ISSN: 2667-6125

JOMAES

JOURNAL OF MANAGEMENT AND ECONOMIC STUDIES

Volume 7
Issue 3
Year 2025

www.jomaes.org

JOMAES JOURNAL OF MANAGEMENT AND ECONOMIC STUDIES

2025, Vol.7, Issue.3

JOMAES JOURNAL OF MANAGEMENT AND ECONOMIC STUDIES

2025, Vol.7, Issue.2

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JOMAES JOURNAL OF MANAGEMENT AND ECONOMIC STUDIES

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http://doi.org/10.26677/TR1010.2025.1588

Enhancing The Competitiveness of Vietnamese Bamboo and Rattan Brands in The International Market: The Mediating Role of Perceived Brand Value

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Abstract

In the context of green consumption receiving increasing global attention, Vietnamese bamboo and rattan products still face difficulties in competing and building international brands. Although consumers have high environmental awareness, actual purchasing behavior is not commensurate which indicates the existence of a green gap. The objective of this study is to examine factors that drive perceived brand value, thereby enhancing the international competitiveness of Vietnamese bamboo and rattan brands. The research used quantitative method through a survey of 408 consumers and SmartPLS 4. The findings show positive impacts of product quality, level of design innovation, country of origin reputation on the mediating variable perceived brand value, and thereby positively impacts international brand competitiveness, however international distribution channel efficiency does not show a positive impact on perceived brand value. Therefore, Vietnamese bamboo and rattan enterprises need to improve product quality, innovate designs, and build national images associated with cultural identity. At the same time, cooperation with experts, state agencies and international partners is necessary to expand the market and take advantage of digital platforms, fairs, and cultural storytelling to help increase brand value.

Keywords: Bamboo and rattan brands, country of origin reputation, international brand competitiveness, level of design innovation, perceived brand value, product quality.

1. INTRODUCTION

In recent years, the global environment has been increasingly challenged by severe issues such as pollution, resource depletion, and climate change. These challenges have sparked a growing demand for sustainable development across all sectors of society, particularly in consumption practices. Green consumption has emerged as a vital strategy, encouraging the use of environmentally friendly products with minimal ecological impact. Among such products, bamboo and rattan have garnered attention for their durability, aesthetic diversity, and biodegradability, positioning them as ideal materials in the sustainable product category (Zhao et al., 2022). The global market for bamboo and rattan products has shown significant

growth potential. According to recent forecasts, the value of the global bamboo market is expected to increase from USD 70.59 billion in 2023 to USD 75.12 billion in 2024, with a compound annual growth rate (CAGR) of 6.4%, while rattan products are projected to grow at a CAGR of 6.5% from 2023 to 2029 (Business Research Company, 2025). Vietnam, with its long-standing tradition in handicraft production, currently exports bamboo and rattan products to more than 163 countries and territories, earning approximately USD 2.2 billion annually. These products are among the top ten non-agricultural export items, with the United States accounting for 35% of total export value (VOV, 2022). However, despite their environmental benefits and export success, Vietnamese bamboo and rattan brands still face considerable challenges in enhancing their competitiveness and brand identity in the international market. Domestically, although about 60% of Vietnamese consumers demonstrate environmental awareness and are willing to pay a premium for green products (Frey et al., 2023), the actual purchasing behavior of bamboo and rattan items remains limited, indicating a clear discrepancy between intention and action.

The Theory of Planned Behavior (TPB) developed by Ajzen and Fishbein (1980), has been widely applied to explain consumer intentions and behaviors. According to TPB, behavior is influenced by attitudes, subjective norms, and perceived behavioral control. Several studies have shown that positive attitudes toward green consumption (Wang and Wang, 2013), alignment with social norms (Sheng et al., 2019), and environmental concern (Tanwir and Hamzah, 2020; Zhao et al., 2014) contribute to green consumption intention. However, other studies suggest that positive attitudes alone are not sufficient to predict actual behavior, giving rise to what is known as the "green gap"—the disconnect between favorable attitudes, intentions, and real consumption behavior (Claudy et al., 2011, Vermeir and Verbeke, 2006; Kushwah et al., 2019). While perceived behavioral control has been proposed as a moderating variable in green consumer behavior (Elhoushy and Jang, 2021), its broad and generalized nature may not adequately explain specific behavioral patterns for particular types of green products, such as bamboo or rattan. Recent research recommends incorporating self-efficacy—a more specific and actionable concept reflecting an individual's belief in their ability to perform a particular behavior—as a more precise predictor of green consumption. Moreover, traditional behavioral models often overlook brand-level perceptions that play a crucial role in competitive markets. According to the Behavioral Reasoning Theory (BRT), consumer decisions are also shaped by reasons behind their attitudes, including perceived uniqueness (Hsu and Ngoc, 2016) and perceived product quality (Lomboan, 2017), which strongly influence intention and purchase behavior.

Given these theoretical insights and practical challenges, this study proposes to explore the mediating role of perceived brand value in enhancing the competitiveness of Vietnamese bamboo and rattan brands in the international market. By integrating the TPB and BRT frameworks, the study aims to explain how consumer perceptions, particularly brand-related evaluations, influence their purchase decisions toward eco-friendly handmade products. The research seeks to bridge the gap between environmental attitudes and actual consumer behavior, while offering both theoretical contributions and practical implications for Vietnamese sustainable handicraft branding in global markets.

2. CONCEPTUAL FRAMEWORK AND RESEARCH MODEL

2.1 International Market of Bamboo and Rattan Products

Bamboo and rattan have long been acknowledged as two of the most important non timber forest products (NTFPs) in Asia and globally, thanks to their ecological sustainability, economic value, and cultural versatility (Beer and McDermott, 1989). Theoretically, their

development is rooted in the NTFP framework, which views forest based resources not only as sources of income but also as pathways to sustainable development, biodiversity conservation, and poverty alleviation, particularly in rural and marginalized communities (Beer and McDermott, 1989). From a policy and development perspective, the establishment of the International Network for Bamboo and Rattan (INBAR), supported by the International Development Research Centre (IDRC) and the International Fund for Agricultural Development (IFAD), has marked a global commitment to promoting these resources. INBAR's approach emphasizes genetic resource conservation, value chain enhancement, post harvest processing, and socio economic development, suggesting that bamboo and rattan are no longer limited to traditional craft sectors but are now positioned within broader strategies of sustainable growth and climate resilience (Beer and McDermott, 1989).

In terms of current global trends, bamboo and rattan are seeing increasing demand as eco friendly alternatives across multiple sectors including furniture, construction, packaging, and fashion. According to the Business Research Company (2025), the global bamboo market is projected to grow from USD 70.59 billion in 2023 to USD 75.12 billion in 2024, at a compound annual growth rate (CAGR) of 6.4 percent, while the rattan market is expected to expand at a CAGR of 6.5 percent from 2023 to 2029 (Business Research Company, 2025). This growth is driven by shifting consumer preferences toward sustainable and biodegradable materials, particularly in Europe, North America, and emerging eco conscious segments in Asia. However, despite this positive trajectory, there remains a gap between raw material potential and market competitiveness. Many bamboo and rattan products from developing countries are still exported as low value, unbranded goods. The lack of strong brand identity, weak market positioning, and limited international recognition hinder their ability to compete with more established sustainable brands (VOV, 2022). Furthermore, although consumers in global markets increasingly favor green products, studies highlight that purchasing decisions are not driven solely by environmental benefits but also by perceived brand value, including design, authenticity, cultural uniqueness, and trust (Hsu and Ngoc, 2016; Lomboan, 2017).

2.2 The Role of Vietnamese Bamboo and Rattan Brands in the International Market

Vietnam has long been known for its rich tradition of bamboo and rattan weaving, with deep cultural roots embedded in rural life and craftsmanship. With approximately 1.4 million hectares of bamboo (equivalent to 6.2 billion trees) and 30,000 hectares of rattan across 28 provinces, these materials represent a substantial national resource. Traditionally, bamboo and rattan have been used to produce household goods and tools, but their role has evolved significantly in recent years, transforming into export oriented products integrated into modern lifestyle, interior design, and hospitality sectors worldwide (Nguyen et al., 2024). Vietnamese bamboo and rattan brands have increasingly established a presence in international markets. As of 2023, the export value of bamboo, rattan, sedge, and carpet products from Vietnam reached nearly USD 700 million, with the United States accounting for 40 percent of total exports. This figure reflects both rising global demand for eco friendly products and Vietnam's growing capacity in design, production, and global distribution. In the first five months of 2024 alone, export turnover reached USD 334.5 million, representing a 15.4 percent year on year increase. Key growth markets include the United States, Japan, the United Kingdom, and emerging EU countries such as Poland and Denmark.

The international appeal of Vietnamese bamboo and rattan products stems from several key factors: their environmentally sustainable nature aligned with the rising trend of green consumption, their affordability due to lower labor costs, and the cultural and artisanal value embedded in traditional Vietnamese craftsmanship. In addition, strategic trade agreements such as the EVFTA and CPTPP, which eliminate up to 90 percent of import duties, have

created significant competitive advantages for Vietnamese products in high value markets. However, despite the sector's rapid expansion, Vietnamese bamboo and rattan brands still face several challenges in branding, differentiation, and perceived value in the global market. Many products are exported as generic, unbranded items, resulting in limited recognition and lower value capture compared to branded competitors (Nguyen et al., 2024). While international consumers increasingly favor green products, purchasing behavior is heavily influenced by perceived brand value, including design uniqueness, authenticity, product quality, and trust (Winzar et al., 2018).

