

The Implementation of Green Marketing and Product Innovation on Purchasing Decisions for Environmentally Friendly Multimedia Products with Government Regulations as Mediation

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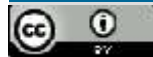
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ABSTRACT

This study examines the influence of product innovation and green marketing implementation on the decision to purchase environmentally friendly products, with government regulations as a mediating variable, in the context of CV. Suvana Solusi Mandiri, a technology company in Indonesia. The research aims to analyze opportunities and challenges in implementing green marketing, contributing to sustainable business practices aligned with the Sustainable Development Goals (SDGs), particularly SDG 9 (Industry, Innovation, and Infrastructure), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action). Using a quantitative explanatory approach with a mediation model, data were collected via questionnaires from 160 respondents in Jabodetabek, selected through purposive sampling. Analysis employed Partial Least Squares Structural Equation Modeling (PLS-SEM) to test seven hypotheses. Results indicate that product innovation significantly and positively affects purchasing decisions for eco-friendly products ($\beta = 0.289$, $t = 3.212$, $p = 0.001$) and government regulations ($\beta = 0.473$, $t = 5.800$, $p = 0.000$). Green marketing implementation also positively influences purchasing decisions ($\beta = 0.221$, $t = 2.634$, $p = 0.008$) and government regulations ($\beta = 0.414$, $t = 4.850$, $p = 0.000$).

INTRODUCTION

Awareness of global environmental issues continues to grow as the volume of global electronic waste (e-waste) soars, projected to reach over 60 million tons by 2025. Low recycling rates and the high impact of heavy metal pollution are driving governments, companies, and consumers to pay closer attention to sustainable business practices. In this context, green marketing has emerged as a crucial strategy that not only emphasizes the promotion of environmentally friendly products but also encompasses sustainability-oriented production, distribution, and innovation processes.

The implementation of green marketing is closely linked to green innovations, such as energy efficiency, reduced resource consumption, and the use of recycled materials, which have been proven to improve operational efficiency and competitive advantage for companies. In addition to building a positive image, green innovation also supports long-term business sustainability. However, implementing this strategy is not always smooth, especially in mid-sized technology companies facing intense competition and limited resources.

CV. Suvana Solusi Mandiri, a systems integrator in Indonesia, faces specific challenges in adopting green marketing, including conventional consumer mindsets, the complexity of integrating sustainability across the supply chain, and the uncertainty of government environmental regulations. Yet, the company's primary customer segments—businesses, government agencies, and professionals—are increasingly concerned about sustainability when selecting technology partners.

Previous research has demonstrated that product innovation and green marketing have a positive influence on purchasing decisions for environmentally friendly products, highlighting the important role of government regulations. However, there is still a gap in research regarding how government regulations act as a mediating variable in the context of mid-sized technology companies in Indonesia. Therefore, this study aims to analyze the influence of product innovation and green marketing implementation on purchasing decisions for environmentally friendly products, with government regulations as a mediating variable, to support the business sustainability of CV. Suvana Solusi Mandiri.

LITERATURE REVIEW

1) Theory of Planned Behavior

The TPB explains that purchasing decisions are influenced by positive attitudes toward environmentally friendly products, social norms (such as environmental awareness), and behavioral control (such as product availability) (Paul et al., 2021). In this study, the pre-survey indicated high positive attitudes toward green innovation (85%) and government regulations (83%), which drive purchasing decisions in CV. Suvana Solusi Mandiri's business segment.

2) Environmentally Friendly Product Purchasing Decision Theory

The Green Product Purchase Decision Theory explains that consumer decisions to purchase green products are influenced by factors such as environmental values, belief in green marketing claims, intrinsic motivation to contribute to sustainability (e.g., through reducing environmental impact),

preference for buying green products, willingness to pay more for green products, the influence of environmental information on purchasing decisions, and loyalty to brands committed to green (Chen et al., 2022; Paul et al., 2021). In the context of this study, this theory is integrated with the TPB to show how green product innovation and government regulation as mediators can strengthen purchase intentions. The pre-survey results showed a high preference for eco-friendly products (75%) and challenges in changing consumer mindsets (70%), which emphasizes the need for green marketing strategies to increase trust and motivation in the CV. Suvana Solusi Mandiri business segment. This theory supports the research model by highlighting the role of regulation in building consumer trust, thereby contributing to the adoption of sustainable technology products and the achievement of SDGs such as SDG 12 (Responsible Consumption and Production).

