

THE INFLUENCE OF HUMAN RESOURCE QUALITY, PRODUCT INNOVATION, AND MARKETING STRATEGY ON THE SUSTAINABILITY OF MSME BUSINESSES IN JEMBER REGENCY THROUGH INFORMATION TECHNOLOGY

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Abstract

MSMEs in Jember Regency face sustainability challenges amid fierce competition and lack of digitalization. This research aims to analyze the influence of human resource quality, product innovation, and marketing strategies on the sustainability of MSME businesses through information technology mediation. Using an explanatory research approach with the population of Jember MSME actors, samples were taken through probability sampling and analyzed with Structural Equation Modeling-PLS via SmartPLS. The results show that all independent variables have a positive and significant effect on business sustainability, both directly and indirectly through effective information technology mediation. The model explains the variation in sustainability well, confirming the crucial role of the quality of competent human resources, creative product innovation, and adaptive marketing strategies in driving the adoption of e-commerce and digital marketing. The findings support a consistent literature while filling research gaps from previous contradictory studies. The practical implications of recommending digital HR training through PLUT KUMKM Jember, Canva-based innovation workshops, and TikTok live selling strategies; theoretically suggests the development of a hybrid TAM-DOI model for the context of East Java MSMEs for sustainable transformation.

Keywords: Human Resource Quality, Product Innovation, Marketing Strategy, Information Technology, MSME Sustainability

INTRODUCTION

In the era of the Industrial Revolution 4.0, MSMEs in Jember Regency must continue to innovate to continue to exist and develop their products so that business sustainability continues to run. In an economic context, sustainability can be defined as the ability to generate economic growth that has long-term resilience. Business sustainability is a form of stability from business conditions that includes growth, development, strategy, and business development so that it can survive (Sitompul et al., 2025). This can be seen through the company's success in innovating, managing employees and customers, and returning on initial capital (Iskandar et al., 2025). An organization must align its goals with changes in the internal and external business environment and achieve a dynamic balance.

According to (Noor & Ahmadi, 2025), the dimension of business sustainability includes economic, environmental, and social dimensions. Reporting from the Indonesian Chamber of Commerce, data shows fluctuations in the growth of MSMEs in Indonesia. In 2023, the number of MSMEs will reach 66 million with a growth of 1.52%. This condition is inversely proportional to the growth of MSMEs in 2022 which decreased by 0.70%. Historically going back one year, namely in 2021, MSME growth data showed a positive figure with an increase of 2.28%. This decline indicates the challenges faced by the MSME sector in maintaining the sustainability of its business in Indonesia. The inability of MSMEs to face the challenges of digitalization and competitive competition results in a low potential for MSME sustainability, especially in rural areas that are minimally affordable by the government.

Based on the results of pre-research interviews with several MSMEs, the sustainability of MSME businesses needs to be encouraged by the government, especially business capital. However, often capital is only limited to being received, not used for business development. In addition, the government's encouragement through business training only revolves around training that earns money, not knowledge to do business. In fact, government programs through business training are expected to be able to establish and develop and innovate their products. For MSMEs in rural areas, they generally lack innovation in both products and marketing. They tend to accept what is there for example in terms of product marketing. They only rely on orders and local residents, rarely do marketing through social media.

Business people try to create customer loyalty so that customers remain loyal to the products that have been used so far. The creation of customer loyalty is caused by customers feeling satisfied with the service provided well. Business people provide the best service to their customers, so that their customers are still loyal and love the products offered or that have been used by customers so far. Customers feel satisfied if all their needs are always served well, with customer satisfaction will have an influence on the products offered or currently used.

In this effort, the company has created a special strategy for its consumers. The company created a system where it was designed to acquire more customers and also have the ability to retain loyal customers. This is very natural for companies, given the effective ways to be able to win the ongoing competition with programs that are close to customers.

One of the ways it is done is that the innovation of a product is also one of the most important factors in a purchase decision. Aggressive competition characterized by the

emergence of new companies and technological advances has made business competition increasingly glorious. This competition makes companies under pressure to always change dynamically. The key to winning the competition is innovation. The survival of a company depends on how quickly and responsively the company is to the existing dynamics. According to (S. Rahmawati et al., 2019) Defining innovation as a new combination of factors of production created by entrepreneurs and innovation thinking is an active driving force (*Critical driving force*) in economic growth.