Ecommerce platforms such as Etsy and Amazon have become effective channels for showcasing Vietnamese bamboo and rattan products under more distinct brand identities. Notable Vietnamese brands and sellers such as VietShopDesign, Miensweethouse, and rattan have achieved strong visibility and sales in overseas markets by offering handcrafted, stylish, and environmentally friendly products. These success cases highlight the potential for branding and digital marketing strategies to enhance competitiveness and consumer engagement globally. The role of Vietnamese bamboo and rattan brands in the international market is undergoing a transition from anonymous, low value exports to branded, high value, sustainable lifestyle products. This evolution requires strategic investments in design innovation, quality control, storytelling, and brand building to reinforce Vietnam's global reputation as a source of premium eco friendly handicrafts. Strengthening perceived brand value is thus not only a marketing priority but also a developmental imperative to ensure long term sustainability and competitiveness in international markets (Nguyen et al., 2024).

2.3 Hypothesis Development

Perceived brand value represents consumers' overall judgment of a brand's usefulness, desirability, and emotional significance. For traditional craft-based sectors such as Vietnamese bamboo and rattan, this perception is influenced not only by the functional quality of the product but also by cultural identity, sustainability, and artisanal authenticity. As noted by Bui et al. (2023), in emerging markets like Vietnam, perceived brand value is a decisive factor in fostering brand loyalty and market engagement, especially when consumers evaluate products with strong cultural narratives and aesthetic appeal. As these brands expand into international markets, perceived brand value becomes a strategic resource. It helps foreign consumers form positive associations with Vietnamese origin products, boosting credibility and trust. According to Winzar et al. (2018), brand competitiveness in the global context is strongly linked to customer-based brand value, where perceived value acts as a bridge between internal brand attributes and external market success. Supporting this, Ilyas et al. (2020) found that brands with higher perceived value achieve better customer satisfaction and repurchase intentions, both of which are essential indicators of long-term competitiveness. For Vietnamese bamboo and rattan brands, enhancing perceived brand value may thus provide a critical pathway to gaining recognition and preference in international markets, beyond low-cost or traditional associations. Based on above agurements, the following hypothesis was proposed:

H1: Perceived brand value has a positive impact on the international competitiveness of Vietnamese bamboo and rattan brands.

Feng (2022) emphasized that product quality plays a fundamental role in shaping effective brand strategies, particularly as consumers increasingly value attributes such as sustainability, durability, and craftsmanship. Jin et al. (2022) further asserted that a strong brand image in the fashion industry cannot be separated from superior product quality and design innovation, as these elements are crucial in shaping consumers' perceived brand value. In the context of

bamboo and rattan products, Xue et al. (2024) illustrated that applying generative design methods significantly enhances product quality through structural refinement, durability, and aesthetics, thereby increasing perceived value. Supporting this, Bui et al. (2023) found that perceived brand value plays a mediating role in transforming product attributes into brand loyalty, especially in industries with strong cultural and artisanal characteristics such as handicrafts. Taken together, these studies suggest that product quality not only has a direct impact on perceived brand value but also indirectly influences a brand's competitiveness in the international market through this perceived value. Based on above agurements, the following hypotheses were proposed:

H2: Product quality has a positive impact on the perceived brand value of Vietnamese bamboo and rattan brands.

H3: Perceived brand value significantly mediates the relationship between product quality and the international competitiveness of Vietnamese bamboo and rattan brands.

In today's competitive global market, design innovation has become a vital component of brand differentiation, especially for traditional craft industries such as Vietnamese bamboo and rattan. Brands that embrace creative and contemporary design elements are more likely to capture consumer attention and enhance brand value through aesthetic appeal, functional improvements, and cultural storytelling. Research has shown that design innovation can positively shape consumers' perception of a brand. According to Yun et al. (2024), innovative modeling and form enhancement in bamboo products improve product desirability and strengthen consumer satisfaction. Similarly, Li and Guo (2019) pointed out that modern design inspired by traditional bamboo culture not only maintains cultural authenticity but also increases market adaptability. Xue et al. (2024) further confirmed that design attributes such as originality, usability, and ecological considerations significantly influence perceived product value in the bamboo-based sector. Beyond its direct influence, design innovation can also drive international brand competitiveness through its effect on perceived brand value. As Jin et al. (2022) noted, when consumers value a brand's creativity and distinctiveness, they are more likely to trust and engage with it across markets. Thus, perceived brand value serves as a crucial pathway through which innovative design contributes to brand success in global contexts. Based on above agurements, the following hypotheses were proposed:

H4: The level of design innovation has a positive impact on the perceived brand value of Vietnamese bamboo and rattan brands.

H5: Perceived brand value significantly mediates the relationship between the level of design innovation and the international competitiveness of Vietnamese bamboo and rattan brands.

For brands rooted in traditional materials and craftsmanship like Vietnamese bamboo and rattan, the country-of-origin image plays a significant role in shaping consumer perceptions. When a country is associated with expertise, authenticity, and quality in a particular industry, this reputation can positively influence how consumers evaluate the brands originating from that country. Aiello et al. (2009) emphasized that the country-of-origin effect is especially pronounced in international markets, where cultural associations and perceived national competencies affect consumers' expectations of product quality and brand status. Likewise, Cai (2002) demonstrated that a positive country image increases consumers' willingness to purchase foreign products by enhancing their confidence in the brand's legitimacy and value. In the case of Vietnam, a country known for its long-standing tradition in bamboo and rattan weaving, the reputation for skilled craftsmanship, sustainable raw materials, and rich cultural heritage can strengthen perceived brand value. As consumers associate Vietnamese origin with authenticity and artisanal excellence, they are more likely to perceive these brands as

credible, meaningful, and high quality. Moreover, the perception of origin contributes not only to how brands are valued but also to how they perform internationally. As Winzar et al. (2018) suggested, brand competitiveness in global markets is tightly linked to customer-based brand value, which is influenced by perceptions of trust, heritage, and differentiation. Ilyas et al. (2020) also noted that positive brand perceptions fuel customer satisfaction and loyalty, both of which are key elements of sustained competitiveness. Therefore, the image of Vietnam as a country-of-origin strengthens brand value and can serve as a crucial pathway to enhancing competitiveness in global markets. Based on above agurements, the following hypotheses were proposed:

H6: Country-of-origin reputation has a positive impact on the perceived brand value of Vietnamese bamboo and rattan brands.

H7: Perceived brand value significantly mediates the relationship between country-of-origin reputation and the international competitiveness of Vietnamese bamboo and rattan brands.

Efficient international distribution channels are critical for ensuring that products reach global consumers reliably, timely, and in good condition. In export-oriented sectors such as Vietnamese bamboo and rattan, distribution channel effectiveness can significantly influence how consumers perceive the brand's professionalism, trustworthiness, and global readiness. Nevins and Money (2008) emphasized that the effectiveness of distribution partners, combined with trust and cultural alignment, plays a direct role in improving performance outcomes in international trade. A well managed distribution system does not simply facilitate logistics but also signals reliability and operational competence, two attributes that enhance a brand’s perceived value in the eyes of international customers. For traditional handicraft brands, the challenge lies not only in design and production, but also in bridging geographic distance and cultural expectations. When international buyers experience consistency in availability, delivery, and service quality, they tend to associate the brand with professionalism and credibility. As a result, perceived brand value increases, especially when the logistics system matches the quality story embedded in the product itself. This enhancement in perceived brand value can translate into improved competitiveness. As noted by Winzar et al. (2018), customer based brand value is a key driver of brand competitiveness in international contexts. Additionally, Ilyas et al. (2020) found that strong distribution experiences contribute to brand awareness and customer satisfaction, ultimately leading to greater repurchase intention and loyalty, both crucial for long term success in global markets. Accordingly, international distribution efficiency is not only a functional factor but also a strategic asset that influences perception and positioning. Based on above agurements, the following hypotheses were proposed:

H8: International distribution channel efficiency has a positive impact on the perceived brand value of Vietnamese bamboo and rattan brands.

H9: Perceived brand value significantly mediates the relationship between international distribution channel efficiency and the international competitiveness of Vietnamese bamboo and rattan brands.

