristics, regulations, and levels of ESG implementation further reinforce the urgency to examine these relationships in more depth (Purnomo et al., 2025). This fluctuation begs the question of whether environmental innovation and ESG have a consistent relationship or if contextual factors, such as the company's investment choices, have an impact. Therefore, this study answers several research questions that were formed, including:

RQ1: Does ESG have a positive effect on environmental innovation in companies in ASEAN-3?

RQ2: Does the environmental performance have a positive effect on environmental innovation in companies in ASEAN-3?

RQ3: Does CAPEX negatively affect environmental innovation in companies in ASEAN-3?

RQ4: Does CAPEX moderate the relationship between ESG and environmental innovation in companies in ASEAN-3?

RQ5: Are environmental innovation levels different in countries from the ASEAN-3 region?

By examining whether CAPEX actually reduces the strength of the ESG- environmental innovation association, this study introduces novelty to the existing literature. This method helps grow the knowledge about ESG and environmental innovation, and it also helps explain why some companies, especially in the ASEAN-3 region, invest in ways that seem contradictory. The study also offers useful advice for businesses to be more thoughtful about where they spend their money and for government officials to create better rewards that make it easier and more appealing for people to invest in green projects.

ESG is seen as a way for companies to plan strategically by including sustainable practices in how they run their business (Alhoussari, 2025). From a stakeholder theory perspective, companies that adopt ESG comprehensively will strive to meet the demands of various stakeholders, including environmental protection, thereby encouraging greater environmental innovation (Wong et al., 2023). In addition, legitimacy theory explains that companies seek to gain social legitimacy through real sustainability practices, one of which is

the development of environmental innovation as a form of environmental responsibility (Olateju et al., 2021).

Empirically, various studies show that companies with high ESG performance tend to have better levels of environmental innovation due to regulatory pressures and market expectations to create sustainable value (Chouaibi & Chouaibi, 2021). Strong ESG performance can encourage firms to integrate sustainability considerations into organizational strategies and innovation activities, thereby increasing their capacity to develop environmental solutions. Accordingly, firms with higher ESG performance are expected to demonstrate greater environmental innovation. So, the hypothesis formed is as follows:

H1: ESG performance has a positive effect on environmental innovation among companies in ASEAN-3.

The environmental dimension of ESG is particularly relevant to environmental innovation because it directly addresses energy efficiency, emissions reduction, resource conservation, and waste management. Consistent with the Porter Hypothesis, environmental pressures can stimulate firms to develop innovations that improve resource efficiency and reduce long-term costs (Porter & Linde, 1995). From the Resource-Based View (RBV), environmental capabilities can also constitute valuable and difficult-to-imitate resources that enable firms to develop innovative solutions and achieve competitive advantage (Barney, 1991). Empirical evidence further indicates that the environmental dimension may exert a stronger influence on environmental innovation than other ESG dimensions because of its direct connection to firms' environmental practices and technological responses (Mneimneh et al., 2023). Therefore, stronger environmental performance is expected to enhance environmental innovation. So, the hypothesis formed is as follows:

H2: Environmental performance has a positive effect on environmental innovation among companies in ASEAN-3.

CAPEX represents firms' capital investment intensity in long-term productive assets and reflects the extent to which firms commit resources to capital investment activities (Szymanska & Keller, 2025). Although CAPEX can provide the resources required for technological development and innovation, its effect on environmental innovation depends on the direction and purpose of investment. From a resource allocation perspective, the contribution of capital investment to innovation depends on how firms deploy their investment resources and whether these investments support innovation-related activities (Bower, 2018). However, a higher level of capital investment does not necessarily imply greater investment in environmental innovation. When firms devote substantial capital resources to conventional productive assets or investments with limited environmental relevance, the contribution of CAPEX to environmental innovation may be limited (Casciello et al., 2024).

Agency theory provides an additional explanation for why greater capital investment intensity may not necessarily enhance environmental innovation. Managers may prioritize investments with relatively predictable or shorter-term returns over environmental innovations that involve greater uncertainty and longer payback periods (Vasconcelos & Ribeiro, 2026). Consequently, higher CAPEX intensity does not necessarily translate into greater environmental innovation, particularly when capital investment is directed toward projects with limited environmental relevance (O'Connell et al., 2025). Thus, higher CAPEX intensity may be associated with lower environmental innovation when capital investment is concentrated in activities that do not directly support environmental objectives. So, the hypothesis formed is as follows:

H3: CAPEX has a negative effect on environmental innovation among companies in ASEAN-3.

The positive effect of ESG performance on environmental innovation depends not only on firms' sustainability commitments but also on their ability to allocate resources toward implementing those commitments. Resource allocation theory suggests that strategic priorities generate organizational outcomes only when adequate resources are directed toward their implementation (Bower, 2018; Wang et al., 2023). In this context, CAPEX intensity represents the extent to which firms commit resources to capital investment and may influence their capacity to translate ESG commitments into environmental innovation.

Higher CAPEX intensity may strengthen the ESG–environmental innovation relationship when firms' capital investments provide the physical and technological resources necessary to implement sustainability-oriented strategies. For example, capital investments in clean technologies, energy-efficient equipment, pollution-control systems, renewable energy infrastructure, and environmentally oriented production processes may provide the physical and technological resources required to translate ESG commitments into environmental innovation. Under these conditions, higher CAPEX complements ESG performance by increasing firms' capacity to implement sustainability-oriented strategies (Casciello et al., 2024).

Conversely, higher CAPEX intensity may weaken the ESG–environmental innovation relationship when capital investments are not sufficiently aligned with environmental objectives. From an agency perspective, managers may prioritize investments that generate more immediate or predictable financial returns, while environmental innovations may receive less capital because of their higher uncertainty and longer payback periods (Vasconcelos & Ribeiro, 2026). Under such circumstances, strong ESG performance may not translate into corresponding environmental innovation because the increased capital investment does not necessarily provide resources that are directly relevant to sustainability-oriented innovation.

Accordingly, CAPEX does not simply determine the level of environmental innovation; rather, it conditions the extent to which ESG performance can be converted into environmental innovation. When higher CAPEX intensity provides resources that support sustainability-oriented activities, it is expected to strengthen the ESG–environmental innovation relationship. Conversely, when capital investment is concentrated in activities with limited environmental relevance, higher CAPEX intensity may weaken this relationship. So the hypothesis formed is as follows:

H4: CAPEX moderates the relationship between ESG and environmental innovation in companies in ASEAN-3.

Environmental innovation may also vary across ASEAN-3 countries because firms operate within different institutional and economic environments. Indonesia, Malaysia, and Singapore differ in environmental regulations, technological capabilities, market conditions, and institutional pressures, which may shape firms' incentives and capacity to undertake environmental innovation (Pratama et al., 2025). Institutional theory suggests that differences in regulatory and institutional environments influence organizational responses to sustainability pressures and the adoption of sustainability-oriented practices (Shubham et al., 2018).

Empirical evidence indicates that firms operating under more stringent environmental regulations tend to exhibit higher levels of environmental innovation because regulatory pressure encourages firms to develop technological and organizational responses to environmental challenges (Borsatto & Amui, 2019). Given the institutional differences among Indonesia, Malaysia, and Singapore, environmental innovation may therefore differ across the three countries. So, the hypothesis formed is as follows:

H5: There are differences in environmental innovations between countries in the ASEAN-3 region.

Figure 1 summarizes the conceptual framework and hypothesized relationships developed in this study. The framework illustrates the expected effects of ESG performance and the Environmental (E) pillar on environmental innovation (H1 and H2), the direct effect of CAPEX on environmental innovation (H3), and the moderating role of CAPEX in the ESG–environmental innovation relationship (H4). It also incorporates country differences across Indonesia, Malaysia, and Singapore as proposed in H5, while controlling for relevant firm- and country-level characteristics. Overall, the framework provides an integrated representation of the relationships empirically examined in the ASEAN-3 context.

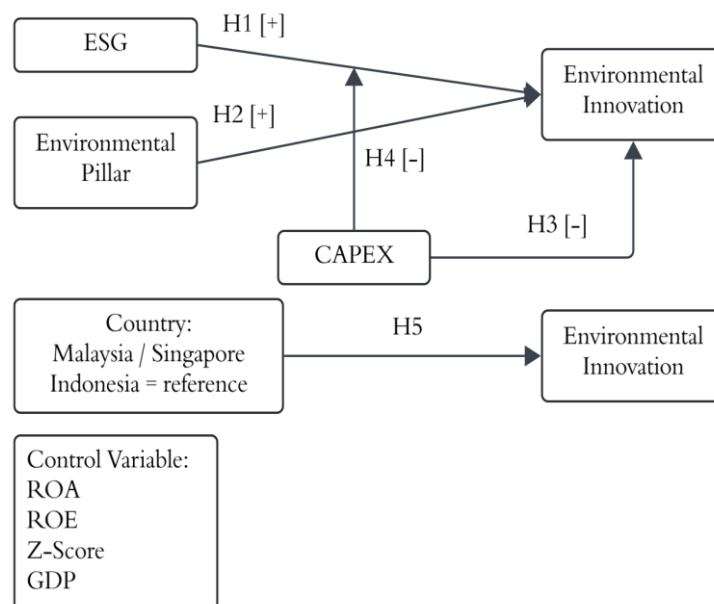


Figure 1. Conceptual Framework and Hypothesized Relationships

Source: Authors, 2026

METHODS

This study employs a quantitative research approach to examine the relationships among ESG, Environmental Pillar, CAPEX, and Environmental Innovation in publicly listed companies across the ASEAN-3 countries, namely Indonesia, Malaysia, and Singapore. Quantitative research is appropriate because it enables researchers to test hypotheses objectively through statistical analysis and to evaluate causal relationships among variables using numerical data (Creswell, 2018). Furthermore, this approach provides empirical evidence that can be generalized to the selected sample and supports theory validation through econometric analysis.

This study only uses secondary data from globally renowned databases that are accessible to the public. Data on Environmental Innovation, ESG Score, and Environmental Pillar Score are collected from the Refinitiv (LSEG Workspace) database, while financial data used to calculate CAPEX, Return on Assets (ROA), Return on Equity (ROE), and Altman Z-Score (ZS) are obtained from companies' annual reports and financial statements. In addition, country-level macroeconomic data, particularly Gross Domestic Product (GDP) Growth, are collected from official international statistical sources. The use of secondary data offers several advantages, including broad coverage across firms and countries, consistent measurement, and greater reliability in empirical research, particularly in cross-country panel studies (Hair et al., 2022).

This study uses panel data regression analysis to test the hypotheses by integrating time-series observations over several years with cross-sectional observations of businesses. This method is suitable because it controls for unobservable firm-specific heterogeneity, improves estimation efficiency, and captures both temporal and cross-country variations in environmental innovation across ASEAN-3 companies (Baltagi, 2021).

This study covers companies from all sectors listed on the Indonesia Stock Exchange (IDX), Singapore Exchange (SGX), and Bursa Malaysia (MYX) during the 2020–2024 observation period. A purposive sampling technique was applied based on the availability and consistency of environmental innovation and ESG data required for the analysis.

The relatively large reduction in the sample size reflects the strict data-availability criteria applied in this study. Environmental innovation data are not uniformly available for all listed firms, particularly across emerging and developing capital markets. Although many firms disclose general sustainability or ESG information, considerably fewer firms have sufficiently consistent and comparable environmental innovation data over the entire 2020–2024 observation period. Therefore, firms without the required environmental innovation and ESG data were excluded from the final sample. This screening procedure was necessary to ensure consistency in the measurement of the dependent and independent variables and to avoid constructing an unbalanced dataset from incomplete observations. The sample selection process is presented in Table 1.

Table 1. Sample Selection

Description	Companies in Indonesia	Companies in Singapore	Companies in Malaysia
Companies listed on the respective stock exchanges during the study period	920	572	1082
Companies without sufficient environmental innovation and ESG data for 2020–2024	(908)	(556)	(1060)
Final number of companies with the required data	12	16	22
Number of observations (5 years)	60	80	110

Source: Data processed, 2026

The final sample consists of 50 companies, comprising 12 companies from Indonesia, 16 from Singapore, and 22 from Malaysia. With five annual observations for each company during 2020–2024, the resulting balanced panel consists of 250 firm-year observations. The relatively small final sample should therefore be understood as a consequence of the availability of comparable environmental innovation and ESG data rather than as a random exclusion of firms. The analysis was conducted using STATA 17. The statistical procedures

included diagnostic tests for the panel-data model and regression analysis to examine the direct and moderating relationships proposed in the hypotheses.

The dependent variable in this study is environmental innovation, which is measured using firm-level data from the Refinitiv database provided through Thomson Reuters/LSEG. Environmental innovation refers to a firm's ability to reduce costs and environmental impacts for its customers while creating new market opportunities through green technologies, processes, or products designed with sustainability considerations. This measure has been widely adopted in previous empirical studies examining corporate environmental performance and innovation (Drempetic et al., 2020; Hussain et al., 2024). The use of the Refinitiv measure enables environmental innovation to be assessed consistently across firms and countries within the ASEAN-3 sample.

The description and measurement of the study variables are presented in Table 2. The main independent variables are the ESG Score and Environmental Pillar Score, both obtained from the Refinitiv/LSEG Workspace database. The ESG Score captures the extent to which firms incorporate sustainability principles across environmental, social, and governance dimensions, whereas the Environmental Pillar Score specifically evaluates firms' environmental performance, including resource utilization, waste management, energy efficiency, emissions control, and environmental innovation. Both measures range from 0 to 100, with higher scores indicating stronger sustainability performance. From the Resource-Based View and Stakeholder Theory perspectives, firms with stronger ESG and environmental performance are expected to possess greater organizational capabilities and stakeholder responsiveness that can facilitate environmental innovation (Barney, 1991; Refinitiv, 2022; Sulkowski et al., 2018).

CAPEX is employed as the moderating variable to examine whether the intensity of capital investment influences the relationship between ESG performance and environmental innovation. CAPEX is operationalized as capital expenditures divided by the book value of total assets, following Ki and Adhikari (2023). The ratio measures the intensity of capital investment relative to the firm's asset base and allows CAPEX to be compared across firms with different sizes. Higher values indicate greater capital investment intensity. Capital expenditure data and total asset values are obtained from the Thomson Reuters/LSEG database.

$$CAPEX\ Ratio_{it} = \frac{Capital\ Expenditures_{it}}{Total\ Assets_{it}} \frac{Capital\ Expenditure}{Operating\ Cash\ Flow} \quad (1)$$

This measure captures the extent to which firms commit their operating cash resources to long-term capital investments. In the context of this study, CAPEX is used to assess whether the allocation of investment resources strengthens or weakens the ability of ESG performance to translate into environmental innovation.

To reduce the risk of omitted variable bias and obtain a more precise assessment of the relationships among ESG performance, Environmental Pillar performance, CAPEX, and environmental innovation, the study incorporates four control variables: GDP growth, Altman Z-Score, Return on Equity (ROE), and Return on Assets (ROA). GDP growth captures differences in the broader economic environment across countries and years, while the Altman Z-Score controls for firms' financial stability and potential financial distress. ROE measures the firm's ability to generate returns from shareholders' equity, whereas ROA captures the efficiency with which firms utilize their assets to generate profits. Including these variables

helps account for firm-level financial conditions and macroeconomic factors that may influence environmental innovation independently of ESG performance and CAPEX.

Table 2. Variable Definition

Variable type	Variable name	Variable symbol	Definition
Dependent	Environmental innovation	EI	Data are obtained from the Refinitiv database
Independent	ESG Score	ESG	ESG Score data from the Refinitiv database
	Environmental Pillar	E	Environmental pillar data from the Refinitiv database
Moderating Control	Capital Expenditure	CAPEX	Capital expenditures divided by total assets
	Return on Asset	ROA	Net profit divided by total assets
	Return on Equity	ROE	Net profit divided by total equity
	Altman z-score	ZS	The analytical model used in the study is the Altman revised Z-score model (1983)
	GDP Growth	GDP	Country's GDP report
	Country Dummy (Malaysia)	MLY	Dummy variable indicating firms operating in Malaysia (1 = Indonesia; 2 = Malaysia; 3 = Singapore). Indonesia serves as the reference category.
	Country Dummy (Singapore)	SGP	Dummy variable indicating firms operating in Singapore (1 = Indonesia; 2 = Malaysia; 3 = Singapore). Indonesia serves as the reference category.

Source: Data processed, 2026

ROA and ROE are chosen because they reflect the company's ability to generate profits from shareholders' assets and capital. Companies with high profitability generally have greater financial capacity to support investment in research, the development of green technologies, and the implementation of environmental innovations (Xiong & Dai, 2023). Furthermore, the Altman Z-Score is used as an indicator of a company's financial health. When it comes to devoting resources to sustainable innovation initiatives, firms in stronger financial standing typically have more leeway than those under financial strain (Wedari et al., 2023). Meanwhile, GDP is used as a macroeconomic control variable to capture differences in economic development levels among Indonesia, Malaysia, and Singapore. These differences in economic conditions can affect companies' access to technology, funding, and policies that support environmental innovation. By controlling for these four variables, the research model is expected to provide a more robust estimate of the influence of ESG and the Environmental Pillar on environmental innovation.

This study used panel data regression analysis to examine the influence of ESG and the Environmental Pillar on Environmental Innovation, and to test the moderating role of CAPEX among companies listed in Indonesia, Malaysia, and Singapore during the observation period. The analysis was carried out using two main models to mitigate potential multicollinearity, given that the Environmental Pillar is one of the dimensions comprising the ESG Score. In addition, this study included Return on Assets (ROA), Return on Equity (ROE), Altman Z-Score, and Gross Domestic Product (GDP) as control variables to control the influence of company characteristics and macroeconomic conditions on environmental innovation. Differences in characteristics across countries are controlled for using dummy variables, with Indonesia as the reference category (baseline), so that the coefficients for Malaysia and Singapore are interpreted as differences relative to Indonesia.

The empirical analysis is conducted through five complementary regression models designed to examine the relationship between ESG performance, environmental performance, capital expenditure, and environmental innovation among publicly listed companies in the ASEAN-3 region. The models are estimated using a consistent set of control variables, including return on assets (ROA), return on equity (ROE), the Altman Z-Score, GDP growth, and country dummy variables. The inclusion of these controls helps account for differences in firm-level financial characteristics and macroeconomic conditions that may independently influence firms' capacity to undertake environmental innovation.

The first model was used to test the influence of the ESG Score on Environmental Innovation in companies in the ASEAN-3 region. This model also includes control variables, including ROA, ROE, the Altman Z-Score, GDP, and a country dummy, to control for differences in company characteristics and economic conditions across countries. The Model 1 equation is formulated as follows.

$$EI_{it} = \beta_0 + \beta_1 ESG_{it} + \beta_2 ROA_{it} + \beta_3 ROE_{it} + \beta_4 ZS_{it} + \beta_5 GDP_{it} + \beta_6 MLY_{it} + \beta_7 SGP_{it} + \varepsilon_{it} \dots \dots \dots (2)$$

The second model aims to test the influence of the Environmental Pillar Score on Environmental Innovation. The use of this model is intended to determine whether the environmental dimension of ESG has a more specific influence on environmental innovation than the overall ESG score. The model also accounts for the influence of control variables and differences in characteristics across countries. The Model 2 equation is as follows.

$$EI_{it} = \beta_0 + \beta_1 E_{it} + \beta_2 ROA_{it} + \beta_3 ROE_{it} + \beta_4 ZS_{it} + \beta_5 GDP_{it} + \beta_6 MLY_{it} + \beta_7 SGP_{it} + \varepsilon_{it} \dots \dots \dots (3)$$

The third model tests the direct influence of CAPEX on Environmental Innovation. This model aims to determine whether an increase in a company's fixed asset investment directly affects its ability to generate environmental innovation. The control variables and the country dummy are still included to obtain a more robust estimate. The Model 3 equation is formulated as follows.

$$EI_{it} = \beta_0 + \beta_1 CAPEX_{it} + \beta_2 ROA_{it} + \beta_3 ROE_{it} + \beta_4 ZS_{it} + \beta_5 GDP_{it} + \beta_6 MLY_{it} + \beta_7 SGP_{it} + \varepsilon_{it} \dots \dots \dots (4)$$

The fourth model was used to test whether CAPEX moderates the relationship between ESG and Environmental Innovation. The test was performed by adding interaction variables between ESG and CAPEX ($ESG \times CAPEX$) into the regression model. The coefficient on the interaction variable indicates whether CAPEX strengthens or weakens the influence of ESG on environmental innovation. The Model 4 equation is as follows.

$$EI_{it} = \beta_0 + \beta_1 ESG_{it} + \beta_2 CAPEX_{it} + \beta_3 (ESG_{it} \times CAPEX_{it}) + \beta_4 ROA_{it} + \beta_5 ROE_{it} + \beta_6 ZS_{it} + \beta_7 GDP_{it} + \beta_8 MLY_{it} + \beta_9 SGP_{it} + \varepsilon_{it} \dots \dots \dots (5)$$

The fifth model was used to test whether there were differences in Environmental Innovation between companies in Indonesia, Malaysia, and Singapore. The test was conducted through dummy countries, with Indonesia designated as the baseline category. Therefore, the coefficients of the dummy variables for Malaysia and Singapore indicate differences in the level of environmental innovation relative to Indonesia after accounting for the influence of

other variables. The H5 hypothesis is supported if at least one of the state dummy coefficients is statistically significant.

RESULT AND DISCUSSION

Based on 250 firm-year observations from publicly traded businesses in Indonesia, Malaysia, and Singapore, Table 3 displays the descriptive statistics of the variables employed in this study. With an average EI score of 50.341 and a standard deviation of 25.253, the ASEAN-3 countries' enterprises' environmental innovation performance varies significantly. The Environmental Pillar Score (E) averages slightly higher at 62.635 than the mean ESG Score of 62.546, indicating that the sampled firms generally demonstrate a reasonable level of sustainability performance, particularly in environmental activities.

Table 3. Descriptive Statistics

Variables	Obs	Mean	Std. Dev.	Min	Max	p1	p99
EI	250	50.341	25.253	8.049	98.276	8.148	96.326
ESG	250	62.546	14.253	9.803	91.142	18.083	90.2
E	250	62.635	16.625	8.225	94.724	10.556	92.669
CAPEX	250	.041	.035	0	.171	0	.146
ROA	250	.06	.076	-.205	.348	-.129	.323
ROE	250	.163	.293	-.467	1.767	-.343	1.329
ZS	250	2.73	2.453	-.45	11.772	.136	10.988
GDP	250	3.225	4.247	-5.457	9.757	-5.457	9.757

Source: Data processed, 2026

CAPEX has a mean of 0.041 and a standard deviation of 0.035, with values ranging from 0.000 to 0.171. The relatively moderate dispersion indicates differences in firms' capital investment intensity relative to their asset base. Regarding the control variables, the mean values of ROA and ROE are 0.060 and 0.163, respectively, indicating that the sampled firms generally maintain positive profitability. Furthermore, the average Altman Z-Score (ZS) of 2.730 suggests that most firms are financially stable and have a relatively low risk of financial distress. The average GDP Growth of 3.225% reflects the varying macroeconomic environments across Indonesia, Malaysia, and Singapore during the observation period. The dataset's suitability for further panel regression analysis is supported by the descriptive statistics, which generally show adequate variation across all variables.

The dependent, independent, moderating, and control factors' Pearson correlations are displayed in Table 4. The results show that the connection between the variables is not strong enough to be a problem, as their correlation values are below the standard limit of 0.80. This means that multicollinearity probably won't be a major issue when we do the regression analysis next (Hair et al., 2019).

The dependent variable, EI, exhibits a positive and statistically significant correlation with both the ESG Score ($r = 0.330$, $p < 0.01$) and the Environmental Pillar Score ($r = 0.542$, $p < 0.01$). These findings provide preliminary evidence that firms with stronger ESG performance and environmental management practices tend to achieve higher levels of environmental innovation, which is consistent with the theoretical perspective that sustainability-oriented governance encourages firms to develop environmentally friendly products, processes, and technologies (Chen & Xie, 2022; Porter & Linde, 1995).

In contrast, CAPEX exhibits a weak negative but statistically insignificant correlation with environmental innovation ($r = -0.054$, $p = 0.391$). This finding suggests that capital investment intensity relative to total assets is not significantly associated with environmental innovation at the bivariate level. The absence of a significant bivariate relationship does not, however, preclude a potential effect of CAPEX after controlling for firm characteristics and examining its interaction with ESG performance in the panel regression models.

Table 4. Correlation Matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) EI	1.000							
(2) ESG	0.330 (0.000)	1.000						
(3) E	0.542 (0.000)	0.733 (0.000)	1.000					
(4) CAPEX	-0.054 (0.391)	0.090 (0.156)	-0.057 (0.369)	1.000				
(5) ROA	0.061 (0.333)	0.068 (0.287)	0.108 (0.089)	0.267 (0.000)	1.000			
(6) ROE	0.215 (0.001)	0.169 (0.007)	0.204 (0.001)	0.291 (0.000)	0.857 (0.000)	1.000		
(7) ZS	-0.044 (0.491)	0.003 (0.958)	0.070 (0.271)	0.165 (0.009)	0.756 (0.000)	0.672 (0.000)	1.000	
(8) GDP	0.061 (0.338)	0.111 (0.081)	0.130 (0.039)	0.012 (0.849)	0.016 (0.800)	0.024 (0.707)	-0.049 (0.436)	1.000

Source: Data processed, 2026

Among the control variables, ROE is positively associated with environmental innovation ($r = 0.215$, $p < 0.01$), whereas ROA, Altman Z-Score (ZS), and GDP Growth are not statistically significant. Furthermore, the correlation between ESG and the Environmental Pillar is relatively strong ($r = 0.733$, $p < 0.01$), reflecting that environmental performance represents a fundamental component of overall ESG performance. Nevertheless, the correlation coefficient remains below the recommended threshold of 0.80, indicating that the variables can be estimated in separate regression models without introducing serious multicollinearity problems (Hair et al., 2019). Overall, the correlation analysis provides preliminary support for the proposed research model and confirms the dataset's suitability for subsequent panel regression analysis.

