

The Effect of Information Technology on Product Innovation and Business Sustainability as A Mediation of Blue Marketing Strategy in Processed Fish Products in Bengkalis Regency

Kurniatul Fil Khoirin

Institut Syariah Negeri Junjungan, Bengkalis, Indonesia

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ABSTRACT

This study investigates the effect of information technology on product innovation and business sustainability, with blue marketing strategy serving as a mediating variable among processed fish product SMEs in Bengkalis Regency, Indonesia. This research addresses the limited empirical evidence on sustainability-oriented marketing as a strategic mechanism linking digital transformation to long-term business performance in coastal-based SMEs. A quantitative approach was employed using a survey method, with data collected from 311 processed fish SMEs through structured questionnaires. The data were analyzed using Structural Equation Modeling–Partial Least Squares (SEM-PLS) to examine both direct and indirect relationships among variables. The results indicate that information technology has a strong and significant positive effect on product innovation and business sustainability. Information technology also significantly enhances the adoption of blue marketing strategies. Furthermore, blue marketing strategy positively influences product innovation and business sustainability and partially mediates the relationship between information technology and both outcome variables. The structural model demonstrates substantial explanatory power, with R^2 values of 0.549 for product innovation, 0.481 for business sustainability, and 0.412 for blue marketing strategy. All constructs satisfy reliability and convergent validity criteria, and no multicollinearity issues are detected. Theoretically, this study extends the digital innovation and sustainability literature by positioning blue marketing as a strategic mediator in SME development. Practically, the findings provide policy-relevant insights for SMEs and local governments in promoting technology-driven and environmentally sustainable business strategies within the fisheries sector.

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Corresponding Author:

Kurniatul Fil Khoirin
Institut Syariah Negeri Junjungan, Bengkalis, Indonesia; khoirinkurniatul@gmail.com

1. INTRODUCTION

The rapid advancement of the digital era has brought significant transformations in various aspects of life, including the business sector. Micro, Small, and Medium Enterprises (MSMEs), as the backbone of the economy, are inevitably influenced by the development of information technology. In the midst of increasingly fierce competition, MSMEs are required to continuously innovate and adapt to changes in the business environment (Falahat et al., 2020; Purba et al., 2021).

Product innovation is the heart of business growth and sustainability in this increasingly competitive era (Almodóvar & Nguyen, 2022; Bai et al., 2024; Falahat et al., 2020; Qi et al., 2020). Product innovation enables an MSME to differentiate itself from competitors by offering unique, high-quality products with better features. Companies can attract more customers and maintain their loyalty. Innovative products can create new markets that were previously untapped, allowing companies to reach a wider consumer segment and increase their market share. Successful new products can generate additional revenue for the company. Furthermore, product innovation can also help increase the selling price of existing products (Almodóvar & Nguyen, 2022; Rasool et al., 2023).

Indonesia, as the world's largest archipelagic country, faces particular challenges in strengthening its economy due to its vast and diverse geography. However, the abundant potential of marine resources provides great opportunities to strengthen its economy through what is known as the blue economy (Prayuda, 2020). The blue economy refers to the sustainable use of marine resources to improve the economic and social welfare of communities while maintaining the health of marine ecosystems (Nthia, 2021). This includes various economic sectors such as fisheries, marine tourism, renewable energy, and other maritime industries (Putri, 2024).

Information technology plays a crucial role in supporting the implementation of blue marketing strategies and driving product innovation in coastal MSMEs (Gorgoglione et al., 2023; Qu & Mardani, 2023). MSMEs can obtain up-to-date information on market trends, consumer preferences, and competitors through the internet (Gyimah & Adeola, 2021; Purba et al., 2021; Utama et al., 2024). Information technology facilitates MSMEs to build business networks with other industry players, both locally and globally (Haug et al., 2023; Mani & Lamçe, 2023; Sonmez Cakir et al., 2024). Information technology can be used to conduct research and development of more innovative new products (Bai et al., 2024; Kurniawan et al., 2023; Qu & Mardani, 2023; Zhou & Chen, 2022).