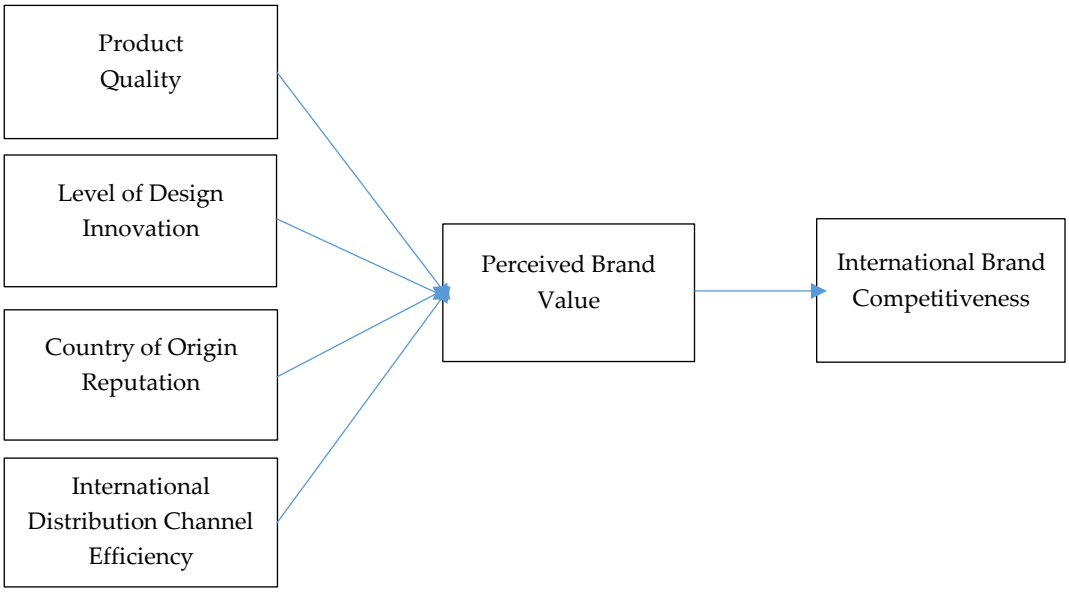

Figure 1. Research Model

3. METHODOLOGY

3.1 Measurement Instrument and Questionnaire Design

The questionnaire consisted of three main parts. The first part was designed to screen participants and confirm their familiarity with bamboo and rattan products. The second part addressed the core variables of the study, while the final section included Likert-scale items representing all constructs. Each item was measured using a five-point Likert scale ranging from 1 (Strongly disagree) to 5 (Strongly agree). The measurement instruments were adapted from previously validated scales to suit the specific research context of Vietnamese bamboo and rattan brands in international markets. The construct "Product Quality" (PQ) was measured using four items derived from previous studies by Feng (2022), Jin et al. (2022), and Xue et al. (2024), covering aspects such as craftsmanship, material durability, and product consistency. "Level of Design Innovation" (LDI) included three items inspired by Yun et al. (2024), Xue et al. (2024), Li and Guo (2019), and Jin et al. (2022), assessing the creativity, modern appeal, and uniqueness of product design. "Country of Origin Reputation" (COR) was measured using three items adapted from Aiello et al. (2009) and Cai (2002), reflecting perceptions of Vietnam's credibility and tradition in handicraft production. "International Distribution Channel Efficiency" (IDC) was assessed through four items drawn from Nevins and Money (2008), focusing on the reliability, responsiveness, and accessibility of distribution systems in foreign markets. "Perceived Brand Value" (PBV) included four items based on Bui et al. (2023), evaluating consumer perceptions of overall brand worth, trust, and relevance. Finally, "International Brand Competitiveness" (IBC) was measured using five items adapted from Winzar et al. (2018) and Ilyas et al. (2020), covering market positioning, brand differentiation, and customer preference on a global scale. The data collected were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM), which is well suited for examining complex models with latent variables and mediation effects. This method also enables prediction and explanation of key relationships, making it particularly appropriate for assessing the drivers of international brand competitiveness.

3.2 Sample and Data Collection

The study targeted adult consumers in Vietnam who have experience purchasing or using bamboo and rattan products, particularly those with awareness of branding and product quality

in both domestic and international markets. To ensure data relevance, respondents were selected based on their familiarity with handicraft products and their ability to evaluate brand-related attributes such as product quality, origin reputation, and distribution experiences. A structured online questionnaire was distributed via social media platforms and community forums focusing on sustainable consumption and traditional crafts. The data collection process lasted for four weeks, during which 450 responses were initially collected. After data screening and cleaning, a total of 408 valid responses were retained for analysis. The study employed a non-probability convenience sampling method, which is suitable for exploratory research within niche consumer markets in developing countries like Vietnam. Demographic data were also collected to better profile the respondents. Gender was categorized as male and female. The age of participants was grouped into four ranges: 18–25 years, 26–34 years, 35–45 years, and above 45 years, with a concentration in the 26–45 age range—representing consumers with stronger purchasing power and lifestyle-driven consumption. Marital status included married, single, and other. Education level ranged from high school to postgraduate, with the majority holding undergraduate or postgraduate degrees. Monthly income was categorized into four brackets: under 10 million VND, 10–20 million VND, 20–30 million VND, and above 30 million VND, which helped to segment responses based on consumer affordability and value perception. This diverse demographic structure provided a robust foundation for analyzing consumer perceptions of Vietnamese bamboo and rattan brands in the international market.

4. RESULTS AND DISCUSSION

4.1 Descriptive Statistics Result

Table 1. Demographic Profile of Respondents

Demographics		Frequency	Percent (%)
Gender	Male	153	37.5
	Female	255	62.5
Age	18–25 years	195	47.8
	26–34 years	118	28.9
	35–45 years	72	17.6
	Above 45 years	23	5.6
Marital Status	Married	142	34.8
	Single	259	63.5
	Other	7	1.7
Educational Level	High school	53	13.0
	College	61	15.0
	Undergraduate	247	60.5
	Postgraduate	47	11.5
Monthly Income	Under 10 million VND	112	27.5
	10–20 million VND	135	33.1
	20–30 million VND	98	24.0
	Above 30 million VND	63	15.4
Total		408	100.0

The descriptive analysis of 408 valid respondents offers important insights into the demographic composition of the sample. In terms of gender, female respondents accounted for a higher proportion with 62.5%, while male participants made up 37.5%. This suggests a growing level of interest and purchasing engagement from women toward Vietnamese bamboo and rattan products, possibly driven by aesthetics, lifestyle preferences, and sustainability values.

Regarding age, the 18 to 25 age group represented the largest segment of the sample, accounting for 47.8%, followed by those aged 26 to 34 (28.9%) and 35 to 45 (17.6%). Only 5.6% of respondents were above 45 years old. These findings highlight the dominance of younger consumers in the market, particularly Gen Z and Millennials, who may be more inclined to appreciate sustainable, handcrafted, and design-oriented products. This demographic also plays a key role in shaping international trends through digital commerce and social media engagement. In terms of marital status, 63.5% of respondents were single, while 34.8% were married. This reinforces the youthful demographic composition of the sample, which may reflect the global trend toward increased consumption of eco-friendly lifestyle products such as bamboo and rattan furniture or decorative items. Education levels showed that 60.5% of participants held an undergraduate degree, followed by 15.0% with college-level education and 11.5% holding postgraduate degrees. Only 13% had a high school education. The high level of academic attainment among the respondents indicates a consumer base that is likely to be brand-conscious and informed, with greater appreciation for product quality, innovative design, and country-of-origin reputation. Monthly income distribution indicates that 33.1% of respondents earned between 10 and 20 million VND, followed by 27.5% earning under 10 million VND, 24.0% earning 20 to 30 million VND, and 15.4% earning above 30 million VND. These results suggest that bamboo and rattan products appeal to a wide range of income groups, with a concentration in the middle-income segment, a strategically important target for both domestic and international market growth. The demographic profile reveals a young, educated, and predominantly female consumer base with moderate income levels, making them especially relevant to branding and international expansion strategies for Vietnamese bamboo and rattan businesses.

4.2 Reliability and Validity Assessment

Table 2 summarizes the results of the reliability and convergent validity tests for the measurement model used in this study on Vietnamese bamboo and rattan brand competitiveness. The model was assessed based on key criteria including internal consistency, convergent validity, and multicollinearity. As recommended by Nunnally and Bernstein (1994), all constructs achieved Cronbach's alpha values above 0.7, indicating satisfactory reliability. The Average Variance Extracted (AVE) values for all constructs exceeded the minimum threshold of 0.5, confirming acceptable convergent validity (Hair et al., 2006; Tabachnick and Fidell, 2007). Multicollinearity was also tested using VIF values, all of which were below 3, indicating no multicollinearity concerns.

Table 2. Reliability and Convergent Validity of Constructs

	Cronbach's Alpha	**rho_A**	**Composite Reliability**	**Average Variance Extracted (AVE)**
COR	0.875	0.878	0.923	0.800
IBC	0.894	0.899	0.922	0.704
IDC	0.864	0.884	0.906	0.707
LDI	0.771	0.707	0.807	0.585
PBV	0.716	0.793	0.746	0.722
PQ	0.885	0.941	0.919	0.740

Discriminant validity was assessed using the HTMT ratio and Fornell-Larcker criterion through Table 3. All HTMT values were below 0.85, with the highest being 0.610 between Country of Origin Reputation and Perceived Brand Value, confirming discriminant validity. The Fornell-Larcker results also showed that the square roots of AVE were higher than the correlations between constructs. These findings confirm that all constructs in the model are distinct and valid for analyzing Vietnamese bamboo and rattan brands in global markets.