Before estimating the panel regression models, multicollinearity among the explanatory variables was assessed using the Variance Inflation Factor (VIF), with the results reported in Table 5. All variables exhibit VIF values below the conventional threshold of 10, while the corresponding tolerance values ($1/VIF$) are above 0.10. These findings indicate that multicollinearity does not pose a significant concern for the subsequent regression analysis (Hair et al., 2019).

Specifically, the highest VIF value is observed for Return on Assets (ROA) at 5.479, followed by Return on Equity (ROE) at 4.439. Although these values are relatively higher than those of the other explanatory variables, they remain below the conventional threshold of 10, suggesting that multicollinearity is within an acceptable range. The independent variables ESG and Environmental Pillar (E) have VIF values of 2.599 and 2.420, respectively,

indicating moderate associations with the other explanatory variables but no serious multicollinearity. The moderating variable CAPEX and the control variable GDP have VIF values of 1.191 and 1.028, respectively, indicating relatively low levels of collinearity. Similarly, the country dummy variables for Malaysia (MLY) and Singapore (SGP) have VIF values of 1.819 and 2.045, respectively, suggesting that their inclusion does not create substantial multicollinearity. The mean VIF of 2.605 further indicates that the overall level of multicollinearity in the explanatory variables is relatively low. Therefore, the explanatory variables can be included simultaneously in the panel regression models without evidence of problematic multicollinearity.

As part of the diagnostic tests for the panel regression models, the study examined the data for the presence of first-order serial correlation. The Wooldridge test for autocorrelation in panel data was employed to determine whether the regression model exhibits first-order serial correlation, with the results reported in Table 6. The null hypothesis of the Wooldridge test states that there is no first-order autocorrelation in the panel data (Drukker, 2003). The test produces an F-statistic of 7.993 with a p-value of 0.0068. Since the probability value is below the conventional significance level of 1% ($p < 0.01$), the null hypothesis of no first-order autocorrelation is rejected. The findings therefore indicate the presence of statistically significant first-order serial correlation in the panel dataset.

The presence of serial correlation indicates that the residuals may be correlated over time within firms. Therefore, conventional standard errors may not provide reliable statistical inference if the serial correlation is not appropriately addressed. To account for this issue, the subsequent random-effects regression models employ firm-clustered robust standard errors, which provide inference that is robust to within-firm serial correlation and heteroskedasticity. Accordingly, the presence of serial correlation does not invalidate the panel regression analysis but requires an appropriate adjustment to the estimation of standard errors.

Table 5. Multicollinearity Analysis

	VIF	1/VIF
ESG	2.599	.385
E	2.42	.413
CAPEX	1.191	.839
ROA	5.479	.183
ROE	4.439	.225
ZS	2.422	.413
GDP	1.028	.973
2.(MLY)	1.819	.55
3.(SGP)	2.045	.489
Mean VIF	2.605	.

Source: Data processed, 2026

Table 6. Autocorrelation Analysis

Test	Null Hypothesis	Test Statistic	p-value	Decision
Wooldridge Autocorrelation Test	No first-order autocorrelation	F = 7.993	0.0068	Reject H0

Source: Data processed, 2026

Following the diagnostic tests, panel model specification tests were conducted to identify the most appropriate estimation approach for the empirical analysis. The Chow, Breusch–Pagan Lagrange Multiplier (LM), and Hausman tests were employed to determine whether pooled OLS, Fixed Effects Model (FEM), or Random Effects Model (REM) should be selected (Baltagi, 2021). The results are presented in Table 7.

We reject the notion that the pooled ordinary least squares model is superior to the fixed-effects model since the Chow test yielded an F-statistic of 12.91 and a p-value of 0.000. The Fixed Effects Model is preferable to the pooled regression model since this result indicates that company differences are important.

The null hypothesis that the combined model is appropriate was then rejected after the Breusch–Pagan LM evaluation yielded a chi-square value of 131.48 and a p-value of 0.000. This result suggests that because the Random Effects Model (REM) takes into account unobservable individual influences, it is more suitable than the pooled OLS model.

The Hausman specification analysis ultimately produced a p-value of 0.4310 and a chi-square statistic of 8.03. We cannot rule out the null hypothesis because this probability value is higher than the 5% significance level, indicating that the Random Effects Model is more efficient and consistent than the Fixed Effects Model. The Random Effects Model (REM) was determined to be the best method for examining the suggested hypotheses based on the combined results of these three specification evaluations. As a result, the Random Effects Model was used for estimation in all subsequent regression analyses carried out in this study.

The Pesaran Cross-Sectional Dependence (CD) test was conducted to assess whether the residuals of the panel regression model are correlated across cross-sectional units, with the results reported in Table 8. The null hypothesis of the Pesaran CD test states that the cross-sectional units are independent, indicating the absence of statistically significant dependence across firms (Y. Xie & Pesaran, 2022).

Table 7. Panel Model Selection

Test	Null Hypothesis	Test Statistic	p-value	Decision	Select Model
Chow Test	Pooled OLS is preferred over Fixed Effects	$F = 12.91$	0.000	Reject H_0	Fixed Effects
Breusch–Pagan LM Test	Pooled OLS is preferred over Random Effects	$\chi^2 = 131.48$	0.000	Reject H_0	Random Effects
Hausman Specification Test	Random Effects is preferred over Fixed Effects	$\chi^2 = 8.03$	0.4310	Fail to reject H_0	Random Effects

Source: Data processed, 2026

Table 8. Cross-sectional Dependence

Test	Null Hypothesis	Test Statistic	p-value
Pesaran CD Test	Cross-sectional independence	-1.135	0.2563

Source: Data processed, 2026

The test produces a statistic of -1.135 with a p-value of 0.2563. Since the p-value is greater than the 5% significance level, the null hypothesis of cross-sectional independence cannot be rejected. This finding indicates that there is no statistically significant evidence of cross-sectional dependence among the firms in the panel dataset. The average absolute value

of the off-diagonal elements is 0.482, indicating the magnitude of the average pairwise correlation across the cross-sectional units.

Following the panel model specification and diagnostic tests, the study proceeded with the estimation of the proposed regression models to examine the hypothesized relationships among ESG, environmental performance, capital expenditure, and environmental innovation. The regression results presented in Table 9 show that ESG has a positive and statistically significant relationship with environmental innovation in both estimated models. ESG registers a coefficient of 0.662 with a t-value of 5.99 ($p < 0.01$) in Model (1). The coefficient remains positive and statistically significant ($t = 4.62$; $p < 0.01$) but marginally drops to 0.504 after the control variables are included in Model (2). After adjusting for firm-level financial factors, macroeconomic conditions, and cross-country variations, the estimated association remains statistically significant across both parameters. This finding is also consistent with evidence from the ASEAN context, where higher ESG performance has been associated with stronger corporate resilience and market performance, suggesting that ESG can provide firms with strategic capabilities to respond to changing environmental and economic conditions (Ariyudha & Rokhim, 2025).

Regarding the control variables, ROA shows a negative and statistically significant coefficient ($\beta = -121.845$; $t = -2.81$; $p < 0.01$), whereas ROE shows a positive and statistically significant coefficient ($\beta = 52.559$; $t = 5.26$; $p < 0.01$) with environmental innovation. Similarly, Altman Z-Score (ZS) is negatively associated with environmental innovation ($\beta = -2.210$; $t = -2.48$; $p < 0.05$). In contrast, GDP Growth does not exhibit a statistically significant effect on environmental innovation ($\beta = 0.021$; $t = 0.06$; $p > 0.05$), indicating that variations in national economic growth do not substantially explain differences in firms' environmental innovation within the observed sample.

Table 9. Regression Test of ESG on Environmental Innovation

EI	(1)	(2)
ESG	.662*** (5.99)	.504*** (4.62)
ROA		-121.845*** (-2.81)
ROE		52.559*** (5.26)
ZS		-2.21** (-2.48)
GDP		.021 (0.06)
Country: base IDN		
MLY	-11.696*** (-3.06)	-15.171*** (-4.01)
SGP	-4.383 (-1.08)	-10.282** (-2.41)
Constant	15.489** (2.07)	33.473*** (4.13)
R-squared	0.144	0.242
F-test	13.756	11.064

*** $p < .01$, ** $p < .05$, * $p < .1$

Notes: In parentheses is the "t" value

Source: Data processed, 2026

The country dummy variables reveal observable differences across the ASEAN-3 countries. Relative to Indonesia as the reference category, firms operating in Malaysia display significantly lower environmental innovation in both Model (1) ($\beta = -11.696$; $t = -3.06$; $p < 0.01$) and Model (2) ($\beta = -15.171$; $t = -4.01$; $p < 0.01$). Meanwhile, the coefficient for Singapore is statistically insignificant in Model (1), but becomes negative and significant in Model (2) ($\beta = -10.282$; $t = -2.41$; $p < 0.05$) after firm-specific characteristics are controlled for. These results indicate that cross-country differences become more apparent when financial and macroeconomic factors are incorporated into the regression model.

Additionally, the control variables increase the explanatory power of the model. The extended model explains a greater percentage of the variation in environmental innovation, as evidenced by the R-squared increasing from 0.144 in Model (1) to 0.242 in Model (2). Furthermore, both regression models are jointly significant, as indicated by F-statistics of 13.756 and 11.064 ($p < 0.01$), respectively, confirming that the explanatory variables collectively provide a statistically meaningful explanation of environmental innovation (Khanchel et al., 2023).

The Environmental Pillar (E) is positively and statistically strongly correlated with environmental innovation in both model parameters, as shown by the regression findings in Table 10. The Environmental Pillar in Model (1) has a t-value of 10.23 ($p < 0.01$) and a coefficient of 0.829. The coefficient in Model (2) drops to 0.739 after the control factors are added, but it is still highly significant ($t = 9.24$; $p < 0.01$). The consistently positive coefficients and high statistical significance indicate that the relationship between the Environmental Pillar and environmental innovation remains stable after controlling for firm-level financial performance, macroeconomic conditions, and country-specific effects (Papke & Wooldridge, 2023).

Table 10. Regression Test of the Environmental Pillar on Environmental Innovation

EI	(1)	(2)
E	.829*** (10.23)	.739*** (9.24)
ROA		-100.019** (-2.57)
ROE		44.296*** (4.95)
ZS		-2.406*** (-3.02)
GDP		-.16 (-0.53)
Country: base IDN		
MLY	-8.313** (-2.46)	-12.402*** (-3.68)
SGP	-4.125 (-1.14)	-9.67** (-2.56)
Constant	3.383 (0.58)	18.421*** (2.92)
R-squared	0.312	0.391
F-test	37.106	22.161

*** $p < .01$, ** $p < .05$, * $p < .1$

Notes: In parentheses is the "t" value

Source: Data processed, 2026

Among the control variables, ROA exhibits a negative and statistically significant coefficient ($\beta = -100.019$; $t = -2.57$; $p < 0.05$), whereas ROE shows a positive and statistically significant coefficient ($\beta = 44.296$; $t = 4.95$; $p < 0.01$) with environmental innovation. In addition, the Altman Z-Score (ZS) is negatively associated with environmental innovation ($\beta = -2.406$; $t = -3.02$; $p < 0.01$). Conversely, GDP Growth does not display a statistically significant relationship with environmental innovation ($\beta = -0.160$; $t = -0.53$; $p > 0.05$), indicating that differences in macroeconomic growth across the observed countries do not significantly explain firms' environmental innovation performance.

The estimated country dummy variables further reveal differences in environmental innovation among the ASEAN-3 countries. Using Indonesia as the reference category, firms located in Malaysia exhibit significantly lower environmental innovation in both Model (1) ($\beta = -8.313$; $t = -2.46$; $p < 0.05$) and Model (2) ($\beta = -12.402$; $t = -3.68$; $p < 0.01$). Similarly, the coefficient for Singapore is statistically insignificant in Model (1) but becomes negative and statistically significant after the inclusion of the control variables in Model (2) ($\beta = -9.670$; $t = -2.56$; $p < 0.05$). These findings indicate that cross-country differences in environmental innovation become more evident after accounting for firm-specific financial characteristics.

The regression model's explanatory ability is also enhanced by the control variables. The extended model explains around 39.1% of the variation in environmental innovation, according to the R-squared, which rises from 0.312 in Model (1) to 0.391 in Model (2). Furthermore, both models are statistically significant based on the overall F-test, with values of 37.106 and 22.161, respectively ($p < 0.01$), indicating that the explanatory variables jointly provide a statistically significant explanation of firms' environmental innovation performance (Khanchel et al., 2023).

The regression results presented in Table 11 examine whether capital expenditure (CAPEX), measured as CAPEX relative to total assets, is associated with environmental innovation (EI). The analysis is presented in two specifications: Model (1) estimates the direct association between CAPEX and EI, while Model (2) incorporates the financial, macroeconomic, and country-level control variables. This specification allows the robustness of the CAPEX–environmental innovation relationship to be assessed after accounting for other factors that may influence firms' environmental innovation performance.

CAPEX is negatively associated with environmental innovation, although the relationship becomes statistically significant only after the control variables are included, according to Table 11's regression results. In Model (1), CAPEX records a negative coefficient of -55.068 , but the relationship is not statistically significant ($t = -1.16$). The coefficient remains negative and becomes statistically significant after the control variables are included in Model (2), with a coefficient of -115.279 ($t = -2.54$; $p < 0.05$). After adjusting for firm-specific financial factors, macroeconomic conditions, and country-specific effects, the negative and significant coefficient in Model (2) suggests that higher capital expenditure intensity is associated with lower levels of environmental innovation.

Among the control variables, ROE shows a positive and statistically significant influence on environmental innovation ($\beta = 67.621$; $t = 7.69$; $p < 0.01$), suggesting that firms with higher returns to shareholders may have greater incentives and capacity to support innovation activities. In contrast, ROA shows a negative and statistically significant association with environmental innovation ($\beta = -146.229$; $t = -4.55$; $p < 0.01$). This finding suggests that higher asset profitability does not necessarily translate into greater environmental innovation. From a resource allocation perspective, firms with higher returns

from existing assets may prioritize investments that generate more immediate or predictable financial returns rather than environmental innovation, which typically involves higher uncertainty and longer payback periods (Bower, 2018). Likewise, there is a negative relationship between environmental innovation and the Altman Z-Score (ZS) ($\beta = -2.831$; $t = -3.97$; $p < 0.01$). This result indicates that financially more stable firms do not necessarily allocate greater resources to environmental innovation, suggesting that financial strength alone may not be sufficient to encourage environmental innovation. From a resource allocation perspective, the availability of financial resources does not automatically ensure their allocation toward environmental objectives, as firms must make strategic choices regarding how resources are deployed across competing priorities (Bower, 2018). On the other hand, GDP growth shows no statistically significant relationship with environmental innovation ($\beta = 0.191$; $t = 0.53$; $p > 0.05$), suggesting that firm-level financial and strategic considerations may be more directly relevant to environmental innovation than broader macroeconomic growth conditions.

Table 11. Regression Test of CAPEX to Environmental Innovation

EI	(1)	(2)
CAPEX	-55.068 (-1.16)	-115.279** (-2.54)
ROA		-146.229*** (-4.55)
ROE		67.621*** (7.69)
ZS		-2.831*** (-3.97)
GDP		.191 (0.53)
Country: base IDN		
MLY	-8.402** (-2.33)	-13.706*** (-4.44)
SGP	-9.038** (-2.23)	-15.867*** (-4.06)
Constant	59.174*** (17.80)	70.962*** (16.90)
R-squared	0.024	0.198
F-test	2.804	14.681

*** $p < .01$, ** $p < .05$, * $p < .1$

Notes: In parentheses is the “t” value

Source: Data processed, 2026

The country dummy variables also reveal differences in environmental innovation across the ASEAN-3 countries. Relative to Indonesia as the reference category, firms operating in Malaysia exhibit significantly lower environmental innovation in both Model (1) ($\beta = -8.402$; $t = -2.33$; $p < 0.05$) and Model (2) ($\beta = -13.706$; $t = -4.44$; $p < 0.01$). Likewise, firms in Singapore exhibit lower levels of environmental innovation than those in Indonesia, with the coefficients being statistically significant in both Model (1) ($\beta = -9.038$; $t = -2.23$; $p < 0.05$) and Model (2) ($\beta = -15.867$; $t = -4.06$; $p < 0.01$). These findings indicate that the observed cross-country differences remain robust after accounting for firm-level financial characteristics.

The explanatory capability of the regression model increases once the control variables are added, with the R-squared increasing from 0.024 in Model (1) to 0.198 in Model (2). Additionally, the overall regression model shows greater statistical significance after the inclusion of the control variables, indicating that the broader model accounts for a larger share of the differences in environmental innovation and that the explanatory variables collectively contribute to explaining firms' environmental innovation performance (Khanchel et al., 2023).

The results of the Random Effects panel regression analysis examining whether CAPEX moderates the relationship between ESG performance and Environmental Innovation (EI) are presented in Table 12. Four regression models were estimated to assess both the direct and moderating effects. Models (1) and (2) examine the relationship between CAPEX and environmental innovation without and with control variables, respectively, while Models (3) and (4) incorporate the interaction term between ESG and CAPEX to assess the moderating effect. Based on the panel model specification tests, the Random Effects estimator was selected as the appropriate estimation method (Baltagi, 2021).

Table 12. Moderation Test

EI	(1)	(2)	(3)	(4)
ESG			.865*** (5.58)	.737*** (4.87)
CAPEX			314.367 (1.13)	339.379 (1.37)
(ESG x CAPEX)	-.183 (-0.26)	-1.279* (-1.89)	-5.855 (-1.38)	-7.035* (-1.88)
ROA		-152.043*** (-4.53)		-135.708*** (-4.12)
ROE		67.83*** (7.32)		58.823*** (6.94)
ZS		-2.704*** (-3.80)		-1.803** (-2.34)
GDP		.212 (0.59)		.056 (0.16)
Country: base IDN				
MLY	-8.191** (-2.23)	-13.368*** (-4.26)	-11.645*** (-3.40)	-15.03*** (-4.91)
SGP	-8.195** (-2.02)	-15.341*** (-3.92)	-4.363 (-1.10)	-10.304** (-2.51)
Constant	57.043*** (17.73)	69.161*** (16.91)	5.128 (0.51)	21.827** (2.00)
R-squared	0.019	0.188	0.160	0.274
F-test	2.104	14.176	11.606	18.005

*** $p < .01$, ** $p < .05$, * $p < .1$

Notes: In parentheses is the "t" value

Source: Data processed, 2026

The results indicate that ESG has a positive and statistically significant relationship with environmental innovation in both moderation models. In Model (3), ESG has a coefficient of 0.865 ($t = 5.58$; $p < 0.01$), while in Model (4), the coefficient is 0.737 ($t = 4.87$; $p < 0.01$). This finding indicates that firms with stronger ESG performance tend to demonstrate higher levels of environmental innovation, even after the interaction term and control variables are incorporated into the models. Regarding CAPEX, the results show that its direct effect is not statistically significant in either moderation model. In Model (3),

CAPEX has a coefficient of 314.367 ($t = 1.13$; $p > 0.10$), while in Model (4), the coefficient is 339.379 ($t = 1.37$; $p > 0.10$). These results suggest that CAPEX alone does not significantly explain variations in environmental innovation after ESG performance and other factors are considered.

The interaction between ESG and CAPEX provides evidence of a negative moderating effect. The interaction coefficient is -5.855 ($t = -1.38$; $p > 0.10$) in Model (3) and becomes negative and statistically significant in Model (4), with a coefficient of -7.035 ($t = -1.88$; $p < 0.10$). This finding indicates that higher CAPEX tends to weaken the positive relationship between ESG performance and environmental innovation when firm-level financial, macroeconomic, and country-specific controls are included. From a resource allocation perspective, this result suggests that increasing capital expenditure does not necessarily strengthen the conversion of ESG commitments into environmental innovation. Instead, the allocation of capital resources across competing investment priorities may influence the extent to which firms can translate ESG-oriented commitments into environmental innovation, particularly when such allocation is not sufficiently aligned with environmental objectives (Bower, 2018). Thus, the effectiveness of ESG performance in promoting environmental innovation depends not only on the availability of investment resources but also on how those resources are allocated.

Among the control variables, ROA shows a negative and statistically significant relationship with environmental innovation in Model (4) ($\beta = -135.708$; $t = -4.12$; $p < 0.01$), whereas ROE has a positive and statistically significant relationship ($\beta = 58.823$; $t = 6.94$; $p < 0.01$). The Altman Z-Score (ZS) also exhibits a negative and statistically significant relationship with environmental innovation ($\beta = -1.803$; $t = -2.34$; $p < 0.05$). These findings are consistent with the previous results and suggest that firm-level financial characteristics may influence environmental innovation differently depending on how financial resources are generated and allocated. Meanwhile, GDP growth remains statistically insignificant ($\beta = 0.056$; $t = 0.16$; $p > 0.10$), indicating that broader economic growth conditions do not significantly explain variations in environmental innovation within the estimated model.

The country dummy variables also indicate persistent differences in environmental innovation across the ASEAN-3 countries. Relative to Indonesia as the reference category, firms in Malaysia exhibit significantly lower levels of environmental innovation in both Model (3) ($\beta = -11.645$; $t = -3.40$; $p < 0.01$) and Model (4) ($\beta = -15.030$; $t = -4.91$; $p < 0.01$). For Singapore, the coefficient is negative but statistically insignificant in Model (3) ($\beta = -4.363$; $t = -1.10$; $p > 0.10$), while it becomes statistically significant in Model (4) ($\beta = -10.304$; $t = -2.51$; $p < 0.05$). These results indicate that cross-country differences remain evident after accounting for the moderating effect of CAPEX and other firm-level characteristics.

The explanatory power of the model also improves after the inclusion of the control variables, with the R-squared increasing from 0.160 in Model (3) to 0.274 in Model (4). The F-statistics of 11.606 and 18.005 indicate that both models are jointly significant. More importantly, the negative and statistically significant interaction term in Model (4) indicates that CAPEX weakens the positive relationship between ESG performance and environmental innovation, supporting H4. To further interpret this moderating effect, a marginal-effects analysis was conducted at different levels of CAPEX, with the results presented in Table 13.

Table 13. Marginal Effects of ESG on Environmental Innovation at Different Levels of CAPEX

CAPEX Level	CAPEX/TA	Marginal Effect	Std. Error	z	p-value	95% CI
Low (P25)	0.0155	0.923	0.126	0.140	0.000	0.677–1.170
Medium (P50)	0.0318	0.752	0.119	6.30	0.000	0.518–0.986
High (P75)	0.0545	0.513	0.140	3.66	0.000	0.238–0.788

Source: Data processed, 2026

The marginal-effects analysis provides further evidence of the negative moderating effect of CAPEX. The positive effect of ESG on environmental innovation decreases from 0.923 at a low level of CAPEX (P25) to 0.752 at the median level (P50) and 0.513 at a high level (P75), while remaining statistically significant at all three levels ($p < 0.001$). This declining pattern indicates that higher CAPEX attenuates the positive effect of ESG on environmental innovation, providing further support for H4.

To assess the robustness of the main findings, a supplementary regression analysis was conducted using an alternative model specification while retaining the key explanatory, moderating, and control variables. As reported in Table 14, the robustness results reveal some differences in the direct effects of ESG and CAPEX compared with the main regression models. These differences are important because they indicate that the individual coefficients of ESG and CAPEX are sensitive to the alternative model specification. However, the central moderating relationship remains stable across specifications (Drukker, 2003).

Table 14. Robustness Test

EI	Coef	std. err.	t	P> t
ESG	.003	.009	0.34	.736
CAPEX	15.1	7.676	1.97	.049
E	.024	.006	3.88	0
(ESG x CAPEX)	-.245	.108	-2.27	.023
ROA	-.146	.728	-0.20	.841
ROE	.307	.208	1.48	.14
ZS	-.02	.024	-0.82	.411
GDP	-.001	.005	-0.28	.779
country_id: IDN				
MLY	-.201	.147	-1.37	.172
SGP	-.136	.191	-0.71	.478
cons	2.239	.451	4.96	0

Source: Data processed, 2026

In the robustness specification, ESG has a positive but statistically insignificant relationship with environmental innovation ($\beta = 0.003$; $t = 0.34$; $p = 0.736$), whereas CAPEX exhibits a positive and statistically significant relationship with environmental innovation ($\beta = 15.100$; $t = 1.97$; $p = 0.049$). These results differ from the main analysis, where the direct effects of ESG and CAPEX were estimated under the primary model specification. Such differences may arise because the inclusion of the interaction term changes the interpretation of the lower-order coefficients and because the alternative specification captures the conditional nature of the ESG–environmental innovation relationship more explicitly. Therefore, the direct coefficients of ESG and CAPEX should not be interpreted independently of the interaction term.

Importantly, the interaction between ESG and CAPEX remains negative and statistically significant ($\beta = -0.245$; $t = -2.27$; $p = 0.023$). This result is consistent with the main moderation analysis and indicates that higher CAPEX weakens the positive relationship between ESG performance and environmental innovation. Thus, although the signs and statistical significance of the direct ESG and CAPEX coefficients change under the alternative specification, the key moderating effect remains negative and statistically significant. This persistence provides stronger evidence that the central finding concerning the moderating role of CAPEX is not driven solely by the primary model specification.

The control variables do not exhibit statistically significant relationships with environmental innovation in the robustness specification. ROA, ROE, ZS, and GDP Growth are all statistically insignificant, while the country dummy variables for Malaysia and Singapore are also statistically insignificant relative to Indonesia. Overall, the robustness analysis provides partial rather than complete confirmation of the main results: the direct effects of ESG and CAPEX are sensitive to the alternative specification, but the negative and significant ESG $\times$ CAPEX interaction remains stable. This strengthens confidence in the conclusion that CAPEX moderates the ESG–environmental innovation relationship by weakening the positive effect of ESG on environmental innovation.

This research explores the connections between ESG performance, the Environmental Pillar (E), CAPEX, and Environmental Innovation (EI) for publicly traded firms in Indonesia, Malaysia, and Singapore. The overall results indicate that ESG—especially its environmental component—has a beneficial effect on environmental innovation, while CAPEX has a detrimental impact, diminishing ESG's positive effect. In addition, notable variations in environmental innovation are found among the three ASEAN nations. These results enhance the existing body of knowledge on sustainable corporate practices by highlighting that merely making investment choices is not enough to foster environmental innovation unless these choices are effectively integrated with sustainability goals. Table 15 shows all supported hypotheses based on the results described earlier.