Bengkalis Regency is a region that includes the eastern part of Sumatra Island and the archipelagic area, with an area of 7,773.93 km² consisting of islands and seas. Bengkalis Regency includes the eastern coastal part of Sumatra Island. The territory of Bengkalis Regency, which consists of islands, is the main factor in the high consumption of fish, both marine fisheries and freshwater fisheries. Bengkalis Regency, with its abundant marine natural resource wealth, has great potential in developing marine-based MSMEs. However, coastal MSMEs in Bengkalis Regency still face various challenges, such as limited access to information technology, low levels of product innovation, and suboptimal utilization of marine resource potential sustainably.

The blue marketing strategy, which refers to the sustainable use of marine resources to create added value, is a relevant approach to developing coastal MSMEs (Majid & Saimy, 2024; Tito Wira Eka Suryawijaya et al., 2024). By adopting a blue marketing strategy, MSMEs can produce unique and high-value products and build a positive brand image. This research is important to address the research gap regarding the relationship between information technology, product innovation, and business sustainability in coastal MSMEs. Previous studies by Zhou & Chen (2022) revealed that information technology can drive product innovation, but have not specifically discussed the role of blue marketing strategy as a mediation in strengthening business sustainability. Furthermore, Tito Wira Eka Suryawijaya et al. (2024) showed that Blue Marketing Strategy in marine and fisheries MSMEs has been proven to have a positive impact on sales growth, brand awareness, and customer retention, by emphasizing sustainability as the main factor to increase marketing effectiveness through empowering consumers to make sustainable choices.

Based on the background described, this study aims to examine the effect of information technology on product innovation and business sustainability mediated by blue marketing strategy in processed fish products in Bengkalis Regency.

2. METHODS

2.1 Research Design

This study employs a quantitative approach to measure the relationship between objective variables. This is done by processing numerical data through statistical analysis. The research is causal in nature to test the effect of information technology on product innovation and business sustainability, with blue marketing strategy as a mediating variable.

2.2 Population and Sample

The population in this study includes all MSMEs registered with the Cooperative and MSME Office of Bengkalis Regency, totaling 41,733 MSMEs. The sample consists of processed fish product business actors in Bengkalis Regency, such as fish cracker producers, shredded fish, smoked fish, and similar products in the food processing business field, totaling 1,402 MSMEs. The sampling technique used is Probability Sampling with Stratified Random Sampling. To prevent waste of time, cost, and effort in data collection, the calculation using the Taro Yamane formula was employed:

$$n = \frac{N}{1 + Ne^2}$$

$$n = \frac{1.402}{1 + (1.402 \times 0.0025)}$$

$$n = \frac{1.402}{1 + 3.505}$$

$$n = \frac{1.402}{4.505}$$

$$n = 311$$

Thus, the sample in this study is 311 MSMEs.

2.3 Operationalization of Variables

The research variables are operationalized as follows:

- Information Technology (X) with indicators: (1) Use of business software; (2) Use of digital media for marketing; (3) Adoption of online sales systems (e-commerce).
- Product Innovation (Y1) with indicators: (1) Creation of new products; (2) Improvement of raw materials and production processes; (3) Product uniqueness compared to competitors.
- Business Sustainability (Y2) with indicators: (1) Increased profits; (2) Business expansion or increased production; (3) Adaptation to market changes.
- Blue Marketing Strategy (M) with indicators: (1) Use of environmentally friendly raw materials; (2) Product promotion with sustainability concepts; (3) Use of unique concepts in branding.

2.4 Data Analysis Technique

Data analysis in this study uses the Partial Least Square (PLS) method with SmartPLS 4.1.1 software. The analysis was conducted in three stages: outer model analysis (convergent validity, discriminant validity, and composite reliability), inner model analysis (R-square and F-square), and hypothesis testing (bootstrapping). The criteria for hypothesis testing used a t-statistic value > 1.96 and p-value < 0.05 at a 5% significance level.

3. FINDINGS AND DISCUSSION

3.1 Respondent Characteristics

The study successfully collected data from 311 respondents with a 100% response rate. Respondent characteristics showed that 51% were male and 49% female. The majority of respondents (39%) were aged 35-44 years, followed by ≥ 45 years (32%), and 25-34 years (29%). Regarding education, 49% held a Diploma (D3), followed by high school graduates (18%), Bachelor's degree (16%), and elementary school (14%). Most businesses had been operating for 4-6 years (30%), followed by 1-3 years (27%), <1 year (23%), and >6 years (21%). The main product types were smoked fish (36%), fish paste (33%), fish crackers (15%), fish mpek-mpek (8%), fish nuggets (5%), and shredded fish (2%).