Table 3. Heterotrait-Monotrait Ratio (HTMT) and Fornell-Larcker Criterion

	Heterotrait-Monotrait Ratio (HTMT)						**Fornell-Larcker Criterion**					
	COR	IBC	IDC	LDI	PBV	PQ	COR	IBC	IDC	LDI	PBV	PQ
COR							0.894					
IBC	0.411						0.364	0.839				
IDC	0.058	0.158					0.049	0.140	0.841			
LDI	0.076	0.054	0.173				0.046	-0.001	0.081	0.765		
PBV	0.610	0.601	0.243	0.300			0.494	0.474	-0.092	0.162	0.650	
PQ	0.053	0.278	0.432	0.209	0.318		0.028	0.242	0.362	0.142	0.165	0.860

4.3 Structural Measurement Assessment and PLS-SEM Result

In this study, 9 hypotheses were formulated and examined using the bootstrapping function of SmartPLS. The results of the analysis are presented in Table 4 and Figure 2. The primary objective of the structural model evaluation was to explore the relationships among the core constructs of the research framework and to assess the model's explanatory capacity for perceived brand value and international brand competitiveness. Table 4 presents detailed findings from the structural model, including path coefficients, t-statistics, p-values, adjusted R^2 values as suggested by Cohen (1988), and f^2 effect sizes for each hypothesized relationship. These results provide empirical support for the proposed conceptual framework and offer valuable insights into the factors driving global brand competitiveness in the context of traditional Vietnamese bamboo and rattan products.

The structural model was evaluated using Partial Least Squares Structural Equation Modeling (PLS-SEM), and the results are presented in Table 4. This analysis aimed to examine the strength and significance of the hypothesized relationships between constructs, as well as the explanatory power of the model in predicting perceived brand value (PBV) and international brand competitiveness (IBC) for Vietnamese bamboo and rattan brands. The findings indicate that proposed hypotheses except H8, are statistically supported, reflecting both the internal consistency of the research model and its alignment with previous theoretical insights.

Firstly, the relationship between perceived brand value and international brand competitiveness was found to be strong and significant ($\beta = 0.474$, $t = 8.577$, $p < 0.001$), supporting H1. This result aligns with Bui et al. (2023), who emphasized that PBV acts as a crucial determinant of consumer loyalty and brand differentiation, especially in sectors rooted in cultural heritage. Furthermore, this finding is consistent with Winzar et al. (2018), who conceptualized customer-based brand value as a key component in achieving competitiveness in global markets, and Ilyas et al. (2020), who showed that high perceived value leads to customer satisfaction and repurchase intention. Thus, the data affirms that enhancing PBV is a strategic pathway to improving the global competitiveness of Vietnamese bamboo and rattan brands.

Regarding H2 and H3, the results showed a positive and significant influence of product quality on PBV ($\beta = 0.206$, $t = 2.187$, $p = 0.029$). This supports the view of Feng (2022), Jin et al. (2022), and Xue et al. (2024), who emphasized the importance of craftsmanship, material durability, and consistency in shaping positive brand perceptions. As PBV significantly influences IBC, H3 is also supported, indicating that product quality enhances competitiveness through its impact on brand value—a finding that is particularly relevant for traditional craft sectors aiming to compete in quality-driven international markets.

The hypothesis concerning design innovation (H4) was also supported, with LDI having a significant impact on PBV ($\beta = 0.126$, $t = 3.137$, $p = 0.002$). This is in line with Yun et al. (2024), Li and Guo (2019), and Xue et al. (2024), who all asserted that the integration of cultural narratives with contemporary aesthetics increases perceived value. Since PBV in turn affects IBC, H5 is validated, confirming the mediating role of PBV between design innovation and international competitiveness. This emphasizes the importance of elevating traditional design through innovation to meet modern consumer expectations while preserving cultural identity.

Country-of-origin reputation (COR) demonstrated the strongest influence on PBV among all predictors ($\beta = 0.492$, $t = 9.956$, $p < 0.001$), supporting H6. This finding reflects earlier studies by Aiello et al. (2009) and Cai (2002), which highlighted the impact of national image and authenticity on brand perceptions, especially in international contexts where consumers rely on origin cues to judge quality and legitimacy. Since PBV is significantly linked to IBC, H7 is supported, affirming that a positive image of Vietnam as a reputable producer of bamboo and rattan products enhances brand competitiveness through increased perceived value. This underscores the need to reinforce the narrative of Vietnam's craftsmanship and cultural tradition in global branding efforts.

The Pearson correlation analysis results show that marketing strategy has a strong positive correlation with financial performance ($r = 0.702$, sig. < 0.01), suggesting that an effective marketing strategy significantly contributes to a company's financial growth. Additionally, marketing capability exhibits a positive correlation with financial performance ($r = 0.422$, sig. < 0.01), indicating that while it has a notable influence, its impact is relatively weaker compared to marketing strategy.

After that, the authors conducted the multiple linear regression analysis. The model shows a high F-value (192.101) and a significance level (sig. = 0.001), indicating that marketing strategy and marketing capability significantly impact financial performance or the existence of the model. The model shows a high correlation ($R = 0.782$), indicating a strong relationship between financial performance and the predictors marketing strategy and marketing capability. The adjusted R Square value of 0.608 (60.8%) suggests that these two factors explain a significant portion of financial performance variability, while the Durbin-Watson statistic (1.918) indicates no significant autocorrelation issues. These findings highlight that improving marketing strategy and marketing capability can significantly enhance financial performance, reinforcing their

importance for businesses in Vietnam's medical equipment sector. The regression results show that both marketing strategy (β = 0.663, p < 0.001) and marketing capability (β = 0.347, p < 0.001) significantly impact financial performance, with marketing strategy having a stronger effect. The low VIF values (1.013) indicate no multicollinearity issues, which ensures the model's reliability.

Table 4. Structural Equation Modelling Results

	Original Sample (O)	**Sample Mean (M)**	**Standard Deviation (STDEV)**	**T Statistics (|O/STDEV|)**	**P Values**	**Adjusted R^2**	**f^2**
COR -> PBV	0.492	0.491	0.049	9.956	0.000	IBC: 0.222 PBV: 0.310	0.353
IDC -> PBV	-0.202	-0.205	0.060	3.365	0.001		0.252
LDI -> PBV	0.126	0.132	0.040	3.137	0.002		0.223
PBV -> IBC	0.474	0.475	0.055	8.577	0.000		0.289
PQ -> PBV	0.206	0.193	0.094	2.187	0.029		0.253

International distribution channel efficiency (IDC) had a significant but negative effect on PBV (β = –0.202, t = 3.365, p = 0.001), so hypothesis H8 is not supported. This counterintuitive result may point to current shortcomings or inconsistencies in international distribution strategies, which could be negatively impacting customer perceptions of brand reliability. Despite the negative coefficient, the relationship remains significant, indicating that distribution strategies are still an important factor in shaping PBV—albeit in need of strategic improvement. Given that PBV influences IBC, H9 is supported, suggesting that even small enhancements in distribution performance can translate into improved brand value and competitiveness. These findings are consistent with Nevins and Money (2008), who argued that effective distribution not only ensures physical delivery but also signals operational competence and professionalism in international markets.

In terms of explanatory power, the model accounted for 31.0% of the variance in perceived brand value (Adj R^2 = 0.310) and 22.2% of the variance in international brand competitiveness (Adj R^2 = 0.222). These values suggest that the proposed model captures a meaningful proportion of the variability in both endogenous constructs, validating the robustness of the hypothesized framework. Additionally, the f^2 values ranged from 0.223 to 0.353, indicating moderate effect sizes for most relationships and confirming the relevance of each independent variable in predicting PBV and IBC.

In summary, the empirical results strongly support the theoretical model, highlighting the importance of product quality, design innovation, country-of-origin reputation, and distribution efficiency in shaping perceived brand value and through it, international competitiveness. The confirmation of above hypotheses (except H8) offers both academic and practical contributions. For scholars, it extends the brand value–competitiveness chain into the context of traditional Vietnamese craft sectors. For practitioners, it provides strategic insights for enhancing global positioning through targeted improvements in product development, design, origin branding, and logistical capabilities

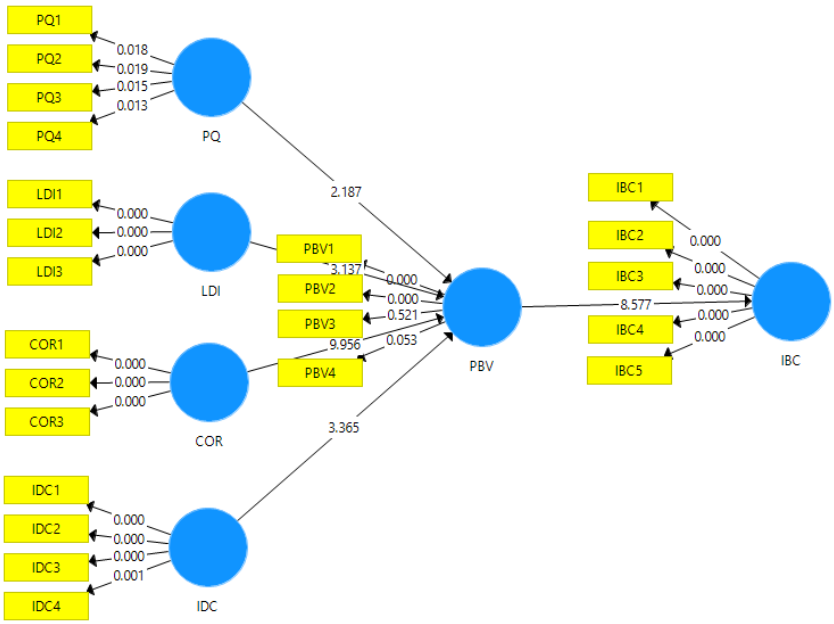

Figure 2. PLS Bootstrapping Model

5. IMPLICATIONS AND CONCLUSION

This study contributes to the theoretical development of brand competitiveness and customer based brand value by contextualizing them within traditional Vietnamese craft industries. The research confirms that perceived brand value plays a critical mediating role in linking internal brand drivers such as product quality, design innovation, country of origin reputation, and distribution channel efficiency to international brand competitiveness. This supports and extends the findings of Winzar et al. (2018) and Ilyas et al. (2020) by demonstrating that even heritage based, resource constrained enterprises can enhance global competitiveness through intangible brand perceptions. Furthermore, the study contributes to emerging market literature by showing how cultural authenticity and artisanal identity can serve as strategic assets in global branding efforts, particularly when aligned with contemporary design and reliable distribution systems.