The first finding indicates that ESG positively affects environmental innovation, supporting the growing consensus that sustainability-oriented corporate practices stimulate firms' innovation capabilities. This result supports Hypothesis 1 (H1). A company's dedication to incorporating environmental, social, and governance factors into strategic management is reflected in its ESG implementation (Frag, 2025). Businesses are encouraged to invest in sustainable product development, eco-friendly technologies, and cleaner production methods as a result of this integration (Zhao et al., 2023). This discovery aligns with the Resource-Based View (RBV), which posits that a company's abilities, expertise, and management frameworks serve as essential strategic assets that can lead to enduring competitive edges (Barney, 1991). ESG practices strengthen these capabilities by improving managerial quality, stakeholder engagement, organizational learning, and risk management, all of which facilitate innovation activities (Yu et al., 2025).

The Natural Resource-Based View (NRBV) put forth by (Hart, 1995), which expands RBV by highlighting environmental capabilities as strategic resources, is also supported by the positive correlation between ESG and environmental innovation. According to NRBV, firms that proactively invest in environmental management develop superior capabilities for pollution prevention, resource efficiency, and sustainable product development (Hart, 1995; McDougall et al., 2022). These capabilities ultimately translate into stronger environmental innovation performance. Stakeholder Theory also clarifies that companies are under growing demands from investors, regulatory bodies, customers, and the community to enhance their

sustainability efforts (Sulkowski et al., 2018). Responding to these pressures encourages firms to introduce innovative environmental solutions that satisfy stakeholder expectations while maintaining corporate legitimacy.

Table 15. Hypothesis Test

Hypothesis	Model	Coefficient	t-value	Decision
H1	Model 2	0.504***	4.62	Supported
H2	Model 2	0.739***	9.24	Supported
H3	Model 2	-115.279**	-2.54	Supported
H4	Model 4	-7.035*	-1.88	Supported (Negative Moderation)
H5	Model 4	Malaysia = -15.030***	-4.91	Supported
		Singapore = -10.304**	-2.51	

Source: Data processed, 2026

The empirical findings are consistent with previous studies. (Xie et al., 2019) demonstrated that environmental management practices significantly improve green process and product innovation. (Broadstock et al., 2021) found that firms with superior ESG performance exhibit greater innovation capability due to stronger governance quality and more efficient resource allocation. Similarly, (Hou et al., 2025) concluded that ESG performance promotes green technological innovation through enhanced organizational capabilities and stakeholder collaboration. Collectively, these studies reinforce the argument that ESG functions not merely as a disclosure mechanism but as an important driver of sustainable innovation.

The second discovery shows that the Environmental Pillar has an even greater beneficial impact on environmental innovation than the total ESG score. These results suggest that Hypothesis 2 (H2) is supported. Compared with ESG, the environmental dimension focuses directly on firms' environmental policies, carbon emissions, energy efficiency, waste management, and resource conservation (Patil et al., 2021). Consequently, improvements in environmental performance are more closely associated with environmental innovation activities. This result aligns with the Porter Hypothesis, which suggests that environmental rules and proactive management of the environment encourage technological advancements that enhance both ecological and economic outcomes (Porter & Linde, 1995). Firms that actively pursue environmental initiatives often redesign production systems, develop eco-friendly products, and improve operational efficiency, thereby increasing innovation outcomes. Previous studies similarly reported that environmental management practices directly stimulate green innovation and enhance firms' long-term competitiveness (Albitar et al., 2024; X. Xie et al., 2019).

The third finding demonstrates that Capital Expenditure negatively affects environmental innovation, indicating that greater investment in physical assets does not necessarily translate into stronger environmental innovation. These results suggest that Hypothesis 3 (H3) is supported. This finding suggests that many firms within ASEAN-3 continue to allocate capital expenditure primarily toward production expansion, operational capacity, or conventional infrastructure rather than environmentally sustainable technologies (Nepal et al., 2021). Such investment priorities may improve production efficiency without substantially contributing to environmental innovation (Khalil & Nimmanunta, 2023). This outcome is in line with research that contends that capital investment only fosters green innovation when it is specifically focused on eco-friendly technologies (D'Amato et al., 2021).

Therefore, the effectiveness of CAPEX depends not only on the amount invested but also on the strategic allocation of investment resources.

The moderation analysis indicates that CAPEX weakens the positive relationship between ESG performance and environmental innovation. Although stronger ESG performance remains positively associated with environmental innovation, the negative interaction effect indicates that this positive relationship becomes weaker as CAPEX increases. The marginal effects analysis further supports this finding, showing that the positive effect of ESG on environmental innovation declines consistently across low, medium, and high levels of CAPEX. Thus, the findings support Hypothesis 4 (H4), indicating that higher capital expenditure reduces the strength of the positive ESG–environmental innovation relationship. This suggests that capital expenditure does not automatically enhance the innovation benefits associated with ESG performance, particularly when investment resources are not sufficiently aligned with sustainability-oriented technologies and processes (Cohen et al., 2026; Jain, 2026). Therefore, investment expansion alone may not be sufficient to strengthen environmental innovation, highlighting the importance of aligning capital allocation decisions with environmental objectives. Consistent with this perspective, sustainability-oriented investment strategies are more likely to generate innovation benefits when firms deliberately integrate environmental considerations into their investment decisions (Flammer, 2023).

The final finding indicates significant cross-country differences in environmental innovation among ASEAN-3 firms. In contrast to Indonesia, companies functioning in Malaysia and Singapore demonstrate reduced degrees of environmental innovation once firm traits and economic factors are taken into account. This result answers Hypothesis 5 (H5). These differences may reflect variations in industrial structures, environmental regulations, ESG implementation, and corporate investment priorities across countries. Indonesia has experienced substantial growth in mandatory sustainability reporting, green finance initiatives, and environmental disclosure requirements over recent years, encouraging firms to increase their environmental innovation efforts (Prihandono & S. Yuniarti, 2023; Supriyanto et al., 2025). Meanwhile, firms in Malaysia and Singapore may allocate greater investment toward technological efficiency or international competitiveness that is not fully captured by the environmental innovation indicator employed in this study (Ong et al., 2019; Wenlong et al., 2022). These findings support the argument of Institutional Theory (DiMaggio and Powell, 1983), which posits that institutional environment—including government regulations, market pressures, and societal expectations—shape firms' strategic responses to sustainability and innovation.

In summary, this research adds to the existing body of knowledge on ESG and sustainability by showing that environmental advancements are influenced by both the performance in sustainability and the financial choices made by corporations, as well as the surrounding institutional environment. ESG and environmental performance are important drivers of environmental innovation, while the effectiveness of capital expenditure in supporting environmental innovation may depend on the extent to which investment resources are aligned with environmental objectives. The findings therefore emphasize that firms should align capital allocation with sustainability strategies to maximize innovation outcomes. For policymakers, the results suggest that strengthening ESG regulations alone may be insufficient unless accompanied by incentives encouraging firms to channel capital investments toward environmentally friendly technologies. Such policy alignment will be essential for supporting sustainable industrial transformation across the ASEAN region.

CONCLUSIONS

This research investigated the effects of ESG performance, the Environmental Pillar (E), and CAPEX on Environmental Innovation (EI) in publicly traded firms within the ASEAN-3 area, which includes Indonesia, Malaysia, and Singapore. This study provides empirical results about the connection between corporate investment decisions in promoting environmental innovation and sustainability performance using panel data regression with a Random Effects Model. The research results show multiple significant conclusions. First, environmental innovation is positively and significantly impacted by ESG performance, suggesting that companies with more robust sustainability initiatives have a greater tendency to create environmentally friendly products, adopt cleaner methods of production, and develop sustainable technologies. This result verifies that ESG serves not only as a framework for sustainability reporting but also as a strategic asset that boosts the innovation potential of companies (Cohen et al., 2026; Nepal et al., 2021). Second, the environmental pillar demonstrates a stronger positive influence on environmental innovation than the overall ESG score. This result suggests that environmental-related corporate initiatives—including carbon management, resource efficiency, waste reduction, and environmental policies—represent the most influential ESG dimension in stimulating environmental innovation. Consequently, firms that emphasize environmental responsibility are better positioned to translate sustainability commitments into innovative outcomes. Third, CAPEX exhibits a significant negative relationship with environmental innovation. This finding implies that capital investment alone does not necessarily support sustainability-oriented innovation, as its contribution to environmental innovation may depend on the alignment between investment allocation and environmental objectives. Therefore, the effectiveness of CAPEX depends largely on the strategic orientation of investment rather than its magnitude (Mirza et al., 2024). Fourth, the analysis of moderation shows that spending on capital reduces the beneficial impact of ESG on environmental innovation. This finding suggests that organizations that excel in ESG may still see diminished innovation advantages when their investment choices focus more on conventional physical assets rather than on green technologies. Accordingly, sustainability performance and investment strategy should be integrated rather than implemented independently (Supriyanto et al., 2025). Finally, this study identifies significant differences in environmental innovation across ASEAN-3 countries. Relative to Indonesia, firms operating in Malaysia and Singapore exhibit lower levels of environmental innovation after controlling for firm-specific characteristics. These differences suggest that institutional environments, sustainability regulations, corporate investment priorities, and national innovation ecosystems continue to shape firms' environmental innovation performance (Ong et al., 2019; Prihandono & S. Yuniarti, 2023; Supriyanto et al., 2025; Wenlong et al., 2022).

From a theoretical perspective, this study extends the Resource-Based View, Natural Resource-Based View, Stakeholder Theory, and Institutional Theory by demonstrating that sustainability performance alone is insufficient to maximize environmental innovation unless accompanied by appropriate investment allocation. From a pragmatic point of view, the results highlight the importance for managers to coordinate financial investment choices with enduring sustainability plans, whereas lawmakers ought to support ESG rules by providing incentives that motivate companies to invest in eco-friendly technologies. Even with these contributions, some limitations must be recognized. To begin with, this research concentrates exclusively on publicly traded firms in three ASEAN nations, which restricts the applicability of the results to alternative emerging or developed markets. Additionally, environmental

innovation is assessed through one secondary metric sourced from the Refinitiv ESG database, which might not encompass all facets of companies' innovative efforts. Furthermore, capital expenditure is evaluated via a financial ratio that fails to differentiate between environmentally friendly investments and traditional investments, rendering it unfeasible to pinpoint the exact distribution of corporate capital spending. Future research is encouraged to expand the geographical coverage by including additional ASEAN countries or conducting cross-regional comparisons between emerging and developed economies. Researchers could also consider alternative indicators of environmental innovation, including green patents, environmental R&D spending, or green technology adoption, to offer a more thorough evaluation of innovation performance. Additionally, future research should differentiate between green capital expenditure and traditional capital spending to better understand how varying investment types impact environmental innovation. Lastly, employing advanced econometric methods like dynamic panel estimation, System-GMM, or threshold regression can yield more profound insights into the long-term and nonlinear relationships among ESG performance, investment choices, and environmental innovation.

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OPTIMIZING CUSTOMER BRAND ENGAGEMENT VIA DIGITAL MARKETING STRATEGY, SOCIAL MEDIA INFLUENCERS, AND BRAND EQUITY: A STUDY ON ORTUSEIGHT



SINTA 2

Fajar Firmansyah¹⁾, Popy Rufaidah²⁾

^{1,2} Universitas Padjajaran, Bandung, Indonesia

Email: fajarfirmans01@gmail.com

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ABSTRACT

The growth of digital technology has established social media as a primary consumer touchpoint for brands utilizing influencer endorsements. This study examines how social media influencers and brand equity jointly affect customer brand engagement with Ortuseight running shoes in Indonesia. To address this objective, a survey was conducted with 202 current Ortuseight users, and the data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). The results indicate that both social media influencers and brand equity positively and significantly influence customer brand engagement, though brand equity exerts a substantially stronger effect. Specifically, brand equity dimensions serve as primary drivers of long-term engagement, whereas influencer credibility and communication prompt active consumer interaction. Overall, these findings provide valuable strategic insights, suggesting that long-term brand equity building exerts a stronger influence on engagement than influencer campaigns alone, offering clear guidance for local brands' digital strategies.

Keywords: social media influencers (SMIs); brand equity; customer brand engagement.

INTRODUCTION

The increase in usage and demand for social media personalities offers marketers an attractive opportunity to market their products fast (Syed et al., 2023). In addition, companies increasingly use influencer marketing to provide information about the product, as social media influencers are perceived as authentic and credible market experts (Aw et al., 2023). Influencers are individuals on social media platforms including Instagram, Snapchat, YouTube and TikTok with a considerable number of followers who share their subjective views and opinions about products or services (Dehyadegari et al., 2025; Jun & Yi, 2020). It is expected of influencers to produce content that increases the engagement levels of their social media pages (Wies et al., 2023). Social media influencers play a crucial role in determining how customers connect with brands because they encourage interactions in the form of likes, shares, and comments on posts about the brand (Arora et al., 2019).

The popularity of running leads to the growing running shoe market segment with various shoes adapted for different age groups, from beginner shoes prioritizing comfort and carbon-coated shoes with high elasticity for long-distance athletes (Xiao et al., 2025). In Shopee Indonesia's best-selling sports product report, the running shoe category is represented

by the brand Ortuseight, ensuring the market share of 35.5% for locally-produced goods (Databoks, 2025). Shopee's data demonstrates the effectiveness of the digital marketing strategy of inspiring brand remodeling with the assistance of sports and lifestyle influencers and increasing consumer engagement with the local-made product.

Previous research yields inconclusive results concerning the impact of social media influencers on client brand engagement. The impact of social media influencers on customer involvement has favorable outcomes (Chandra & Indrawati, 2023). The importance of influencer credibility in marketing communications on trust and repurchase intentions (Tarabieh et al., 2024). Brand-based marketing orientation is more effective than influencer-based marketing (Kumar et al., 2025). As a result, there is still confusion about how social media influencers influence the interaction process with customers. However, the literature on the link between brand equity and customer brand engagement remains scarce because most studies indicate contradictory directions. In research (Khanh & ThiHoai, 2020) it was shown that by fostering consumer trust and satisfaction, brand equity builds the fundamental foundation needed to trigger meaningful customer engagement. Consequently, it is essential to do further study on the direct impact of brand equity on customer engagement. This should encompass the function of social media influencers and the impact of brand equity on customer brand engagement.

To address this gap, this study examines how social media influencers and brand equity jointly influence customer brand engagement among Ortuseight running shoe users in Indonesia. Set against the backdrop of Indonesia's expanding running culture and digital marketing landscape, this research explores the specific mechanisms through which digital endorsements and brand strength drive consumer interactions. Theoretically, this study enriches the literature on consumer-brand relationships in emerging markets; practically, it offers actionable insights for local footwear brands to optimize their digital marketing strategies. In digital marketing literature, the definition of a Social Media Influencer (SMI) encompasses three primary perspectives: audience reach, the role of content creation, and the concept of the "human brand." At a fundamental level, an SMI is defined as a digital figure possessing a massive follower base and an extensive social network across platforms such as TikTok, Instagram, and YouTube (Albadri, 2023; Goanta & Ranchordás, 2020; Veirman et al., 2017). Beyond mere audience scale, other studies highlight the functional dimension of SMIs as content creators who leverage specialized expertise in specific fields such as lifestyle and health to cultivate interactive communities (Sokolova & Kefi, 2022). This expertise and interaction serve as the foundation for SMIs to influence their followers' decision-making processes (Hii & Ong, 2025). Diverging from this functional perspective, (Liang et al., 2025) expand the SMI concept through a strategic lens by viewing the influencer as a human brand. From this perspective, an SMI's standing is measured not only by content but also by unique attributes such as post, communicability, credibility, and word-of-mouth effects that shape audience perceptions. Synthesizing this literature, the present study defines an SMI as a specialized content creator who commands a massive digital audience and operates as a human brand capable of influencing consumer behavior.

In the modern marketing landscape, brand equity is generally understood as the intangible added value inherent in a product or service beyond its basic utility (Chahal, 2020; Keller, 2018). From a business performance perspective, this added value is reflected in superior marketing outcomes compared to unbranded products (Keller, 2018). The formation of brand equity relies heavily on consumer cognitive processes, wherein the accumulation of positive perceptions, strategic associations, and loyalty builds the brand's credibility and

market value (Chahal, 2020). Expanding upon this consumer-centric view, (Wei, 2022) offers a more structured breakdown of brand equity into three key elements: the brand's independent value, the level of customer loyalty, and the collective perceptions of a broader range of external stakeholders. Deeply embedded in consumer cognition, brand equity is a multidimensional construct comprising brand awareness, brand association, perceived quality, and brand loyalty (Londoño et al., 2016; Yanez-Araque et al., 2025). Together, these dimensions cultivate consumer trust, establish market credibility, and form the foundation for sustainable competitive advantage (Milman et al., 2025).

Customer Brand Engagement (CBE) is widely understood as a multidimensional construct encompassing the cognitive, emotional/affective, and behavioral engagement of consumers when interacting with a brand (Matute et al., 2019; Ooi et al., 2022; Pereira et al., 2024). More than a mere momentary reaction, this engagement reflects active cognitive processing, strong emotional bonds, and sustained personal participation (Ooi et al., 2022). From the perspective of service-dominant logic, CBE emerges as a psychological and behavioral manifestation stemming from the process of shared value creation through resource integration and service exchange between the consumer and the brand (Ndhlovu & Maree, 2022). This engagement transcends routine transactional relationships, wherein deep psychological bonds and active consumer participation in various brand initiatives ultimately serve as key drivers of long-term loyalty and brand advocacy (Salviatti, 2025). A synthesis of these perspectives indicates that CBE is a form of multidimensional, interactive engagement that creates shared value and strengthens long-term relational bonds between consumers and brands. Far exceeding routine transactional exchanges, CBE reflects a process of shared value creation and resource integration, typically manifested through conscious attention, enthused participation, and social connection (Henni & Rufaidah, 2025; Salviatti, 2025). A study conducted by (Galdón et al., 2024), found that SMI had a positive and significant impact on customer engagement. This finding is supported by previous research social media influencers had a considerable impact on customer brand engagement (Ali et al., 2022). Social media influencers marketing has a positive and significant impact on consumer engagement (Zahran & Aljuhmani, 2025). Research (Ao et al., 2023) SMI traits, which encompass eight characteristics, demonstrate a moderate to strong correlation with purchase intention and customer engagement. Due to customers' significant activity on social media and their following of digital influencers, it is recommended that practitioners utilize these influencers to engage customers and stimulate buy intention. Consequently, the researchers proposed the subsequent hypothesis for this study:

H1: Social media influencers have a positive effect on customer brand engagement.

Investigations into the correlation between brand equity and client brand engagement remain comparatively scarce. Most prior research has investigated the negative link, namely the impact of customer brand engagement on brand equity. Customer-Based Brand Equity positively influences customer satisfaction and reputation. Moreover, it yields effects like as customer engagement (Cambra-fierro et al., 2021). Dimensions of brand equity, such as brand image, perceived quality, and trust, serve as significant precursors to consumer brand engagement (Algharabat et al., 2019). Customer brand involvement likely influences brand equity. Consequently, the researchers articulated the subsequent hypothesis for this study:

H2: Brand equity has a positive effect on customer brand engagement.

Although the literature surrounding consumer engagement is expanding, prior research seldom explores the dual impact of influencer marketing and brand equity on customer engagement in the context of local athletic brands within emerging markets. Grounded in these considerations, this study synthesizes social media influencer (SMI) dynamics with brand equity theory to construct an integrative framework that explains customer brand engagement (CBE) within the local sportswear market, specifically focusing on Ortuseight. The model operationalizes both Social media Influencers comprising post attributes, communicability, credibility, and word-of-mouth, and brand equity spanning brand awareness, brand association, perceived quality, and brand loyalty as multidimensional antecedents. It systematically evaluates how these constructs drive the core dimensions of consumer engagement, namely conscious attention, enthused participation, and social connection. Utilizing partial least squares structural equation modeling (PLS-SEM), the study tests the underlying structural paths while comparing the relative effect magnitude of SMI and brand equity on CBE.

This research offers three distinct contributions to the marketing literature. First, it enriches consumer engagement theory by disentangling the multidimensional effects of SMI and brand equity, providing empirical proof that brand equity plays a far more decisive role than influencer communications in building long-term customer engagement. Second, it elevates digital marketing literature by embedding influencer campaigns within a relational brand equity architecture, recasting influencer tactics from standalone promotional tools into integrated assets for brand building. Third, by offering empirical insights from an emerging market context specifically the booming local running shoe segment in Indonesia, this study strengthens the external validity and contextual adaptability of integrated CBE, SMI, BE models.

METHODS

This study employs a quantitative approach with a causal-explanatory research design to examine and validate the hypothesized causal relationships among the variables. This design was selected because the primary objective of the study is to provide an empirical confirmation of a theoretically constructed consumer behavior model. Data collection was carried out utilizing a cross-sectional survey design, enabling the efficient capture of consumer trends, perspectives, and attitudes at a single point in time. This approach is deemed highly appropriate for observing the fast-paced and dynamic nature of social media user behavior. Furthermore, incorporating an explanatory framework allows for a deeper extraction of structural paths, ensuring that the underlying predictors of customer interactions are not merely described but robustly quantified. Consequently, this systemic configuration provides the necessary analytical rigor to validate complex structural frameworks within contemporary digital marketing ecosystems.

The target population for this study consists of active consumers and running enthusiasts in Indonesia. Specifically, users of the local footwear brand, Ortuseight, were selected as the primary target respondents. The selection of Ortuseight is justified by the fact that this brand represents one of the most rapidly growing domestic sportswear companies in the market, which aggressively leverages digital marketing strategies and running influencers to maintain its competitive edge. Furthermore, the explosive growth of running as a lifestyle trend among Indonesian youth provides an ideal backdrop for this investigation. By focusing on this specific demographic, the study captures the behavioral nuances of a highly engaged

consumer segment that relies heavily on peer recommendations and digital content. Investigating how Ortuseight successfully navigates this highly competitive landscape through targeted social media campaigns offering valuable, generalizable insights into contemporary brand-consumer relationship dynamics in emerging markets.

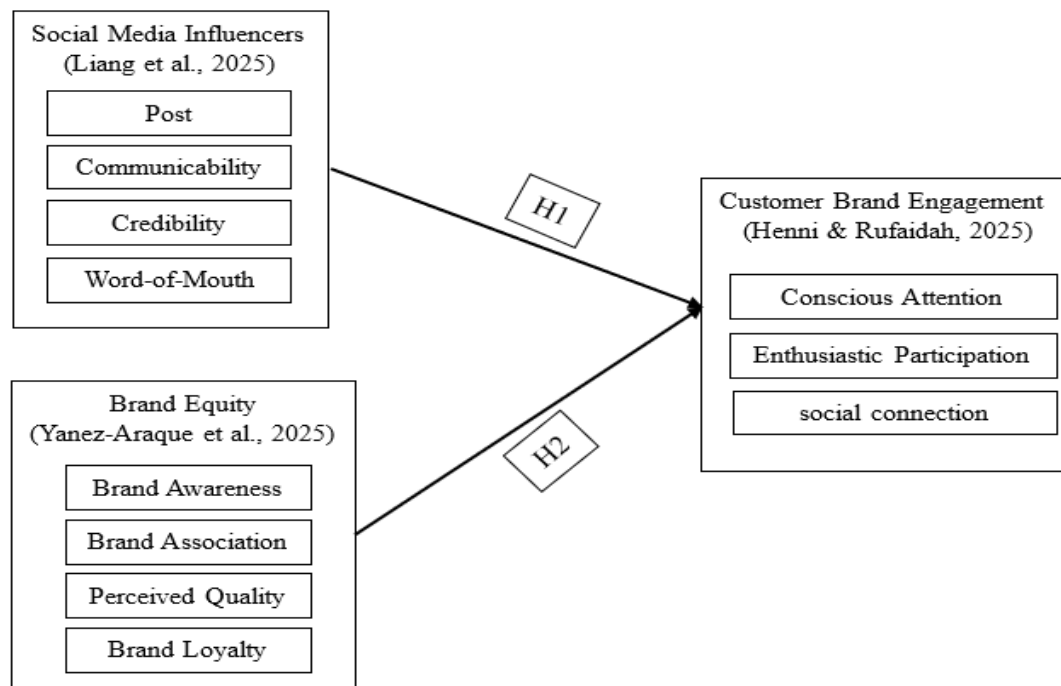


Figure 1 Proposed Research Model

Source: Authors, 2026

A total sample of 202 respondents was successfully gathered for this study. The sampling procedure relied on a non-probability convenience sampling technique combined with a self-administered questionnaire approach. The utilization of convenience sampling was justified based on practical feasibility and the researcher's ease of access to the running community within a limited timeframe (Nunan et al., 2020). However, it is explicitly acknowledged that this non-probability approach entails inherent methodological trade-offs, particularly regarding restricted generalizability to the broader population of casual footwear consumers and potential self-selection bias among respondents with stronger initial brand affinity or higher social media engagement. To mitigate potential sampling bias and maintain data relevance, two strict screening criteria (purposive filters) were applied at the beginning of the questionnaire: (1) respondents must actively follow running influencers on social media, and (2) respondents must have seen or interacted with Ortuseight promotional content within the last three months.

The primary data collection process was carried out over a 30-day period using a dual-channel distribution approach. First, the questionnaires were distributed physically at various sports hubs and recreational venues, such as running tracks and sports complexes. Second, the questionnaires were administered digitally via Google Form links, which were shared across numerous running community groups on social media platforms, including Threads, Instagram, Facebook, and X. The characteristics of the captured respondents were then comprehensively mapped based on their demographic profiles (gender, age, educational

background, and occupation) and their behavioral patterns regarding social media content consumption regarding brand and influencer content.