3.2 Outer Model Evaluation

Convergent Validity: All loading factors exceeded 0.7, ranging from 0.819 to 0.916 for Information Technology, 0.834 to 0.874 for Product Innovation, 0.824 to 0.889 for Business Sustainability, and 0.820 to 0.860 for Blue Marketing Strategy. The Average Variance Extracted (AVE) values for all constructs exceeded 0.5: Product Innovation (0.738), Business Sustainability (0.718), Blue Marketing Strategy (0.716), and Information Technology (0.765), indicating good convergent validity.

Discriminant Validity: Cross-loading values showed that each indicator had the highest correlation with its respective construct compared to other constructs. The Fornell-Larcker criterion confirmed that the square root of AVE for each construct was higher than its correlations with other constructs, indicating good discriminant validity.

Composite Reliability: Cronbach's Alpha and Composite Reliability values for all constructs exceeded 0.7: Information Technology (0.845, 0.907), Product Innovation (0.823, 0.894), Business Sustainability (0.803, 0.884), and Blue Marketing Strategy (0.802, 0.883), confirming good internal consistency reliability.

3.3 Inner Model Evaluation

R-Square Values: The structural model demonstrated substantial explanatory power with R^2 values of 0.549 for Product Innovation, 0.481 for Business Sustainability, and 0.412 for Blue Marketing Strategy. These values indicate moderate to strong predictive accuracy.

F-Square Values: Information Technology had a very large effect on Blue Marketing Strategy ($f^2 = 0.701$), a moderate effect on Business Sustainability ($f^2 = 0.261$), and a moderate effect on Product Innovation ($f^2 = 0.173$). Blue Marketing Strategy had a moderate effect on Product Innovation ($f^2 = 0.266$) and a small effect on Business Sustainability ($f^2 = 0.089$).

3.4 Hypothesis Testing

The results of hypothesis testing are presented in Table 1.

Table 1. Hypothesis Testing Results

Hypothesis	Relationship	Original Sample (O)	T-Statistics	P-Values	Conclusion
H1	TI $\rightarrow$ PI	0.655	9.686	0.000	Supported
H2	TI $\rightarrow$ BS	0.660	9.876	0.000	Supported
H3	TI $\rightarrow$ BM	0.642	8.820	0.000	Supported

Hypothesis	Relationship	Original Sample (O)	T-Statistics	P-Values	Conclusion
H4	BM → PI	0.452	7.633	0.000	Supported
H5	BM → BS	0.280	4.115	0.000	Supported
H6	TI → BM → PI	0.290	5.096	0.000	Supported
H7	TI → BM → BS	0.180	3.346	0.001	Supported

3.5 Discussion

The Effect of Blue Marketing Strategy on Product Innovation: The study found that Blue Marketing Strategy has a positive and significant effect on Product Innovation ($\beta = 0.452$, $p < 0.001$). This finding indicates that marketing strategies emphasizing the creation of new value, differentiation based on marine resource sustainability, and long-term orientation can drive the emergence of more adaptive and value-added processed fish product innovations. This result is consistent with Value Innovation Theory and Blue Ocean Strategy, emphasizing that innovation emerges when companies can create unique value beyond conventional competition. This finding is supported by Mani and Lamçe (2023), who showed that the integration of blue economy and digital marketing drives marine-based product innovation, and Tito Wira Eka Suryawijaya et al. (2024), who affirmed that blue marketing strategies open innovation opportunities for coastal MSMEs.

The Effect of Blue Marketing Strategy on Business Sustainability: The results showed that Blue Marketing Strategy has a positive and significant effect on Business Sustainability ($\beta = 0.280$, $p < 0.001$), although with relatively small effect strength. This indicates that sustainability-based marketing strategies can strengthen consumer trust and business image but are not yet the dominant factor in maintaining business continuity for processed fish products. This finding aligns with Triple Bottom Line Theory, emphasizing the balance of economic, social, and environmental aspects as the foundation of business sustainability. Research by Ferlito and Faraci (2022) and Hanaysha et al. (2022) also showed that innovation and sustainability-based strategies contribute to business resilience.