From a practical standpoint, the findings offer clear guidance for businesses and policymakers seeking to improve the international performance of Vietnamese bamboo and rattan brands. Firms should focus on improving product quality and integrating innovative design elements that blend traditional aesthetics with modern appeal. Building and communicating a strong country of origin image centered on Vietnam's rich heritage in bamboo and rattan craftsmanship can also strengthen perceived brand value. In addition, establishing efficient and reliable international distribution channels is crucial for reinforcing professionalism and trust with foreign customers. Managers are encouraged to leverage digital platforms, trade fairs, and cultural storytelling to highlight the uniqueness and sustainability of their products.

Collaborative efforts with branding experts, government trade agencies, and international partners can further accelerate brand recognition and global reach.

Despite offering valuable insights, this study has several limitations. Firstly, the use of convenience sampling may limit the representativeness and generalizability of the findings. Secondly, the model primarily captures consumer perceptions and does not incorporate firm level performance data, which could provide a more balanced view of brand competitiveness. Thirdly, the research focuses solely on Vietnamese bamboo and rattan products; therefore, its findings may not be directly applicable to other traditional or craft based industries. Future studies could address these limitations by employing probability sampling techniques, incorporating longitudinal data, or comparing cross national contexts. Researchers are also encouraged to explore additional factors such as environmental labeling, social identity, or digital engagement, which may further influence perceived brand value and global competitiveness.

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Journal of Management and Economic Studies
2025, Vol.7, No.3, 261-278
http://doi.org/10.26677/TR1010.2025.1589

When Small Businesses Go Digital: Exploring Innovation and Insecurity in Urban Micro MSMEs

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Abstract

Micro, Small, and Medium Enterprises (MSMEs) play a crucial role in Indonesia's economy but face major challenges in adopting technology. Despite its potential to improve competitiveness, especially in today's digital era, Indonesia's Information and Communication Technology (ICT) index remains relatively low. This study proposes a new model that combines Innovation, Insecurity, and the Technology Acceptance Model (TAM) to better understand the technology adoption process among micro-MSMEs. The research includes variables such as Perceived Usefulness, Perceived Ease of Use, Attitude, Behavioral Intention, Actual Use, Innovation, and Insecurity. Data were collected using a Likert-scale questionnaire, which underwent face validity, construct validity, and reliability testing. The analysis was conducted using Partial Least Squares Structural Equation Modeling (PLS-SEM) to examine relationships between variables. The findings indicate that the proposed model is well-supported and positively influences the adoption process. Most relationships among variables are strong and positive, except for Insecurity, which shows a negative relationship.

Keywords: Technology Adoption, SMEs, Innovation, Insecurity, Perceived Usefulness

1. INTRODUCTION

Micro, Small, and Medium Enterprises (MSMEs) play a crucial role in economic growth in Indonesia's urban areas. As a dynamic nation, Indonesia has around 1.51 million MSMEs (BPS, 2023), contributing approximately 97% to job creation and 61% to local economic empowerment. However, despite their vital role, many MSMEs face significant challenges in accessing capital, developing marketing strategies, and adopting technology, which hampers their growth and sustainability (Nafisah et al. 2023).

Technology offers potential solutions to these challenges by improving MSME efficiency through automating business processes such as inventory management and financial reporting

(Dombrovskaya, 2019), as well as enhancing logistics management (Singh, 2019). Furthermore, technology facilitates MSMEs in managing data and analyzing customer behavior, enabling more accurate decision-making (Liu et al. 2020). In the realm of marketing, social media and online advertising provide effective and targeted promotional strategies for MSMEs (Dwivedi et al. 2021), while selling through marketplaces reduces operational costs without requiring a physical store (Yue & Guo, 2022).

While digital technology offers numerous advantages, Indonesia's Information and Communication Technology (ICT) index remains relatively low. In 2021, Indonesia's ICT index was only 5.76 out of 10, indicating that Indonesian businesses have tapped into only about 57.60% of the available technological potential (Untari et al. 2021). This suggests a gap in MSMEs' ability to leverage digital solutions for business growth.

As business units operating in the digital era, MSMEs need to increasingly master and adopt technology to remain competitive. One widely-used model for understanding the technology adoption process is the Technology Acceptance Model (TAM), initially designed for computer usage. However, with the rapid development of technology, especially in the MSME context, this model needs to be adapted.

Recent research applying TAM to MSMEs shows that promoting innovation is one strategy to boost technology adoption (Shaikh et al. 2021). Innovation can occur across various areas such as marketing (Suherlan & Okombo, 2023), human resources (Caselli et al. 2024), training (Gayan et al. 2019), and content marketing (Mansour & Barandas, 2017). Innovation in these areas can attract consumer interest, increase sales, and encourage MSMEs to continue evolving.

In addition, creating a sense of security in technology use is also essential. Some studies indicate that MSME actors still feel insecure about using technology due to data security risks (Arroyabe et al. 2024), limited technical skills (Domi & Domi, 2021), and uncertainties about the outcomes of technology adoption (Shaikh et al. 2021). These factors can hinder technology adoption, but they can be addressed through education, training, and clear evidence of the benefits of technology (Arroyabe et al. 2024; Shaikh et al. 2021).

While innovation and insecurity have become relevant issues for MSMEs, limited research specifically examines the adoption process in micro MSMEs, the most vulnerable category among all MSMEs (Mamun, 2019). Additionally, there is a scarcity of empirical evidence regarding the impact of innovation and insecurity on technology adoption in micro MSMEs.

Therefore, this study will observe and test the impact of a new model combining innovation, insecurity, and TAM on the technology adoption process in micro MSMEs. This research is crucial as it provides insights that can help MSMEs adapt and survive in an increasingly competitive market.

2. LITERATURE REVIEW

2.1. Micro SMEs

Micro-enterprises within MSMEs (Micro, Small, and Medium Enterprises) refer to businesses operating on a very small scale in terms of assets, turnover, and workforce size. In Indonesia, micro-enterprises are defined as businesses with assets of up to Rp50 million (excluding land and business premises) and an annual turnover of up to Rp300 million, as outlined in Law No. 20 of 2008 on MSMEs. Typically, micro-enterprises are managed by individuals or families, featuring simple structures and limited resources.

Micro-enterprises are considered the most vulnerable group within the MSME sector (Mamun, 2019). Their primary weaknesses, compared to other MSME classes, include limited capital

(Prijadi et al. 2020; Nafisah et al. 2023), a small-scale economy (Meressa, 2020), restricted market reach (Mukherjee, 2019), and limited managerial capabilities (Domi & Domi, 2021; Gure & Karugu, 2018).

In addition, micro-enterprises in Indonesia face challenges in utilizing technology for business development and marketing. One major factor is the limited digital knowledge and skills, which prevent many MSME operators from effectively using e-commerce platforms, social media, or other business applications (Xiong, 2016). Furthermore, access to technology remains an issue, especially in remote areas where internet infrastructure is still lacking (Salemink et al. 2017). The high cost of implementing technology also acts as a barrier, as the initial investment for hardware, software, or digital services often exceeds the financial capacity of MSMEs (Hendrawan et al. 2024; Rahman et al. 2024).

Data security is another serious concern for micro-enterprises. A lack of understanding of cybersecurity leaves MSMEs vulnerable to digital threats (Rahman et al. 2024). Lastly, limited awareness of the long-term benefits of digitalization leads some MSMEs to avoid investing in technology, with a conservative business culture that favors traditional methods (Hendrawan et al. 2024).

To address these challenges, technology needs to evolve to become more accessible for micro-enterprises. Research suggests that technology adoption by micro-enterprises becomes easier when the technology is user-friendly and affordable (Hendrawan et al. 2024), adaptable to specific needs and compatible with other systems (Marlyana et al. 2018), operable in remote regions (Salemink et al. 2017), protected against cyber threats (Rahman et al. 2024), and beneficial for product or service innovation in micro-enterprises (Rasool et al. 2023).

Overall, while these limitations make micro-enterprises more vulnerable and less competitive than small and medium-sized enterprises, embracing and innovating through technology across various business aspects can enhance the competitiveness of micro-enterprises in today's digital era.