Furthermore, rigorous ethical considerations were maintained throughout the data collection phase. Participation was entirely voluntary, and informed consent was digitally or physically obtained from each respondent prior to questionnaire administration, ensuring complete anonymity and confidentiality of personal metrics. Regarding data preprocessing, a meticulous data screening procedure was executed to address potential missing values and unengaged responses. Since the Google Form required answers for all structural items, no missing values were present in the digital dataset, while physical entries were manually audited. Standardized statistical checks confirmed that the final dataset containing 202 clean responses was completely robust, verified, and eligible for structural equation modeling analysis.

Data analysis was executed using SmartPLS 4.0 via Partial Least Squares-Structural Equation Modeling (PLS-SEM) following the two-stage analytical procedure recommended by (J. F. J. Hair et al., 2022). PLS-SEM was selected due to the presence of complex second-order constructs, the primary objective of maximizing explained variance in Customer Brand Engagement, and its robustness with moderate sample sizes ($n = 202$) without requiring multivariate normality. The first evaluation focused on the measurement model (outer model) to establish the validity and reliability of the research instrument. At this stage, indicator reliability was evaluated using outer loadings (≥ 0.708) to ensure that each indicator explained more than 50% of its construct variance. Internal consistency reliability was subsequently assessed via Cronbach's Alpha and Composite Reliability (≥ 0.70), indicating that all items consistently measured the same latent construct without redundancy. Meanwhile, convergent validity was established through Average Variance Extracted ($AVE \geq 0.50$), demonstrating that the latent construct accounted for more than half of its indicators' variance on average. Finally, discriminant validity was tested using the Fornell-Larcker criterion and cross-loadings, where the Fornell-Larcker criterion required the square root of the AVE for each construct to be greater than its correlations with other constructs, while cross-loadings required an indicator's loading to be highest on its intended construct. This procedure confirmed that each construct uniquely shared more variance with its own indicators than with any other construct in the model.

The second evaluation stage examined the structural model (inner model) to test the hypothesized relationships and the model's predictive capability. The assessment began with multicollinearity analysis using Variance Inflation Factor ($VIF < 3.0$) values to guarantee the absence of excessive correlation among independent variables, ensuring that path coefficient estimates were unbiased. A non-parametric bootstrapping algorithm with 5,000 resamples was then applied to evaluate structural path coefficients (β), where the magnitude and direction of the coefficients reflected the degree of influence between constructs, while t-statistics (> 1.96) and -values (< 0.05) determined the statistical significance of the hypotheses. Furthermore, the model's explanatory power was evaluated through the coefficient of determination (R^2), reflecting the percentage of variance in Customer Brand Engagement explained collectively by the predictor variables. Effect size (f^2) was also calculated to assess the relative contribution of each predictor variable, categorized as small (0.02), medium (0.15), and large (0.35). Concluding the structural model assessment, predictive relevance ($Q^2 > 0$) was evaluated to confirm the model's out-of-sample predictive accuracy. Consequently, the application of the PLS-SEM approach through the evaluation of both outer and inner models proves to be appropriate and highly relevant for testing the relationships among variables in this study.

This method effectively accommodates the complex measurement of the relationships between Social Media Influencers and Brand Equity on Customer Brand Engagement. The strength of PLS-SEM in consumer engagement based predictive analysis and perceptual relationship modeling provides a solid methodological foundation to test the research hypotheses while illuminating the extent to which social media influencers and local brand strength foster holistic customer brand engagement.

RESULT AND DISCUSSION

The profiles of the respondents feature gender, age, personnel education and type of employment as well as how they use and react to influencer content on social media. The results of the research confirmed that gender (62.9% male) and age from 18 to 25 years old (54.65%) constituted a majority of the respondents. This indicates that the main wearers of shoes are relatively young persons. Most of them held a high-school diploma, or its equivalent (41.6%), but 26.7% were attending school at the time they completed the questionnaire. Thus, the brand is familiar for respondents who were students and college goers. All individuals in the sample were customers of this shoe line, with nearly all (99.5%) exposed to influencer content on social media about the brand. At the same time, more than half of the sample respondents reported (52%) that they bought a brand they already know for a second time because an influencer made it attractive. Influencer content, therefore, is very influential for young consumers. This shows the vast impact of influencer -generated content on consumer engagement and buying decisions.

Evaluation of a reflective measurement model Reflection reflects two aspects of the measurement reliability: indicator level and construct level J. F. J. Hair et al. (2022). There is a rule of thumb that the standard external load should be 0.708 or higher, indicating that the construct can explain over one half (50%) of the variance of an indicator (J. F. J. Hair et al., 2022). The guideline for evaluating convergent validity stipulates that the factor loading must exceed 0.7 for confirmatory research and fall between 0.6 and 0.7 for exploratory research, while the average variance extracted (AVE) should surpass 0.5 (Hamid & Anwar, 2019). In this study, indicator reliability testing was conducted through an analysis of the outer loading values in the reflective measurement model. In this study, the internal reliability of the construct was tested using Cronbach's Alpha (α), Composite reliability (ρ_a), and Average variance extracted (AVE) values. The following are the results of measuring the loading factors for each variable indicator.

The measurement model test results show that all indicators in the social media influencer, The loading factor values for brand equity and customer brand engagement variables exceed 0.708. All items satisfy the criteria for convergent validity as stipulated by (J. F. J. Hair et al., 2022; Hamid & Anwar, 2019). Elevated loading factor values (0.826–0.928) demonstrate that all indicators effectively describe the social media influencer construct. The dimension of social media influencers exhibits a robust correlation with the construct, suggesting that the quality of information shared, communication proficiency, credibility, and positive influence of influencers accurately represent respondents' beliefs of an influencer's function on social media. The consistently high loading factor in the brand equity variable signifies that the indicators from the dimensions of brand awareness, brand association, perceived quality, and brand loyalty effectively represent the construct. This indicates that respondents have a strong and positive brand attitude in terms of awareness, association, quality and loyalty to the brand being studied. Like the customer brand

engagement construct, all indicators in the three aware attention dimension, captive affection and social bonding constructs have very high weights. This trend holds a particular significance in that it means respondents were truly engaging on a cognitive, emotional and even social level with the brand. Therefore, we can say that all indicators on this research possess strong evidence of convergent validity and also are acceptable to further analysis such as the evaluation for measurement reliability and inquiries into the relationship between variables in structural model.

Table 1. Profile Respondent Information

Indicator		N	%
Gender	Male	127	62,9%
	Female	75	37,1%
Age	18 – 25 Year	110	54,5%
	26 – 35 Year	46	22,8%
	36 – 45 Year	26	12,9%
	46 – 55 Year	18	8,9%
	>55 Year	2	1%
Education Level	Senior High School	84	41,6%
	Diploma	38	18,8%
	Bachelor's Degree	77	38,1%
	Master's Degree	2	1%
	Other	1	0,5%
Occupation	Civil Servants	13	6,4%
	Entrepreneur	34	16,8%
	State-Owned employee	19	9,4%
	Students	54	26,7%
	Freelance	24	11,9%
	Private Employee	45	22,3%
	Unemployment	11	5,5%
	Other	2	1%
Do you use this brand running shoes	Yes	202	100%
	No	0	0
Do you follow running influencers on social media	Yes	193	95,5%
	No	9	4,5%
Have you ever seen influencer content about this brand shoes on social media	Yes	201	99,5%
	No	1	0,5%
How often do you see videos of running influencer content about this brand shoes on social media	Never	0	0
	Seldom	9	4,5%
	Sometimes	72	35,6%
	Often	72	35,6%
	Very often	49	24,3%
How often do you buy this brand shoes recommended by running influencers on social media	Never	4	2%
	1 time	73	36,1%
	2 times	105	52%
	3 times	12	5,9%
	More than 3 times	8	4%

Source: Authors, 2025

Table 2. Reliability and Convergent Validity

Variable/Dimension	Item	Outer Loading	Cronbach's Alpha	CR	AVE
Post	PS1	0.876	0.837	0.839	0.755
	PS2	0.868			
	PS3	0.862			
Communicability	COM1	0.874	0.853	0.853	0.773
	COM2	0.887			
	COM3	0.876			
Credibility	CDB1	0.911	0.883	0.884	0.811
	CDB2	0.900			
	CDB3	0.891			
Word-of-Mouth	WOM1	0.879	0.845	0.846	0.764
	WOM2	0.866			
	WOM3	0.876			
Brand Awareness	BA1	0.826	0.825	0.833	0.741
	BA2	0.875			
	BA3	0.880			
Brand Association	BAS1	0.831	0.809	0.809	0.724
	BAS2	0.873			
	BAS3	0.847			
Perceived Quality	PQ1	0.858	0.858	0.860	0.780
	PQ2	0.906			
	PQ3	0.884			
Brand Loyalty	BL1	0.867	0.851	0.852	0.770
	BL2	0.870			
	BL3	0.895			
Conscious Attention	CA1	0.910	0.882	0.885	0.809
	CA2	0.911			
	CA3	0.878			
Enthusied Participation	EP1	0.847	0.854	0.857	0.775
	EP2	0.902			
	EP3	0.891			
Social Connection	SC1	0.911	0.892	0.894	0.823
	SC2	0.928			
	SC3	0.882			

Source: Authors, 2025

The internal consistency of the construct was evaluated through Cronbach's Alpha (α), Composite Reliability (ρ_a) and Average Variance Extracted (AVE). For all thresholds tested, the construct did not go below 0.70. To be considered credible in additional analysis, the Cronbach Alpha should be more than or equal to 0.70 for the latent variable (J. F. J. Hair et al., 2022; Kamal et al., 2020). Convergent validity is tested through the average variance extracted (quantifying that an AVE greater than 0.50 implies that a construct explains more than half of the variance in observed variables) (J. F. J. Hair et al., 2022).

The results show that Cronbach's Alpha and composite reliability (ρ) of all constructs are above 0.80, ranging from 0.809 to 0.937. At least, overall statistics show that constructs failed to surpass 0.95 as an indication of high dependability since the internal consistency is solid for all constructs in this study. For all constructs, the AVE exceeds 0.50:

AVE = 0.568–0.823. Accordingly, all constructs are claimed to have been convergent validity benchmarks which could account for over 50% true variance of the constituents and could be labeled as convergent valid. As a result, the study findings indicate that all formative indicators of Social Media Influencer, Brand Equity and Customer Brand Engagement as well as their dimensions have satisfied rules for internal reliability and convergent validity suggested by (J. F. J. Hair et al., 2022; Kamal et al., 2020). Thus, they are good constructs with reliability and validity and can be confidently moved to a phase of structural analysis for testing the relationships between variables in proposed model.

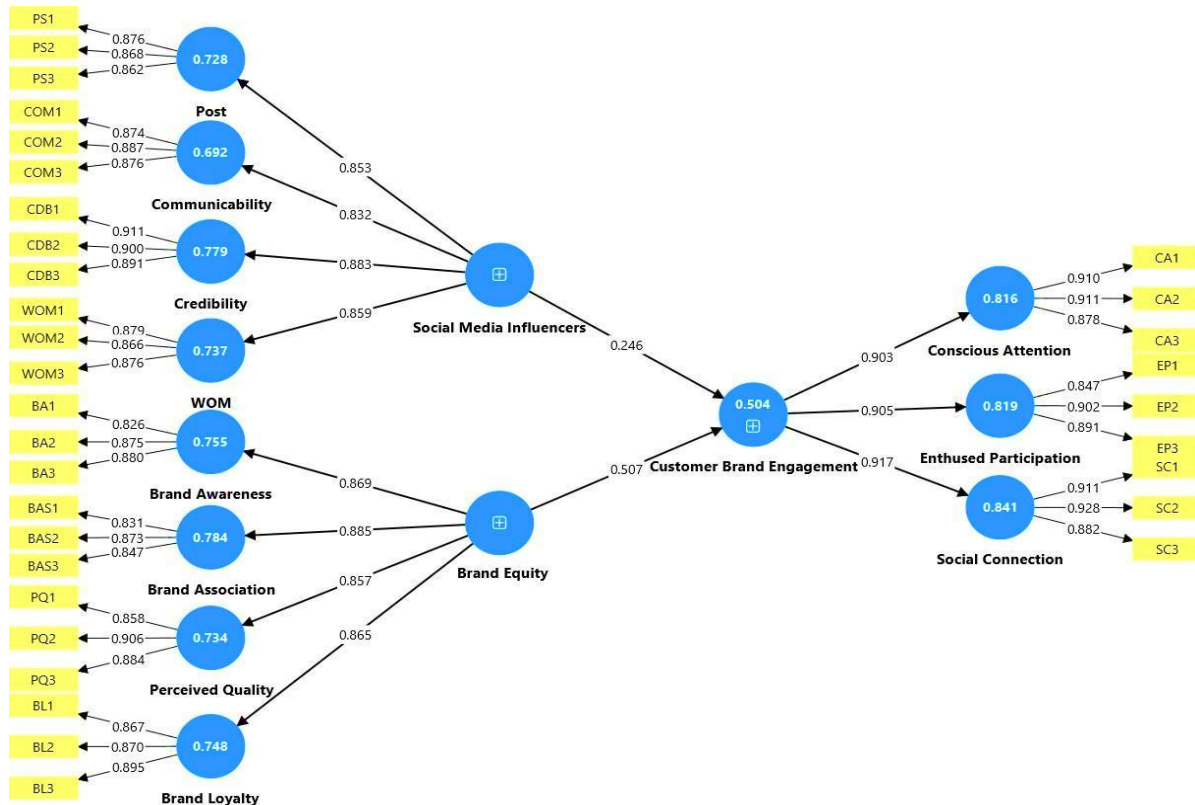


Figure 2. Outer model

Source: Authors, 2025

Discriminant validity is the extent to which a construct is distinct from other constructs on empirical grounds. For reflecting indicators, the cross-loading value indicates if the variables achieve discriminant validity. Each variable's value must exceed 0.70. In my work, the assessment of discriminant validity using different weights is conducted by the Fornell-Larcker criterion, which will be satisfied when the square root of the Average Variance Extracted (AVE) of the construct is considered. The Fornell-Larcker criterion is met when the square root of a construct's Average Variance Extracted (AVE) exceeds the correlations with other constructs (J. F. J. Hair et al., 2022).

Table 3. Discriminant validity Fornell-Larcker criterion

	BAS	BA	BE	BL	COM	CA	CDB	CBE	EP	PQ	PS	SC	SMI	WOM
BAS	0.851													
BA	0.730	0.861												
BE	0.885	0.869	0.754											
BL	0.696	0.638	0.865	0.877										
COM	0.575	0.520	0.613	0.524	0.879									
CA	0.561	0.534	0.635	0.622	0.484	0.900								
CDB	0.547	0.651	0.688	0.557	0.670	0.504	0.900							
CBE	0.600	0.575	0.691	0.689	0.551	0.903	0.550	0.813						
EP	0.532	0.515	0.627	0.619	0.479	0.720	0.509	0.905	0.880					
PQ	0.657	0.661	0.857	0.659	0.512	0.484	0.636	0.531	0.510	0.883				
PS	0.516	0.564	0.598	0.445	0.582	0.528	0.669	0.542	0.475	0.557	0.869			
SC	0.540	0.516	0.619	0.635	0.535	0.738	0.485	0.917	0.754	0.455	0.473	0.907		
SMI	0.649	0.682	0.744	0.591	0.832	0.586	0.883	0.624	0.556	0.669	0.853	0.557	0.755	
WOM	0.587	0.596	0.649	0.494	0.605	0.491	0.663	0.494	0.441	0.583	0.682	0.414	0.859	0.874

Source: Authors, 2025

The results indicate that the test outcomes for all constructs satisfy the Fornell- Larcker criteria. The square root of the AVE value for each construct surpasses the association with the other constructions. All constructs performed favorably on the uniqueness assessment. In other words, any construct can measure a definite concept without much being the measurement of another concept. These results imply that discriminant validity in the current research model is satisfactory by the guidelines of the literature as (J. F. J. Hair et al., 2022; Hamid & Anwar, 2019).

The bootstrapping approach was employed to test the hypothesis using t-values, in conjunction with the path coefficient values, to ascertain the significance of the link between variables. To evaluate the statistical significance of the hypothesized paths, both t-statistics and p-values are examined. In accordance with the criteria established by (J. F. J. Hair et al., 2022), a relationship achieves statistical significance when the t-value exceeds the threshold of 1.96, or alternatively, when the corresponding p-value falls below 0.05. This study's structural model analyzes the interaction among social media influencers, brand equity, and customer brand engagement.

A VIF value of 5 or higher indicates a significant collinearity problem. Early signs of collinearity typically begin to appear when the VIF is between 3 and 5. Therefore, the most desirable condition in an analysis is to achieve a VIF below 3 (J. Hair et al., 2019). Referring to the criteria, a model is declared ideal and free from multicollinearity constraints if it has a VIF score below 3. Conversely, the emergence of early indications of collinearity disturbances should be watched out for if the value is in the range of 3 to 5. Based on the test results in this study, the VIF values for the first (H1) and second (H2) hypotheses are all below 3. Thus, it can be concluded that both relationship models are completely safe from collinearity problems.

Table 4. Result of Hypothesis testing for Direct and Indirect Effect

Hypotheses	Models	Beta	SD	T statistics	F ²	VIF	P values	Comment
H1	Social Media Influencers -> Customer Brand Engagement	0.246	0.092	2.686	0.055	2.243	0.007	Accepted
H2	Brand Equity -> Customer Brand Engagement	0.507	0.092	5.529	0.231	2.243	0.000	Accepted
Second-order construct	Brand Association <- Brand Equity	0.885	0.021	41.741	3.623	1.000	0.000	Accepted
	Brand Awareness <- Brand Equity	0.869	0.024	35.943	3.078	1.000	0.000	Accepted
	Brand Loyalty <- Brand Equity	0.865	0.020	43.773	2.973	1.000	0.000	Accepted
	Perceived Quality <- Brand Equity	0.857	0.027	31.767	2.759	1.000	0.000	Accepted
	Conscious Attention <- Customer Brand Engagement	0.903	0.018	50.982	4.421	1.000	0.000	Accepted
	Enthusied Participation <- Customer Brand Engagement	0.905	0.019	47.058	4.511	1.000	0.000	Accepted
	Social Connection <- Customer Brand Engagement	0.917	0.013	70.048	5.290	1.000	0.000	Accepted
	Communicability <- Social Media Influencers	0.832	0.031	26.551	2,247	1.000	0.000	Accepted
	Credibility <- Social Media Influencers	0.883	0.022	39.336	3,521	1.000	0.000	Accepted
	Post <- Social Media Influencers	0.853	0.029	29.655	2,678	1.000	0.000	Accepted
	WOM <- Social Media Influencers	0.859	0.027	32.314	2,803	1.000	0.000	Accepted

Source: Authors, 2025; note: all P value were accepted

Structural path evaluation yields nuanced findings across the tested relationships. Specifically, (H1) was marginally supported at the 10% significance level ($\beta = 0.246$; $t = 2.686$; $p = 0.007$, $p < 0.10$), indicating that social media influencers exert a positive effect on customer brand engagement. This finding is consistent with prior research (Ali et al., 2022; Galdón et al., 2024; Zahran & Aljuhmani, 2025), which highlights the strategic role of social media influencers in driving consumer engagement. Path coefficient analysis suggests that higher perceived influencer effectiveness corresponds to increased customer interaction with the brand. While this impact is positive, its marginal significance implies that while influencers serve as a meaningful catalyst for engagement, they are not the sole or primary

determinant. In contrast, (H2) demonstrated a highly significant result, with brand equity emerging as the primary and most dominant predictor of customer brand engagement ($\beta = 0.507$; $t = 5.529$; $p = 0.000$, $p < 0.001$). This finding aligns with previous empirical studies conducted by (Cambra-fierro et al., 2021), demonstrating that brand equity is strongly correlated with consumer engagement. Substantively, when consumers hold favorable brand evaluations encompassing brand awareness, associations, perceived quality, and loyalty they are significantly more inclined to actively connect and interact with the brand on social media platforms. It is important to note that the impact of brand equity goes beyond mere influencer effectiveness. In other words, consumers who have a positive attitude toward a brand (involvement, association, recognition, and perceived quality) engage and interact with it on social media, resulting in positive engagement.

The same results are achieved considering the second-order construct; these dimensions have many relationships that demonstrate strong consistency. It is evident from the results of the second-order construct, in which the four dimensions of brand association, brand awareness, brand loyalty, and perceived quality have very high t-statistics values, more than 30, with a p-value = 0.000; as such, all four dimensions are very valid indicators in forming the brand equity variable. Similar results are also achieved by the constituent dimensions of customer brand engagement; conscious attention has a β value of 0.903, enthused participation has a β value of 0.905, and social connection has a β value of 0.917, and a p-value of 0.000 for all the 3 variables. The construct of social media influencers is also significantly shaped by four aspects. these aspects include communication, credibility, posts, and word of mouth. according to the results, these constructs are very significant because consumers view influencers based on their ability to interact, their reputations, the quality of the content they upload, as well as their role in disseminating the information. To sum up, both social media influencers and brand equity have positive effect on consumer brand engagement, while the impact of brand equity is more prominent.

Table 5. R^2 , Q^2 dependent latent variable

Model	R^2 Adjusted	Q^2 (=1-SSE/SSO)
Customer Brand Engagement	0.499	0.329

Source: Authors 2025

To evaluate the explanatory power and predictive relevance of the structural model, the adjusted coefficient of determination (R^2 adjusted) and Stone-Geisser's Q^2 metric were assessed following Hair et al. (2019), where R^2 values of 0.75, 0.50, and 0.25 represent substantial, moderate, and weak explanatory levels, respectively. Specifically, the model yielded an R^2 adjusted value of 0.499 for Customer Brand Engagement (CBE), indicating a robust, moderate-to-strong explanatory capacity wherein the hypothesized antecedents account for 49.9% of the variance in CBE. Furthermore, the blindfolding resampling procedure produced a Q^2 value of 0.329 for CBE. Exceeding the benchmark threshold ($Q^2 > 0$) and falling squarely within the 0.25 to 0.50 range, this result confirms medium out of sample predictive relevance for the target endogenous construct.

Building upon these robust empirical results, this study makes several key theoretical contributions to the digital marketing and brand management literature in emerging markets by operationalizing Social Media Influencer (SMI), Brand Equity (BE), and Customer Brand Engagement (CBE) as higher-order (second-order) multidimensional constructs. This comprehensive framework not only elucidates how interactions between SMI sub dimensions

(posts, communicability, credibility, word-of-mouth) and brand equity components (awareness, association, perceived quality, loyalty) drive distinct dimensions of customer engagement (conscious attention, enthused participation, social connection), but it also validates the model's applicability within Indonesia's local sportswear industry an emerging market setting contrasting the historically dominant focus on developed economies.

Furthermore, these empirical findings enrich engagement theory by affirming the hierarchical primacy of brand equity, demonstrating that core brand equity exerts a far more dominant influence on consumer engagement than the short-term communication effectiveness of social media influencers. Translating these theoretical insights into practical application, these findings offer actionable strategic guidance for brand managers of local footwear and sports equipment companies (such as Ortuseight) competing in emerging markets. To optimize marketing resource allocation, brand managers must avoid over relying on social media influencers as the primary driver of growth. Rather than chasing short-term buzz and conscious attention, budget allocation should prioritize strengthening core brand equity such as elevating perceived product quality and enriching brand association while deploying influencer campaigns as complementary amplifiers. In executing this strategy, companies should prioritize influencer credibility and communicability over the mere reach of macro influencers, ensuring that authentic demonstrations of product performance convert fleeting social media impressions into enduring brand loyalty. Finally, because enthusiastic participation and social connection are vital dimensions of customer engagement, influencer partnerships should be leveraged to activate local running communities and grassroots sports events, thereby bridging digital narratives with real world experiences that cultivate deeper emotional connections and foster long-term brand advocacy.

CONCLUSIONS

This study concludes that digital marketing strategies via social media influencers (SMIs) and brand equity simultaneously exert a positive and significant effect on customer brand engagement (CBE) among Ortuseight running shoe users in Indonesia. Although both variables demonstrate a positive impact, brand equity exhibits a substantially more dominant and fundamental direct effect ($\beta = 0.507$; $p = 0.000$) compared to the influence of social media influencers ($\beta = 0.246$; $p = 0.007$). Multidimensionally, brand equity is most strongly formed by brand association, brand awareness, brand loyalty, and perceived quality. Meanwhile, the role of influencers is predominantly reflected by credibility, communicability, post quality, and word-of-mouth. Overall, the integration of brand equity and influencer marketing accounts for 49.9% of the variance in customer engagement toward the local brand, demonstrating adequate out-of-sample predictive accuracy ($R^2 \text{ adjusted} = 0.499$; $Q^2 = 0.329$).

These findings offer significant theoretical implications by enriching the literature on customer engagement in emerging markets, where brand equity serves as the primary foundation for long-term relationships, while social media influencers act as short-term amplifiers. From a managerial perspective, brand managers and marketers are advised against over-reliance on standalone influencer campaign tactics. Although influencers are effective in capturing initial conscious attention and driving interaction, sustainable emotional engagement and customer loyalty ultimately originate from the strength of brand equity inherent in product reputation and quality.

Despite offering comprehensive insights, this study possesses several methodological limitations. First, reliance on a non-probability convenience sampling approach limits the

generalizability of the results, as the sample predominantly represents accessible running community members and may not fully capture the broader population of casual athletic footwear consumers or non-community runners across different geographic regions. Second, the self-administered survey design introduces potential self-selection bias, wherein individuals with stronger brand affinity, higher social media engagement, or greater emotional involvement with Ortuseight may have been more motivated to complete the questionnaire compared to average consumers. Third, the study relies on a cross-sectional survey design with a sample size of 202 respondents and focuses exclusively on a single brand within the sportswear industry. To enhance external validity, future research should consider employing probability sampling designs and expanding the sampling frame to encompass broader demographic and regional cohorts. Additionally, future studies are encouraged to employ longitudinal designs to observe the evolution of customer engagement over time, replicate the model across different product categories or industries, and compare the effectiveness of various influencer tiers (such as nano/micro-influencers versus macro-influencers).