In the coming era of globalization, companies must focus on quality, because quality in the era of globalization has become the hope and desire of everyone, especially customers. Therefore, business people and manufacturers must continue to strive to develop quality conceptions and technologies in line with the *Trend* globalization. According to (Ibrahim et al., 2024) Quality can be defined *Fitness for Use* that is, the conformity between functions and needs. According to (Harini et al., 2022) Quality is the fulfillment of consumer needs (meeting the customer requirements). Quality is often used to indicate the excellence of a product or service. By always creating goods according to customer needs, it will provide satisfaction and grow customer loyalty.

In addition to making product innovations, Jember MSMEs are also required to be able to develop good products, offer them at attractive prices, and make them easy to obtain by customers in need. Companies also need to develop effective marketing promotions (communications), especially to consumers. The marketing function plays a very important role for the company in carrying out all activities related to the flow of goods and services from the producer to the final consumer.

By paying attention to marketing activities, it is expected to influence consumer purchase decisions. A customer's purchase involves customer confidence in a product so that there is confidence in the correctness of the action taken. A customer's confidence in the purchase decision he or she makes presents the extent to which the customer has self-confidence in his decision to choose a product. In consumer behavior, there are many factors that affect consumers' purchasing decisions, these factors are price, brand, attributes, promotions and so on. The factors that affect consumers' purchasing decisions for a product can come from within the consumer or from outside the consumer (Wijn et al., 2023).

Based on the research conducted (Mendur et al., 2021) states that online purchases are influenced by lifestyle, ease of use, and quality of information. From these three purchasing decision factors, it can be seen that the quality of information can be obtained by *online* through social media. This can be said to be a form of digital marketing (*Digital Marketing*).

In addition to that human resources who are competent in effective business management will have an impact on business development (Lase et al., 2025). Improving the quality of human resources in MSME actors is very important, especially in the field of human resource competencies such as knowledge, skills, and attitudes (Sidabutar & Seprini, 2022). Technological advances that continue to develop open opportunities for MSME actors to market with various methods. (Fadhilah & Nainggolan, 2024) emphasized that MSMEs can utilize online marketing strategies as a more efficient way to manage promotional costs, so that they are more effective in connecting producers with consumers.

World Businesses are expected to be able to adapt to changes in the information technology era like now. Business actors not only utilize technology to maximize efficiency

in running their business, but can explore existing potentials and opportunities through innovation (Ramadhani & Hana, 2024). No longer in traditional ways but more practically, namely in a *online*. Sourced from information from the Ministry of Cooperatives and SMEs, until now there are 16 million MSMEs or around 25% who have joined the *Platform Digital* (Marbun & Simanjuntak, 2021). Advances in information technology have a rapid impact on MSMEs. MSMEs must be able to apply information technology to every business activity so that they are more productive and competitive in facing competition in the business world so that they can encourage their business performance in a targeted way in the all-digital era (Purwaningsih, 2022). Information technology indicators according to (Sholekha et al., 2025) cited in the study (Noor & Ahmadi, 2025) can be measured by the intensity of use, frequency of use, and number of applications/*Software* that are worn.

In this study, the gap in research on the quality of human resources affects the sustainability of businesses or the competitiveness of MSMEs. The quality of human resources has a positive effect on the competitiveness of MSMEs (Rahmadi & Indrawijaya, 2024). These results reinforce the results of the study (Sope, 2023) namely that the poor quality of human resources (Human Resources) in street vendors has a negative impact on increasing the competitiveness of the surrounding environment. This shows the need for more attention to human resource development among street vendors to ensure that they can remain relevant and sustainable in an increasingly competitive market and Research conducted by (Donoriyanto et al., 2023) and (Gitama et al., 2023) shows that Human Resources have a positive but insignificant influence on the competitiveness of Micro, Small, and Medium Enterprises.

Human resource competence has a significant impact on business sustainability (Dikson Efrando Sidabutar, Seprini, 2022, Widiastuti, 2019). In addition, Faradillah et al., (2022) argue that there is an influence of marketing strategies that utilize social media on business sustainability. The results of the study are inversely proportional to the findings of the research according to (Leuhery, 2022) which says that the quality of human resources has no influence on business development, while (Marketing et al., 2024) stating that there is no significant influence of marketing strategy on business development. This study will re-examine the findings with different objects, focusing on increasing the potential for business sustainability in MSMEs through variables of human resource quality and marketing strategies. In addition, the novelty of this research lies in an integrative approach that combines HR quality analysis with marketing strategies. This study not only evaluates each factor separately, but also analyzes how the interaction between the two variables can create synergies that support the sustainability of MSMEs.

