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Future-Proofing MSMEs: An Integrated Model of Digital, Financial, and Green Capabilities

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ABSTRACT

Micro, Small, and Medium Enterprises (MSMEs) play a vital role in economic development, employment generation, and business resilience. However, sustaining competitiveness in an increasingly digital and sustainability-oriented environment requires MSMEs to develop multiple organisational capabilities. Drawing upon the Resource-Based View and Dynamic Capability Theory, this study developed and validated an integrated capability model by examining the effects of technology adoption, financial literacy, and green intellectual capital on MSME sustainability across Indonesia, Japan, and Malaysia. Using a quantitative approach, survey data were collected from 360 MSME owners and managers and analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM). The results revealed that technology adoption, financial literacy, and green intellectual capital positively influenced MSME sustainability, with technology adoption emerging as the strongest predictor. Multi-group analysis indicated no significant differences across the three countries, suggesting that the proposed model was robust across diverse national contexts. This study contributes to the literature by providing cross-national evidence for an integrated capability framework that combines digital, financial, and sustainability capabilities in explaining MSME sustainability. The findings offer practical implications for policymakers and practitioners seeking to enhance the long-term sustainability and resilience of MSMEs in increasingly dynamic business environments.

JEL CLASSIFICATION: M130, O310, G39

1. INTRODUCTION

Micro, small and medium enterprises (MSMEs), have been identified as being a vital component in contributing towards, economic growth, job creation, innovation and societal progress. Globally MSME's represent over 90% of all businesses with an impact on employment and overall National GDP (OECD, 2023). Apart from playing an important role in the economy, MSME's now also play a growing role in Sustainable Development due to increased levels of socially responsible business practice and community involvement and social value. The rapid changes occurring within the business environment such as; digital transformation, environmental challenges and increasing stakeholders' expectations were all placing pressure on MSME's to create the capability that will enable them to achieve long-term sustainability and resilience.

The organisation's capability of achieving sustainable development is becoming a key area of focus for both researchers and policymakers due to the fact that many small- and medium-sized enterprises are now faced with increased pressures from consumers, competitors and regulatory bodies in addition to traditional resource-based barriers including lack of resources, limited management experience, technology limitations and changing market expectations (Ndubisi et al., 2021). These challenges have made it increasingly difficult for MSMEs to achieve sustainable growth; therefore, there is a need to identify the organisational capabilities required by MSMEs to achieve sustainable growth.

Technology is one of the key drivers for organisational change in the area of sustainable business development. Through digital technologies, MSMEs are able to increase their operational efficiencies, create better experiences for customers, support innovation, and provide greater access to markets through digital platforms and e-commerce systems (Jaish et al., 2023). Digital technologies will help build an organisation's agility by providing opportunities for data driven decision making and knowledge exchange. While technology can be beneficial, it will have no sustainable impact without effective deployment and integration of technology into business processes and strategy. The ability for entrepreneurship to be financially literate has received significant interest. Financially literate entrepreneurs are able to manage their resources and investments, find financing options and limit the risk of financial challenges (Lusardi & Mitchell, 2023). A well-developed financial literacy provides a greater opportunity for MSME's to have better strategy and resource allocation with respect to innovative and business development strategies. There is some consistent proof that there is a positive effect of financial literacy on an MSME's business performance or survival. However, little research has been done as to how financial literacy can help an organization become sustainable overall and also help along-side other organizational skills.

The development of green human capital, green structural capital, and green relational capital are critical resources through which organisations can develop long term competitive advantage by improving environmental performance, enhancing innovation, strengthening stakeholder trust and contributing to sustainable business practice. Yusoff et al. (2019) defined green intellectual capital as an organisation's ability to produce and utilise environmentally orientated knowledge. They also described this as having environmentally orientated competences and organisational systems, with the ability to support sustainable value creation through their relationship with stakeholders. With increasing emphasis on environmental sustainability as a key component of successful business operations, it will be vital for MSMEs to adopt green intellectual capital strategies in order to ensure continued sustainability and ultimately success.

In order to explain why developing such an array of abilities is so important, we used two different theoretical frameworks, the Resource-based View (RBV) (Barney, 1991) and the Dynamic Capability Theory (Teece et al., 1997). According to the RBV, organizations have better performance when they possess resources and/or capabilities that are valuable, rare, difficult to imitate or replace and do not have substitutes. The Dynamic capability Theory takes the view further, by focusing on how well an organization can integrate, transform and deploy its resources in reaction to changing environmental conditions. With respect to this theoretical model, we considered the use of technology to be a form of digital capability, the ability to read and understand finance as a form of financial capability and as a form of green intellectual capital. In aggregate, all three types of capabilities enable MSMEs to react to environmental changes and grow sustainably, while building their relationships with stakeholders.

Despite the number of recent research papers about MSME sustainability there were still many major knowledge gaps. Firstly, most previous research has looked at technology adoption, financial literacy and green intellectual capital as separate factors that determine how well an organisation performed and if it can be considered sustainable (Susan, 2023; Solihin, 2023; Kurniasari et al., 2025). Although these studies gave us a lot of useful information for our knowledge base, they did not show us the full picture of what makes organisations sustainably successful. They each considered one capability in isolation, when the reality of the situation suggested that MSMEs sustainability cannot come from just one organisational capability. Instead, sustainable growth would likely arise through the interactions among different complementary capabilities that created collective organisational resilience, innovation, and added value to stakeholders.

Secondly, little attention has been paid to how digital, financial and sustainability capabilities integrated within a single framework of theory. Research into the three separate areas of technology adoption, financial literacy and green intellectual capital has been conducted but very little is known as to how they can be used collectively to achieve sustainability goals. The lack of knowledge regarding this area has resulted in a deficiency of a capability-based framework for explaining MSME sustainability from the perspective of both the Resource-Based View and Dynamic Capability Theory. Thirdly, whilst empirical evidence supporting MSMEs sustainability exists there was an over reliance upon the body of work that supported single country studies. As such it is unclear if the findings generated were applicable across differing levels of economic and institutional context. Given the vast differences amongst Asian Pacific economies with respect to their level of economic development; the state of their technological readiness; the nature of their financial systems; and their orientation towards sustainability greater cross-national evidence will be required in order to ascertain whether capability-based frameworks for explaining MSMEs sustainability existed across varying national contexts.