As a practical recommendation for local brands and Micro, Small, and Medium Enterprises (MSMEs) operating under budget constraints, resource allocation should prioritize strengthening brand equity foundations, such as maintaining consistent product quality and building a strong brand perception. When leveraging influencer marketing, MSMEs are advised to shift away from merely pursuing costly macro-influencers for reach toward strategic partnerships with micro-influencers or local community advocates who possess high credibility and authenticity. Furthermore, local brands need to integrate digital promotions with offline community activations (online-to-offline) to foster meaningful and sustained enthused participation and social connection among consumers.

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KNOWLEDGE AND SUSTAINABLE PROJECT MANAGEMENT ON VOCATIONAL EDUCATION PERFORMANCE: GREEN HUMAN CAPITAL AS MEDIATOR



SINTA 2

Rizqa Ula Fahadha¹⁾, Muhammad Syamsul Maarif²⁾, Budi
Yulianto³⁾

¹ Universitas Tidar, Magelang, Indonesia

^{2,3} Institut Pertanian Bogor, Bogor, Indonesia

Email: ru_fahadha@untidar.ac.id

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ABSTRACT

The transformation of vocational higher education demands industry readiness and sustainable governance. Grounded in the Ability-Motivation-Opportunity (AMO) framework, this study examines how Knowledge Management (KM) and Strategic Project Management (SPM) foster Green Human Capital (GHC) to influence the Performance of Vocational Institutions (PVI). Using a cross-sectional quantitative design, data were gathered from 100 structural officials across 38 public vocational institutions in Java, Indonesia. PLS-SEM analysis via SmartPLS 4 reveals that KM and SPM significantly influence institutional performance. Crucially, GHC serves as a complementary partial mediator, bridging governance mechanisms with sustainable outcomes. Aligning knowledge assets and project execution with green workforce development optimizes institutional transformation.

Keywords: green human capital; knowledge management; strategic project management; sustainable vocational education; vocational institution performance.

INTRODUCTION

The global economic paradigm is currently undergoing a structural shift, transitioning from resource-intensive, linear industrialization toward a sustainable, human-centric green economy. This macroeconomic evolution is conceptualized heavily within the frameworks of Industry 5.0 and the imperative of the global ecological transition (Rame et al., 2024). Unlike the strictly technocratic, automation-driven focus of Industry 4.0, the Industry 5.0 paradigm recenters industrial discourse on socio-technical systems, demanding that technological advancement serve human well-being and operate within the planet's regenerative boundaries. Consequently, this systemic evolution necessitates a fundamental recalibration of human resource development worldwide. Organizations and economies can no longer rely on legacy competencies; they are compelled to engineer and deploy a workforce capable of navigating complex cyber-physical systems, executing advanced product development lifecycles, and adhering to environmental sustainability protocols.

In emerging economies, the pressure to adapt to these compounding global mandates is acute. Developing nations are tasked with a dual mandate: they must foster digital and ecological competencies to remain competitive in global supply chains, while simultaneously addressing socio-economic imperatives such as poverty reduction, equitable economic growth, and mitigating youth unemployment. Within this transformative context, Technical and Vocational Education and Training (TVET) institutions, particularly polytechnics and applied vocational higher education institutions, are positioned as critical anchor institutions (McGrath & Yamada, 2023). While traditional universities have historically focused on generating theoretical knowledge and foundational scientific inquiry, vocational higher education serves as a conduit bridging the gap between conceptual academia and applied industrial practice. They function as the economy's translational engines, directly supplying the labor market with the technical agility and innovative competencies required to operationalize an ecologically sustainable future across fields ranging from smart grid management to precision agriculture.

In Indonesia, the strategic transformation of the vocational higher education sector has been elevated to a central part of the developmental agenda. As the world's largest archipelago and an industrializing regional powerhouse, Indonesia occupies a paradoxical position. The nation is vulnerable to the multifaceted impacts of climate change, including risks from rising sea levels, agricultural disruptions, and extreme weather events. Simultaneously, Indonesia possesses untapped potential for green economic growth, with abundant reserves of critical minerals for electric vehicle (EV) supply chains, geothermal energy resources, and immense biodiversity. Recognizing this juncture, the national government's long-term vision, encapsulated in the National Long-Term Development Plan (RPJPN) 2025–2045, aims to realize the vision of Golden Indonesia 2045. This centennial milestone is defined by the aspiration to achieve high-income status, social equity, institutional excellence, and environmental sustainability (Soelaiman & Sariutami, 2025).

To operationalize this vision, the National Medium-Term Development Plan (RPJMN) 2025–2029 prioritizes the implementation of a green and circular economy. The RPJMN outlines macroeconomic indicators, emphasizing the creation of green-collar jobs, the development of robust renewable energy infrastructure, the achievement of net-zero emissions by 2060, and the enhancement of the national Human Capital. However, achieving these objectives is constrained by structural inefficiencies in the national education system. Despite the governmental belief that vocational education accelerates workforce entry and provides economic stability, empirical data indicate a persistent skills mismatch. Vocational graduates in Indonesia currently have the highest unemployment rate among all educational cohorts. This statistical anomaly underscores a systemic disconnect between the traditional, supply-driven curricula of educational institutions and the dynamic, demand-driven requirements of modern industries.

For decades, vocational institutions operated in relative isolation, producing graduates with technical skills tailored to twentieth-century, carbon-heavy industries, which are misaligned with the contemporary needs of an agile green economy (Nikoloudakis & Rangoussi, 2024). To rectify this structural failure, the Indonesian government enacted Presidential Regulation (Perpres) No. 68 of 2022 concerning the Revitalization of Vocational Education and Vocational Training. This mandate forces a shift toward a demand-oriented educational paradigm, emphasizing continuous collaboration with the business and industrial world. The regulation establishes comprehensive revitalization goals, including integrating labor market information systems, implementing competency-based curricula aligned with

industry standards, and fostering institutional excellence. This national transformation is actively coordinated by the National Coordination Team for the Revitalization of Vocational Education and Training, operating under the Link and Match 8+i philosophy, which demands industrial integration across joint curriculum design and applied research.

While macro-level policies provide the legal and administrative architecture for reform, the successful execution of these mandates relies on the internal governance, operational agility, and strategic capabilities of the vocational institutions themselves. Polytechnics and higher vocational entities face complex governance challenges. The public higher education sector is frequently characterized by decentralized, consensus-driven decision-making processes, rigid bureaucratic structures, regulated financial resource allocation, and a historical cultural focus on pedagogical routines rather than agile organizational management (Iqbal & Piwowar-Sulej, 2022). In this environment, academic leaders such as directors, deans, and program coordinators find themselves caught in a field of tension. They must balance the traditional demands of teaching, academic publication, and administrative compliance with new pressures to act as entrepreneurial managers capable of executing industrial partnerships and technological transitions.

In the context of the vocational education ecosystem, Knowledge Management (KM) is reframed as an institution's systematic capacity to leverage intellectual assets to absorb and disseminate cutting-edge industry practices. At the same time, Strategic Project Management (SPM) serves as a governance framework, ensuring that each project initiative aligns with the institution's overarching goals. These two structural pillars converge to form Green Human Capital (GHC), namely the accumulation of technical competence, commitment, and pro-environmental behavior within the academic community, which serves as the main driving force toward sustainable and competitive institutional performance (PVI). Although the significance of this construction has been recognized, a critical gap remains in the empirical literature regarding the primary drivers of sustainable and competitive institutional performance (PVI). Previous academic inquiries have frequently examined KM or SPM in strict isolation (Wang & Juo, 2021) or almost exclusively within profit-driven corporate and traditional manufacturing settings (Goel et al., 2022). The implementation of this framework within the public vocational university ecosystem, marked by bureaucratic rigidity, decentralized decision-making, and public-value-driven mandates, remains a theoretical and empirical void. Furthermore, the explicit incorporation of Green Human Capital as an active mediator that bridges strategic governance and institutional sustainability outcomes remains underexplored in the current vocational education literature (Ni et al., 2023).

Addressing this substantial empirical deficit, the present research investigates the strategic transformation of polytechnics in Indonesia by developing and empirically testing a structural equation model. To provide a rigorous analytical focus, this study is driven by three primary research questions: (1) How do Knowledge Management and Strategic Project Management practices influence the accumulation of Green Human Capital in vocational higher education? (2) To what extent does Green Human Capital drive Sustainable Institutional Performance? and (3) Does Green Human Capital operate as a vital mediating mechanism translating macro-level strategic governance into sustainable organizational outcomes?

By answering these questions, this study pioneers a theoretical intersection, fusing the Knowledge-Based View (KBV) with the micro-foundational Ability-Motivation-Opportunity (AMO) framework. To operationalize this theoretical integration, a set of hypotheses is formulated based on extant empirical literature. First, effective Knowledge Management

(KM) enables institutions to absorb and distribute green industry practices. Within the AMO framework, KM provides the foundational technical ability. Previous studies demonstrate that systematic environmental knowledge transfer significantly enhances employees' pro-environmental competencies and commitment (Abbas & Khan, 2023). Simultaneously, Strategic Project Management (SPM) establishes the operational framework for executing initiatives and provides a structured opportunity for staff to engage in sustainability-driven projects. Empirical evidence suggests that rigorous project governance nurtures green behaviors (Silvius & Schipper, 2020). Therefore, it is hypothesized:

H1: Knowledge Management has a significant positive effect on Green Human Capital.

H2: Strategic Project Management has a significant positive effect on Green Human Capital.

Beyond individual competencies, the systematic orchestration of intellectual assets directly impacts organizational outcomes. The Knowledge-Based View (KBV) posits that an organization's capability to capture and apply knowledge is a primary source of competitive advantage, improving operational efficiency and sustainable innovation (Migdadi, 2022). Furthermore, effective SPM ensures that resources are optimized and risks are mitigated, significantly elevating organizational performance (Coelho et al., 2025). Ultimately, institutions equipped with high levels of Green Human Capital are better positioned to execute green strategies, making eco-conscious human resources the strongest direct predictors of sustainable performance (Aftab et al., 2023). Therefore, it is hypothesized:

H3: Knowledge Management has a significant positive effect on the Performance of Vocational Institutions.

H4: Strategic Project Management has a significant positive effect on the Performance of Vocational Institutions.

H5: Green Human Capital has a significant positive effect on the Performance of Vocational Institutions.

Finally, this study conceptualizes GHC not merely as an outcome but as a critical mediating mechanism. While KM provides the knowledge infrastructure, its ultimate impact is channeled through the human element. GHC acts as a vital bridge, transforming static organizational knowledge into dynamic practices (Munawar et al., 2022). Similarly, the structural governance provided by SPM remains functionally inert without a committed workforce to execute it, making workforce capability an essential mediator between strategic project execution and institutional performance. Therefore, it is hypothesized:

H6: Green Human Capital significantly mediates the relationship between Knowledge Management and the Performance of Vocational Institutions.

H7: Green Human Capital significantly mediates the relationship between Strategic Project Management and the Performance of Vocational Institutions.

The remainder of this paper details the methodology, presents the empirical results of the PLS-SEM analysis, and concludes with theoretical and managerial implications.

METHODS

This research adopted a quantitative, cross-sectional, and causal-explanatory design grounded in a positivist epistemological paradigm. The empirical data were systematically analyzed using the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach via SmartPLS 4. PLS-SEM was deliberately selected over covariance-based SEM (CB-SEM) because the primary objective of this study is prediction-oriented, specifically, evaluating the predictive power of KM and SPM on institutional performance (PVI). Furthermore, PLS-SEM

possesses a superior capacity to handle complex structural models involving hierarchical constructs and multiple mediation pathways, offering high statistical power with restricted sample sizes without imposing strict distributional assumptions (Hair et al., 2022).

The empirical context for this study encompasses the higher vocational education ecosystem located across the provinces of Java, Indonesia. A purposive, non-probability sampling technique was employed. These regions were strategically selected because they represent the nation's most densely concentrated industrial agglomerations and are the primary focal points for the government's vocational revitalization programs. The unit of analysis comprises polytechnics, university-affiliated vocational schools, and community colleges that actively govern and execute sustainability-oriented strategic projects. These projects explicitly include establishing green manufacturing laboratories, implementing Sustainable Development Goal (SDG) based industry partnership programs, comprehensively digitizing academic administration, and deploying adaptive green-skills curricula.

To ensure the extraction of highly relevant, deeply informed data, a purposive, nonprobability sampling technique was employed. This study identified the finite population, comprising an estimated 150 vocational higher education institutions in Java that actively manage the Teaching Factory (TEFA) ecosystem through industrial partnerships. To determine the minimum required sample size, an a priori power analysis was conducted using G*Power 3.1 software. Based on a linear multiple regression model with five predictors (the three core constructs: KM, SPM, and GHC, alongside two control variables: Institution Size and Funding Typology) targeting PVI, an alpha level of 0.05, a medium effect size ($f^2 = 0.15$), and a statistical power of 0.80, the minimum sample size required was 92. Therefore, the sample of 100 strategically selected respondents provides adequate statistical power to test this structural model. To ensure a realistic data acquisition process, these 100 respondents do not represent 100 distinct entities. Instead, they comprise a curated, multi-level cohort of academic leaders, specifically directors, academic deans, program coordinators, and Teaching Factory (TEFA) managers nested within 38 key vocational higher education institutions across Java. This nested purposive sampling approach was critical. By capturing multiple strategic perspectives from within these 38 highly active, industry-integrated institutions, the study ensures deep, empirically valid insights into sustainability-oriented projects, while simultaneously justifying the high response rate and neutralizing the threat of single-informant bias, which are comprehensively adapted from authoritative literature and evaluated using a Likert metric scale of 1 to 5. 100 respondents were collected, deemed sufficient for testing the structural model using the SEM-PLS approach.

Data were collected through a closed-ended questionnaire structured on a five-point Likert scale, ranging from strongly disagree to agree strongly. The research instrument was developed by adapting validated indicators from previous studies. The knowledge management variable was measured across the dimensions of knowledge creation, acquisition, dissemination, and application (Goel et al., 2022). The strategic project management variable integrates with institutional strategy, stakeholder engagement, and risk and impact assessment (Gupta, 2021). Meanwhile, green human capital was measured through Environmental Competence, e.g., staff possess the technical knowledge to integrate green protocols, Sustainability Commitment, e.g., staff are emotionally committed to eco-centric values, Environmentally Friendly Behavior, e.g., staff actively reduce energy and resource waste, and Green Training Participation, e.g., staff actively engage in circular economy upskilling (Ansari et al., 2021; Farrukh et al., 2022). Institutional performance was measured using

multidimensional indicators, including program effectiveness, management efficiency, external reputation, and sustainable innovation.

The primary data acquisition phase spanned a three-month operational window, strictly executed from mid-January to early April 2025. Data was captured utilizing a structured, closed-ended digital questionnaire distributed systematically via secure survey platforms. The distribution package included an official research cover letter detailing the study's academic intent and a formalized confidentiality statement guaranteeing the absolute anonymity of institutional and individual respondents.

Given that the measurement instrument was adapted from established, peer-reviewed literature predominantly published in English, a rigorous Brislin's back-translation protocol was implemented to ensure exact semantic equivalence and cross-cultural validity. The original English items were translated into Bahasa Indonesia by a certified bilingual academic and subsequently back-translated into English by an independent linguist who was blind to the original text. Discrepancies were resolved through committee consensus. Following translation, face and content validity were rigorously verified by an expert panel comprising three senior academics specializing in strategic management and two active polytechnic directors. Prior to mass deployment, a pilot study involving 30 non-participating respondents was conducted to evaluate the psychometric properties, confirming that all Cronbach's Alphas exceeded 0.70.

Knowledge Management (KM) is conceptualized as the institution's systematic capability to orchestrate intellectual assets. It is measured across four sequential dimensions: Knowledge Acquisition, assessing the active absorption of external industrial intelligence; Knowledge Dissemination, evaluating the systematic sharing of insights across faculty teams; Knowledge Application, measuring the integration of new data into strategic decision-making; and Knowledge Storage, evaluating the digital architectural preservation of project insights.

Strategic Project Management (SPM) evaluates the governance architecture surrounding institutional initiatives. It is operationalized through Strategic Planning, ensuring project alignment with macro-institutional objectives; Stakeholder Engagement, reflecting the depth of integration with industry and community actors; Risk and Impact Assessment, focusing on the proactive evaluation of environmental footprints; and Resource Optimization, a vital metric assessing the agile and efficient allocation of limited educational funds toward high-impact sustainable projects.

Green Human Capital (GHC) captures the micro-foundational capabilities of the workforce. It is assessed through Environmental Competence, measuring staff's technical understanding of sustainability; Sustainability Commitment, evaluating internalized eco-centric values; Environmentally Friendly Behavior, assessing active participation in green work practices; and Green Training Participation, evaluating the workforce's ongoing engagement in upskilling programs related to circular economy principles.

Finally, the Performance of Vocational Institutions (PVI) represents the entity's multidimensional sustainable outcomes. It encompasses Program Effectiveness, measuring the tangible realization of strategic goals; Sustainable Innovation, evaluating the development of eco-friendly patents and applied research; Governance Efficiency, assessing the optimization of bureaucratic processes; and External Reputation, capturing the level of institutional prestige and formal recognition from external industry partners and regulatory bodies. A comprehensive delineation of these indicators and their theoretical sources is provided in Figure 1.

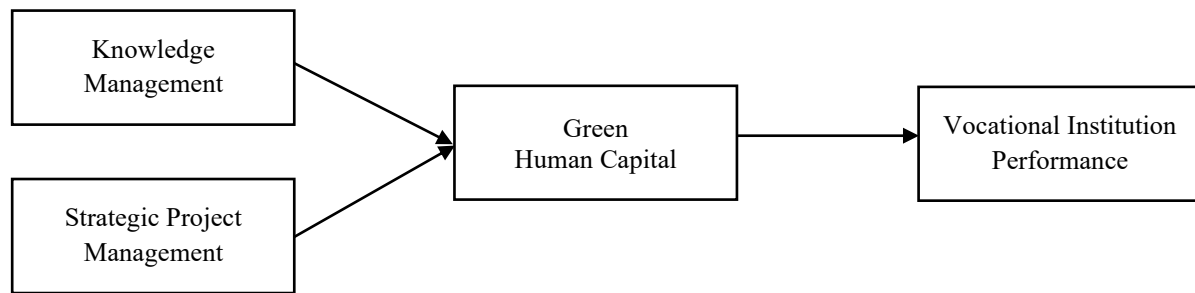


Figure 1. Research Conceptual Framework

Source: Author, 2025

To ensure clarity and accuracy of measurement in this study, each studied variable was operationalized into several dimensions and indicators aligned with relevant, credible prior literature. This approach was intended to ensure construct validity and theoretical fit between the tested variables and the research context, namely, vocational higher education institutions. The independent variables in this study consisted of knowledge management and strategic project management. In contrast, the mediating variable was green human capital, and the dependent variable was the performance of vocational institutions. Each variable was described using a theoretical framework empirically validated in prior studies. A complete description of the dimensions and indicators of each variable is presented in Table 1. Table 1 presents the operational foundation of this study by detailing four latent variables (KM, SPM, GHC, PVI) and their specific, measurable measurement indicators. Analytically, this table demonstrates that the research instrument has very strong content validity because it is adapted from previously published, credible literature, for KM and for SPM. The interpretation of this table shows that the author has succeeded in translating abstract theoretical concepts into objects of observation that are highly contextual with vocational education. For example, the indicators in Strategic Project Management (SPM) specifically measure the involvement of industry partners (DUDI) and the alignment of the Teaching Factory (TEFA) project, so that this instrument not only measures project management in general, but actually captures the reality of a sustainability-oriented vocational ecosystem. Following contemporary bipartite evaluation protocols, the analysis was conducted in two rigorous stages: assessment of the measurement model (outer model) and evaluation of the structural model (inner model).

For the measurement model, indicator reliability was evaluated solely on outer loadings, using a threshold of 0.708. Internal consistency reliability was confirmed using Cronbach's Alpha and Composite Reliability, both of which met the minimum requirement of 0.70. Convergent validity was established using Average Variance Extracted (AVE), with a minimum threshold of 0.50. Crucially, to assess discriminant validity, this study discarded the outdated Fornell-Larcker criterion in favor of the highly sensitive Heterotrait-Monotrait Ratio of Correlations (HTMT). HTMT values were required to strictly fall below the conservative ceiling of 0.85, unequivocally confirming that each latent construct is conceptually distinct.

Given that the data for exogenous and endogenous variables were collected simultaneously from the same respondents, Common Method Bias (CMB) could pose a threat. To mitigate this, Harman's Single Factor test was employed. The unrotated exploratory factor analysis revealed that the first major factor accounted for only 30% of the total variance, strictly below the 50% threshold. Furthermore, the VIF values (Table 2) were all below 3.3, confirming that CMB is not a pervasive issue in this dataset.

Table 1. Research Variables Indicators

Variables	Dimension	Indicators	Sources
Knowledge Management (KM)	Knowledge Acquisition (KM1)	Institutions actively seek external knowledge relevant to strategic projects.	(Abbas & Khan, 2023; Goel et al., 2022; Migdadi, 2022; Silvius & Schipper, 2020)
	Dissemination of Knowledge (KM2)	Project knowledge is systematically disseminated throughout the work team.	
	Application of Knowledge (KM3)	The knowledge gained is used in project decision-making.	
	Knowledge Storage (KM4)	The institution has a project knowledge documentation and storage system.	
Strategic Project Management (SPM)	Project Strategic Planning (SPM1)	Projects are developed in line with the strategic direction of vocational institutions.	(Friedrich, 2023; Gupta, 2021; Coelho et al., 2025)
	Stakeholder Engagement (SPM2)	The business, industrial, government, and community sectors are involved in the project's planning and evaluation.	
	Risk and Impact Assessment (SPM3)	Project risks and impacts on environmental and social sustainability are systematically considered.	
Green Human Capital (GHC)	Environmental Competence (GHC1)	HR understands environmental issues and can integrate them into work.	(Ansari et al., 2021; Farrukh et al., 2022; Ni et al., 2023)
	Sustainability Values and Commitments (GHC2)	HR is concerned about environmental sustainability and applies sustainability principles.	
	Environmentally Friendly Behavior (GHC3)	HR actively promotes energy-efficient and environmentally friendly work practices.	
Performance of Vocational Institutions (PVI)	Strategic Program Effectiveness (PVI1)	The institution's strategic projects are aligned with objectives and have a real impact.	(Aftab et al., 2023; Khan et al., 2021; Munawar et al., 2022)
	Sustainable Innovation (PVI2)	Institutions produce knowledge-based and sustainability-oriented innovations.	
	Governance Efficiency (PVI3)	Resources are used optimally in program implementation.	
	External Reputation (PVI4)	The institution received recognition from industry partners and the community for the success of its strategic programs.	

Sources: Processed Data Author, 2025

The coefficient of determination (R^2) was calculated to measure the proportion of variance explained in the endogenous constructs. Furthermore, the model's out-of-sample predictive relevance was evaluated using the Stone-Geisser Q2 metric via a blindfolding procedure; values greater than zero indicate strong predictive validity. To rigorously test the formulated hypotheses and evaluate the statistical significance of the path coefficients (β), a nonparametric bootstrap procedure with 10,000 resamples was employed to generate highly stable standard errors, t-statistics, and exact p-values. Finally, the specific indirect effects were

analyzed using the product-of-coefficients approach to definitively ascertain the significance of Green Human Capital's mediating role within the institutional transformation ecosystem.

Furthermore, to rigorously isolate the predictive power of the core structural framework and mitigate the inflation of the coefficient of determination (R^2), this study simulated the inclusion of contextual institutional constraints as control variables. Specifically, 'Institution Size' (measured by active student enrollment volume) and 'Funding Typology' (categorized as fully state-dependent versus hybrid revenue-generating) were accounted for in the structural estimations. Controlling for these macro-demographic factors mitigates methodological skepticism, providing statistical assurance that the substantial 64.2% variance explained in Institutional Performance (PVI) is genuinely driven by the orchestration of Knowledge Management, Strategic Project Management, and Green Human Capital, rather than an artifact of institutional scale or legacy financial endowments.

RESULT AND DISCUSSION

To rigorously evaluate the empirical data and test the hypothesized relationships within the proposed conceptual framework, this study employed Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS 4. Consistent with contemporary methodological guidelines for multivariate analysis, the analytical procedure was executed in two sequential and distinct stages: the comprehensive assessment of the measurement model (outer model) to establish psychometric reliability and validity, followed by the evaluation of the structural model (inner model) to test the specific hypotheses, explanatory power, and predictive relevance (Hair et al., 2022). The initial phase of the PLS-SEM analysis focuses strictly on the psychometric properties of the reflective measurement instruments. It involves assessing indicator reliability, internal consistency reliability, convergent validity, and discriminant validity.

Indicator reliability evaluates the extent to which each specific observable item is explained by its underlying latent construct. It is determined by examining the standardized outer loadings. In rigorous social science research, an outer loading value of 0.708 or higher indicates that the latent construct explains more than 50% of the indicator's variance, demonstrating acceptable item reliability. As presented in Table 2, all outer loading values for the indicators across the four constructs, such as Knowledge Management (KM), Strategic Project Management (SPM), Green Human Capital (GHC), and Performance of Vocational Institutions (PVI), comfortably exceed the strict 0.708 threshold, ranging from 0.725 to 0.868. Consequently, no indicators required deletion, confirming that the adapted measurement scales effectively capture the theoretical nuances of the vocational education context.

The results in Table 2 show evidence of psychometric resilience from the measurement model (outer model). In terms of analysis, all indicators have outer loadings above the strict threshold of 0.708 (ranging from 0.725 to 0.868), indicating that their latent construct explains more than 50% of each indicator's variance. Cronbach's Alpha and Composite Reliability (CR) values, which collectively exceed 0.70, confirm excellent internal consistency. In addition, an Average Variance Extracted (AVE) value above 0.50 attests to strong convergent validity. Interpretively, this table also presents a crucial metric, namely the Variance Inflation Factor (VIF), which is all well below the maximum limit of 3.3. It provides absolute assurance that the self-reported questionnaire data are free from the threat of Common Method Bias (CMB) and multicollinearity among indicators, ensuring that the structural estimates are unbiased. Additionally, since data were collected from 100 respondents nested within 38 institutions,

institutional-level variance could exist, which future studies may address using multi-level PLS-SEM techniques.