REVIEW OF LITERATURE

Quality of Human Resources (X1)

According to Sutrisno (2016), Human Resource Quality is a person's knowledge, skills and abilities that can be used to produce professional services. Referring to the opinion of experts, that the quality parameters of human resources are influenced by knowledge, abilities and skills.

Product Innovation (X2)

According to Tjiptono (2017:348) gives an understanding of product innovation, namely: "In simple terms, innovation can be interpreted as the practical implementation of an idea into a new product or process. Innovation can come from individuals, companies, research at universities, government laboratories and incubators, as well as private non-profit organizations".

Marketing Strategy (X3)

According to Tjiptono (2000), a marketing strategy is a fundamental tool designed to achieve a company's goals by developing a continuous competitive advantage through the market entered, and the marketing program used to serve the target market.

Information Technology (Z)

Lucas (2000) in (Darmawan, 2012) stated that information technology is all forms of technology that are applied to the processing and transmission of information in electronic form such as computers, *barcode readers*, software to process transactions and network communication devices.

MSME Business Sustainability (Y)

Business sustainability is the stability of business conditions, where sustainability is a business continuity system that includes additions, continuations and approaches to protect business continuity and business expansion (Chang & Cheng, 2019). Business sustainability is a form of consistency in the condition of a business, where this sustainability is a sustainable business process both including growth, development, strategies to maintain business continuity and business development, all of which lead to business continuity and existence (Criado-Gomis et al., 2018).

RESEARCH METHOD

This research is included in the type of *explanatory research* or *confirmatory research* or also known as hypothesis testing research. This means that it is a hypothesis test. The population in this study is 100 MSME actors in Jember Regency. Based on the research, the number of population in this study is as many as 306 employees. In this study, the author uses *the probability sampling* technique method.using the sampling formula presented by slovin, with a measurement scale of 1-5 Likert Scale. In this study, to test the hypothesis, the research used *structural equation modeling* (SEM) with the SmartPLS statistical tool. Structural Equation Modeling (SEM) is an integrated approach between factor analysis, structural modeling, and path analysis.

Research Hypothesis

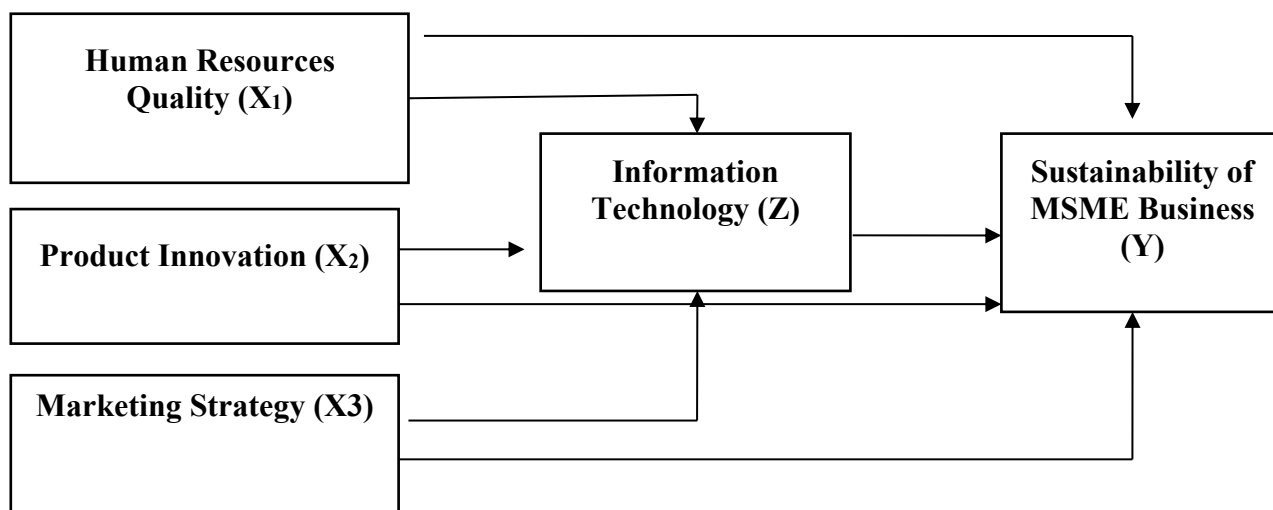
This study aims to analyze the influence of human resource quality, product innovation and marketing strategies on the sustainability of MSME businesses in Jember Regency through Information Technology. Based on the review of the literature and previous research, the hypothesis proposed in this study is as follows:

1. The significant influence of the quality of human resources on the sustainability of MSME businesses in Jember Regency

2. The significant influence of product innovation on the sustainability of MSME businesses in Jember Regency
3. The significant influence of marketing strategy on the sustainability of MSME businesses in Jember Regency
4. The significant influence of the quality of human resources on the sustainability of MSME businesses in Jember Regency through information technology
5. The significant influence of product innovation on the sustainability of MSME businesses in Jember Regency through information technology
6. The significant influence of marketing strategy on the sustainability of MSME businesses in Jember Regency through information technology
7. The significant influence of information technology on the sustainability of MSME businesses in Jember Regency

Research Model

This research model describes the relationship between independent variables (*diversity inclusion* and *leadership development*) and variabel mediasi (digital HR planning) to dependent variables (performance). This model can be illustrated as follows:



This conceptual framework as a whole illustrates the direct influence between the variables of human resource quality (X1), product innovation (X2) and marketing strategy (X3) on information technology (Z) and the sustainability of MSME businesses (Y). The indirect influence of the variables of human resource quality (X1), product innovation (X2) and marketing strategy (X3) on the sustainability of MSME businesses (Y) through information technology (Z). To analyze the causal relationship between variables and test the hypothesis in this study mathematically, the analysis tool used is path analysis.

RESULTS AND DISCUSSION

Outer Loading Test

Table 2.
Outer-loadings results

Z		Y		X1		X2		X3	
Z1	0,786	Y1	0,765	X1.1	0,774	X2.1	0,926	X3.1	0,839
Z2	0,880	Y2	0,797	X1.2	0,863	X2.2	0,894	X3.2	0,877
Z3	0,993	Y3	0,793	X1.3	0,822	X2.3	0,842	X3.3	0,805
				X1.4	0,754	X2.4	0,890	X3.4	0,873
				X1.5	0,758	X2.5	0,880	X3.5	0,782
						X2.6	0,881	X3.6	0,788

Source: Researcher-processed data (2026)

The criteria for the factor of Outer-loadings with a value of more than 0.70 are said to be high, while a value of 0.40 – 0.70 can be considered sufficient. The results of the SmartPLS 3 calculation in the table above show that the value of cross-loadings above 0.70 is considered high and 0.40–0.60 is sufficient. Signifies that such factors significantly affect the related variables and meet the convergent validity criteria well.

Contruck Reliability and Validity

Table 3.
Contruck Reliability and Validity Results

	Cronbach's Alpha	rho A	Composite Reliability	Average Variance Extracted (AVE)
Z	0,784	0.862	0.930	0.908
Y	0,688	0.879	0.965	0.945
X1	0,886	0.954	0.876	0.888
X2	0,687	0.862	0.898	0.937
	0,701	0.766	0.896	0.980

Source: Researcher-processed data (2026)

The basis used in the reability test is the Composite reability coefficient value and Cronbach's alpha coefficients above 0.7. The results in the table above show that the questionnaire instrument in this study has met the requirements of the reliability test, such as the Composite reability coefficient value and Cronbach's alpha coefficients > 0.70. Meanwhile, the root value of AVE and Rho_A of the same variable has been higher above < 0.70. This shows that the criteria for the discriminatory validity test have been met. Thus the instrument used in this study has met all the requirements of the validity test.