To address these limitations, this study was developed to validate an MSME sustainability capability model. The originality of this study stems from its ability to conceptualise technology adoption, financial literacy, and green intellectual capital as part of the same set of capabilities which all contributed to sustainability of businesses. While other studies have examined each one separately, this study integrated digital capability, financial capability and sustainability capability into a single framework based upon Resource-Based View and Dynamic Capability Theory. An integrated perspective provided a better understanding of how MSME's achieve their sustainability and long-term resilience in increasingly turbulent markets. As such, the study focused on MSME's located in Indonesia, Malaysia and Japan; these represented

developing, emerging and developed economic systems respectively. By studying these three countries, also allowed the researchers to test if there were any variations to the capability models across different economic systems. Instead of identifying any differences in performance among the countries studied, the study will identify whether or not an integrated capability approach to sustainability can be applied equally well across all countries. In addition to these contributions, this study makes three key contributions to existing research. Firstly, it presents and validates through empirical data an integrated capability model of technology adoption, financial literacy and green intellectual capital as a collective explanatory framework for MSMEs' sustainability. Secondly, it expanded upon the Resource-Based View and Dynamic Capability Theory with empirical evidence demonstrating how individual capabilities interacted collectively to create sustainable business outcomes. Finally, it added cross national evidence from Indonesia, Malaysia and Japan to enhance the ability of capability-based models to explain MSMEs sustainability. Overall, the purpose of this study was to investigate the influence of technology adoption, financial literacy and green intellectual capital on MSME sustainability and to validate an integrated capability model for developing sustainable MSMEs

2. LITERATURE REVIEW

2.1 MSME Sustainability

The importance of MSMEs in promoting sustainable development through the creation of jobs, innovation, and wealth cannot be overstated. As such, there is a growing shift away from the traditional view that defined "business success" as merely meeting financial criteria toward an ever-broadening definition of successful business that now included sustainability. Sustainability in MSMEs pertains to the capacity of the enterprise to continue conducting its business over time and create added value for various stakeholder groups economically, socially, and environmentally (Ndubisi et al., 2021; Kamble et al., 2020). Therefore, this conceptualization of MSME sustainability was consistent with the TBL model - where economic wealth, social welfare and environmental protection were equally important.

Sustainability is particularly significant for MSMEs since they often function with limited resources in an environment characterized by rising competition, technological disruptions, and increasing stakeholder expectations. The ability of sustainable MSMEs to be resilient in the face of growing environmental uncertainty; enhance their use of resources; create positive, enduring relationships with stakeholders; and provide long term stability to the organisation, make them better positioned to manage risks (Yang et al., 2023). Sustainability has also moved from being a discretionary goal for organisations into a mandatory business strategy. Governments, customers, investors, and community groups are increasingly demanding greater levels of accountability for corporate social responsibility. Sustainability is now an essential part of competitive advantage and therefore a strategic necessity for organisations. However, achieving sustainability necessitates more than just access to sufficient financial capital. Organisations must possess the capabilities required to identify and adapt to changes in the external environment; capitalize on new opportunities created by those changes; and satisfy the needs and expectations of various stakeholders. Therefore, researchers have increased emphasis placed on understanding how the organizational capabilities of firms impact sustainable business performance. In this paper we drew on both the Resource-Based View (RBV) and Dynamic Capability Theory (DCT), to argue that sustainability among MSMEs will be impacted by combinations of three types of capabilities: digital capability, financial capability, and sustainability capability

2.2 Theoretical Foundation: Resource-Based View and Dynamic Capability Theory

The Resource Based View (RBV), is one of the most critical theoretical frameworks, explaining how organizational competencies and capabilities lead to long-term sustainability. RBV suggests organizations can outperform their rivals by possessing strategic resources which include being valuable, rare, imitable and non-substitutable; these strategic resources allow companies to create a sustainable competitive advantage that is difficult for rivals to copy or reproduce (Barney, 1991). Whereas RBV explains what it means to have strategic assets, the Dynamic Capabilities Theory explains how companies can develop new ways of integrating, reconfiguring and deploying existing resources as the environment changes (Teece et al., 1997). Companies' ability to sense both opportunity and threat and be proactive to capitalize on future opportunity and continually adapt the firm's resources to remain competitive is a result of developing dynamic capabilities.

In an increasingly unpredictable business environment, the ability of MSMEs to develop their digital, financial, and sustainability capabilities through the development of a new capability, such as that developed by combining RBV with Dynamic Capability Theory will be critical. Technology adoption can be seen as one form of digital capability; financial literacy as a type of financial capability; and green intellectual capital as a type of sustainability capability. These capabilities are interdependent; they support each other; and they can provide MSMEs with the ability to respond effectively to environmental changes, maintain and build on the positive relationship between the organisation and its stakeholders, and improve the organisations' sustainability performance. Therefore, sustainable growth is likely to be realised when an organisation has many different types of resources (capabilities) which work well together.

2.3 Sustainability Capability: Green Intellectual Capital

Green Intellectual Capital (GIC) is defined as the amount of information about the environment, the expertise in the field of the environment, the organizational system or structure for an organization to be able to carry out environmentally friendly practices for the organization (Yusoff et al., 2019). Green intellectual capital is generally categorized as; green human capital, green structural capital, and green relational capital. Green human capital relates to the knowledge and skill level of the employee related to the environment. Structural Capital relates to the processes and systems that allow organizations to implement sustainable practices. Relational Capital relates to environmentally oriented relationships with consumers, suppliers, regulatory agencies and other stakeholders. According to Resource-Based View (RBV), Green Intellectual Capital is a unique intangible asset which cannot easily be replicated by competitors and provides long term competitiveness advantage for organizations. Organizations that have superior knowledge of the environment and superior organizational structures and systems for implementing sustainable practices will be better positioned to develop innovative solutions for sustainability, improve their use of resources, and meet increasingly higher stakeholder demands on sustainability (Chen, 2008).

Previous research has demonstrated that there was a strong positive relationship between green intellectual capital, and both organizational performance and sustainability. According to Solihin (2023), green intellectual capital contributes to enhanced business sustainability by improving innovation and enhancing an organization's environmental performance. In addition, Mukarram et al. (2025) identified that environmentally focused knowledge bases provide a positive contribution to organizational resilience and sustainable development. Green intellectual capital also enabled MSMEs to develop new ways of

conducting their businesses in a responsible way; build trust with stakeholders; and generate new products or processes that are sustainable over time, thereby contributing to long term sustainability.

Accordingly, the following hypothesis was proposed:

H1: Green intellectual capital positively influences MSME sustainability.

2.4 Financial Capability: Financial Literacy

Beginning with the definition of "financial literacy," Lusardi and Mitchell defined it as the knowledge, skills and competences an individual needs to be able to interpret and use financial data in their decision-making (Lusardi & Mitchell, 2023). The more financially literate an entrepreneur is, the better they will be at managing their cash flow, evaluating potential investments, accessing funding sources and reducing risk associated with running their own business. From a Dynamic Capability view, financial literacy is an ability of management to utilize resources efficiently and make strategic responses to changes in business conditions. More financially literate MSME owners have greater capacity to recognize potential areas of growth, to identify and manage uncertainty and to provide informed choices on matters related to innovative processes, new technologies or sustainable investment.

Financial literacy has been shown to be a factor in business success as indicated in research. In an empirical study conducted by Susan (2023), it was shown that MSME's will have better performance and resilience due to higher levels of financial literacy. Research conducted by Heriyati et al. (2024) also showed that MSME owners with higher levels of financial literacy are more apt to use their knowledge to support innovation and strategic development. Hossain and Maji (2021) also found that financial literacy aids in providing funding options and increases operating efficiency. As a result of the need for long-term planning and investment in sustainability, we expected that financial literacy will support sustainable development through improved resource allocation, financial planning, and strategic decision making.