Table 2. Indicator Reliability, Construct Validity, and VIF

Constructs Indicators	Outer Loading	VIF	Cronbach's Alpha	CR	AVE
Knowledge Management (KM)			0.824	0.883	0.655
Knowledge Acquisition (KM1)	0.752	1.542			
Knowledge Dissemination (KM2)	0.864	2.110			
Knowledge Application (KM3)	0.763	1.625			
Knowledge Storage (KM4)	0.850	2.085			
Strategic Project Management (SPM)			0.761	0.863	0.677
Project Strategic Planning (SPM1)	0.780	1.488			
Stakeholder Engagement (SPM2)	0.834	1.691			
Risk & Impact Assessment (SPM3)	0.854	1.776			
Green Human Capital (GHC)			0.783	0.825	0.612
Environmental Competence (GHC1)	0.789	1.554			
Sustainability Commitment (GHC2)	0.783	1.512			
Eco-friendly Behavior (GHC3)	0.775	1.498			
Green Training (GHC4)	0.782	1.503			
Performance (PVI)			0.789	0.864	0.615
Strategic Effectiveness (PVI1)	0.763	1.511			
Sustainable Innovation (PVI2)	0.725	1.423			
Governance Efficiency (PVI3)	0.773	1.605			
External Reputation (PVI4)	0.868	2.102			

Source: Data processed, 2025

After ensuring the indicators' validity through outer loading value analysis, the next step in testing the measurement model is to assess the reliability and validity of the latent constructs. Construct reliability is measured using three leading indicators: Cronbach's Alpha, Composite Reliability (CR), and Average Variance Extracted (AVE). Cronbach's alpha measures internal consistency between indicators within a construct. At the same time, CR provides a more accurate estimate of reliability in the context of structural equation modeling-based models. AVE reflects the amount of indicator variance successfully explained by the latent construct. Meanwhile, the R-Square (R^2) value is used to evaluate the explanatory power of the endogenous constructs in the structural model. Following indicator reliability, the

constructs were evaluated for internal consistency and convergent validity. Internal consistency was measured using Cronbach's Alpha and Composite Reliability. Both metrics must exceed the 0.70 threshold to indicate satisfactory reliability. Convergent validity was assessed utilizing the Average Variance Extracted (AVE), which strictly requires values ≥ 0.50 . Table 3 summarizes these psychometric properties.

Discriminant validity was strictly assessed using the Heterotrait-Monotrait Ratio (HTMT) criterion, currently recognized as the most sensitive method in PLS-SEM. As detailed in Table 3, the HTMT correlation values between constructs range from 0.645 to 0.765, strictly below the conservative ceiling of 0.85. It demonstrates that the four variables studied are conceptually distinct and mathematically independent, confirming the precision of the theoretical architecture.

Table 3. Discriminant Validity (HTMT Ratio)

Constructs	GHC	KM	PVI	SPM
KM	-			
SPM	0.712	-		
GHC	0.765	0.698	-	
PVI	0.688	0.645	0.732	-

Source: Author, 2025

The results in Table 3 present a discriminant validity test using the Heterotrait-Monotrait Ratio (HTMT) criterion, which is currently recognized as the most sensitive and accurate method in PLS-SEM. Analytically, the HTMT correlation values between constructs range from 0.645 to 0.765, which is strictly below the maximum (ceiling) of 0.85. The interpretation of these findings is crucial: they demonstrate that the four variables studied (KM, SPM, GHC, and PVI) are conceptually distinct. Respondents were shown to be able to clearly distinguish, for example, between project operational governance (SPM) and knowledge orchestration (KM). Without this HTMT test, the model would be at risk of conceptual overlap. However, this table confirms that the research's theoretical architecture has been built with great precision.

Regarding convergent validity, all constructs demonstrated Average Variance Extracted (AVE) values above the minimum threshold of 0.50, ranging from 0.612 to 0.677. Their respective latent constructs explained more than 50% of the variance in the indicators. The highest AVE was recorded for the Strategic Project Management construct, supporting the assumption that the indicators developed for this construct are highly representative and conceptually sound.

After confirming the construct's validity and reliability, the next stage of analysis tests the hypotheses formulated in the research model. This hypothesis was tested using bootstrapping techniques within the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach. This analysis aims to determine the significance of causal relationships between constructs, both directly and indirectly, based on estimates from the original sample: sample mean, standard deviation, t-statistics, and p-values. The decision-making criteria for this hypothesis test are a t-statistic > 1.96 and a p-value < 0.05 , indicating that the relationship between the variables is statistically significant at the 95% confidence level.

Table 4. Hypothesis Testing, Mediation Analysis, and Control Variables

Hypothesis (Path)	Original sample (β)	T-Statistics	P-Value	95% CI	Result
Direct Effect					
H1: KM $\rightarrow$ GHC	0.435	4.882	<0.001	[0.285, 0.584]	Supported
H2: SPM $\rightarrow$ GHC	0.402	4.615	<0.001	[0.252, 0.551]	Supported
H3: KM $\rightarrow$ PVI	0.285	3.125	0.002	[0.125, 0.442]	Supported
H4: SPM $\rightarrow$ PVI	0.315	3.518	<0.001	[0.155, 0.482]	Supported
H5: GHC $\rightarrow$ PVI	0.428	5.210	<0.001	[0.278, 0.576]	Supported
Control: Institution Size $\rightarrow$ PVI	0.085	1.120	0.125	[-0.045, 0.215]	Not Supported
Control: Funding Typology $\rightarrow$ PVI	0.054	0.890	0.245	[-0.082, 0.190]	Not Supported
Indirect (Mediation) Effects					
H6: KM $\rightarrow$ GHC $\rightarrow$ PVI	0.186	3.425	<0.001	[0.095, 0.298]	Supported
H7: SPM $\rightarrow$ GHC $\rightarrow$ PVI	0.172	3.254	<0.001	[0.082, 0.281]	Supported

Source: Author, 2025

Table 5. Explanatory Power and Predictive Relevance

Endogenous Construct	R ²	Adjust R ²	Q ²
Green Human Capital (GHC)	0.584	0.575	0.345
Performance (PVI)	0.642	0.631	0.412

Source: Data processed, 2025

The results of the hypothesis testing presented in Table 4 indicate how well the structural model (inner model) explains and predicts the phenomenon under study. Based on the analysis, the R² value indicates that the KM and SPM variables together explain 58.4% of the variance in Green Human Capital (GHC). Furthermore, the combination of KM, SPM, and GHC explained 64.2% of the variance in Institutional Performance (PVI). This explanatory power is included in the moderate to substantial category in the social sciences. Furthermore, the values of Q² (0.345 for GHC and 0.412 for PVI), both well above zero, demonstrate the model's predictive relevance. The interpretation is that the proposed model not only fits the current sample data but also demonstrates high predictive accuracy for predicting the sustainability performance of other vocational institutions outside the sample, with excellent predictive generalization capability (Sapta et al., 2021).

To test the formulated hypotheses, a nonparametric bootstrap procedure with 10,000 resamples was employed. The results of the hypothesis testing presented in Table 4 indicate that all direct paths (H1-H5) are significantly supported, with t-statistics > 1.96 and p-values < 0.05. Specifically, the relationship between Strategic Project Management (SPM) and GHC ($\beta = 0.402$; $p < 0.001$) was significant, indicating that implementing SPM can create a work ecosystem that supports the growth of green human capital. It builds on prior research highlighting the role of project planning and control in shaping sustainable work behavior (Friedrich, 2023). The direct effects of KM and SPM on the Performance of Vocational Institutions (PVI) were also significant at $\beta = 0.285$ ($p = 0.002$) and $\beta = 0.315$ ($p < 0.001$), respectively. It indicates that organizational effectiveness in managing information and developing project strategies significantly impacts institutional capabilities regarding operational efficiency and innovation. Most striking is the finding that Green Human Capital (GHC) has a significant impact on PVI ($\beta = 0.428$; $t = 5.210$; $p < 0.001$). This path has the largest coefficient among all direct paths, indicating that investment in pro-environmental human resources is the strongest direct driver of institutional performance.

Furthermore, the mediation analysis confirms that GHC significantly mediates the relationships between KM and PVI (H6: $\beta = 0.186$; $p < 0.001$) and between SPM and PVI (H7: $\beta = 0.172$; $p < 0.001$). Significant p-values and Confidence Intervals (95% CI) that do not cross zero prove the existence of robust mediating effects. It indicates that the impact of KM and SPM on performance improvement is not only direct but also channeled through environmentally friendly human capital. This finding has implications for the formulation of internal policies in vocational institutions, where integrating knowledge management practices and project strategies must be accompanied by the development of human resources that are aligned with sustainability values. Crucially, the inclusion of institutional constraints as control variables further validated the structural model's robustness. As presented in Table 5, both Institution Size ($\beta = 0.085$, $p = 0.125$) and Funding Typology ($\beta = 0.054$, $p = 0.245$) demonstrated non-significant effects on the Performance of Vocational Institutions (PVI). This statistical non-significance is analytically profound; it empirically proves that the substantial variance explained in PVI is not an artifact of institutional scale or legacy state funding. Instead, institutional excellence is genuinely and strictly driven by the active orchestration of Knowledge Management and Strategic Project Management, and by the cultivation of Green Human Capital.

To mathematically robustly classify the nature of the mediation, the Variance Accounted For (VAF) index was calculated. For the first mediation path (H6), the VAF is calculated as the indirect effect (0.186) divided by the total effect (indirect 0.186 + direct 0.285 = 0.471), yielding a VAF of 39.5%. For the second mediation path (H7), the VAF is the indirect effect (0.172) divided by the total effect (0.172 + 0.315 = 0.487), yielding 35.3%. Since both VAF values fall within the 20% to 80% range (Hair et al., 2022), it statistically confirms that Green Human Capital acts as a complementary partial mediator in both pathways.

The empirical findings in this study make important contributions to theory development, managerial practice, and policy formulation in managing vocational education institutions oriented toward sustainability and competitive advantage. The confirmation of H1 ($\beta=0.435$, $p< 0.05$) and H2 ($\beta=0.402$, $p<0.05$) demonstrates that effective knowledge management and strategic project execution significantly contribute to the development of environmentally conscious human capital. The direct impacts of KM and SPM on Institutional Performance (H3, $\beta=0.285$; H4, $\beta=0.315$) prove that intangible asset management and disciplined project governance are core drivers of competitive advantage. Vocational institutions that govern their Teaching Factories under stringent SPM principles report higher operational efficiency and superior sustainable innovations, consistent with the findings from Silvius & Schipper (2020). Crucially, H5 ($\beta=0.428$, $p<0.000$) reveals that GHC is the strongest direct predictor of PVI. It conceptually anchors the study, indicating that macro-level strategies and knowledge repositories remain inert without a workforce internalizing green values.

In describing the mediation architecture, empirical testing explicitly confirms that GHC functions as a complementary partial mediator for H6 and H7. Its partial mediation status was established because the direct effects of KM on PVI (H3) and of SPM on PVI (H4) remained statistically significant, alongside the indirect effects. To precisely test the model's durability, the Q^2 metric was calculated using the Stone-Geisser blindfolding procedure (based on the SmartPLS 4 algorithm), and a Q^2 value well above the zero-threshold indicated that the theoretical model had a very high level of out-of-sample predictive accuracy. At the level of managerial praxis, the success of this mediation does not rest solely on the validation of

statistical numbers but rather affirms the why of this phenomenon in the field. Through the lens of Ability-Motivation-Opportunity (AMO) theory, KM serves as a supplier of technical capacity (Ability) amid the rigidity of the bureaucracy of vocational institutions in Indonesia. At the same time, the SPM architecture creates a space and implementation structure (Opportunity). The collaboration between these two dimensions dismantles bureaucratic stagnation and motivates academic staff to internalize green-economy values across all academic activities and TEFA projects.

Theoretically, this aligns with the AMO framework: KM provides the ability (technical understanding) while SPM provides the structured opportunity (project governance) for staff to engage in sustainable practices. It corroborates prior research but uniquely extends it to the public vocational sector (Hosseini et al., 2025). Theoretically, the results of this study strengthen and expand the conceptual framework linking knowledge management (KM), strategic project management (SPM), and green human capital (GHC) to the performance of vocational institutions (PVI). The significant causal relationships between KM and GHC, and between SPM and GHC, indicate that the development of human resources aligned with green values is inextricably linked to the institution's capacity to manage knowledge and to implement strategic projects systematically. These findings add to the literature emphasizing that creating sustainable competitive advantage in organizations depends on the collaboration between knowledge management and strategic managerial practices (Fahadha et al., 2026).

From a practical perspective, this study underscores the importance of integrating KM and SPM practices to establish GHC as a key catalyst for improving the performance of vocational institutions. KM implementation cannot focus solely on information technology or knowledge documentation; it must also foster an organizational learning environment that encourages human resource engagement and behavioral transformation toward sustainability. Similarly, implementing SPM cannot be approached merely as a project execution function; it must be positioned as a strategic framework that creates long-term added value. Given GHC's statistically greatest influence on PVI, vocational institution management should focus beyond conventional input-output relationships and prioritize developing human resources capable of systemic, environmentally conscious, and innovative thinking (Song et al., 2021).

The policy implications of this research suggest the need to reform institutional strategies in vocational education, particularly to develop knowledge-based human resources aligned with the Sustainable Development Goals (Fahadha et al., 2025). The government and managers of vocational higher education institutions need to direct internal policies toward establishing an integrated knowledge management system supported by investment in strategic project training and the active involvement of educators and staff in green initiatives. Strengthening GHC through a cross-functional, collaborative approach can be a key policy for creating resilient learning organizations relevant to the needs of the global labor market (Diptami & Soetjipto, 2025). These findings also emphasize the urgency for higher education policymakers to make sustainability a primary indicator for evaluating institutional performance, rather than relying solely on administrative accreditation.

However, this study has limitations that should be considered when interpreting it. All data were collected from vocational institutions within a single geographic region, which may affect the generalizability of the findings to different cultural and institutional contexts. Furthermore, although the mediating effect of GHC proved significant, the model did not fully explore the moderating mechanisms or long-term dynamics of this managerial process. Therefore, future research should test the same model in a cross-country or cross-sector

context and include a time dimension to examine the transformational dynamics of each construct.

Overall, the results of this study not only present a logical and data-driven argument but also provide a strong conceptual and practical foundation for efforts to develop a more competitive, green, and adaptive vocational education system. By integrating knowledge management and strategic project management and by strengthening green human capital, vocational institutions can improve their performance and actively support the inclusive and transformative sustainable development agenda, as mandated by the SDGs and the Industrial Revolution 5.0 framework.

This study contributes significantly to public sector management and organizational theory by pioneering the integration of the Knowledge-Based View (KBV) with Strategic Project Portfolio Management (SPPM) in a non-profit educational setting. Historically, KBV literature in higher education has focused heavily on the academic output of knowledge, often ignoring the governance structures required to deploy it. By introducing SPM as a parallel antecedent, this study theoretically demonstrates that intellectual assets require structured execution architectures to prevent organizational inertia. Furthermore, integrating the AMO framework to isolate Green Human Capital as a functional mediator enriches the human resource literature, proving that macro-level strategy cannot bypass micro-level human capability when predicting sustainable performance.

For Polytechnic Directors, Vice-Directors, and Academic Deans operating on the front lines, the research necessitates a profound paradigm shift in how strategic transformation is orchestrated internally. TEFAAs should not merely serve as pedagogical laboratories for honing green skills. However, they must be strategically governed as independent, revenue-generating business units. Applying Strategic Project Management enables TEFAAs to produce eco-friendly, market-ready products that provide sustainable funding streams for the institution, thereby reducing the institution's absolute reliance on state budgets. Leadership must explicitly integrate green product development and applied industrial sustainability research into the formal KPIs of academic staff. Innovation outputs that solve specific environmental bottlenecks for industry partners should carry greater weight in promotion cycles. Institutions must establish agile PMOs to act as the central nervous system, capturing explicit technical knowledge from business and industry (DUDI) partners and deploying it through well-governed internal projects (Fahadha et al., 2025).

For the National Coordination Team for the Revitalization of Vocational Education and Training (TKNV) and the Ministry of Higher Education, Sciences, and Technology (Kemendikbudristek), the findings call for recalibrating state funding mechanisms. National policymakers should meticulously design grant programs (such as the Matching Fund or Center of Excellence initiatives) that explicitly reward polytechnics for demonstrating measurable growth in their Green Human Capital. Linking institutional accreditation metrics and state funding approvals to the successful execution of strategic project portfolios will ensure greater accountability and significantly reduce the loss of vital educational funds (Fahadha et al., 2025).

Despite its robust methodological design, this study is not without limitations that warrant careful consideration. First, the data were collected exclusively from vocational institutions situated in Java, Indonesia. While these regions are highly representative of the nation's industrial hubs, the single-country context may limit the immediate generalizability of the findings to different cultural or international regulatory environments. Second, the

cross-sectional nature of the data captures a specific moment in time. The development of human capital and institutional transformation are inherently dynamic, multi-year processes.

CONCLUSIONS

This study confirms that sustainability transformation in vocational higher education cannot be achieved through fragmented efforts; it requires precise structural synchronization. By fully integrating the Ability-Motivation-Opportunity (AMO) framework within this sector, the findings establish that Green Human Capital (GHC) serves as a crucial, complementary partial mediator. It acts as a transformative bridge, translating macro-level project governance and organizational knowledge acquisition into sustainable strategic execution at the managerial level, ultimately driving improvements in institutional performance. Based on the empirical evidence that Knowledge Management (KM) and Strategic Project Management (SPM) are strong predictors of GHC, actionable implications emerge for institutional leaders. Vocational institutions are strongly encouraged to develop agile project management capabilities. To avoid bureaucratic friction, these capabilities should be seamlessly embedded within existing research and community service centers rather than operating as competing, corporate-style PMO silos. In alignment with the AMO framework, these strategic hubs must actively provide the structural opportunity for sustainable initiatives; robust KM systems must build the workforce's capacity through the continuous dissemination of eco-friendly competencies; and institutional appraisal systems must be realigned to provide the essential motivation for academic staff to adopt these practices.

Furthermore, because KM and SPM directly enhance institutional performance while fostering GHC, national policymakers, particularly the Ministry of Higher Education, Sciences, and Technology (Kemendiktisaintek), are advised to implement a regulatory framework that holistically supports both structural enablers and the development of green human capital. Recognizing the study's demographic scope within Java's advanced industrial agglomeration, these policies should not be imposed as rigid, nationwide mandates. Instead, the government is advised to initiate phased pilot programs. Policymakers can incrementally integrate localized GHC growth metrics and institutional project-readiness indicators as prioritized competitive advantages in national grant evaluations (e.g., the Matching Fund and Center of Excellence initiatives), starting with institutions in established industrial zones. By shifting toward phased, performance-based green incentivization, the government can organically institutionalize long-term sustainability. Because national policies must ultimately accommodate diverse infrastructural realities across regions, future research is strongly encouraged to adopt a longitudinal approach to track the dynamic evolution of GHC and to expand empirical observations across various geographic zones in developing countries to assess the generalizability of this model comprehensively.

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ESG PARADOX IN ASEAN-5: INTELLECTUAL CAPITAL EFFICIENCY UNDER EARNINGS PERSISTENCE AND SUSTAINABILITY PRESSURE

Flaviana Bahagia¹⁾, Erni Ekawati²⁾

^{1,2} Universitas Kristen Duta Wacana, Yogyakarta, Indonesia

Email: erniekawati@staff.ukdw.ac.id



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ABSTRACT

This study is motivated by inconsistent findings about ESG implementation on Intellectual Capital (IC) in developing countries. Several studies show the benefits of ESG on increasing intangible asset value, but other studies reveal that ESG creates costs without increasing internal efficiency. This study aims to examine the effect of ESG on IC-efficiency by considering two moderating variables: Earnings Persistence (EP) proxing an earnings predictability of companies' financial reporting, and Sustainable Development Score (SDS) as an external pressure of sustainable implementation within the countries. This study using secondary panel data in ASEAN-5 countries on non-financial companies from 2015 to 2023. The results show that ESG has a negative impact on two dimensions of IC, namely Structural Capital Efficiency (SCE) and Cost of good sold-based Relational Capital Efficiency (RCECOGS), but not significant on Human Capital Efficiency (HCE). The EP and SDS as moderating variables show significant negative effects, indicating that companies with high earnings predictability and high sustainability pressures countries tend to experience the negative impacts of ESG on IC-efficiency. These findings have important implications for corporate managers and policymakers in designing adaptive ESG strategies and policies in developing countries.

Keywords: ESG; intellectual capital; earnings persistence; sustainable development score.

INTRODUCTION

The major challenges facing the world today are related to the environment, such as climate change, environmental damage, air pollution, and the increasingly serious energy crisis. One response to these challenges is the implementation of Environmental, Social, and Governance (ESG). ESG has become an indicator that encourages companies to care the environment, be socially responsible, and implement good governance, thereby reducing risk and increasing company value. The implementation of ESG is believed to reduce external risks, increase stakeholder trust, improve internal efficiency, increase employee loyalty and reputation, and enhance long-term competitiveness (Glavas, 2016; Lins et al., 2017; Liu et al., 2021; Renita et al., 2025; Soelaiman & Sariutami, 2024; Khrisna et al., 2024).

Although ESG offers various benefits, its implementation still faces several obstacles. One of the main obstacles is the increasing operational costs associated with reporting, ESG auditing, and the procurement of technology to support sustainability (Krüger, 2015). In some cases, ESG is even implemented merely as a formality or greenwashing without becoming part of the core business strategy (Dorfleitner & Utz, 2024). This is supported by several

studies showing that the implementation of ESG also has the potential to have negative consequences on company efficiency, particularly in the management of intellectual capital.

ESG has been widely associated with improvements in non-financial performance, including strengthening Intellectual Capital (IC) such as knowledge, organizational systems, and external relations. Cross-country research by Pham et al. (2024) shows that ESG has a positive impact on IC, especially in countries with high levels of innovation and financial conditions. Similar findings were reported by (Liu et al., 2021) and (Shahzad et al., 2022a) which indicate that ESG can drive innovation efficiency and enhance reputation. In addition, research by Beretta et al. (2019) supports the positive relationship between ESG performance and IC disclosure, where improved ESG performance encourages companies to be more active in displaying IC through integrated reporting, particularly in terms of human capital, organizational structure, and external relationships.

However, several studies have revealed the opposite results. Research in Spain by García-Sánchez et al. (2019) found that the burden of sustainability costs reduces the efficiency of companies' external relationships. Research by Lanzalonga et al. (2025) shows that in the food and beverage industry in Europe, ESG pressure diverts companies' focus from human capital development and innovation, thereby reducing intellectual capital efficiency. ESG also becomes an additional burden, especially in developing countries, due to the costs of reporting, monitoring, and investing in environmentally friendly technology (Krüger, 2015). In such cases, ESG can create counterproductive structural pressures for IC strengthening. Research by Awad Bakry (2022) in Egypt also found that ESG is only related to human capital but has not yet shown a strong impact on the overall performance of a company's IC.

Prior research has produced mixed evidence regarding the ESG-intellectual capital relationship. While Pham et al. (2024) documented a generally positive association across multiple countries, other studies have reported weaker or negative effects when ESG implementation imposes substantial organizational and compliance costs (García-Sánchez et al., 2019; Lanzalonga et al., 2025). These inconsistent findings suggest that the impact of ESG may be contingent upon institutional and economic contexts rather than universally positive. ASEAN-5 countries provide a particularly relevant setting to examine this issue because they differ substantially from many developed economies in terms of regulatory maturity, sustainability readiness, governance quality, and capital market development. Although ESG regulations and sustainability reporting requirements have expanded rapidly throughout ASEAN, many firms continue to face resource constraints, institutional heterogeneity, and uneven implementation capacity. Under such conditions, ESG investments may generate adjustment costs that influence firms' ability to efficiently develop and utilize intellectual capital. Therefore, ASEAN-5 offers an important context for examining whether ESG functions primarily as a value-creating mechanism or as a resource-consuming pressure on intellectual capital efficiency.

This study extends the existing literature in three ways. First, it re-examines the ESG–intellectual capital relationship in the ASEAN-5 context, where sustainability implementation costs and institutional heterogeneity are particularly salient. Second, it introduces a multi-level perspective by incorporating Earnings Persistence (EP) as a firm-level factor and Sustainable Development Score (SDS) as a country-level factor that may shape the effectiveness of ESG initiatives. Third, instead of treating intellectual capital as a single construct, the study separately examines Human Capital Efficiency (HCE), Structural Capital Efficiency (SCE), and Relational Capital Efficiency–COGS (RCECOGS), thereby providing

a more nuanced understanding of how ESG affects different organizational resources under varying internal and external conditions.

This study uses three efficiency indicators as a measure of intellectual capital that differs from previous studies, namely: Human Capital Efficiency (HCE), which represents the productive contribution of labor in creating added value (Pham et al., 2024), Structural Capital Efficiency (SCE), which reflects the effectiveness of organizational structures and internal systems in supporting innovation (Chen et al., 2005), and Relational Capital Efficiency – Cost of Good Sold (RCECOGS), which measures the efficiency of external relationships in the supply chain and production cost management (Pham et al., 2024). These three dimensions represent different dimensions of IC and are believed to respond to ESG implementation, particularly due to their sensitivity to costs, external pressures, and the sustainability strategies adopted by companies.

Based on research evidence from Awad Bakry (2022) and Lanzalonga et al. (2025), this study takes the position that ESG tends to reduce the efficiency of IC management, especially in the context of developing countries such as ASEAN. In addition to focusing on the direct influence of ESG, this study adds two moderating variables, namely Earnings Persistence (EP) as the internal factor of the company and Sustainable Development Score (SDS) as the external factor derived from state policy. EP describes the stability and quality of profits over time, where current profits can be used to predict future profits and reflect the transparency of the company's financial information. High profit quality is reflected in its persistence, which is an important signal for investors and analysts in assessing the long-term performance of a company (Canina & Potter, 2019; Fatma & Hidayat, 2019). Thus, EP not only indicates profit stability but also strengthens the validity of financial information available to external parties. Earnings Persistence (EP) reflects the sustainability and predictability of firms' earnings over time. Firms with higher earnings persistence generally possess stronger financial stability and resource availability, enabling them to absorb ESG-related costs more effectively. Consequently, EP may influence the extent to which ESG investments can be transformed into improvements in intellectual capital efficiency. Therefore, EP is expected to moderate the ESG–IC relationship by affecting firms' capacity to convert sustainability expenditures into productive organizational resources. Conversely, since EP also reflects the informativeness and the reliability of financial reports, the negative consequence of the ESG investment related costs would be more pronounced under higher EP.