2.2. Technology acceptance model (TAM)

The TAM (Technology Acceptance Model) has become a popular framework for examining the influence of external factors on an individual's beliefs, attitudes, and intentions to accept technology (Chatterjee et al. 2021; Kayali & Alaaraj, 2020). The primary purpose of TAM is to provide a comprehensive understanding of how individuals perceive and respond to the acceptance or rejection of technology. This model explores cognitive factors, specifically Perceived Usefulness (PU) and Perceived Ease of Use (PEOU), and offers a more detailed explanation of individual beliefs. PU refers to an individual's personal assessment of how adopting a particular application within an organizational context will improve their job performance. Meanwhile, PEOU refers to the extent to which prospective users expect that the targeted system can be used with minimal effort. In addition to these factors, the TAM model also includes Behaviour Intention, Attitude, and Actual Use (Davis & Venkatesh, 1996).

Over time, TAM has been adapted and modified across various industries and organizational contexts, including MSMEs, to better understand technology adoption in enhancing competitiveness and productivity (Viet Tam et al. 2024; To & Trinh, 2021). Originally, this theory was developed to measure and evaluate the market potential for various PC-based applications (Davis & Venkatesh, 1996). In the context of technology adoption for MSMEs, it appears that adjustments to this model are also necessary. As we know, technology has evolved rapidly and now encompasses various forms such as mobile technology, social media applications, and e-commerce. Therefore, the TAM approach needs to be aligned with current conditions.

2.3. Research in SMEs for acceptance model

After reviewing previous studies, several have been found to apply the TAM framework across various sectors, such as banking (Viet et al. 2024), digital wallets (To & Trinh, 2021), manufacturing (Chatterjee et al. 2021), education (Kampa, 2023), and the F&B industry (Pangestu, 2022) in different countries. Some studies have also expanded the TAM model by adding variables, such as in the research by Viet et al. (2024), which incorporated Gamification and Perceived Value, and by To & Trinh (2021), which added Trust and Enjoyment.

In the context of MSMEs, TAM has also been used to understand the technology adoption process. Studies by Shetty & Panda (2023), Wei et al. (2021), and Rokhim et al. (2021) show that using TAM to analyze technology adoption in MSMEs yields positive and satisfactory results. This application of TAM could be valuable and engaging for MSME stakeholders, where the findings and practical implications can offer significant benefits.

2.4. Hypothesis Development

To achieve a more comprehensive research objective, this study integrates key elements from the original TAM model and expands it by including additional variables, namely innovation and insecurity. Previous studies have highlighted the importance of these variables in influencing technology acceptance, such as Suherlan & Okombo (2023) and Van Essen et al. (2023) for innovation, and Nemțeanu & Dabija (2023) and Lissitsa & Chachashvili-Bolotin (2016) for insecurity. To analyze the relationships among these proposed factors, this study employs structural equation modeling (SEM) and presents a path diagram. This approach allows for a visual representation of the connections between different variables, as well as an assessment of their impact on technology adoption (Figure 1).

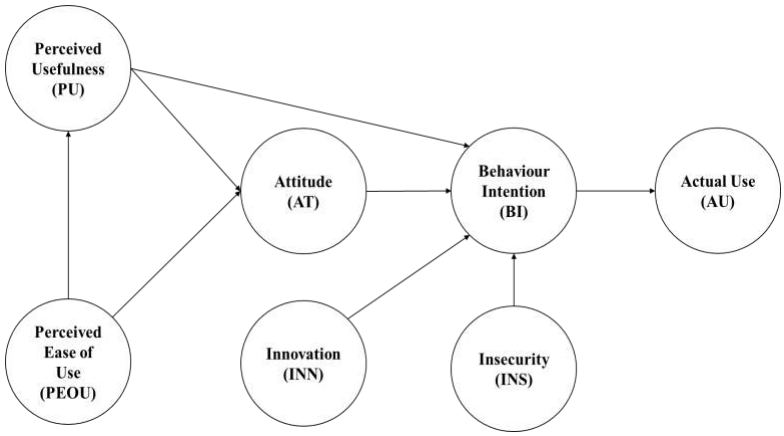

Figure 1. Model Hypothesis

2.5. Perceived Usefulness (PU)

PU (Perceived Usefulness) is defined as the extent to which an individual believes that using a particular technology will improve their performance or productivity (Davis & Venkatesh, 1996). In the context of MSMEs, PU plays a crucial role in influencing Behavioral Intention (BI) to drive technology adoption, as business owners are more likely to adopt technology when they see direct benefits to their operations, such as increased efficiency, cost savings, or market expansion (Sudirjo et al. 2023; Wijayanti & Sutarno, 2019; Taufik & Hanafiah, 2019). Furthermore, Liesa-Orus et al. (2023), Asmara & Ratmono (2021), and Lo & Stevenson (1991) also indicate that PU impacts Attitude (AT). Based on these references, the following hypothesis is proposed:

H1: Perceived Usefulness (PU) has a positive relationship with Behavioral Intention (BI) in MSME technology adoption.

H2: Perceived Usefulness (PU) has a positive relationship with Attitude (AT) in MSME technology adoption.

2.6. Perceived Ease of Use (PEOU)

Perceived Ease of Use (PEOU) refers to the belief that using a particular technology will be free from excessive effort (Davis & Venkatesh, 1996). In this regard, PEOU is crucial, especially for MSMEs, which often face resource limitations in terms of technical knowledge or technology training.

PEOU has a direct impact on PU, as technologies that are easier to use are generally perceived as more beneficial. Gefen et al. (2003) noted that technology perceived as easy to learn and use has a higher likelihood of being accepted by users, including MSME owners. Additionally, PEOU also influences Attitude (AT), as highlighted by Liesa-Orus et al. (2023) and Asmara & Ratmono (2021). If MSME owners feel that technology can be implemented without requiring significant investment in training or sacrificing considerable time, their intention to adopt the technology will be stronger. Based on these references, the following hypotheses can be proposed:

H3: Perceived Ease of Use (PEOU) has a positive relationship with Perceived Usefulness (PU) in MSME technology adoption.

H4: Perceived Ease of Use (PEOU) has a positive relationship with Attitude (AT) in MSME technology adoption.

2.7. Attitude (AT)

An attitude is defined as an organized and consistent way of thinking, feeling, and reacting regarding people, groups, social issues, or more generally any event in one's environment (Renato, 2023). In the context of technology adoption by MSMEs, attitude refers to the perceptions or views of MSME owners and managers towards new technology. According to Davis & Venkatesh (1996), Bechler et al. (2021), and Ajzen (2014), Attitude (AT) can significantly influence Behavioral Intention (BI). Based on these references, the following hypothesis can be proposed:

H5: Attitude (AT) has a positive relationship with Behavioral Intention (BI) in MSME technology adoption.

2.8. Behaviour Intention (BI)

Behavioral Intention (BI) is a function of attitudes toward behavior and subjective norms, and it predicts an individual's likelihood of engaging in a specific behavior based on their evaluation and social pressures (Pangestu, 2022). In the context of technology adoption, BI refers to a user's intention to use technology based on their perceptions of its usefulness and ease of use (Ajzen, 2014). BI is influenced by Perceived Usefulness (PU) and Perceived Ease of Use (PEOU), and according to Venkatesh et al. (2000), PU has a stronger influence on BI compared to PEOU, particularly in the context of technology usage at the workplace. Additionally, research by Davis & Venkatesh (1996), Anthony et al. (2023), Zahrani (2021), and Hossain et al. (2017) shows that BI directly affects Actual Use (AU) in the technology adoption process. Based on these references, the following hypothesis can be proposed:

H6: Behavioral Intention (BI) has a positive relationship with Actual Use (AU) in the adoption of technology by MSMEs.

2.9. Actual Use (AU)

Actual use, in the context of technology adoption by MSMEs, is a key indicator of the success of the technology adoption itself. A technology that has been adopted will only bring benefits if it is used routinely, effectively, and tailored to the business needs. If a technology is easy to use, relevant to business processes, and supported by adequate training, it will be key to increasing actual use among MSMEs (Andarwati et al. 2020).

Actual use (AU) refers to the actual use of technology by the users. In the TAM model, AU is the result of Behavioral Intention (BI), meaning the higher an individual's intention to use the technology, the more likely they are to actually use it (Manda & Salim, 2021; Andarwati et al. 2020; Davis & Venkatesh, 1996).

2.10. Innovation (INN)

According to Baregheh (2009), innovation is a multi-stage process in which an organization transforms ideas into new or improved products, services, or processes to move forward and compete in the market. In the context of technology adoption in MSMEs, the innovation variable refers to a business's ability to introduce new or beneficial ideas, products, or processes. This variable strongly influences the Behavioral Intention (BI) (Suherlan & Okombo, 2023; Van Essen et al. 2022) of MSME owners or managers regarding their decision to adopt new technology. Based on these references, the following hypothesis can be formulated:

H7: Innovation (INN) has a positive relationship with Behavioral Intention (BI) in the adoption of technology by MSMEs.