Accordingly, the following hypothesis was proposed:

H2: Financial literacy positively influences MSME sustainability.

2.5 Digital Capability: Technology Adoption

Technology Adoption, as defined by Rogers (2003) is the utilization of digital technologies, information systems, automated tools, and innovative technologies to enhance organizational operations and overall business success. In the context of MSME's, "technology adoption" was defined as the application of e-commerce, digital payment systems, cloud computing, business analytics, artificial intelligence, and numerous other technological solutions. Adoption of technology has become an increasingly important aspect of organizations to improve efficiency in operational activities, decrease transaction costs associated with conducting business, increase communication and relationship building with customers, and extend their potential customer base (Castillo-Vergara et al., 2025). Additionally, through the use of digital technologies organizations are able to develop new ideas, share knowledge and learn from one another, ultimately increasing their competitive advantage and ability to adjust quickly to changing environmental conditions. Theory on Dynamic Capabilities posits that technology adoption allows organizations to identify opportunities within markets, capitalize on competitive advantages, and continually restructure available resources in response to dynamic environmental conditions (Teece et al.,

1997). As such, technology adoption enhances an organization's flexibility and resiliency, both of which are key factors in achieving long-term sustainable economic development.

Technology has been shown in a number of empirical studies to have a highly positive effect on organizational performance. As Gama et. al. (2019) showed technology can assist businesses with the implementation of sustainable business models as well as resource efficient processes. In addition, Zahoor and Al-Tabbaa (2020) also showed that through technology driven innovation organizations are able to improve their competitive advantage over the long term and increase their organizational growth. Most recently, both, Nugraheni et al. (2025), and Castillo-Vergara et al. (2025) had provided evidence that digital transformation can lead to significant increases in MSME's productivity, market access and overall business sustainability. Therefore, technology adoption is expected to contribute positively to MSME sustainability.

H3: Technology adoption positively influences MSME sustainability.

2.6 Integrated Capability Model for MSME Sustainability

Although several previous studies have shown how each one of these elements contributes to an individual's ability to be successful with technology adoption, their own financial literacy and green intellectual capital, there was still no comprehensive understanding of all of them together due to most of the past research being done separately (Kurniasari et al., 2025; Susan, 2023; Solihin, 2023). In addition to limiting the potential for synergy among these different types of abilities, isolating each type limited our ability to see if sustainable business success can come from the combination of many different but related resources as opposed to just relying on one. This study used both The Resource Based View and Dynamic Capability Theory to argue that MSME Sustainability comes from the use of at least two or more of the three identified capability areas. A company's digital capability will contribute to its overall digital competence and ability to innovate, improve efficiencies and respond rapidly to changing market conditions. The use of a company's financial capability will enable it to effectively allocate resources and make strategic decisions. A company's sustainability capability will enable it to take responsibility for the environment, engage with stakeholders and create long term shareholder value.

The main novelty of this research is the way it viewed all three (digital capability, financial capability, and sustainability capability) as part of a complete organisational capability system. So instead of looking at each one individually for its ability to help MSME achieve sustainability; the study looked at them as a whole. A complete view of MSME sustainability was provided through this integrated perspective. The integrated approach also developed upon previous studies with regard to showing that when several different types of organisational capabilities were combined, they provided collective contributions towards achieving sustainable business results.

In addition, this study tested the framework developed by utilising data collected from MSME in Indonesia, Malaysia and Japan. Although there have been many studies conducted regarding MSME's sustainability across various countries, most studies focused on identifying significant differences in business practices between countries. However, this study attempted to assess if the integrated capability model can explain MSME's sustainability equally well in countries that have significantly differing economies and institutional environments. Consequently, the study added additional cross-national evidence to capability-based explanations of MSME's sustainability which improved the generalizability of such theories.

Figure 1 presents the Integrated Capability Model proposed in this study.

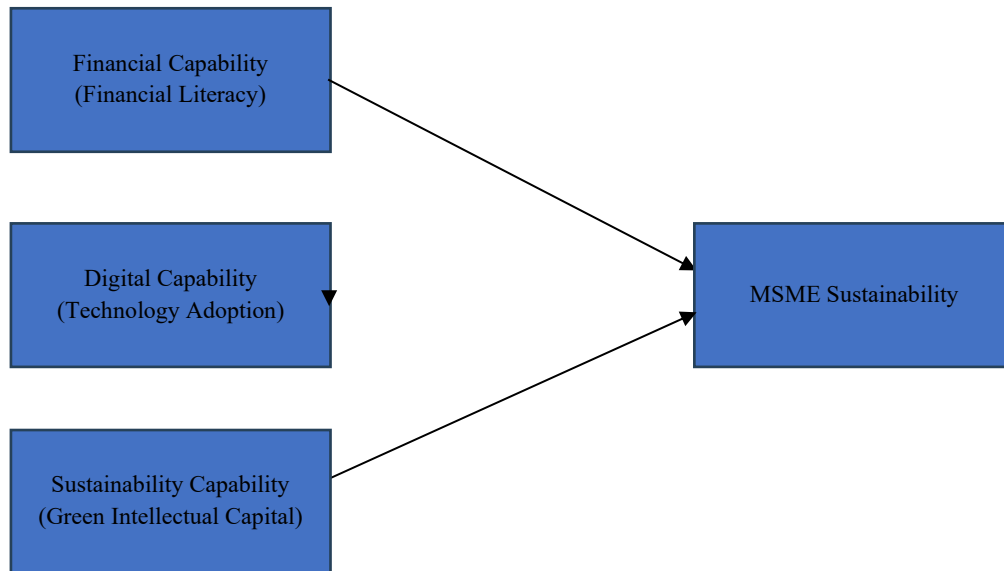


Fig. 1. Integrated Capability Model

Source: Author (2026)

3. RESEARCH METHODOLOGY

This study employed a quantitative cross-sectional survey design to examine the influence of Technology Adoption, Financial Literacy, and Green Intellectual Capital on MSME Sustainability. A structured questionnaire was used to collect primary data from MSMEs operating in Indonesia, Malaysia, and Japan. The survey instrument contained items measuring the key constructs of the proposed Integrated Capability Model, namely Technology Adoption, Financial Literacy, Green Intellectual Capital, and MSME Sustainability. The quantitative approach was considered appropriate because it enables systematic examination of relationships among multiple organizational capabilities and sustainability outcomes across different national contexts.

The inclusion of respondents from three countries was intended to enhance the generalizability of the findings and provide a broader representation of MSME practices in Asia. Rather than conducting a country-by-country comparison, the study focused on testing a unified capability model across MSMEs operating in different institutional environments. Therefore, the country context served as a source of sample diversity rather than as the primary unit of analysis.