3) Green Marketing Theory

Green marketing is defined as a marketing strategy that promotes environmentally friendly products or services, from production to distribution (Thompson & et al., 2022). This theory emphasizes that green marketing not only enhances a company's image but also encourages green innovation to reduce environmental impacts. In this study, green marketing was implemented by CV. Suvana Solusi Mandiri to target business, government, and professional consumer segments, with a focus on reducing resource consumption and energy efficiency (Chen et al., 2022). This implementation includes product promotions with environmentally friendly messages, the use of recyclable packaging, marketing campaigns emphasizing environmental ethics, and the company's involvement in green initiatives.

4) Product Innovation Theory

Green product innovation involves the use of recycled materials, energy-efficient technologies, and minimal waste, including unique eco-friendly features such as automatic energy-saving modes, recycled materials from e-waste, technological innovations to reduce environmental impacts such as AI sensors, and designs that support sustainability, such as modular features for easy repair (Naruetharadhol et al., 2021). This enhances competitive advantage and long-term sustainability, influencing purchasing decisions through government regulations as mediators, such as tax incentives or certification. These innovations encourage ethical consumer choices, reduce carbon emissions, and contribute to climate change mitigation and a circular economy.

5) Government Regulation Theory

According to Wang et al. (2021), government regulations can serve as "innovation drivers" that compel companies to adopt sustainable practices, thereby increasing efficiency and reducing long-term costs. In the Indonesian context, regulations such as Law No. 32/2009 concerning Environmental Protection and Management act as mediators that strengthen the relationship between product innovation and green marketing and purchasing decisions (Chen et al., 2023). This theory explains that regulations not only punish violations but also provide incentives, such as government policies on environmentally friendly product standards, tax incentives for green companies,

regulations on green product labels, and government oversight of sustainable business practices, to encourage the adoption of environmentally friendly products.

This study adopts theories such as Huang et al.'s (2024) findings on consumer awareness to explain consumer purchasing decisions influenced by attitudes, subjective norms, and behavioral control, Chen and Chang's (2022) Green Innovation Theory which highlights how product innovation can reduce costs and improve energy efficiency, and Chen et al.'s (2023) findings which demonstrate the role of regulation as a mediator explaining government regulation as a driver of innovation and business efficiency. This study also integrates findings from previous studies such as Huang et al.'s (2024) on consumer awareness, Naruetharadhol et al.'s (2021) on organizational commitment to sustainability, and Smith et al.'s (2022) meta-analysis and Chen et al.'s (2023) study which demonstrate the role of regulation as a mediator.

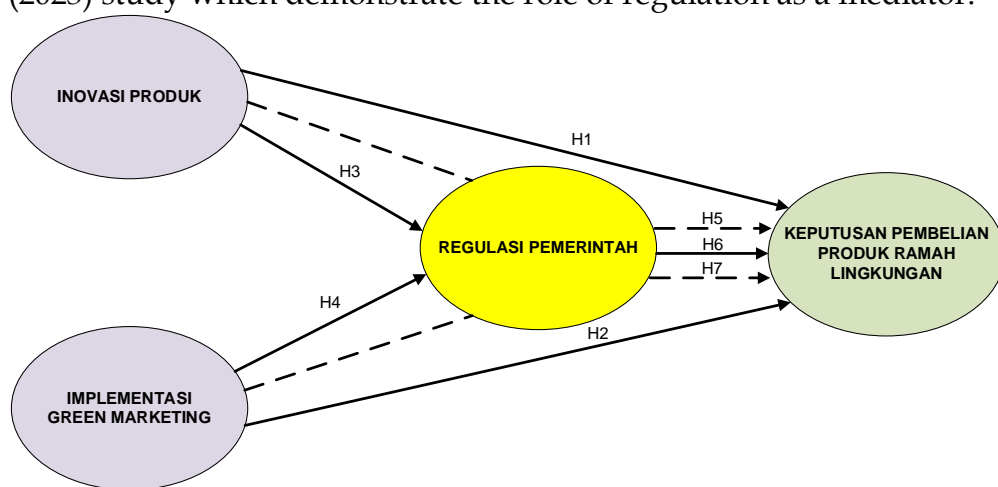


Figure 1. Conceptual Framework

From the conceptual framework of thinking, the hypothesis obtained is as follows:

H1: Product innovation has a positive influence on purchasing decisions for environmentally friendly products.