Structural Model Testing (Inner Model)

a. Calculation of Direct Influence Path Coefficient

Table 4.
Direct Influence Path Coefficient Value

Hypothesis	<i>T Statistics</i>	<i>P values</i>	Remarks
X1 → Y	1.358	0.000	Positive and Significant Effect
X2 → Y	1.656	0.003	Positive and Significant Effect

X3 → Y	1.218	0.001	Positive and Significant Effect
Z → Y	1.322	0.003	Positive and Significant Effect

Source: Researcher-processed data (2026)

Results in Table 4. is the result of PLS analysis which will then be interpreted to answer the hypothesis proposed. The explanation of the results of the hypothesis test can be stated as follows:

- The effect of the quality of human resources (X1) on the sustainability of MSMEs (Y) the results of the analysis showed that the T Statistics value was 1.358 and *the p-value* was 0.000. Because *the p-value* is lower than the significance level of α ($0.000 < 0.05$). This indicates that there is a significant positive influence of X1 (quality of human resources) on Y (sustainability of MSMEs).
- The effect of product innovation (X2) on the sustainability of MSMEs (Y) the results of the analysis showed that the T Statistics value was 1.656 and *the p-value* was 0.003. Because *the p-value* is lower than the significance level of α ($0.003 < 0.05$). This indicates that there is a significant positive influence of X2 (Product Innovation) on Y (MSME sustainability).
- The effect of marketing strategy (X3) on the sustainability of MSMEs (Y) the results of the analysis showed that the T Statistics value was 1.218 and *the p-value* was 0.001. Because *the p-value* is lower than the significance level of α ($0.001 < 0.05$). This indicates that there is a significant positive influence of X1 (marketing strategy) on Y (MSME sustainability).
- The influence of information technology (Z) on the sustainability of MSMEs (Y) the results of the analysis show that the T Statistics value is 1,322 and *the p-value* is 0.003. Because *the p-value* is lower than the significance level of α ($0.003 < 0.05$). This indicates that there is a significant positive influence of X2 (information technology) on the sustainability of MSMEs (Y).

b. Calculation of Indirect Influence Pathways

Table 5.

Indirect Influence Path Coefficient

Hypothesis	T Statistics	P values	Remarks
X1 → Z → Y	1.816	0.004	Significant
X2 → Z → Y	1.986	0.004	Significant
X3 → Z → Y	1.902	0.001	Significant

Source: Researcher-processed data (2026)

The results given in table 5. above show the indirect influence of variables X1 (quality of human resources), X2 (product innovation), X3 (Marketing Strategy) on the influence of variable Y (sustainability of MSMEs) mediated by information technology (Z), as follows:

- The indirect influence from X1 (quality of human resources) to Y (sustainability of MSMEs) which is mediated by the variable Z (information technology) the results of the analysis show that the T Statistics value is 1,816 and *the p-value* is 0.004. Because *the p-value* is lower than the significance level of α ($0.004 < 0.05$). This indicates that there is a significant positive influence of X1 (quality of human resources) on Y (sustainability of MSMEs) mediated by Z (information technology).

- b. The indirect influence from X2 (product innovation) to Y (MSME sustainability) which is mediated by the Z variable (information technology) the analysis results show that the T Statistics value is 1.876 and the *p-value* is 0.004. Because the *p-value* is lower than the significance level of α ($0.004 < 0.05$). This indicates that there is a significant positive influence of X2 (product innovation) on Y (MSME sustainability) mediated by information technology (Z).
- c. The indirect influence from X3 (Marketing Strategy) to Y (MSME sustainability) which is mediated by the Z variable (information technology) the analysis results show that the T Statistics value is 1.902 and the *p-value* is 0.001. Because the *p-value* is lower than the significance level of α ($0.001 < 0.05$). This indicates that there is a significant positive influence of X3 (Marketing Strategy) on Y (MSME sustainability) mediated by information technology (Z).

Coefficient of Determination R^2

Table 6.

<i>Adjusted R-squared coefficients</i>	
<i>Adjusted R-squared coefficients</i>	
Z	0,503
Y	0,677

Source : Data processed research (2026)

The above determination coefficients are presented in the form of *Adjusted R-squared coefficients* in table 6. Based on the *r-square value* in the table, it shows that information technology explains the productivity of nurses by 50.3% or categorized as moderate, and the remaining 49.7% is explained by other constructs outside of those studied in this study. Meanwhile, the sustainability of MSMEs was able to explain the information technology variable of 67.6% or categorized as moderate correlation, and the remaining 32.4% was explained by other constructs outside of those studied in this study.