3.1 Population and Samples

A total of 1,500 questionnaires were distributed to MSMEs identified through official business directories obtained from Badan Pusat Statistik Indonesia (BPS) (2024), SME Corporation Malaysia, and the Ministry of Economy, Trade and Industry (METI) (2025), Japan. The sampling frame comprised

MSMEs operating in urban areas and employing between 10 and 250 employees, consistent with the OECD and Eurostat (2018) guidelines.

Of the 1,500 firms contacted, 855 initiated the survey, resulting in a response rate of 57%. After data screening and removal of incomplete responses, 360 usable questionnaires were retained for analysis, representing an effective response rate of 24%. The final sample consisted of MSMEs from Indonesia, Malaysia, and Japan. Questionnaires were completed by key organizational informants, including chief executive officers, department managers, deputy managers, or other representatives authorized by the firm. Tables 1 and 2 present the distribution of respondents by country and industry sector.

Table 1. Demographic profile (N = 360)

Country	Sector	Sample	Small business		Medium-sized business
Indonesia (128 Companies)	Transportation and logistics	38	8 (27%)		30 (73%)
	Property	18	2 (11%)		16 (89%)
	Industrials	54	36 (67%)		18 (33%)
	Technology	18	3 (17%)		15 (83%)
Malaysia (126 Companies)	Transportation and logistics	2	2 (100%)		0 (0%)
	Property	13	9 (69)		4 (31%)
	Industrials	88	32 (36)		56 (64%)
	Technology	20	6 (30)		14 (70%)
	Healthcare	3	0 (0%)		3 (100%)
	Transportation and logistics		16	2 (13%)	14 (88%)
Japan (106 Companies)	Property		12	0 (0%)	12 (100%)
	Industrials		6	1 (17%)	5 (83%)
	Technology		37	10 (27%)	27 (73%)
	Healthcare		27	6 (21%)	21 (75%)
	Consumer cyclicals		8	8 (24%)	0 (0%)

Table 2. Sector Classification

Sector Classification	Sample	%
Transportation and logistics	56	16%
Property	43	12%
Industrials	148	41%
Technology	75	21%
Healthcare	30	8%
Consumer cyclicals	8	2%
Total Sample	360	100%

3.2 Data analysis

The data were analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM) with SmartPLS software. PLS-SEM was selected because it is well suited for testing complex theoretical models involving multiple latent constructs and predictive relationships (Hair et al., 2022). Furthermore, PLS-SEM imposed minimal distributional assumptions and was appropriate for exploration and theoretical development research involving relatively moderate sample sizes.

The analysis followed the two-stage procedure recommended in the PLS-SEM literature. First, the measurement model was evaluated by assessing indicator reliability, internal consistency reliability, convergent validity, and discriminant validity. Second, the structural model was assessed through the examination of path coefficients, coefficients of determination (R^2), effect sizes (f^2), predictive relevance (Q^2), and bootstrapping procedures to determine the significance of the hypothesised relationships. Prior to estimating the structural model, a One-Way Analysis of Variance (ANOVA) was conducted to determine whether significant differences existed among MSMEs from Indonesia, Malaysia, and Japan with respect to the study variables. The results revealed no statistically significant differences across countries for Technology Adoption ($F = 0.128$, $p = 0.880$), Financial Literacy ($F = 0.111$, $p = 0.895$), Green Intellectual Capital ($F = 0.154$, $p = 0.858$), and MSME Sustainability ($F = 0.109$, $p = 0.897$). Since all p -values exceeded the 0.05 threshold, the null hypothesis of equal group meant that it could not be rejected. These findings indicated that MSMEs from the three countries exhibited comparable characteristics regarding the constructs under investigation. Consequently, the responses were pooled into a single dataset for subsequent PLS-SEM analysis. Pooling the data enhanced statistical power and enabled the assessment of a unified Integrated Capability Model applicable across the three national contexts.

4. RESULTS AND DISCUSSION

The one-way ANOVA results revealed that there were no statistically significant differences in technology and innovation adoption, financial literacy, green intellectual capital, and business sustainability among

MSMEs across Malaysia, Indonesia, and Japan ($p > 0.05$ for all variables). This indicated that respondents from the three countries demonstrated relatively similar levels of digital adoption, financial capability, environmental intellectual resources, and perceived sustainability performance.

Table 3. ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
x1	Between Groups	.108	2	.054	.128	.880
	Within Groups	150.649	357	.422		
	Total	150.757	359			
x2	Between Groups	.088	2	.044	.111	.895
	Within Groups	141.122	357	.395		
	Total	141.209	359			
x3	Between Groups	.129	2	.064	.154	.858
	Within Groups	149.284	357	.418		
	Total	149.412	359			
Y	Between Groups	.076	2	.038	.109	.897
	Within Groups	124.454	357	.349		
	Total	124.530	359			

Source: Author (2026)

Therefore, countries of origin did not significantly differentiate the key constructs in this study. Since all ANOVA results were not statistically significant ($p > 0.05$), post hoc analyses were not conducted, and the data were pooled across Malaysia, Indonesia, and Japan for subsequent PLS-SEM analysis.

4.1 Results of the Measurement Model

The structural model assessment did not indicate any evidence of severe multicollinearity among the predictor constructs. Furthermore, the results suggested that the hypothesised relationships can be interpreted with reasonable confidence. The measurement model was first assessed to establish the reliability and validity of the constructs. The collinearity assessment indicated no evidence of severe multicollinearity among the predictor constructs, suggesting that the estimated path coefficients could be interpreted with confidence. Furthermore, all indicator loadings exceeded the recommended threshold of 0.60 (Hair et al., 2022), demonstrating satisfactory indicator reliability. The Average Variance Extracted (AVE) values for all constructs exceeded 0.50, confirming convergent validity, while Composite Reliability

(CR), Cronbach's Alpha (CA), and rho_A values exceeded the recommended thresholds, indicating strong internal consistency reliability.

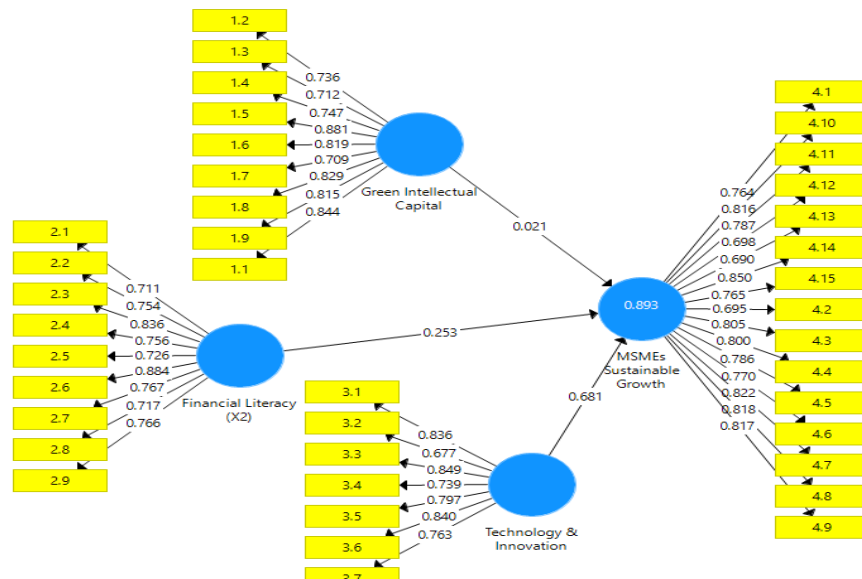


Fig. 2. Measurement model

Source: Author (2026)