H2: Implementation of green marketing has a positive influence on purchasing decisions for environmentally friendly products.

H3: Product innovation has a positive effect on government regulations.

H4: Implementation of green marketing has a positive effect on government regulations.

H5: Government regulations have a positive and significant influence on the decision to purchase environmentally friendly products.

H6: Government regulations mediate the influence of product innovation on purchasing decisions for environmentally friendly products.

H7: Government regulations mediate the influence of green marketing implementation on purchasing decisions for environmentally friendly products.

METHODOLOGY

This study uses a quantitative approach with an explanatory research method, which aims to examine the causal relationship between product innovation and green marketing implementation on purchasing decisions for environmentally friendly products, with government regulations as a mediating variable. The research design is designed to explain the direct and indirect effects between variables through a mediation model, in line with green marketing theory, green innovation, and the Theory of Planned Behavior (TPB).

The study population was all consumers of CV. Suvana Solusi Mandiri domiciled in Indonesia, specifically the Greater Jakarta area, who have purchased or are considering purchasing environmentally friendly technology products. The sampling technique used purposive sampling with certain criteria, such as being at least 17 years old, having experience or knowledge of environmentally friendly products, and having been exposed to green marketing information. The sample size was set at 160 respondents, in accordance with the minimum sample size recommendation for Partial Least Squares-Structural Equation Modeling (PLS-SEM) analysis.

Data collection was conducted using a structured questionnaire with a 5-point Likert scale, distributed in person and online (Google Forms and social media). The research instrument measured four main variables: product innovation, green marketing implementation, government regulations, and purchasing decisions for environmentally friendly products, each operationalized through several indicators based on the latest scientific literature.

Data analysis was conducted in stages, beginning with descriptive analysis to describe respondent characteristics and response distribution. Next, hypothesis testing was conducted using PLS-SEM, which included evaluation of the outer model (convergent validity, discriminant validity, and reliability tests) and the inner model (path coefficient, R^2 , f^2 , Q^2 , and SRMR tests). The government regulation mediation test was conducted through bootstrapping to confirm the role of the mediating variables in strengthening the relationship between the independent variables and purchasing decisions.

RESEARCH RESULT

Descriptive Analysis

Descriptive analysis is an initial statistical technique for summarizing and describing the characteristics of primary data from questionnaire surveys, such as those collected through social media in this study, with a focus on variables such as product innovation, green marketing implementation, government regulations, and purchasing decisions for environmentally friendly products (Chen et al., 2022). This technique involves calculating frequencies and percentages for the distribution of responses on a 5-point Likert scale (e.g., the percentage of respondents who strongly agree with product innovation), as well as measures of central tendency such as the mean (average score) to identify general patterns, and measures of variability such as standard deviation and range to assess the spread of the data. This analysis helps understand the respondent profile (e.g., age, location within Greater Jakarta) and ensures the

data is ready for hypothesis testing, with visualization through tables, bar graphs, or histograms to reveal initial trends, such as the level of green marketing knowledge among the 160 purposive sampling respondents.

Partial Least Squares Structural Equation Modeling (PLS-SEM)

PLS-SEM (Partial Least Squares Structural Equation Modeling) is a multivariate analysis method used to test causal relationship models between latent (not directly measurable) variables based on quantitative data from surveys or experiments, such as in your research involving product innovation, green marketing implementation, government regulations, and purchasing decisions for environmentally friendly products (Hair et al., 2022).

PLS-SEM offers high flexibility with data, not requiring a normal multivariate distribution like covariance-based SEM methods. It can handle non-normal data, small samples, or missing values without extensive transformations, focusing on maximizing explained variance rather than overall model fit. This makes it ideal for exploratory or confirmatory research, such as analyzing product innovation and green purchasing decisions, as described in Hair et al. (2022).