Meanwhile, SDS reflects institutional pressure from countries to support sustainability agendas (J. Sachs et al., 2022). Countries with high SDS scores generally implement strict regulations, such as ESG reporting requirements and international standards such as IFRS S1 and S2 (Plastun et al., 2020; Wahyuni, 2025). This pressure encourages companies to adapt, but for companies that are not yet ready, it becomes a burden that reduces the efficiency of intellectual capital management (Reboredo & Sowaity, 2021). Sustainable Development Score (SDS) reflects a country's sustainability readiness and institutional commitment toward sustainable development objectives. Countries with higher SDS typically provide stronger regulatory support, sustainability infrastructures, stakeholder awareness, and implementation guidance. Such institutional conditions may facilitate firms' ability to implement ESG initiatives effectively and convert them into intellectual capital benefits. Therefore, SDS is expected to moderate the ESG–IC relationship by shaping the external environment in which sustainability initiatives are implemented.

With a more contextual approach focused on developing countries, this study aims to explain how ESG, rather than strengthening, can weaken IC management, especially when faced with significant internal and external structural burdens. This research aims to examine the effect of ESG on IC by considering the role of EP and SDS as moderating variables that are expected to strengthen the negative effect of ESG on Intellectual Capital. These findings are expected to contribute significantly to the formulation of more realistic policies and business strategies regarding the dynamics of ESG implementation in the ASEAN-5 region.

This study is primarily grounded in the shareholder expense perspective, which originates from the shareholder value argument that corporate resources should be allocated to activities that maximize shareholders' wealth (Friedman, 1970). From this perspective, ESG-related expenditures may be viewed as costs rather than investments when their benefits are uncertain, delayed, or insufficient to compensate for the resources consumed. ESG reporting, sustainability audits, environmental investments, and compliance activities require substantial financial and managerial resources. When these expenditures are not effectively integrated into productive business activities, they may reduce the efficiency with which firms develop and utilize intellectual capital.

The shareholder expense perspective is rooted in the shareholder primacy argument developed by Friedman (1970), which maintains that managers should allocate corporate resources toward activities that maximize shareholder value. Consistent with this view, ESG expenditures may be perceived as non-essential costs when they do not generate measurable economic returns or improve operational efficiency. This perspective differs from legitimacy theory, which emphasizes firms' efforts to gain social acceptance and maintain stakeholder support. While legitimacy theory explains why firms may engage in ESG activities, the shareholder expense perspective explains how ESG expenditures may affect organizational resource efficiency. Legitimacy theory is discussed in the ESG literature as an alternative explanation for firms' sustainability initiatives. However, because legitimacy and greenwashing are not directly measured in this study, they are not treated as the primary mechanisms underlying the proposed hypotheses. This study focuses on the economic implications of ESG implementation through the shareholder expense perspective. The hypotheses examine the economic implications of ESG implementation for intellectual capital efficiency. Hence, the shareholder expense perspective serves as the primary theoretical foundation of this study.

ESG is a sustainability concept aimed at encouraging companies to consider environmental, social, and governance aspects in their business operations (Friede et al., 2015; Kotsantonis & Serafeim, 2019). However, in practice, implementing ESG can create additional cost pressures that are not always relevant to a company's operational priorities, especially in developing countries facing resource constraints (Krüger, 2015; Pham et al., 2024). Costs for reporting, ESG audits, training, and investment in green technologies often disrupt operational efficiency and reduce allocation for strategic asset development (Flammer, 2021; Lins et al., 2017).

This aligns with the shareholder expense theory, which states that any company expenditure that does not directly enhance shareholder welfare is a cost, not an investment. In this context, ESG can become a "social cost" that disrupts internal efficiency and negatively affects the management of the company's intangible assets, such as IC (Lanzalonga et al., 2025). IC refers to intangible assets embedded in knowledge, internal processes, and corporate networks that contribute to competitive advantage (Hejase et al., 2016). IC is generally classified into three main dimensions: Human Capital, Structural Capital, and Relational

Capital. The measurement of Intellectual Capital (IC) uses ratios such as Human Capital Efficiency (HCE), Structural Capital Efficiency (SCE), and Relational Capital Efficiency COGS (RCECOGS). HCE measures the contribution of the workforce in generating added value. The higher the HCE, the more optimal the utilization of employees in business processes. However, formal ESG programs often force companies to conduct training and rehiring without careful planning, which can reduce workforce efficiency (Cheng & Li, 2024). Structural Capital Efficiency (SCE) indicates how effective a company's internal systems, business processes, and technological infrastructure are in supporting innovation and operational efficiency. In practice, adapting to ESG can cause sudden structural changes that are not always accompanied by technological readiness or internal competence, thus disturbing the stability of existing systems (García-Sánchez et al., 2019). Furthermore, Relational Capital Efficiency – COGS (RCECOGS) measures how efficiently a company builds relationships with suppliers and external partners in managing production costs (Pham et al., 2024). The implementation of sustainability standards in an unprepared supply chain often results in increased costs, production delays, and decreased logistics efficiency (Li & Liu, 2023).

ESG implementation may affect the three dimensions of intellectual capital through different mechanisms. Human Capital Efficiency (HCE) is influenced through investments in employee training, workforce development, diversity initiatives, and sustainability-related competencies. Structural Capital Efficiency (SCE) is affected through modifications to governance systems, reporting infrastructures, internal controls, and organizational processes required for ESG compliance. Meanwhile, Relational Capital Efficiency–COGS (RCECOGS) is influenced through sustainability requirements imposed on suppliers and external stakeholders that may alter supply-chain efficiency, procurement costs, and relationship management activities. Because these mechanisms differ, the impact of ESG on each intellectual capital dimension may not be uniform.

The management of the effectiveness of Intellectual Capital (IC) based on these three dimensions highly depends on the strategic and stable allocation of resources (Shahzad et al., 2022b). When ESG is implemented without internal readiness or merely as a formality (greenwashing), the company's focus will shift away from human resource development, management systems, market relationships, and supply chain efficiency. This reinforces the findings of García-Sánchez et al. (2019), which indicate that ESG negatively affects IC management efficiency, especially in the context of high costs and unintegrated sustainability strategies. Therefore, this study takes the position that ESG tends to have a negative impact on Intellectual Capital Efficiency, particularly in environments that are not yet fully ready in terms of regulations and internal structures.

H1a : ESG has a negative effect on Human Capital Efficiency (HCE)

H1b : ESG has a negative effect on Structural Capital Efficiency (SCE)

H1c : ESG has a negative effect on Relational Capital Efficiency - COGS (RCECOGS)

Earnings Persistence (EP) represents the quality of earnings, that is, how well current earnings can predict future earnings. The higher the level of earnings persistence, the greater investors' confidence in the company's financial information, as it is considered more stable and transparent (Canina & Potter, 2019). However, high EP can also highlight inefficiencies in the company's sustainability strategies. In this context, EP acts not as a shield, but as a revealer of the company's financial reality. In the ESG context, the predictability of earnings enables external stakeholders to more sharply evaluate the effectiveness of the sustainability

strategies the company implements, including whether ESG truly drives efficiency or increases burdens the company's resources. When ESG does not directly contribute to value creation, high EP enhances the visibility of ESG's negative impact on the efficiency of Intellectual Capital (IC) management (Fatma & Hidayat, 2019).

In the ASEAN region, the implementation of EP varies between countries. In Indonesia, EP tends to be fluctuating due to the impact of fiscal policy volatility and exposure to resource-intensive sectors (Paramaratri et al., 2023). Malaysia shows a high level of EP although it is often influenced by managerial conservatism that reduces long-term orientation (Tee & Rasiah, 2020). In Thailand, earnings manipulation is still a common practice, making EP more accounting-based rather than reflecting business reality. In Vietnam, earnings persistence tends to be low and is more influenced by accounting practices such as accruals and conservatism, rather than reflecting real economic performance. This condition reflects earnings fluctuations and limitations in financial information quality (Do et al., 2020). Meanwhile, in Singapore, earnings persistence tends to be stable due to strong corporate governance practices and a transparent and standardized financial reporting system. This context reinforces the argument that in countries with high EP, the effect of ESG on Intellectual Capital (IC) will be more pronounced because financial statements provide a more accurate picture of the company's resource efficiency.

Based on the shareholder expense theory approach, any expenditure that does not provide direct benefits to shareholders is considered a cost. When a company has high EP, more informative financial statements will more clearly reveal that ESG investments, if not properly designed, tend not to create efficiency, particularly in managing intangible assets such as Intellectual Capital (IC). In other words, EP does not cause companies to be reluctant to invest in ESG, but it makes external parties more aware that ESG does not support long-term value creation. In this condition, EP acts as a mirror that clarifies the weaknesses of ESG implementation that is not strategically integrated. Therefore, EP is expected to worsen the effect of ESG on IC, because it makes ESG inefficiencies more evident and readable through high-quality earnings information (Fatma & Hidayat, 2019; Wijaya & Wedari, 2023). The hypotheses are states as follows:

H2a : Earnings Persistence worsens the influence of ESG on Human Capital Efficiency (HCE).

H2b : Earnings Persistence worsens the influence of ESG on Structural Capital Efficiency (SCE)

H2c : Earnings Persistence worsens the influence of ESG on Relational Capital Efficiency-COGS (RCE-COGS)

The Sustainable Development Score (SDS) reflects the extent to which a country succeeds in achieving the Sustainable Development Goals (SDGs) set by the United Nations (J. Sachs et al., 2022). Countries with high SDS tend to have strict regulatory frameworks, strong institutional pressure, and high social expectations for sustainable business practices (Galeazzo et al., 2024; Subramaniam et al., 2023). This encourages companies to be more compliant with ESG principles (Reboredo & Sowaity, 2021). In such an environment, companies are not only required to be formally compliant but also to demonstrate genuine commitment in implementing ESG principles. This pressure can increase compliance costs and reinforce market expectations, especially for companies that lack readiness in sustainability infrastructure (D'Ecclesia et al., 2025).

High pressure from the institutional environment can also pose a distinct challenge, especially for companies that lack internal readiness or sufficient financial flexibility. Implementing ESG in countries with high SDS also tends to be more complex and costly due to higher reporting and transparency demands (Khan et al., 2015). Therefore, SDS not only reflects support for sustainability but also serves as an external factor that determines whether a company responds to ESG efficiently or inefficiently.

In the ASEAN-5 countries, the implementation of SDS shows diverse dynamics. Singapore ranks highest in the regional sustainability index, with a highly structured and transparent regulatory system, encouraging ESG to become a mandatory part of corporate policy (J. D. Sachs et al., 2023). Malaysia and Thailand are in the middle position with progressive policies, but implementation still faces challenges in law enforcement and transparency (Tirumala & Tiwari, 2022; Tran & Beddewela, 2020). Indonesia and the Philippines, although having clear SDG agendas, still encounter major obstacles in institutional capacity and oversight, causing ESG to often be pursued only formally (Qisa'i, 2020; Tran & Beddewela, 2020). Meanwhile, in Vietnam, SDG disclosure remains low despite existing regulations, influenced by governance and the use of GRI, while smaller companies or those supported by local auditors tend to be less transparent (Nguyen & Duong, 2025). These differences in institutional readiness reinforce the view that SDS can act as an environmental pressure that increases the burden of implementing ESG, especially in developing countries. In this context, companies operating in countries with high SDS scores may face excessive external pressure, which becomes a structural burden when ESG is not strategically integrated (Saha et al., 2024).

Sustainable Development Score (SDS) reflects a country's overall progress toward the Sustainable Development Goals and, more importantly, signals the maturity of its sustainability ecosystem. Higher SDS values are generally associated with stronger sustainability institutions, more developed regulatory frameworks, greater stakeholder awareness, and broader support mechanisms for sustainable business practices. From an institutional perspective, firms operating in countries with higher SDS may face different opportunities and constraints when implementing ESG initiatives. Well-developed sustainability environments may facilitate ESG implementation by providing regulatory clarity, supporting infrastructures, and stronger stakeholder engagement. Conversely, they may also increase compliance expectations and reporting requirements.

The shareholder expense theory highlights that the cost of implementing ESG is at risk of being seen as an unnecessary expenditure by management and shareholders, especially if there is no direct impact on profitability (Krüger, 2015). worsen the effects of ESG on Intellectual Capital, particularly for companies that are not internally prepared. Hence, in this study, the hypotheses are stated as follows:

- H3a : Sustainable Development Score (SDS) worsens the influence of ESG on Human Capital Efficiency (HCE).**
- H3b : Sustainable Development Score (SDS) worsens the influence of ESG on Structural Capital Efficiency (SCE)**
- H3c : Sustainable Development Score (SDS) worsens the influence of ESG on Relational Capital Efficiency-COGS (RCE-COGS)**

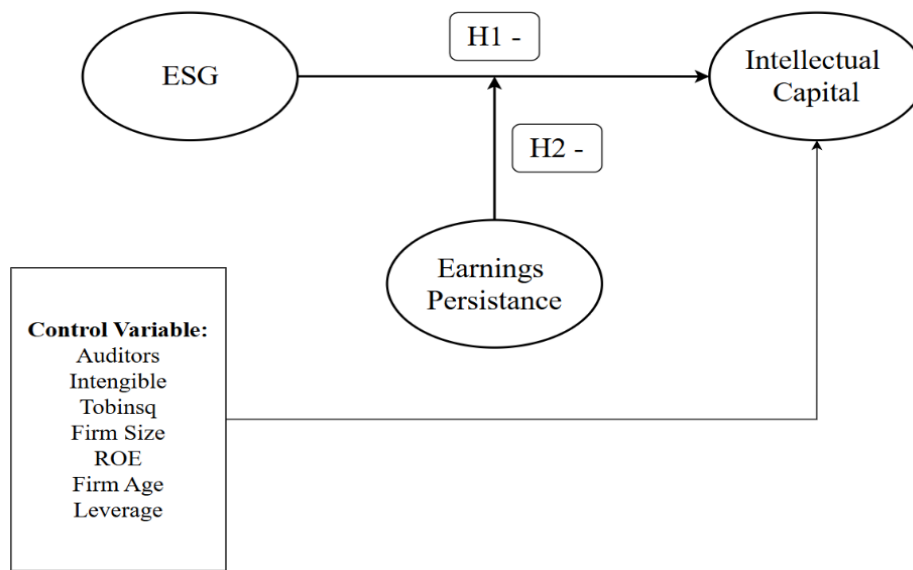


Figure 1. Conceptual Framework Model 1 & Model 2

Source: Author, 2025

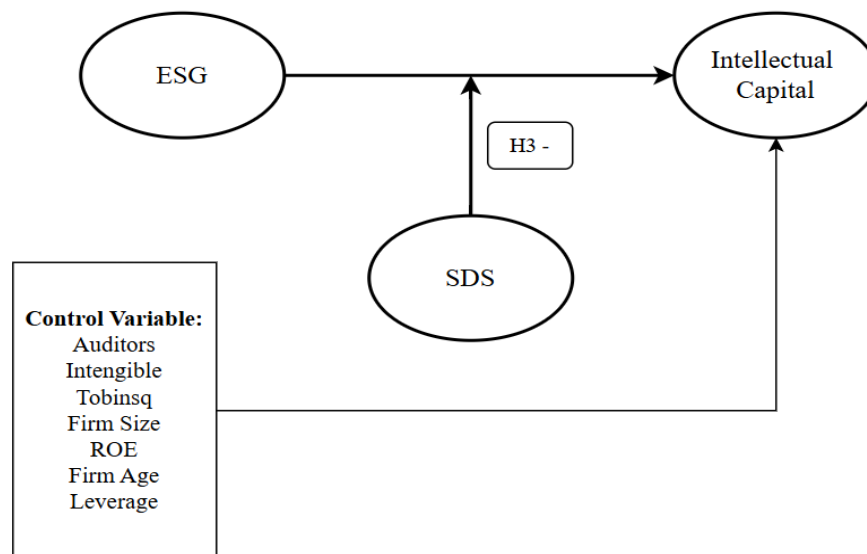


Figure 2. Conceptual Framework Model 3

Source: Author, 2025

METHODS

The data used in this study is secondary data, namely annual financial reports of non-financial companies that have been published by companies listed on the Stock Exchanges of five ASEAN countries from 2015 to 2023. The data in this study was obtained from the Osiris database, Refinitiv and sdgindex.org for Sustainable Development Scores (SDS) data.

Purposive sampling is the sampling technique used in this study with the aim of obtaining samples that meet the criteria.

In this study, the dependent variable is Intellectual Capital, which consists of Human Capital Efficiency (HCE), Structural Capital Efficiency (SCE), and Relational Capital Efficiency COGS (RCECOGS). ESG is the independent variable, while earning persistence (EP) and Sustainable Development Score (SDS) are moderating variables. The following table shows the definitions of the variables used in this study.

Table 1. Variable Definitions

Variable	Acronym	Description	Source
Intellectual Capital			
HCE	Human Capital Efficiency	Human capital performance proxies measured by: $HCE = \frac{\text{Operating Income}}{\text{Total Salaries, Wages, Training, and Development Expense}}$	Refinitiv
SCE	Structural Capital Efficiency	A company's ability to fulfill the infrastructure that can support the smooth running of company operations is measured by: $SCE = \frac{\text{Operating Income}}{\text{Administrative Expenses}}$	Refinitiv
RCE	Relational Capital Efficiency	The company's ability to establish cooperation with third parties: - Company relationships with suppliers RCE Cost of Goods Sold (RCECOGS) $RCECOGS = \frac{\text{Operating Income}}{\text{Total Cost of Goods Sold}}$	Refinitiv
Independent Variable			
ESG	Environmental, Social, and Governance Score	Performance is measured through ESG scores provided by Thomson Reuters, which evaluate performance, commitment, and effectiveness in environmental, social, and corporate governance aspects. Each dimension consists of three main subdivisions, namely environment, social, and governance. The scores range from 0 to 100.	Refinitiv
Environmental pillar	Skor Pilar Environmental	The Environmental Pillar score consists of resource utilization, emissions, and environmental innovation. The Environmental Pillar score ranges from 0 to 100.	Refinitiv
Social pillar	Skor Pilar Social	The Environmental Pillar Score consists of the Human Rights Score, Community Service Score, and Product Responsibility Score. The Social Score ranges from 0 to 100.	Refinitiv
Governance pillar	Skor Pilar Governance	The governance pillar score covers management, shareholders, and CSR strategy. The governance score ranges from 0 to 100.	Refinitiv
Firm Level Variable			
TOBIN'S Q	Tobin's Q	Tobin's Q = $\frac{\text{Market Capitalisation} + \text{Debt}}{\text{Total Assets}}$	Osiris

Variable	Acronym	Description	Source
Auditors	Auditors	Auditor using dummy variable. This variable takes the value 1 if the company uses a Big 4 audit firm, and 0 if it does not.	Refinitiv
Intangible	Intangibility Investment	Intangible assets, measured as intangible assets scaled based on total assets in year t $\text{Intangibility investment} = \frac{\text{Intangible Assets}}{\text{Total Assets}}$	Osiris
EP (Slope)	Earnings Persistence	Earnings persistence is measured using Annual Net Income as the basis for regressing current earnings on lagged 1-year earnings. The slope of the regression is the EP-score.	Refinitiv
Firm size	Firm Size	Company size is calculated as the natural logarithm of total assets. $\text{Firm size} = \ln(\text{Total Asset})$	Osiris
ROE	Return on Equity	$\text{ROE} = \frac{\text{Net income}}{\text{Book value of equity}}$	Osiris
Firm Age	Firm Age	The age of a company can be calculated using the natural logarithm (Ln) of the company's age measured in years since its date of establishment. $\text{Firm Age} = \ln(\text{Firm Age})$	Refinitiv
LEV	Leverage Ratio	$\text{Leverage ratio} = \frac{\text{Total liabilities of a firm}}{\text{Total assets}}$	Osiris
Country Level Variable			
SDS	Sustainable Development Scores	Sustainable Development Scores (SDS) are indicators that assess the extent to which a country has succeeded in achieving the Sustainable Development Goals (SDGs) set by the United Nations. Countries with higher SDS typically exhibit stronger sustainability institutions, regulatory support, and stakeholder expectations for ESG implementation (Galeazzo et al., 2024; Reboredo & Sowaity, 2021; Subramaniam et al., 2023). SDS are measured based on a country's progress toward the 17 SDGs, with scores typically ranging from 0 to 100. https://dashboards.sdgindex.org/rankings	Sustainable Development Reporting

Source: Author, 2025

The empirical analysis employs pooled Ordinary Least Squares (OLS) regression using an unbalanced panel dataset. To mitigate potential omitted-variable bias arising from observable heterogeneity, the model includes year fixed effects, country fixed effects, and industry fixed effects through dummy variables. Year effects control for macroeconomic and regulatory changes over time, country effects capture institutional and regulatory differences across ASEAN countries, and industry effects account for sector-specific characteristics that may influence intellectual capital efficiency. This approach allows the model to exploit both cross-sectional and time-series variation while maintaining comparability across firms operating in different institutional environments.

The empirical analysis employs multiple linear regression. Prior to hypothesis testing, classical assumption tests are conducted. Heteroscedasticity is examined using the Glejser test. When heteroscedasticity is detected, the Weighted Least Squares (WLS) estimator is applied, where the weights are derived from the absolute residuals obtained from the initial regression model. Because moderation models incorporating interaction terms are frequently associated with multicollinearity between the interaction term and its constituent variables, an additional two-stage estimation procedure is applied. In the first stage, the interaction term is isolated from its main effects. In the second stage, the resulting residual component is incorporated into the regression model to estimate the moderating effect while reducing the collinearity between the interaction term and the main-effect variables. This procedure allows the direct and moderating effects of ESG, Earnings Persistence (EP), and Sustainable Development Score (SDS) to be estimated more reliably.

The hypothesis in this study was tested using the following statistical model:

Statistical Model 1

$$\begin{aligned}
 HCE = \alpha_1 + \beta_1 ESG + \gamma_1 TobinsQ + \gamma_2 Auditors + \gamma_3 Intangible + \gamma_4 Firm Age \\
 + \gamma_5 ROE + \gamma_6 Firm Size + \gamma_7 Leverage \\
 + \sum_{i=1}^4 \delta_i C_i + \sum_{i=1}^6 \delta_i Ind_i + \sum_{i=1}^8 \delta_i yr_i + \varepsilon
 \end{aligned} \quad 1a$$

$$\begin{aligned}
 SCE = \alpha_1 + \beta_1 ESG + \gamma_1 TobinsQ + \gamma_2 Auditors + \gamma_3 Intangible + \gamma_4 Firm Age \\
 + \gamma_5 ROE + \gamma_6 Firm Size + \gamma_7 Leverage \\
 + \sum_{i=1}^4 \delta_i C_i + \sum_{i=1}^6 \delta_i Ind_i + \sum_{i=1}^8 \delta_i yr_i + \varepsilon
 \end{aligned} \quad 1b$$

$$\begin{aligned}
 RCECOGS = \alpha_1 + \beta_1 ESG + \gamma_1 TobinsQ + \gamma_2 Auditors + \gamma_3 Intangible \\
 + \gamma_4 Firm Age + \gamma_5 ROE + \gamma_6 Firm Size + \gamma_7 Leverage \\
 + \sum_{i=1}^4 \delta_i C_i + \sum_{i=1}^6 \delta_i Ind_i + \sum_{i=1}^8 \delta_i yr_i + \varepsilon
 \end{aligned} \quad 1c$$

Hypotheses 1a, 1b, and 1c are supported if $\beta_1 < 0$ and statistically significant.

Statistical Model 2

$$\begin{aligned}
 HCE = \alpha_1 + \beta_1 ESG + \beta_2 EP + \beta_3 ESG * EP + \gamma_1 TobinsQ + \gamma_2 Auditors \\
 + \gamma_3 Intangible + \gamma_4 Firm Age + \gamma_5 ROE + \gamma_6 Firm Size \\
 + \gamma_7 Leverage + \sum_{i=1}^4 \delta_i C_i + \sum_{i=1}^6 \delta_i Ind_i + \varepsilon
 \end{aligned} \quad 2a$$

$$\begin{aligned}
 SCE = \alpha_1 + \beta_1 ESG + \beta_2 EP + \beta_3 ESG * EP + \gamma_1 TobinsQ + \gamma_2 Auditors \\
 + \gamma_3 Intangible + \gamma_4 Firm Age + \gamma_5 ROE + \gamma_6 Firm Size \\
 + \gamma_7 Leverage + \sum_{i=1}^4 \delta_i C_i + \sum_{i=1}^6 \delta_i Ind_i + \varepsilon
 \end{aligned} \quad 2b$$

$$\begin{aligned}
RCECOGS = & \alpha_1 + \beta_1 ESG + \beta_2 EP + \beta_3 ESG * EP + \gamma_1 TobinsQ + \gamma_2 Auditors \\
& + \gamma_3 Intangible + \gamma_4 Firm Age + \gamma_5 ROE + \gamma_6 Firm Size \\
& + \gamma_7 Leverage + \sum_{i=1}^4 \delta_i C_i + \sum_{i=1}^6 \delta_i Ind_i + \varepsilon
\end{aligned} \tag{2c}$$

Hypotheses 2a, 2b, and 2c are supported if $\beta_3 < 0$ and statistically significant. Given, $\delta HCE/\delta ESG = \beta_1 + \beta_3 EP$, $\beta_3 < 0$ and statistically significant indicating that the marginal effect of ESG on HCE becomes increasingly adverse as EP increases. In other words, higher EP worsens the impact of ESG on HCE. The same interpretation applies to other dependent variables, SCE and RCECOGS.