Table 4. Validation of measurement model

Composite	Indicator	Outer Loading	Construct Reliability and Validity
Green Intellectual Capital (Mulatsih, 2025)	1.1. We have a relevant work team with the knowledge and skills to carry out business activities.	0,844	AVE : 0,724 CA : 0,923 rho_A : 0,927 CR : 0,937
	1.2. The education and training provided to the work team can enhance their ability to contribute to business development.	0,736	
	1.3. We are actively seeking individuals with specialized expertise to fill certain positions, in order to enhance our competitive business.	0,712	
	1.4. We store and manage important information such as business operations, procedures, customer databases, and product knowledge so that it can be easily accessed by team members.	0,747	
	1.5. The information and communication technology system that we implement helps optimize business processes and contributes to innovation.	0,881	
	1.6. We build an organizational culture that is conducive to the work environment, so it can contribute to the sustainability of the business.	0,819	
	1.7. We interact well with customers to understand their needs, preferences, and feedback regarding the products or services we offer.	0,709	
	1.8. We implement customer retention strategies, such as loyalty programs or after-sales services, to build long-term relationships with customers.	0,829	
	1.9. We hope that customers can recommend the product or service to others based on their positive experiences.	0,815	

Source: Author (2026)

Table 4 presents the measurement model assessment for the Green Intellectual Capital construct. All factor loadings exceeded the recommended threshold of 0.70, indicating satisfactory indicator reliability.

Furthermore, the construct achieved acceptable convergent validity and internal consistency, as demonstrated by the AVE, Composite Reliability (CR), Cronbach's Alpha (CA), and rho_A values, all exceeding the recommended thresholds suggested by Hair et al. (2022).

Table 5. Validation of measurement model

Composite	Indicator	Outer Loading	Construct Reliability and Validity
Financial Literacy (Marcellia Susan, 2023)	2.1 Understanding financial literacy for business operations	0,711	AVE : 0,794 CA : 0,914 rho_A : 0,919 CR : 0,994
	2.2 You spend money according to the needs of your business.	0,754	
	2.3 In managing finances, you prioritize business needs over desires.	0,836	
	2.4 You always plan the finances for the future of the business.	0,756	
	2.5 You realize that finances require good planning.	0,726	
	2.6 You always compare prices when you buy or shop for the business.	0,884	
	2.7 You always make a monthly expense list.	0,767	
	2.8 When about to make a purchase, you are always careful in determining the price of the item to be bought.	0,717	
	2.9 Controlling and evaluating finances is important in running a business.	0,766	

Source: Author (2026)

Table 5 presents the measurement model assessment for the Financial Literacy construct. All outer loading values exceeded the recommended threshold of 0.70, indicating satisfactory indicator reliability. The construct also demonstrated acceptable convergent validity and internal consistency reliability, consistent with the recommendations of Hair et al. (2022).

Table 6. Validation of measurement model

Composite	Indicator	Outer Loading	Construct Reliability and Validity
Technology Adoption (Ji et al., 2024)	3.1 Our business adopts digital technologies to support daily operations.	0,836	AVE : 0,801 CA : 0,898 rho_A : 0,905 CR : 0,919
	3.2 Technology adoption has improved the efficiency of our business processes.	0,677	
	3.3 The use of technology helps our business respond more quickly to market changes.	0,849	
	3.4 Technology adoption provides significant benefits for business activities.	0,739	
	3.5 Technology adoption has contributed to improving business performance.	0,797	
	3.6 Technology adoption facilitates access to business information and services.	0,840	
	3.7 Our business is willing to invest in new technologies to support future growth.	0,763	

Source: Author (2026)

As shown in Table 6 the Technology Adoption construct had very good reliability and validity. The factors for each indicator were greater than 0.50, with an average factor loading greater than 0.70, indicating a significant contribution from these indicators. The AVE root value of 0.901 indicated that this construct could explain the variance of the indicators well. In addition, the Cronbach Alpha value of 0.898, rho_A of 0.905, and Composite Reliability of 0.919 indicated very good internal consistency. Overall, this measurement model met the necessary criteria for reliability and construct validity.

Table 7: Validation of measurement model

Composite	Indicator	Outer Loading	Construct Reliability and Validity
MSMEs Sustainability (Zoyza & Takaoka, 2019)	4.1 We always strive to measure and understand the positive impact generated by business activities on the surrounding community.	0,764	AVE : 0,780 CA : 0,954 rho_A : 0,955 CR : 0,959
	4.2 We maintain consistency in making daily business decisions that integrate with social values.	0,816	
	4.3 We actively engage with customers or other stakeholders in identifying areas where social impact can be enhanced.	0,787	
	4.4 We ensure that our business operations run smoothly without violating human rights in terms of labor and the environment.	0,698	
	4.5 We have policies or practices that support the protection of workers' rights and the empowerment of the surrounding community.	0,690	
	4.6 We openly communicate our commitment to human rights to all parties involved.	0,850	
	4.7 We interact with the local community to understand their needs, aspirations, and issues that can be addressed through business activities.	0,765	
	4.8 We encourage community participation in activities or programs related to social or environmental goals.	0,695	
	4.9 We have mechanisms to measure the effectiveness of interactions with the community in achieving sustainable goals.	0,805	
	4.10 We implement policies that promote diversity within the work team and, as a sign of respect, we involve all team members.	0,800	
	4.11 We ensure that all individuals, regardless of their background, feel valued and have equal opportunities.	0,786	
	4.12 We have a strategy to respond to and reduce gaps in diversity through recruitment, training, and development.	0,770	
	4.13 We support communities or social causes through donations or contributions that are not directly related to business operations.	0,822	
	4.14 We are involved in local or national communities for philanthropic activities that can help improve social conditions.	0,818	
	4.15 We have planned philanthropy or programs that provide positive benefits to the surrounding community.	0,817	

Source: Author (2026)

As shown in Table 7 the MSMEs Sustainability construct had very good reliability and validity based on individual indicators. The factor loadings for each indicator were greater than 0.50, with an average factor loading greater than 0.70, indicating that these indicators significantly measured the intended construct. The AVE root value of 0.780 indicated that this construct could explain most of the variance of its indicators. In addition, the Cronbach Alpha value reaching 0.954, rho_A of 0.955, and Composite Reliability of 0.959 indicated very high internal consistency, far exceeding the recommended threshold. Composite reliability (CR) was also above the 0.60 threshold for all constructs, further supporting the validity and reliability of the measurement model in this study. Thus, the measurement model for MSMEs Sustainable Growth met the criteria for excellent construct reliability and validity.