1. Outer Model

Measurement model evaluation is a critical process in statistical data analysis, particularly within the Structural Equation Modeling (SEM) framework (Finch et al., 2022). This measurement model aims to describe the relationship between latent variables, such as psychological or social constructs that cannot be directly measured, and their indicators, which are observed variables. Evaluation is conducted to ensure the model is accurate, consistent, and reliable before being used in further analysis (Yang et al., 2022). Without proper evaluation, research results can be biased or invalid, so researchers must consider both statistical and substantive aspects to avoid misinterpretation.

The initial evaluation step involves checking basic assumptions, such as multivariate normality of the data, adequate sample size (typically at least 5–10 observations per parameter), and the absence of issues such as multicollinearity. After that, the focus shifts to goodness-of-fit analysis, which assesses how well the model fits the empirical data. Fit indices such as Chi-square (χ^2) are used to test the significance of the fit, although they are sensitive to large sample sizes. Other indices such as the Root Mean Square Error of Approximation (RMSEA) provide an indication of the approximation error, with values below 0.08 indicating an acceptable fit.

Convergent and discriminant validity are important in measuring constructs in confirmatory factor analysis or structural equation modeling. Convergent validity indicates that indicators of the same construct are highly correlated, measuring similar things. Discriminant validity ensures that different constructs are not over-correlated, distinguishing constructs clearly. For convergent validity, use the following criteria: AVE > 0.5 (more than 50% of construct variance explained by indicators), CR > 0.7 (internal reliability), factor loading > 0.7. Test based on CFA output; revise indicators that do not meet these criteria. For discriminant validity, use the Fornell-Larcker criteria: AVE >

squared inter-construct correlation. Alternative: compare cross-loadings or chi-square difference test between the free model and the forced correlation model 1. If not met, combine constructs or revise the model. Test the second validity after the model fits well (RMSEA < 0.08, CFI > 0.9). Use software such as AMOS or LISREL. Reference: Hair et al. (2019). Ensure adequate sampling and normal data for accuracy.

Table 1. Rule of Thumb Convergent Validation

Criteria	Rule Thumb of	Brief Explanation
<i>Average Variance Extracted(AVE)</i>	0.5	More than 50% of the construct's variance is explained by its indicators; indicating good convergence.
<i>Composite Reliability(CR)</i>	0.7	Measures the internal reliability of the construct; values below this indicate reliability problems.
<i>Loading Factor(per Indicator)</i>	0.7	The indicator contributes strongly to the construct; ideally > 0.5, but > 0.7 is preferred for high validity.
<i>Loading FactorAverage</i>	0.7	The average loading of all indicators; supports the overall strength of the construct.

Validity ensures conceptual accuracy, while reliability ensures data reliability. In practice, reliability is often a prerequisite for validity; if reliability is low, validity is difficult to achieve. The research context (e.g., sample size or model complexity) can influence thresholds, so use the guidelines as a guide, not an absolute rule. If a construct fails in either, model or instrument revision is necessary. These criteria are based on standard guidelines such as Hair et al. (2022) and Nunnally et al. (1994). These values are guidelines; the research context can influence interpretation. The following table illustrates the Rule of Thumb for Reliability in PLS:

Table 2. Rule of Thumb Reliability

Criteria	Rule Thumb of	Brief Explanation
<i>Cronbach's Alpha</i>	0.7	Measures the internal consistency of the indicator; values below this indicate low reliability, suitable for exploratory analysis.
<i>Composite Reliability(CR)</i>	0.7	Measures the internal reliability of constructs in CFA/SEM models; more accurate than Alpha for confirmatory models.

2. Collinearity

Multicollinearity, or collinearity, occurs when the predictor variables in a linear regression model are highly correlated, making it difficult to distinguish their individual contributions to the response variable. Besides causing variance inflation of regression coefficients, as measured by a Variance Inflation Factor (VIF) above 10, this can make parameter estimates unstable, increase standard errors, and reduce model accuracy, even resulting in misdirected coefficients. To detect this, in addition to the VIF, we can use the correlation matrix or tolerance value ($1/\text{VIF}$), where a low tolerance (<0.1) indicates a problem. Ways to address this include removing one of the correlated variables, combining them through principal component analysis (PCA), or using regularization techniques such as ridge regression, which adds a penalty to mitigate the impact of multicollinearity without losing important information (Kumar et al., 2022; Vatcheva et al., 2023).