2.11. Insecurity (INS)

In the context of capitalism, insecurity refers to a sense of unease arising from the ongoing disruption of traditional ways of life (Eriksen et al. 2010). In the context of technology adoption in MSMEs, the insecurity variable refers to feelings of uncertainty or concern about new technologies, such as doubts about outcomes, data security risks, or the ability to operate the technology. This variable can influence the Behavioral Intention (BI) of MSME owners or managers in deciding whether to adopt new technology (Nemțeanu & Dabija, 2023; Sudirjo et al. 2023; Lissitsa & Chachashvili-Bolotin, 2016).

Behavior towards new technology can be negative if MSME owners feel uncertain or fearful about the risks posed by technology, such as operational difficulties, cybersecurity threats, or an inability to keep up with changes (Sudirjo et al. 2023). Based on these references, the following hypothesis can be formulated:

H8: Insecurity (INS) has a negative relationship with Behavioral Intention (BI) in the adoption of technology by MSMEs

2.12. METHODOLOGY

The survey for this research was conducted from June to September 2024, targeting micro MSMEs with the following criteria: at least 3 years in operation, and monthly turnover not exceeding IDR 50 million. The research variables—Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Attitude (AT), Behavioural Intention (BI), Actual Use (AU), Innovation (INN), and Insecurity (INS)—are latent variables developed based on Davis & Venkatesh (1996); Baregheh (2009); Ajzen (2014); Lissitsa & Chachashvili-Bolotin (2016); Taufik & Hanafiah (2019); Wijayanti & Sutarno (2019); Andarwati et al. (2020); Asmara & Ratmono (2021); Bechler et al. (2021); Gefen et al. (2003); Nemțeanu & Dabija (2023); Liesa-Orus et al. (2023); & Sudirjo et al. (2023).

To ensure that the micro MSMEs are familiar with and are using all these latent variables in their business activities, a Focus Group Discussion (FGD) was conducted. The FGD was held with 5 micro MSMEs, and the results are shown in Table 1. Table 1 indicates that all variables were found and used by the micro MSMEs.

Next, to obtain more valid and reliable data for statistical testing, the research instrument was developed based on the results of the FGD and previous studies. The research instrument can be seen in Table 2. The instrument was summarized in the form of a questionnaire, and before being distributed to 200 potential respondents, a face validity check was conducted. The instrument was measured using a Likert scale (1 = "strongly disagree"; 10 = "strongly agree"). Each variable is measured using 3-5 constructs.

Table 1. Results of FGD Formulation

Variable	Response
Perceived Usefulness	• Useful because it can be used as a marketing tool and medium. • Particularly useful for women because it can be done at home and generate income.
Perceived Ease of Use	• Easy, practical, with flexible timing. • However, it requires time and skills for editing. • The Canva app is easy to use.
Attitude	• Likes it because everything is already available and it helps in creating content with AI. • Likes it, but content needs to be created wisely.
Behaviour Intention	• Will continue to use it regularly, like TikTok, IG, FB Ads, and WhatsApp. • Must be wise in using digital technology.
Actual Use	• Already using apps like QRIS and Buku Warung. • E-commerce hasn't been used again due to the need for an admin. • Using WhatsApp status for selling, Instagram for branding, Facebook Business for selling, Google Business, and hashtags. • Have tried using paid ads. • Using a smartphone, tablet, and laptop.
Innovation	• Innovating by using the Canva app. • Creating videos of store activities.
Insecurity	• Concerned about data theft. • Privacy is compromised. • There are many scams. • Policies of some apps are not supportive, such as discount cuts or app shutdowns. • Price wars occur on marketplaces. • The least secure technology: Facebook.

The sample for this study was selected randomly via an online questionnaire created using Google Forms. The questionnaire was distributed through social media, and also by field enumerators. The questionnaire included information about the purpose and benefits of the research, as well as a consent statement for respondents to complete the questionnaire honestly and thoroughly.

After conducting the observation and validation of the questionnaire, valid data were obtained

from 180 respondents. Before data processing, a test of the validity and reliability of the constructs was carried out. The items for each variable after the validity and reliability tests are presented in Table 4.

To examine the relationships between variables, Partial Least Squares Structural Equation Modeling (PLS-SEM) is used. PLS-SEM allows for testing relationships between latent variables, which are often abstract and cannot be directly measured, and can predict how these variables interact. Additionally, this method can handle complex structural models with multiple latent variables and indicators, moderator variables, mediator variables, and various causal relationships between these variables through a stepwise analysis. This approach is suitable for analysis with small sample sizes or data that do not follow a normal distribution (Hair et al. 2019). For descriptive data processing, Microsoft Excel is used, while PLS-SEM testing and analysis are conducted using Smart-PLS 4 software.

Table 2. Research Instrument

Variable	Research Instrument	References
Perceived Usefulness	• It improves the operational efficiency of my business. • It helps me complete tasks more quickly. • It increases the productivity of my business. • It allows me to serve customers better. • It helps me optimize product marketing.	FGD Davis (1989) Fortes & Rita (2016) Mudialba (2016)
Perceived Ease of Use	• It is easy to use in my daily business activities. • It simplifies business processes. • It's easy to learn how to use it. • The features are easily accessible and user-friendly. • It doesn't require much assistance to use.	FGD Davis (1989) Fortes & Rita (2016) Mudialba (2016)
Attitude	• I enjoy using technology in my business. • I have a positive attitude towards technology. • I feel motivated to use technology.	FGD Davis (1989) Fortes & Rita (2016)
Behavior Intention	• I intend to continue using technology. • I would recommend this technology to others. • I want to use technology for all aspects of my business operations. • I will continue to use digital technology even if there are other options.	FGD Davis (1989) Fortes & Rita (2016) Agag & El-Masry (2016)
Actual Use	• I use technology every day in my business. • I access technology from various devices. • I use technology to communicate with customers or business partners. • I use technology for marketing products or serving customers..	FGD Davis (1989) Andarwati et al. (2020) Yawised & Apasrawirote (2022)
Innovation	• I am always interested in and eager to try new technologies. • I am excited about new technologies that can improve the way I work. • I am always looking for information about the latest technologies on the market. • I believe that adopting new technology can provide a competitive advantage.	FGD Wang et al. (2008) Yu & Tao (2009) Van Essen et al. (2022) Mudialba (2016) Lányi et al. (2021)

Insecurity	• I am concerned about my personal data. • New technology often brings greater risks than benefits. • Some e-commerce platforms may suddenly shut down. • Usage fees are controlled by the app owners. • I have to rely entirely on technology to complete my work.	FGD Nemțeanu & Dabija (2023) Olsson & Bernhard (2021) Indrawati (2020) Tam et al. (2021)

3. RESULTS

3.1. Respondent Profile

The respondent profile for this study can be seen in Table 3. The table shows that the majority of the respondents have been in business for more than 3 years. This indicates that their businesses are well-established and accepted in the market, allowing them to continue and expand their operations.

Table 3. Respondent Profile

Description	Percentage
How many years has this MSME been in business?	
1 - 3 years	16,11
3 - 5 years	42,22
5 - 10 years	20,00
More than 10 years	21,67
What is the average monthly sales revenue?	
Rp.0 – Rp.10 million/month	62,78
Rp.10 – Rp.25 million/month	30,56
Rp.25 – Rp.50 million/month	6,67
Gender	
Male	58,33
Female	41,67
Education:	
High school or equivalent	86,11
Diploma (D1-3)	2,78
Bachelor's (S1)	10,56
Master's (S2)	0,56

Additionally, most respondents reported monthly sales of less than Rp.25 million. This aligns with the criteria for the respondents targeted in this study, which focuses on micro MSMEs as defined by the Indonesian Law No. 20 of 2008 on MSMEs. Furthermore, Table 3 also illustrates a relatively balanced ratio of male and female respondents, with most having a high school education.

4. Measurement Model

The first step in evaluating the measurement model is to assess the convergent validity of each item, which is determined based on the outer loading values. An item is considered reliable if the outer loading value is greater than 0.708 (Hair et al. 2019). In this case, all outer loading values exceed 0.708 (Table 4). The analysis continues by examining the convergent validity of each construct based on the Average Variance Extracted (AVE) values. An acceptable AVE value is 0.5 or higher, indicating that the construct explains at least 50% of the variance of its items (Fornell & Larcker, 1981). Based on Table 4, the AVE values for each construct range from 0.741 to 0.842.

The second step in evaluating the measurement model is to assess internal consistency, which is measured by the Composite Reliability (CR) and Cronbach's Alpha values (Hair et al. 2019). A construct is considered consistent if the CR value is greater than 0.7, as well as the Cronbach's Alpha value (Hair et al. 2019). In this case, the CR and Cronbach's Alpha values range from 0.865 to 0.955 (Table 4).

The next step is to evaluate discriminant validity, which indicates the extent to which a construct is empirically distinct from other constructs in the research model. One approach to assess this is the Fornell-Larcker criterion. Each construct demonstrates the highest quality when the correlation matrix shows that the first construct has a higher correlation coefficient with itself than with any other construct below it, and the second construct should show the same pattern (Fornell & Larcker, 1981). At this stage, one item from AU, INN, INS, PEOU, and PU had to be dropped to meet the Fornell-Larcker criterion requirements. Table 5 shows that the resulting matrix confirms that each construct is distinct from the others.