Table 8: Fornell-Larcker Criterion and Heterotrait-Monotrait Ratio (HTMT)

		X1	X2	X3	Y
X1	Green Intellectual Capital	0.979			
X2	Financial Literacy	0.778 (0.772)	0.990		
X3	Technology Adoption	0.724 (0.801)	0.899 (0.813)	0.980	
Y	MSMEs Sustainable	0.856 (0.811)	0.928 (0.833)	0.941 (0.832)	0.9881

As shown in Table 8 the measurement model also met the criteria for discriminant validity, which was very important to ensure that the constructs being measured were truly different from one another and do not overlap. Using the Fornell and Larcker (1981) criteria, it was found that the square root of the AVE for each construct was greater than the correlation values between constructs (non-diagonal elements), indicating that these constructs had good discriminant validity. Additionally, the heterotrait-monotrait (HTMT) ratio values were below the threshold of 0.90 (Cheung et al., 2023), further reinforcing the evidence that the constructs in this model did not significantly overlap with each other. Overall, the results obtained from the reliability and validity tests indicated that the measurement model in this study had very good quality and can be used to analyze the relationships between variables in a valid and reliable manner.

Table 9. Structural Equation Modeling (SEM)

Country	Variable	R Square	f Square	Path Coefficient	T-Statistic	P value
Indonesia	Green Intellectual Capital		0,00	0,02	0,12	0,90
	Financial Literacy	0,89	0,02	0,29	1,23	0,22
	Technology Adoption		0,34	0,65	4,24	0,00
Malaysia	Green Intellectual Capital		0,01	(0,14)	1,25	0,21
	Financial Literacy	0,87	0,07	0,37	2,47	0,01
	Technology Adoption		0,56	0,70	5,76	0,00
Japan	Green Intellectual Capital		0,00	0,01	0,08	0,93
	Financial Literacy	0,90	0,01	0,20	0,74	0,46
	Technology Adoption		0,45	0,75	4,23	0,00

The analysis results from 360 data using PLS-SEM showed that Technology Adoption was the main factor in supporting the sustainability of MSMEs growth with a Path Coefficient value of 0.362. This was in line with the research by Frishammar & Parida (2019) which emphasized that continuously evolving technology and innovation among MSME actors play a crucial role in maintaining competitiveness and business continuity. MSMEs that can adopt the latest technology and innovate sustainably will be better prepared to face market challenges, improve efficiency, and expand their market, thereby supporting sustainability and long-term growth.

Financial literacy ranked second in supporting the sustainability and acceleration of MSMEs sustainability, with a Path Coefficient value of 0.171. Good financial literacy was very important for MSMEs actors in managing their financial resources effectively, which was closely related to Technology Adoption. A strong understanding of financial management enables MSME actors to optimally utilize technology and innovation, make wise investment decisions, and enhance their ability to plan and develop their businesses. With adequate financial literacy, MSMEs can grow faster and more sustainably in facing economic challenges.

Green Intellectual Capital (GIC) ranked last in supporting sustainability and accelerating the growth of MSMEs, with a Path Coefficient value of 0.015. Although its contribution was relatively small, GIC still played an important role, especially in an era that increasingly emphasized environmental sustainability.

GIC encompasses knowledge, skills, and innovations that focus on environmentally friendly practices, which can enhance resource efficiency, reduce costs, and improve the company's image. For MSMEs, the implementation of GIC can create competitive advantage through the adoption of green technology, which also contributes to the long-term sustainability of their business.

The structural model achieved an adjusted R^2 value of 0.892, indicating that Technology Adoption, Financial Literacy, and Green Intellectual Capital collectively explained 89.2% of the variance in MSME Sustainability. This substantial explanatory power suggested that the proposed integrated capability model provided a robust explanation of sustainability outcomes among MSMEs. The result supported the argument that sustainability was not driven by a single organisational capability but rather emerged from the combined influence of digital capability, financial capability, and sustainability capability. Consequently, MSMEs that developed these complementary capabilities were more likely to achieve long-term resilience and sustainable performance.

4.2 Results of the structural model

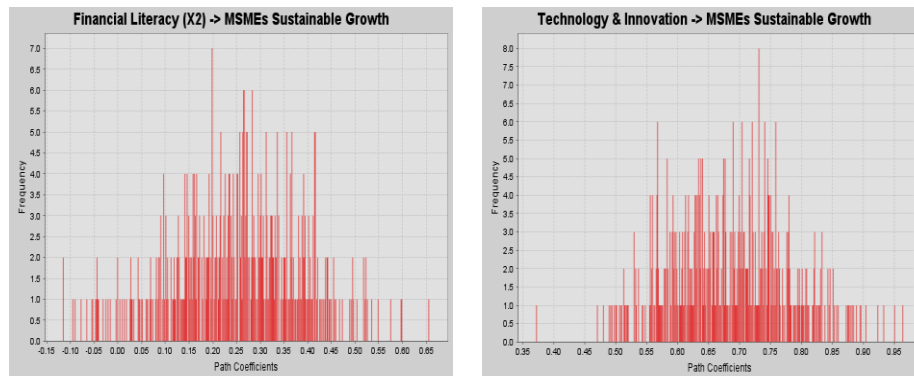


Fig. 3. NCA scatter plots

Source: Author (2026)

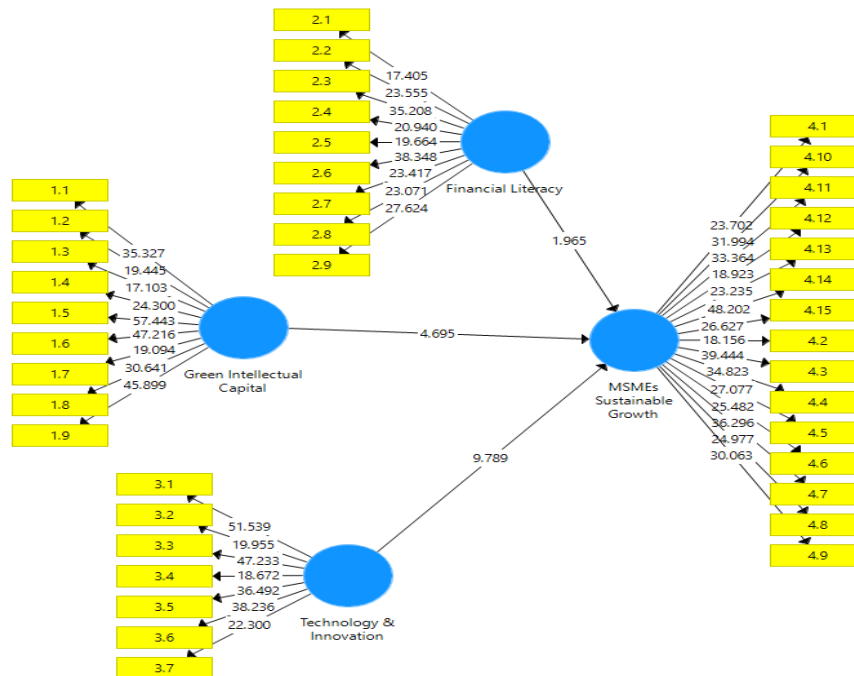


Fig 4. Structural Model

Source: Author (2026)

Table 10: Result of the PLS-SEM and NCA.