3. Inner Model

Inner model Partial Least Squares Structural Equation Modeling (PLS-SEM) refers to the structural part that tests the causal relationship between latent constructs, such as independent variables (product innovation and green marketing implementation), mediating variables (government regulations), and dependent variables (purchase decisions for environmentally friendly products). This model aims to explain variance in endogenous variables and test research hypotheses, including mediating effects, using empirical data from a questionnaire survey (Hair et al., 2022).

Evaluation of the inner model begins with an examination of the coefficient of determination (R^2), which measures the proportion of variance in the dependent variable explained by the predictor variables. A good R^2 value varies depending on the context; for example, an $R^2 > 0.25$ is considered moderate, > 0.50 strong, and > 0.75 very strong (Hair et al., 2022). Next, path coefficients are evaluated for significance using bootstrapping (typically 5,000 resamplings) to generate t and p values, with a threshold of $p < 0.05$ indicating a significant relationship. An effect size (f^2) is calculated to assess the predictor's contribution to the R^2 , where $f^2 > 0.02$ is small, > 0.15 is moderate, and > 0.35 is large.

For the mediation model, the mediation effect was tested through indirect path analysis, with significance determined by the bootstrapping confidence interval. If the interval does not include zero, the mediation effect is significant, in accordance with Baron et al.'s (1986) approach extended in PLS-SEM (Hair et al., 2022). Additionally, predictive relevance (Q^2) was measured using blindfolding to assess the model's ability to predict new data, with $Q^2 > 0$ indicating adequate predictive relevance.

In this study, the inner model will be tested to confirm hypotheses H1 to H7, such as the direct relationship between product innovation (X_1) and purchasing decisions (Y), as well as the mediating effect of government regulation (Z) on the relationship between X_1 and green marketing implementation (X_2) on Y . If the model does not meet the criteria (e.g., low R^2 or insignificant path), revisions are made through the addition of paths or moderators, ensuring the model fits the empirical data and contributes to the

Sustainable Development Goals (SDGs). This evaluation is supported by software such as SmartPLS or WarpPLS, with outputs that allow substantive interpretation for practical implications in green marketing. In evaluating the structural model used by researchers, the following Rule of Thumbs table is used:

Table 3. Rule of Thumb

Criteria	Rule of Thumb	Brief Explanation
Coefficient of Determination (R ²)	0.25 (weak), > 0.50 (moderate), > 0.75 (strong)	Measures the proportion of variance in the dependent variable explained by the predictors; higher values indicate a better model at explaining variation in the data.
Path Coefficients	t-value > 1.96 (p < 0.05 significant)	Measures the strength and direction of a causal relationship; significance is tested through bootstrapping to ensure the relationship did not occur by chance.
Effect Size (f ²)	0.02 (small), > 0.15 (medium), > 0.35 (large)	Assesses the contribution of predictors to the increase in R ² ; helps determine the substantive impact of the independent variable on the dependent.
Predictive Relevance (Q ²)	0 (relevant), > 0.25 (moderate), > 0.50 (strong)	Measures the model's ability to predict new data using blindfolding; positive values indicate the model has predictive power.
Standardized Root Mean Square Residual (SRMR)	< 0.08 (good)	Measures the overall fit of the model; low values indicate small differences between the observed and predicted covariance matrices.
Goodness of Fit (GoF)	0.36 (moderate), > 0.50 (strong)	A composite index combining AVE and R ² ; used to assess the overall fit of the structural and measurement models.

Indirect Hypothesis Testing and Mediation

In the context of this research, indirect and mediation hypothesis tests were conducted to examine the mediating effect of government regulation (Z) on the relationship between the independent variables (product innovation X1 and green marketing implementation X2) on the dependent variable (purchase decisions for environmentally friendly products Y). This approach uses Partial Least Squares Structural Equation Modeling (PLS-SEM) to analyze causal effects, including direct, indirect, and total effects, in accordance with the

recommendations of Hair et al. (2022) in *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. The mediation test aims to determine whether government regulation acts as a mediator that explains the mechanism of influence of X1 and X2 on Y, thereby supporting the research's contribution to the Sustainable Development Goals (SDGs), particularly goals related to sustainable consumption and production.