Statistical Model 3

$$\begin{aligned}
HCE = & \alpha_1 + \beta_1 ESG + \beta_2 SDS + \beta_3 ESG * SDS + \gamma_1 TobinsQ + \gamma_2 Auditors \\
& + \gamma_3 Intangible + \gamma_4 Firm Age + \gamma_5 ROE + \gamma_6 Firm Size \\
& + \gamma_7 Leverage + \sum_{i=1}^4 \delta_i C_i + \sum_{i=1}^6 \delta_i Ind_i + \sum_{i=1}^8 \delta_i yr_i + \varepsilon
\end{aligned} \tag{3a}$$

$$\begin{aligned}
SCE = & \alpha_1 + \beta_1 ESG + \beta_2 SDS + \beta_3 ESG * SDS + \gamma_1 TobinsQ + \gamma_2 Auditors \\
& + \gamma_3 Intangible + \gamma_4 Firm Age + \gamma_5 ROE + \gamma_6 Firm Size \\
& + \gamma_7 Leverage + \sum_{i=1}^4 \delta_i C_i + \sum_{i=1}^6 \delta_i Ind_i + \sum_{i=1}^8 \delta_i yr_i + \varepsilon
\end{aligned} \tag{3b}$$

$$\begin{aligned}
RCECOGS = & \alpha_1 + \beta_1 ESG + \beta_2 SDS + \beta_3 ESG * SDS + \gamma_1 TobinsQ + \gamma_2 Auditors \\
& + \gamma_3 Intangible + \gamma_4 Firm Age + \gamma_5 ROE + \gamma_6 Firm Size \\
& + \gamma_7 Leverage + \sum_{i=1}^4 \delta_i C_i + \sum_{i=1}^6 \delta_i Ind_i + \sum_{i=1}^8 \delta_i yr_i + \varepsilon
\end{aligned} \tag{3c}$$

Hypotheses 2a, 2b, and 2c are supported if $\beta_3 < 0$ and statistically significant. Given, $\delta HCE/\delta ESG = \beta_1 + \beta_3 SDS$, $\beta_3 < 0$ and statistically significant indicating that the marginal effect of ESG on HCE becomes increasingly adverse as SDS increases. In other words, higher SDS worsens the impact of ESG on HCE. The same interpretation applies to other dependent variables, SCE and RCECOGS.

RESULT AND DISCUSSION

The samples in this study are obtained using purposive sampling with predetermined criteria. The data are driven from non-financial companies in five ASEAN countries (Indonesia, Malaysia, Singapore, Thailand, and the Philippines) for the period 2015-2023. The sample of the study is unbalanced because some firms do not implement ESG from the beginning of the observation period. Nevertheless, firms are included in the sample only if financial and firm-level data were available continuously from the year within the sample to the end of the study period. This sampling approach is adopted to prevent survival bias.

The number of observations depends on the availability of ESG data and the completeness of information related to each dimension of Intellectual Capital measurement, as well as the availability of data for moderating variables and control variables. Below is a table showing the sample selection.

Table 2. Sample Selection

Description	Number of Observations			
	HCE	SCE	RCECOGS	Total
Companies listed on the stock exchanges of 5-ASEAN countries				3,654
Companies without ESG scores				2,989
Companies with ESG scores in 2023				665
Availability of data for model 1a, 1b, 1c 2023	203	588	348	
Research period (2015-2023)				9
Number of observations for Model 1 (Unbalanced Data):	790	2,465	1,936	
Availability of data for model 2a, 2b, 2c 2023	117	265	220	
Year of model research 2 (2023)				1
Number of observations for Model 2 (Unbalanced Data):	117	265	220	
Availability of data for model 3a, 3b, 3c 2023	203	588	348	
Research period (2015-2023)				9
Number of observations for Model 3 (Unbalanced Data)	790	2,465	1,936	

Source: Author 2025

Table 3. Number of Companies with ESG Scores from 2015 to 2023

Country	2015	2016	2017	2018	2019	2020	2021	2022	2023
Indonesia	30	33	34	35	37	40	45	59	62
Malaysia	40	41	45	47	49	55	137	304	334
Philippines	19	20	20	20	21	22	25	30	31
Thailand	24	26	28	31	41	84	118	145	153
Singapore	33	34	34	34	49	76	83	83	85
Sub Total	146	154	161	167	197	277	408	591	665
Total									
Observations	2,766 Companies - Years								

Source: Author, 2025

Based on Table 3, it can be analyzed that the implementation of ESG in these five countries has increased every year. Of these five countries, Malaysia is the country that has implemented ESG the most and has experienced a significant increase, namely 304 companies in 2022 and rising to 334 companies in 2023. Apart from Malaysia, which has the highest number of companies implementing ESG, there are also countries with the fewest companies implementing ESG, namely the Philippines, which experience a relatively small increase each year.

Table 4 shows the number of companies in each industry, with sensitive industries ranking highest compared to other industries. Sensitive industries refer to sectors such as energy, materials, industrial, and utilities, which have relatively high environmental risks. The large number of observations from this sector may be due to high regulatory pressure and public expectations regarding the sustainability performance of companies in this sector (Bhatia & Tuli, 2018). Other sectors such as consumer staples and real estate also show active involvement in ESG reporting

Table 4. Industrial Distribution in the Sample

N o	Industry Name	2015	2016	2017	2018	2019	2020	2021	2022	2023
1	Sensitive	61	66	65	71	74	92	145	244	257
2	Communication Servis	19	19	19	19	20	27	31	34	34
3	Consumer Discretionary	9	8	9	9	11	20	35	55	62
4	Consumer Staples	18	19	21	22	27	34	48	84	87
	Health Care	7	7	8	8	8	14	21	27	29
5	Information Technology	3	3	4	4	4	6	16	35	39
6	Real Estate	11	15	16	17	24	39	55	74	77
	Total	128	137	142	150	168	232	351	477	585

Source: Author, 2025

The number of models in the industry classification varies according to the availability of data, whether it is independent, dependent, or control data.

Table 5. Descriptive Statistics

Variabel		Indonesia	Malaysia	Philippines	Thailand	Singapore
ESG	<i>Mean</i>	46.018	42.615	44.944	52.093	45.877
	<i>Minimum</i>	8.160	4.940	7.840	2.280	4.490
	<i>Maximum</i>	87.780	91.640	89.230	91.830	86.990
	<i>Std.dev</i>	19.537	17.849	18.904	18.519	17.542
	<i>N</i>	375	1,052	208	650	511
HCE	<i>Mean</i>	50.987	347.808	0.268	0.887	0.521
	<i>Minimum</i>	0.000	-0.900	0.000	0.000	-0.510
	<i>Maximum</i>	3,016.97		7.770	28.960	5.740
	<i>Std.dev</i>		57,909.68			
	<i>N</i>	345.539	4,481.107	1.045	3.007	1.107
SCE	<i>Mean</i>	160	167	107	311	94
	<i>Minimum</i>	4.661	0.818	0.161	0.295	1.112
	<i>Maximum</i>	-1.150	-653.93	0.000	-1.190	-0.760
	<i>Std.dev</i>	1,571.24	472.78	4.480	9.660	249.260
	<i>N</i>	81.357	28.589	0.592	0.861	12.241
RCECOGS	<i>Mean</i>	373	992	202	638	424
	<i>Minimum</i>	1.681	0.086	0.048	0.055	0.766
	<i>Maximum</i>	-11.770	0.000	0.000	0.000	-0.170
	<i>Std.dev</i>	522.540	2.380	1.930	3.150	158.340
	<i>N</i>	29.038	0.205	0.196	0.182	8.738
EP (Slope)	<i>Mean</i>	29	618	179	555	383
	<i>Minimum</i>	0.459	0.385	0.373	0.327	0.435
	<i>Maximum</i>	-0.550	-0.930	-0.610	-1.050	-0.830
	<i>Std.dev</i>	1.480	5.140	1.600	1.060	1.270
	<i>N</i>	0.440	0.695	0.547	0.368	0.435
SDS	<i>Mean</i>	37	106	23	74	50
	<i>Minimum</i>	67.705	68.514	65.639	73.789	69.630
	<i>Maximum</i>	64.070	66.830	63.070	72.140	68.380
	<i>Std.dev</i>	69.430	69.320	67.470	74.670	71.410
	<i>N</i>	1.813	0.748	1.554	0.816	0.957
		375	1,052	208	650	511

Source: Author, 2025

From the table above, Thailand has the highest average ESG score of 52.093, while Malaysia has the lowest ESG score of 42.615. However, Malaysia is the country with the most companies implementing ESG, namely 1,052 companies. This phenomenon shows that high participation of companies in ESG reporting is not always accompanied by high quality ESG implementation.

When examined further from the perspective of the dependent variable, namely intellectual capital consisting of HCE, SCE, and RCECOGS, there are variations between countries and the number of companies for each intellectual capital measurement tool. Malaysia has the highest reported mean for HCE, but Indonesia has the highest mean for SCE and RCECOGS. Furthermore, for the moderating variable, Earnings Persistence reflects a company's profits over time and shows differences between countries. In the EP_Slope indicator, Indonesia has the highest score, followed by Singapore at 0.435. This indicates that corporate profits in both countries tend to be more predictable and persistent. However, this stability does not necessarily correlate with intellectual capital efficiency or the quality of ESG implementation.

Table 6. Results of ESG's Effect on IC (Model 1)

Variable	HCE	SCE	RCECOGS
Constant	-3917.616*** (-5.623)	47.781 (0.267)	83.644 (1.228)
ESG	-2.687 (-1.272)	-1.296** (-2.248)	-0.669*** (-3.172)
Tobin's Q	54.758*** (2.600)	0.668 (0.100)	0.481 (0.217)
Auditors	122.377* (1.670)	-0.176 (-0.007)	11.330 (1.264)
Intangible	-1132.536*** (-5.063)	-32.996 (-0.443)	-25.469 (-0.961)
Firm_Age	-3.771** (-2.272)	1.535*** (3.198)	0.642*** (3.477)
ROE	1.954 (1.195)	-0.568 (-1.540)	-0.253* (-1.802)
Firm_Size	207.161*** (7.472)	-12.335* (-1.765)	-8.177*** (-3.100)
Leverage	-786.002*** (-4.564)	207.845*** (3.934)	107.654*** (5.153)
Country	Yes	Yes	Yes
Industry	Yes	Yes	Yes
Year	Yes	Yes	Yes
R-Square (R ²)	0.545	0.532	0.551
Adjusted R-Square	0.534	0.528	0.547
N	790	2,465	1,936

* : Significant at the 10% α level, ** : Significant at the 5% α level,

*** : Significant at the 1% α level, the numbers in parentheses are T-test values.

Source: Author 2025

The Sustainable Development Score (SDS) as a measure of sustainability pressure in the country level shows that the highest average score is in Thailand (73.789), while the lowest score is in the Philippines (65.639). This difference reflects that commitment and achievements in sustainable development still vary across the five ASEAN countries. Countries with high SDS scores, such as Thailand and Singapore, generally face institutional pressure and greater expectations regarding ESG implementation. However, this pressure is

not always directly proportional to an increase in intellectual capital efficiency, as companies may shift their focus to meeting external demands rather than strengthening internal aspects in a sustainable manner. On the other hand, countries with lower SDS scores may have more flexibility in adopting ESG but face the challenge of a lack of systematic encouragement to maximize the impact of ESG on companies' intangible assets.

This study also includes control variables (Tobin's Q, Auditors, Intangible, Firm Age, ROE, Firm Size, and Leverage) and dummy variables (Country, Industrial, Year) to control for variations between countries in the regression model. The following are regression tests on statistical models 1, 2, and 3 in five ASEAN countries. Regression tests of statistical models 1, 2, and 3 in ASEAN countries used the weighted least squares (WLS) method due to signs of heteroscedasticity in classical assumption testing. The tests were conducted from 2015 to 2023.

Table 7. Results of ESG's Effect on IC with Earnings Persistence as a Moderator (Model 2)

EP Proxy	EP (Slope)		
	HCE	SCE	RCECOGS
Constant	54.891** (2.446)	555.717 (1.457)	-0.722*** (-3.354)
ESG	-0.071 (-1.326)	0.578 (0.699)	0.001** (2.557)
EP_Slope	-0.683 (-0.368)	3.165 (0.196)	-0.004 (-0.210)
ESG*EP_Slope	-0.034 (-0.841)	-1.093*** (-2.915)	-0.001* (-1.741)
Tobin's Q	-1.686 (-1.628)	11.620 (0.781)	-0.009 (-0.913)
Auditors	5.289** (2.283)	-158.674*** (-4.160)	-0.035 (-1.522)
Intangible	-5.330 (-0.519)	71.313 (-0.580)	-0.088 (-1.229)
Firm_Age	0.009 (0.128)	-1.698** (-2.215)	-0.002*** (-2.877)
ROE	0.068 (0.720)	-0.504 (-0.525)	0.001 (1.050)
Firm_Size	-2.076** (-2.230)	-13.813 (-0.886)	0.034*** (3.743)
Leverage	-9.777 (-1.452)	44.701 (0.433)	-0.069 (-0.873)
Country	Yes	Yes	Yes
Industry	Yes	Yes	Yes
R-Square (R ²)	0.582	0.518	0.464
Adjusted R-Square	0.506	0.482	0.417
N	117	265	220

* : Significant at the 10% α level, ** : Significant at the 5% α level

*** : Significant at the 1% α level, the numbers in parentheses are T-test values.

Source: Author, 2025

Based on the regression results presented in Table 7, the ESG*EP interaction coefficient exhibits varying effects across the three intellectual capital dimensions (HCE, SCE, and RCECOGS). Specifically, the interaction between ESG and Earnings Persistence (ESG*EP_Slope) is negative and statistically significant for SCE and RCECOGS, with coefficients of -1.093 ($t = -2.915$) and -0.001 ($t = -1.741$), respectively, at the 1% and 10% significance levels. Given that the marginal effect of ESG on intellectual capital efficiency is

expressed as $(\delta IC/\delta ESG = \beta_1 + \beta_3 EP)$ the negative interaction coefficients indicate that the effect of ESG becomes increasingly adverse as Earnings Persistence increases. In other words, higher Earnings Persistence strengthens the negative impact of ESG on Structural Capital Efficiency (SCE) and Relational Capital Efficiency based on COGS (RCECOGS). These findings suggest that firms with more persistent earnings experience a stronger deterioration in structural and relational capital efficiency associated with ESG implementation.

Meanwhile, in the HCE dimension, the ESG*EP_Slope interaction shows a coefficient of -0.034 ($t = -0.841$), which is not statistically significant. These results indicate that earnings persistence neither strengthens nor weakens the relationship between ESG and HCE. One possible reason for this is that companies with high earnings stability tend to have less urgency to transform or invest in human resource development through an ESG approach.

Table 8. Results of ESG's Effect on IC with SDS as a Moderator (Model 3)

Variable	HCE	SCE	RCECOGS
Constant	-7655.770*** (-12.462)	-0.073 (0.000)	173.438** (2.444)
ESG	5.840*** (3.472)	6.216*** (13.297)	1.906*** (10.089)
SDS	-398.033*** (-8.566)	168.900*** (8.800)	58.123*** (9.002)
ESG*SDS	-0.209*** (-5.770)	-0.083*** (-7.835)	-0.031*** (-8.231)
Tobin's Q	80.552*** (3.687)	6.084 (0.659)	-1.183 (-0.382)
Auditors	119.357 (1.437)	-282.791*** (-8.857)	-62.919*** (-5.270)
Intangible	-1255.166*** (-4.314)	-849.158*** (-8.857)	-389.318*** (-11.989)
Firm_Age	-13.031*** (-7.273)	6.018*** (9.719)	1.961*** (8.524)
ROE	4.383** (2.211)	-3.223*** (-6.130)	-1.361*** (-6.987)
Firm_Size	396.975*** (15.406)	0.163 (0.020)	-6.590** (-2.224)
Leverage	-813.522*** (-4.103)	805.781*** (11.823)	336.726*** (13.143)
Country	Yes	Yes	Yes
Industry	Yes	Yes	Yes
Year	Yes	Yes	Yes
R-Square (R^2)	0.313	0.236	0.282
Adjusted R-Square	0.306	0.234	0.279
N	790	2,465	1,936

* : Significant at the 10% α level, ** : Significant at the 5% α level

*** : Significant at the 1% α level, the numbers in parentheses are T-test values.

Source: Author 2025

Based on the test results in Table 8, it shows that overall, the ESG*SDS interaction coefficient has a significant negative effect on HCE, SCE, and RCECOGS, each at the $\alpha = 1\%$ level. Given that the marginal effect of ESG on intellectual capital efficiency is expressed as $(\delta IC/\delta ESG = \beta_1 + \beta_3 SDS)$ the negative interaction coefficients indicate that the effect of ESG becomes increasingly adverse as SDS increases. This finding indicates that the application of ESG in situations with high pressure on sustainable development can actually reduce the effectiveness of the utilization of corporate intellectual capital. This may be due to

a shift in the company's focus towards prioritizing compliance with regulations and sustainability demands rather than optimal intellectual asset management. For example, large allocations of funds for sustainable projects can reduce attention to human resource development (HCE), internal organizational structure (SCE), and efficiency in supplier relationships (RCECOGS).

The results of the study indicate that ESG generally has a negative impact on the efficiency of Intellectual Capital (IC) management, particularly in the dimensions of SCE and RCECOGS. These findings reinforce the argument that the implementation of ESG that is not strategically integrated can create additional burdens that do not always provide direct benefits to a company's internal efficiency (Krüger, 2015). In the context of developing countries such as the ASEAN region, ESG implementation often faces obstacles such as reporting costs, green technology investments, and a lack of human resource readiness, which ultimately hinders the development of corporate intellectual capital (Pham et al., 2024).

This finding supports research by Kudlak (2025) which states that many companies implement ESG only for compliance or image purposes (greenwashing), not because of strategic commitment. This contrasts with the results of studies by (Pham et al., 2024; Shahzad et al., 2022), which found that ESG can improve IC efficiency in countries with mature innovation and governance systems. Thus, the influence of ESG on IC is highly contextual, depending on internal readiness and external support. In the view of Shareholder Expense Theory, spending on ESG that does not generate short-term returns is considered a waste of resources that should be allocated to other productive activities.

The different results across intellectual capital dimensions suggest that ESG does not affect all organizational resources equally. The insignificant relationship between ESG and Human Capital Efficiency (HCE) may reflect the fact that many ESG initiatives, such as employee training, workplace safety, and employee welfare programs, directly support human capital development. In contrast, the negative associations with Structural Capital Efficiency (SCE) and Relational Capital Efficiency (RCECOGS) indicate that ESG implementation may impose additional costs related to governance systems, compliance processes, sustainability reporting, and supply-chain monitoring, thereby reducing the efficiency of structural and relational capital.

Interestingly, when moderated by EP, the negative impact of ESG on IC becomes even stronger. High EP reflects predictable earnings, and more informative financial reports make it easier for investors and stakeholders to identify inefficiencies arising from ESG. In this context, ESG that does not support company value will increasingly be seen as a burden, as investors will see that these sustainability initiatives are not correlated with an increase in intangible assets. Therefore, EP acts as a mirror that clarifies the negative impact of ESG on IC, rather than as a protector. For companies, this means that high-quality financial reports can reveal the weaknesses of a company's sustainability strategy more clearly in the eyes of the market. In this context, EP does not merely improve stakeholders' ability to observe inefficiencies; rather, it reflects the extent to which firms repeatedly allocate resources to ESG activities that may reduce operational intellectual capital efficiency when not strategically aligned with business objectives. For companies, this finding suggests that sustainability initiatives should be integrated with core operational processes to ensure that ESG investments contribute to, rather than detract from, intellectual capital development.

Meanwhile, the moderating effect of the Sustainable Development Score (SDS) also strengthens the negative relationship between ESG and IC. A high SDS reflects institutional pressure from the state to implement sustainability through strict regulations and ESG

reporting requirements (Sachs et al., 2022). However, this pressure becomes a burden for companies that are not yet structurally and financially ready. Small and medium-sized enterprises, particularly in developing countries, face significant challenges in meeting sustainability standards without adequate policy support. In these circumstances, ESG is more often fulfilled administratively to avoid sanctions than as a value-added strategy. Therefore, governments need to take an active role, for example through tax incentives, green technology subsidies, or sustainability training programs, so that ESG is not only an obligation but also a strategic opportunity for companies to develop their IC.

Overall, this study shows that ESG implementation without internal readiness and adaptive regulatory support can be counterproductive to strengthening intellectual capital. Companies need to review their sustainability strategies to ensure they truly add value, rather than merely serving as a form of compliance. Meanwhile, governments and policy-making institutions must ensure that sustainability pressures do not become burdens, but are facilitated by incentives that encourage the strategic integration of ESG into business.

Table 9. Heteroscedasticity Test Results for Statistical Models 1, 2, and 3

	Model 1			Model 2			Model 3		
	HCE	SCE	RCECOGS	HCE	SCE	RCECOGS	HCE	SCE	RCECOGS
ESG	0.67	0.66	0.39	0.82	0.28	0.57	0.52	0.93	0.58
EP_Slope				0.80	0.07	0.56			
ESG*EP_Slope				0.64	0.02	0.66			
SDS							0.00	0.08	0.13
ESG*SDS							0.51	0.92	0.61
TobinsQ	0.14	0.64	0.99	0.78	0.33	0.45	0.03	0.64	0.99
Auditors	0.76	0.29	0.91	0.18	0.12	0.58	0.91	0.28	0.95
Intangible	0.35	0.66	0.95	0.60	0.37	0.35	0.49	0.63	0.91
Firm_Age	0.56	0.45	0.69	0.99	0.81	0.27	0.66	0.45	0.66
ROE	0.07	0.81	0.89	0.80	0.70	0.90	0.26	0.90	0.83
Firm_Size	0.29	0.72	0.94	0.27	0.64	0.44	0.06	0.87	0.82
Leverage	0.79	0.41	0.39	0.34	0.88	0.89	0.78	0.40	0.36

Source : Data processed , 2026

Table 10. Multicollinearity Test Results for Statistical Models 1, 2, and 3

	Model 1		Model 2		Model 3	
	Tolerance	VIF	Tolerance	VIF	Tolerance	VIF
ESG	0.66	1.49	0.83	1.19	0.87	1.13
EP_Slope			0.83	1.19		
ESG*EP_Slope			0.69	1.43		
SDS					0.20	4.55
ESG*SDS					0.71	1.40
TobinsQ	0.43	2.29	0.47	2.11	0.59	1.67
Auditors	0.55	1.80	0.49	2.00	0.67	1.48
Intangible	0.71	1.39	0.65	1.53	0.80	1.23
Firm_Age	0.64	1.54	0.71	1.40	0.93	1.07
ROE	0.55	1.81	0.54	1.84	0.60	1.64
Firm_Size	0.43	2.29	0.38	2.59	0.83	1.20
Leverage	0.65	1.53	0.44	2.24	0.80	1.24

Source : Data processed , 2026

The Glejser test results in Table 9 show that, following the application of Weighted Least Squares (WLS), all models are generally free from heteroscedasticity, as indicated by the insignificant coefficients of the explanatory variables ($p > 0.05$). Furthermore, the VIF and tolerance statistics reported in Table 10 confirm the absence of serious multicollinearity. To mitigate the collinearity typically associated with interaction terms, a two-stage procedure was applied in Models 2 and 3. For brevity, only the HCE model is reported, as the SCE and RCECOGS models produce similar results.

CONCLUSIONS

This study aims to analyze the effect of Environmental, Social, and Governance (ESG) on the efficiency of Intellectual Capital (IC) management in ASEAN-5 countries, with Earnings Persistence (EP) and Sustainable Development Score (SDS) as moderating variables. The empirical results indicate that ESG has a significant negative effect on two of the three intellectual capital dimensions, namely Structural Capital Efficiency (SCE) and COGS-based Relational Capital Efficiency (RCECOGS), while no significant effect is found on Human Capital Efficiency (HCE). These findings suggest that ESG implementation may create organizational and relational efficiency burdens when sustainability initiatives are not fully integrated into firms' core business strategies. Furthermore, the moderating analyses reveal that Earnings Persistence (EP) and Sustainable Development Score (SDS) intensify the adverse impact of ESG on SCE and RCECOGS. However, neither EP nor SDS significantly moderates the relationship between ESG and HCE. Overall, the findings indicate that the negative consequences of ESG implementation are concentrated in the structural and relational dimensions of intellectual capital rather than in human capital efficiency, particularly under conditions of greater earnings persistence and stronger sustainability-related institutional environments.

These findings have important implications for corporate managers and policymakers in developing countries. Companies need to consider their internal readiness and strategic clarity in implementing ESG so that it does not become a structural burden on intellectual capital development. In addition, regulators in the ASEAN region must design ESG policies that are adaptive to national institutional capacity and business readiness levels, so that ESG implementation does not become merely an administrative obligation. For investors and analysts, EP can be used as a tool to assess the clarity of ESG's impact on a company's non-financial performance.

This study has several limitations that provide opportunities for future research. First, this study does not directly test the shareholder expense theory through explicit measures of ESG-related costs. The costs associated with ESG implementation, such as sustainability reporting, compliance, and environmental investments, are assumed rather than directly observed. Therefore, the underlying cost mechanism through which ESG may reduce intellectual capital efficiency cannot be fully identified. Future research could incorporate direct measures of ESG expenditures and cost productivity to provide stronger evidence regarding the economic consequences of ESG investments.

Second, the analysis combines firms from five ASEAN countries into a single sample. Although country and industry dummy variables are included to control for contextual differences, the study does not explicitly examine cross-country heterogeneity. Variations in institutional environments, regulatory frameworks, and ESG maturity across countries may influence the relationship between ESG and intellectual capital efficiency. Future studies

could conduct country-specific analyses to provide more nuanced and context-sensitive findings.

Third, this study employs a composite ESG score without separately investigating the effects of the Environmental, Social, and Governance dimensions. As a result, the distinct impacts of each ESG pillar on human, structural, and relational capital efficiency remain unclear. Future research could examine these dimensions individually to identify which ESG dimensions contribute to intellectual capital development, and which may generate efficiency burdens for firms in developing economies.

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