Hypotheses	Path Coefficient	Std Dev	95% Confidence Interval Bias Corrected	T Statistics (O/STDEV)	P Values	PLS-SEM	NCA
H1 GIC * MSMEs Sustainable Growth	0,015	1,919	0,496	4,695	0,009	Significant	Significant as necessary condition
H2 Fl * MSMEs Sustainable Growth	0,171	0,258	0,169	1,965	0,021	Significant	Significant as necessary condition
H3 T&I * MSMEs Sustainable Growth	0,362	7,358	0,874	9,789	0,001	Significant	Significant as necessary condition

4.3 Green Intellectual Capital Significantly Influences the Sustainability of MSMEs.

Green Intellectual Capital (GIC) was found to have a statistically significant positive relationship with MSME Sustainability ($\beta = 0.015$, $p < 0.05$). Although the effect was significant, its practical influence was considerably smaller than those of Technology Adoption and Financial Literacy. This finding suggested that sustainability-oriented knowledge, environmental awareness, and green organisational practices contribute to MSME sustainability but currently play a supporting rather than dominant role. One possible explanation is that many MSMEs remain primarily focused on digital transformation and financial management as immediate strategic priorities, while environmental capabilities were still developing. Nevertheless, the significance of GIC indicated that sustainability-oriented capabilities complemented digital and financial capabilities in strengthening long-term organisational sustainability.

4.4 Financial Literacy Significantly Affects the Sustainability of MSMEs.

Financial Literacy was found to exert a significant positive influence on MSME Sustainability ($\beta = 0.171$, $p < 0.05$). This finding supported the Resource-Based View (Barney, 1991), which suggests that valuable organisational capabilities contribute to sustainable competitive advantage. Financially literate entrepreneurs are better able to allocate resources efficiently, evaluate investment opportunities, manage financial risks, and make strategic business decisions. Although the magnitude of the effect was lower than that of Technology Adoption, financial capability remained an important organisational resource that enabled MSMEs to sustain operations and pursue long-term growth opportunities. The finding was consistent with Lusardi and Mitchell (2023), who argued that financial literacy strengthened business resilience and enhances organisational decision-making quality.

4.5 Technology Adoption Significantly Influences the Sustainability of MSMEs.

The structural model results indicated that Technology Adoption was the strongest predictor of MSME Sustainability ($\beta = 0.362$, $p < 0.01$). The dominance of Technology Adoption suggested that MSME sustainability in developing, and transition economies is increasingly capability-driven through digital transformation. While previous studies have treated technology adoption as an operational tool, the present findings indicated that digital capability functioned as a strategic resource that enabled firms to integrate, reconfigure, and deploy organisational resources more effectively. This finding supported Dynamic Capability Theory (Teece et al., 1997), which argues that organisations achieve superior outcomes through their ability to sense opportunities, seize resources, and continuously adapt to changing environments. For MSMEs operating in increasingly digital and competitive markets, technology adoption enhanced operational efficiency, improved market responsiveness, facilitated innovation, and expanded access to customers and business networks. The finding further suggested that digital capability has become a foundational requirement for sustaining business performance and long-term organisational resilience. Consistent with previous studies (Frishammar & Parida, 2019; Jaish et al., 2023), technology adoption enabled MSMEs to improve competitiveness while simultaneously supporting sustainable business practices.

5. DISCUSSION OF THE RESULTS

The findings support the proposed Integrated Capability Model for MSME Sustainability, demonstrating that Technology Adoption, Financial Literacy, and Green Intellectual Capital collectively contributed to sustainability outcomes among MSMEs. The structural model explained 89.2% of the variance in MSME Sustainability, indicating substantial explanatory power and suggesting that sustainable business performance was best understood through the combined influence of multiple organisational capabilities. This finding challenged the tendency of previous studies to examine technological, financial, and sustainability factors independently and instead highlights the importance of capability integration in explaining MSME sustainability.

5.1 Integrated Capability Perspective on MSME Sustainability

A central contribution of this study is the validation of an integrated capability perspective for understanding MSME Sustainability. While previous studies have typically investigated Technology Adoption, Financial Literacy, and Green Intellectual Capital as separate determinants of business performance, the present findings suggested that sustainability was more accurately explained by the interaction of these complementary capabilities. The high explanatory power of the model indicated that MSMEs achieve sustainable growth not through isolated organisational strengths but through the simultaneous development of digital capability, financial capability, and sustainability capability.

From the Resource-Based View (RBV), these capabilities represent valuable organisational resources that contribute to competitive advantage (Barney, 1991). However, the findings suggested that possessing a single capability is insufficient to ensure long-term sustainability. Rather, sustainability emerged when MSMEs were able to combine technological resources, financial competencies, and sustainability-oriented knowledge in a manner that creates organisational synergy. This finding extended the RBV by demonstrating that sustainable performance depends not only on the possession of valuable resources but also on their complementary deployment within the organisation.

The findings also supported the Dynamic Capability Theory (Teece et al., 1997), which emphasised the ability of firms to adapt and respond to rapidly changing business environments. Technology Adoption enabled MSMEs to identify and exploit opportunities arising from digital transformation, Financial Literacy facilitates effective resource allocation and strategic decision-making, while Green Intellectual Capital strengthens organisational responsiveness to environmental and stakeholder expectations. Together, these capabilities enhanced organisational flexibility and resilience, enabling MSMEs to continuously reconfigure resources to maintain sustainable performance.

Importantly, the findings suggested that the value of each capability was strengthened when supported by the others. Investments in digital technology were more likely to generate sustainable outcomes when entrepreneurs possess the financial knowledge necessary to evaluate and manage those investments. Similarly, sustainability-oriented initiatives were more likely to succeed when supported by both sound financial management and appropriate technological infrastructure. Consequently, MSME sustainability appeared to be a capability-integration phenomenon in which digital, financial, and sustainability capabilities operated as mutually reinforcing organisational assets.

5.2 Digital Capability as the Primary Sustainability Driver

Among the three capabilities examined, Technology Adoption emerged as the strongest predictor of MSME Sustainability ($\beta = 0.362$, $p < 0.01$). This finding highlighted the increasingly strategic role of digital capability in supporting sustainable business development. Through the adoption of digital technologies, MSMEs can improve operational efficiency, enhance customer engagement, expand market access, strengthen innovation activities, and respond more effectively to changing market conditions. In an increasingly digitalised business environment, technology adoption has evolved beyond an operational tool and now functions as a strategic capability that enabled firms to sustain competitiveness while pursuing long-term sustainability objectives.