Table 4. Convergent Validity, Internal Consistency, and VIF

Construct/Items	Load' Factors	VIF	Cronbach'alpha	CR	AVE
Attitude			0,891	0,932	0,821
AT 1	0,898	2,458			
AT 2	0,915	2,790			
AT 3	0,905	2,665			
Actual Use			0,865	0,917	0,787
AU 1	0,904	2,385			
AU 3	0,910	2,747			
AU 4	0,847	1,954			
Behavior Intention			0,908	0,936	0,784
BI 1	0,861	2,339			
BI 2	0,899	3,044			
BI 3	0,913	3,327			
BI 4	0,868	2,539			
Innovation			0,905	0,933	0,778
INN 1	0,901	3,141			
INN 2	0,899	3,059			
INN 3	0,889	2,713			
INN 4	0,837	2,167			
Insecurity			0,860	0,915	0,782
INS 1	0,843	1,739			
INS 2	0,895	2,745			
INS 4	0,913	2,906			
Perceived Ease of Use			0,884	0,919	0,741
PEOU 1	0,895	3,515			
PEOU 2	0,889	3,404			
PEOU 4	0,825	2,379			
PEOU 5	0,831	2,379			
Perceived Usefulness			0,937	0,955	0,842
PU 1	0,930	4,568			
PU 2	0,916	3,522			
PU 4	0,923	4,343			
PU 5	0,902	3,174			

4.1. Structural Model

Before analyzing structural relationships, collinearity should be checked to ensure no bias in the regression results. Ideally, the variance inflation factor (VIF) value should be lower than 3, though values up to 5 are acceptable in some cases (Hair et al. 2019). In this model, all VIF values are below 5, ranging from 1.739 to 4.568 (Table 4).

The bootstrap process, using 10,000 subsamples, was applied to evaluate significant indicators and path coefficients. Model evaluation involved the coefficient of determination (R^2), cross-validated redundancy (Q^2), and path coefficient (Hair et al. 2019). In this study, an R^2 value of 0.809 (table 6) indicates the strength of the influence of AT, INN, INS, and PU on BI. An R^2 of 0.749 indicates the influence of PEOU and PU on AT, while an R^2 of 0.728 indicates the strength of PEOU's influence on PU. Meanwhile, an R^2 of 0.540 shows the influence of BI on AU.

Table 5. Discriminant Validity Test by Fornell-Larcker Criterion

	Actual Use	Attitude	Behaviour Intention	Innovation	Insecurity	Perceived Ease of Use	Perceived Usefulness
Actual Use	0,887						
Attitude	0,677	0,906					
Behaviour Intention	0,737	0,863	0,885				
Innovation	0,683	0,811	0,833	0,882			
Insecurity	-0,171	-0,223	-0,161	-0,039	0,884		
Perceived Ease of Use	0,697	0,830	0,815	0,784	-0,147	0,861	
Perceived Usefulness	0,722	0,839	0,817	0,744	-0,217	0,854	0,918

To assess the model's predictive accuracy based on empirical data, Q^2 values were calculated (Hair et al. 2019). The higher the Q^2 value (typically approaching or exceeding 0.5), the stronger the predictive relevance. Q^2 values for BI, AT, and PU are 0.628, 0.608, and 0.608, respectively, and the Q^2 for AU is 0.418 (table 6). These results indicate that BI, AT, and PU have strong predictive relevance based on the influencing variables, while the predictive relevance of AU based on BI is moderate.

Table 6. Structural Model

	Coefficient	P Values	Coefficient of determination (R^2)	Predictive Relevance (Q^2)
AT → BI	0,379	0,000	0,809	0,628
INN → BI	0,349	0,000		
INS → BI	-0,011	0,750		
PU → BI	0,238	0,001		
PEOU → AT	0,419	0,000	0,749	0,608
PU → AT	0,482	0,000		
PEOU → PU	0,854	0,000	0,728	0,608
BI → AU	0,737	0,000	0,540	0,418

5. DISCUSSION

Based on the proposed hypothesis model in Fig. 1, this model is considered adequate. This conclusion is supported by the coefficient values, R^2, and Q^2 shown in Table 6. With the addition of innovation and insecurity variables, the model becomes more responsive in the micro-MSME context, where these business entities face resource constraints and require innovation to remain competitive. Correlation test results indicate that Behavioral Intention is strongly influenced by its exogenous variables—Innovation, Insecurity, Attitude, and Perceived Usefulness—with an R^2 value of 80.90%. This finding aligns with Suherlan & Okombo (2023) and Van Essen et al. (2022), who noted that innovation positively impacts MSME behavior in technology adoption. This suggests that the technology adopted by micro-MSMEs is sufficiently designed with beneficial and user-friendly features. Moreover, the technology can boost efficiency through business process automation (Mudialba, 2016), reduce operational costs (McFarlane et al. 2020), facilitate customer relationship management and product customization (Marion & Fixson, 2021), expand market access via digital marketing and e-commerce platforms (Lányi et al. 2021), enable more accurate, real-time data-driven decisions (Duan et al. 2020), and respond to pressure from business partners who are already technology-enabled (Darby, 2020). MSMEs also need to adapt to increasingly digital consumer trends, as customers expect easily accessible online services.

Innovation assists in understanding the positive factors driving adoption, while insecurity sheds light on psychological barriers or risks faced by MSME owners. The test results for Insecurity on Behavioral Intention reveal that Behavioral Intention is negatively influenced by Insecurity (Nemțeanu & Dabija, 2023; Lissitsa & Chachashvili-Bolotin, 2016), although this effect is not significant (P-value: 0.750). Discomfort with technology in MSMEs can stem from a lack of digital knowledge and skills, leading to overwhelm (Olsson & Bernhard, 2021). Additionally, high costs of technology implementation and maintenance may raise concerns about the investment's return (Indrawati, 2020), and MSMEs also face cybersecurity risks that could jeopardize business and customer data (Tam et al. 2021).

Studies by Sudirjo et al. (2023), Wijayanti & Sutarno (2019), and Taufik & Hanafiah (2019) confirm that Perceived Usefulness also impacts Behavioral Intention. Furthermore, Olipas & Leona (2022) and Yusuf (2021) noted that Behavioral Intention is influenced by other variables such as Perceived Ease of Use in addition to Attitude (Bechler et al. 2021).

In general, this study's results indicate that the proposed hypothesis model is acceptable and supports technology adoption processes among MSMEs. The relationships between variables in this model are positive and strong, except for Insecurity which negatively correlates with Behavioral Intention. Variables influenced through mediation by other variables also show positive outcomes. This finding is consistent with previous studies by Shetty & Panda (2023), Wei et al. (2021), and Rokhim et al. (2021), which used the TAM model to examine technology adoption.

5.1. Practical Implications for Asian Business

This study provides valuable insights for businesses across Asia, particularly for those working with micro, small, and medium enterprises (MSMEs). MSMEs form the backbone of many Asian economies, including Indonesia, where they significantly contribute to economic growth and employment. However, these enterprises face considerable challenges in adopting and integrating technology, which is increasingly necessary for business survival and competitiveness in the digital age. The model developed in this research offers a framework for understanding and addressing technology adoption challenges in micro-MSMEs, focusing on the variables of innovation, insecurity, perceived usefulness, perceived ease of use, attitude, behavioral intention, and actual use.

One of the key takeaways is the importance of promoting technological innovation among MSMEs. Asian countries, especially those with growing digital economies like Indonesia, can benefit from encouraging a culture of innovation within MSMEs. Governments and business associations should consider offering targeted training and incentives to foster innovation, helping businesses see technology not only as a tool for operational improvement but as an enabler of creative solutions and market differentiation. Countries like South Korea and Japan, where MSMEs have successfully integrated technology into their processes, provide models that other Asian nations can look to for structuring support and incentives around technological adoption and innovation.

Another practical implication is the need to address the insecurity associated with adopting new technologies. The study found that insecurity negatively influences behavioral intention towards technology adoption. This finding highlights that MSME owners may perceive technology as risky due to concerns over costs, data privacy, or lack of familiarity with digital tools. To mitigate this insecurity, policymakers and industry stakeholders in Asia should focus on building trust and reducing perceived risks associated with technology. This could include developing clear data protection laws, offering accessible support channels, and creating affordable technology solutions designed with MSMEs in mind.

In addition, support from local governments and industry organizations is crucial in building an ecosystem where MSMEs feel empowered to adopt and experiment with new technologies. By providing subsidies for technology purchases, creating co-working tech hubs, and offering digital literacy programs, these entities can foster an environment where MSMEs feel more confident in their ability to engage with technology. For instance, Japan's extensive support system for small businesses includes subsidies, technology transfer programs, and regional innovation hubs, which help alleviate barriers to technology adoption.

Finally, these findings can guide non-governmental organizations (NGOs), private companies, and CSR programs in designing programs that assist MSMEs in navigating digital transformation. By providing accessible digital solutions and training programs, these organizations can help MSMEs overcome perceived challenges and embrace technology for sustained growth. For example, large corporations could establish mentorship programs that guide smaller businesses through digital transformation, offering expertise and resources to bridge the technology gap.

Acknowledgment

Our sincere thanks go out to the Directorate General of Higher Education, Research, and Technology, Ministry of Education, Culture, Research, and Technology for their crucial role in providing funding for our research.

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