The Effect of Information Technology on Blue Marketing Strategy: The results prove that Information Technology has a very strong and significant effect on Blue Marketing Strategy ($\beta = 0.642$, $p < 0.001$). This finding confirms that the use of digital technology, consumer data analysis, and online marketing media are the main foundations in implementing blue marketing strategies for processed fish products. This finding strengthens Digital Transformation Theory and Dynamic Capability Theory, stating that technology enables organizations to respond to market dynamics quickly and strategically. This is consistent with research by Mani and Lamçe (2023) and Tito Wira Eka Suryawijaya et al. (2024), affirming that digital technology and big data are the main drivers of blue marketing strategies in coastal MSMEs.

The Effect of Information Technology on Product Innovation: Information Technology has a positive and significant effect on Product Innovation ($\beta = 0.655$, $p < 0.001$). This finding indicates that information technology capabilities enable processed fish product business actors to access market information, improve design processes, and accelerate new product development. This result aligns with Innovation Diffusion Theory and Knowledge-Based View, positioning technology as the primary means of creating and disseminating innovation. This finding is consistent with studies by Rasool et al. (2023), Haug et al. (2023), Bai et al. (2024), and Bresciani et al. (2021), showing that information technology capabilities and digital transformation are main catalysts for product innovation.

The Effect of Information Technology on Business Sustainability: The results show that Information Technology has a positive and significant effect on Business Sustainability ($\beta = 0.660$, $p < 0.001$). This finding confirms that information technology utilization increases operational efficiency, decision-making quality, and business adaptation capability to changing business environments. This result aligns with Sustainable Competitive Advantage Theory, stating that technology is a source of long-term competitive advantage. This finding is supported by Utama et al. (2024), Kurniawan et al. (2023), and Menne et al. (2022), affirming that technology adoption significantly contributes to MSME business sustainability.

Mediation of Blue Marketing Strategy on the Effect of Information Technology on Product Innovation: The study found that Blue Marketing Strategy significantly mediates the effect of Information Technology on Product Innovation (indirect effect = 0.290, $p < 0.001$). This finding indicates that information technology does not automatically produce innovation but requires sustainability-based marketing strategies for product innovation to be realized optimally. This is consistent with research by Latifah et al. (2020) and Chen and Liu (2020), showing that strategies and mediation mechanisms strengthen the relationship between technology and product innovation.

Mediation of Blue Marketing Strategy on the Effect of Information Technology on Business Sustainability: The results also show that Blue Marketing Strategy significantly mediates the effect of Information Technology on Business Sustainability (indirect effect = 0.180, $p < 0.01$). This finding demonstrates that information technology needs to be directed through value-based and sustainability marketing strategies to create long-term impacts on business continuity in processed fish products. This aligns with Ferlito and Faraci (2022) and Nthia (2021), affirming that blue economy and sustainability-based strategies become important links between technology capabilities and business resilience.

4. CONCLUSION

This study investigated the effect of information technology on product innovation and business sustainability mediated by blue marketing strategy in processed fish products in Bengkalis Regency. Based on the results of data analysis and discussion, the following conclusions can be drawn: Blue Marketing Strategy has a positive and significant effect on Product Innovation. The application of value-based and blue economy marketing strategies can encourage product innovation in processed fish businesses. Blue Marketing Strategy has a positive and significant effect on Business Sustainability, contributing to business continuity through long-term competitive advantage creation. Information Technology has a positive and significant effect on Blue Marketing Strategy, serving as the main foundation in formulating and implementing blue economy-based marketing strategies. Information Technology has a positive and significant effect on Product Innovation, increasing product innovation capacity through accelerated product development and production efficiency. Information Technology has a positive and significant effect on Business Sustainability, strengthening business resilience through market adaptation and operational efficiency. Blue Marketing Strategy significantly mediates the effect of Information Technology on Product Innovation, making technology more effective when directed through value-based and blue economy marketing strategies. Blue Marketing Strategy significantly mediates the effect of Information Technology on Business Sustainability, confirming that business sustainability requires strategic orientation toward value and sustainability.

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