This finding was consistent with Dynamic Capability Theory and previous studies that identify digital transformation as a key driver of organisational resilience and sustainable performance (Frishammar & Parida, 2019; Jaish et al., 2023). The result suggests that MSMEs seeking sustainable growth should prioritise investments in digital technologies and innovation capabilities as part of their broader strategic development efforts.

5.3 Financial Capability as an Enabling

Financial Literacy was also found to exert a significant positive influence on MSME Sustainability ($\beta = 0.171$, $p < 0.05$). This finding supported the Resource-Based View, which argued that managerial competencies constitute valuable organisational resources that contribute to sustainable competitive advantage (Barney, 1991). Financially literate entrepreneurs are better equipped to manage resources efficiently, evaluate investment opportunities, mitigate financial risks, and make informed strategic decisions.

Although its influence was smaller than that of Technology Adoption, financial capability remained a critical enabling resource that supported the effectiveness of other organisational capabilities. MSMEs with stronger financial literacy were more capable of financing technological investments, assessing business opportunities, and implementing sustainability initiatives. Consequently, financial capability provided the managerial foundation necessary for sustaining organisational growth and resilience. This finding reinforced previous evidence that financial literacy enhanced business performance and strengthened organisational decision-making quality (Lusardi & Mitchell, 2023).

5.4 Sustainability Capability and Long-Term Value Creation

Green Intellectual Capital was found to have a statistically significant but comparatively modest influence on MSME Sustainability. Although its direct effect was smaller than those of Technology Adoption and Financial Literacy, the finding suggested that sustainability-oriented knowledge, environmental awareness, and green organisational practices contributed positively to long-term sustainability outcomes.

One possible explanation for the relatively small effect is that many MSMEs continued to prioritise digital transformation and financial management as immediate strategic concerns, while sustainability-related capabilities remained at a developing stage. Nevertheless, the significance of Green Intellectual Capital indicated that environmental knowledge and sustainability-oriented resources complemented digital and financial capabilities by promoting responsible business practices, strengthening stakeholder trust, and

supporting long-term value creation. As environmental expectations continued to increase among consumers, investors, and policymakers, the strategic importance of Green Intellectual Capital was likely to become more pronounced. This finding supported prior studies that identify green intellectual capital as an important contributor to sustainable competitive advantage and business sustainability (Chen, 2008; Yusoff et al., 2019).

5.5 Cross-National Implications

Although this study included MSMEs from Indonesia, Malaysia, and Japan, no significant differences were observed across countries. This finding suggested that the proposed Integrated Capability Model demonstrated robustness across diverse economic and institutional environments. The result indicated that digital capability, financial capability, and sustainability capability represented fundamental organisational requirements that supported MSME Sustainability regardless of national context.

The absence of significant cross-country variation strengthened the potential generalisability of the model and suggested that capability development strategies may be applicable across a broad range of MSME settings within the Asia-Pacific region. Consequently, the findings provide evidence that sustainability-oriented capability development is a universal concern for MSMEs operating in increasingly dynamic and competitive business environments.

5.6 Theoretical Contribution

This study contributes to the literature by extending both the Resource-Based View and Dynamic Capability Theory through the development and validation of an Integrated Capability Model for MSME Sustainability. The model conceptualized Technology Adoption as digital capability, Financial Literacy as financial capability, and Green Intellectual Capital as sustainability capability. Rather than examining these capabilities independently, the study demonstrated that they collectively explained MSME Sustainability and functioned as complementary organisational resources.

The primary novelty of this study lay in integrating digital, financial, and sustainability capabilities within a single framework and validating the model across three national contexts. While previous studies have largely investigated these capabilities separately, the present research provided evidence that sustainable MSME development is fundamentally a capability-integration process. The findings therefore offer a more comprehensive explanation of MSME Sustainability and provided a foundation for future research examining how multiple organisational capabilities interacted to support long-term business resilience and sustainable growth.

6. CONCLUSIONS

The current study developed and validated an Integrated Capability Model for MSME Sustainability. Specifically, this research examined how (1) Technology Adoption; (2) Financial Literacy; and (3) Green Intellectual Capital together impacted MSMEs in Indonesia, Malaysia, and Japan. A positive relationship was identified for each of the three dimensions examined which directly related to MSME sustainability. These relationships were found to be significant at different levels of contribution to MSME sustainability with technology adoption being identified as the greatest contributor to MSME sustainability. The next contributors were found to be financial literacy and green intellectual capital. Together the combination of

capabilities explained a large portion of the variation in MSME sustainability. Thus, the structural model provided empirical evidence supporting the simultaneous development of organizational capabilities rather than reliance upon a single organizational resource and competency. In terms of theory the current study extended both the Resource-Based View and Dynamic Capability Theory by providing empirical support for an integrated capability view of MSME sustainability. Digital capability was represented by Technology Adoption. Financial capability was reflected through Financial Literacy. Sustainability capability was embodied through Green Intellectual Capital. As such it can be concluded that these capabilities functioned as interdependent organizational resources that collectively created long-term sustainability and increased adaptability and resilience within MSMEs. Sustainable business outcomes therefore are achieved when individual capabilities function synergistically to produce a cumulative effect.

The main novelty of the current study is based on developing and testing (cross-nationally) a capability model for MSME sustainability that integrated both digital, financial and sustainable capabilities into one. There are many previous studies that have primarily studied the separate effects of each capability type on MSME sustainability. In contrast, the present study has shown how all three types of capabilities contributed to sustainability outcomes for MSMEs in at least three different countries. Furthermore, as there were no cross-country differences found in the empirical results, it supported the idea that the proposed capability model will be applicable to MSMEs throughout the entire Asia-Pacific region.

Furthermore, from a practical perspective, the findings provided evidence that policymakers, development agencies and organizations supporting MSMEs should consider implementing a comprehensive capability development strategy. Strengthening MSME sustainability by solely emphasizing digitalization efforts will not suffice; additionally, other capacity building programs such as those enhancing financial literacy and sustainability-related knowledge must also be implemented. To support the long term competitive advantage, resiliency and sustainability of MSMEs in today's rapidly changing and highly competitive market where sustainability considerations are becoming increasingly important, investments in digital infrastructure, programs improving financial education skills and programs designed to improve green capabilities may support the implementation of a comprehensive MSME sustainability initiative.

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8. CONFLICT OF INTEREST STATEMENT

The authors declares that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

9. AUTHORS' CONTRIBUTIONS

Karsam: Data collection, data analysis, investigation, and writing the original draft; **Nadiyah Abd Hamid:** conceptualisation, improvement of the research framework and research questions, critical review and improvement of the manuscript, validation of the data analysis and findings, and writing, review and editing.; **Solihin:** validation of the results and findings, editing, and overall refinement of the manuscript.

10. DATA AVAILABILITY/SUPPLEMENTARY MATERIALS

The data that support the findings of this study are available from the corresponding author upon reasonable request.

11. ETHICS STATEMENT

Informed consent was obtained from all individual participants included in the study.

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