Hypotheses H1 to H5 test direct relationships, while H6 and H7 test mediation effects (indirect effects through Z). Indirect and mediation hypothesis testing is performed through PLS-SEM inner model analysis using software such as SmartPLS or WarpPLS. The main steps include:

- 1) Direct Relationship Testing: Evaluate the path coefficients for H1-H5 using bootstrapping with 5,000 resamplings. The hypothesis is accepted if the t-value is > 1.96 ($p < 0.05$) and the path coefficient is positive, indicating a significant relationship.
- 2) Testing Indirect Effects (Mediation): For H6 and H7, the mediation effect is measured through the indirect effects, namely the product of the path coefficients $X1 \rightarrow Z \rightarrow Y$ and $X2 \rightarrow Z \rightarrow Y$. The significance of the indirect effect is determined by bootstrapping, where a 95% confidence interval not including zero indicates significant mediation. This approach follows the method of Baron et al., (1986) extended in PLS-SEM (Hair et al., 2022), which requires:
 - The direct relationship $X \rightarrow Y$ is significant (for partial mediation) or not significant (for full mediation).
 - $X \rightarrow Z$ is significant.
 - $Z \rightarrow Y$ is significant.
 - The indirect effect is significant.
- 3) Measurement of Mediation Strength: Using the mediation effect size (VAF - Variance Accounted For), calculated as $(\text{indirect effect} / \text{total effect}) \times 100\%$. VAF $> 20\%$ indicates partial mediation, $> 80\%$ full mediation, and 20-80% complementary mediation (Hair et al., 2022).
- 4) Additional Evaluation: If mediation is significant, analyses are conducted to ensure there are no issues such as collinearity ($VIF < 5$) or suppressor effects. Model revisions are made if necessary, for example by adding moderators if the mediation effect is weak.

The results of this test will be interpreted to provide empirical insights into the role of government regulations in strengthening the implementation of green marketing and product innovation to encourage environmentally friendly purchasing decisions, in line with the studies of Chen et al. (2023) and Kumar et al. (2022). If the mediation hypothesis is accepted, this study contributes to policy recommendations to support the SDGs through effective regulations.

CONCLUSIONS

1. Implement the Green Marketing behavior influence positively to the consumer's decision to buy environmentally friendly products. Suvana Solusi Mandiri. This is a strategic that I

- use build my image re k yang po sitive, se until me ndo ro ng ko nsume n for me choose pro environmentally friendly even be rse he me pay le bih.
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RECOMMENDATIONS

1. In the product innovation variable, the dominant value is seen in the statement "The design of technology products from CV. Suvana Solusi Mandiri supports environmental sustainability (e.g., easy to recycle)." Companies should create technology product designs that support environmental sustainability focusing on a comprehensive product life cycle approach, such as providing relevant environmentally friendly certifications to validate product sustainability claims.
2. In the green marketing implementation variable, the dominant value is seen in the statement "CV. Suvana Solusi Mandiri uses recyclable product packaging." Companies should switch to recyclable product packaging as a good step for the environment, such as using the arrow triangle symbol (resin identification code) on plastic packaging.

3. In the variable of government regulation implementation, the dominant value is seen in the statement "Government supervision of sustainable business practices ensures that CV. Suvana Solusi Mandiri complies with environmental standards." Companies should train and improve the quality of human resources (HR) in supervisory institutions, such as the Environmental Supervisory Agency, to have in-depth expertise in sustainability standards and the latest green technology.

ADVANCED RESEARCH

Suggestions for penelitian yang akan dilanjutkan, yang akan dilakukan penelitian di bidang yang sama dan menggunakan tesis ini sebagai referensi, maka mungkin perlu direvisi kembali ke belakang karena tidak jauh dari sana mungkin ada pernyataan-pernyataan yang lebih baik, karena saya sendiri seperti menulis di sini masih banyak kekurangan dan kelebihan dalam menyelesaikan tesis ini.

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