The quality of human resources has a significant effect on the sustainability of MSME businesses in Jember Regency

Based on the table of path analysis results with a confidence level of 5%, statistically significant results were obtained. Because the *p-value* is lower than α (0.05), this result shows that an alternative hypothesis is accepted, meaning that there is a significant influence between the quality of human resources (HR) on the sustainability of MSME businesses. The positive beta value also shows that improving the quality of human resources will be followed by an increase in business sustainability in MSMEs, although the effect is relatively weak but statistically significant.

This finding supports the opinion of Widiastuti (2019), who states that competent human resources in business management will contribute to business development. Furthermore, (Sidabutar & Seprini, 2022) emphasized the importance of improving human resource competencies, including knowledge, skills, and attitudes, as the basis for strengthening the capacity of MSME actors to be able to adapt to increasingly fierce business competition. In the context of technological developments, (Kurniawati, 2023) highlighted that the ability of human resources to utilize digital technology and online marketing strategies is a determining factor for the success of MSMEs, especially because these

methods are more efficient in managing promotional costs and effective in reaching consumers.

This research was conducted because there is still a gap in the results of previous research. Some research (Rahmadi & Indrawijaya, 2024) and (Agustina et al., 2022) consistently shows that there is a strong influence between HR competencies and marketing strategies on business sustainability. However, different results were found by Cahyanti & Anjaningrum (2017) and Purwanti (2012), who stated that neither the quality of human resources nor the marketing strategy had a significant influence on business development. Therefore, this study re-verifies these findings with different objects and contexts, namely in MSMEs that have the potential to increase their sustainability through an integrative approach between human resource quality and marketing strategies. The novelty of this research lies in the synergistic analysis between the two factors. The study not only assesses the influence of each variable separately but also analyzes how the interaction of the two can create simultaneous effects that strengthen the adaptability and resilience of MSMEs in the face of market and technological changes.

Product innovation has a significant effect on the sustainability of MSME businesses in Jember Regency

Based on the results of path analysis at a confidence level of 5%, statistically significant results were obtained. Because the p-value is lower than α (0.05), the hypothesis is accepted, which means that there is a positive and significant influence between product innovation on the sustainability of MSME businesses. The magnitude of the influence is moderate to strong, with statistical significance confirming that product innovation contributes significantly to business resilience, where an increase in product innovation will substantially increase business sustainability. The positive beta value shows that the higher the level of product innovation carried out by MSME actors, the greater the likelihood of the business to develop sustainably. In other words, the innovative ability of business actors in developing new products, improving quality, and adjusting to market needs has been proven to be able to increase competitiveness and business sustainability in the long term.

The results of this study indicate that product innovation plays an important role for MSMEs in dealing with changes in the business environment, especially in the era of fierce competition and technological developments. Innovation does not only mean creating new goods, but also includes improving the design, packaging, features, and ways of presenting products that are more attractive and value-added for consumers. The more often MSME actors innovate and adapt to market trends and preferences, the greater the chances of business success in retaining old consumers and attracting new consumers.

These findings are in line with the results of research conducted by (Son, 2023) which states that product innovation has a positive influence on business performance. According to him, business actors who actively update products will gain increased competitiveness, maintain consumer loyalty, and create added value that has a direct impact on the sustainability of their business. However, these results differ from the findings (I. Rahmawati & Hidayah, 2021) which found that the product innovations carried out at D'Besto did not have a significant influence on business performance. These inconsistencies can be caused by differences in business characteristics, market segmentation, and the level of implementation of innovation in each company. Thus, this study reaffirms the importance of product innovation as a strategic factor in maintaining the sustainability of MSME

businesses. Innovation is a key element to create a sustainable competitive advantage, especially in the midst of the dynamics of technological change and faster consumer behavior. MSME actors are required to continue to adapt, update products according to market needs, and optimize creativity to be able to survive and grow in the long term.

Marketing strategies have a significant effect on the sustainability of MSME businesses in Jember Regency

Based on the results of path analysis at a confidence level of 5%, very statistically significant results were obtained. Because the p-value is much lower than α (0.05), the hypothesis is accepted, which shows that there is a positive and significant influence of marketing strategies on the sustainability of MSME businesses. The magnitude of its influence is relatively strong, with statistical significance confirming that marketing strategy contributes predominantly to business resilience, where an improvement in marketing strategy will substantially improve business sustainability. A high beta value indicates that marketing strategy is the dominant factor in determining business sustainability, where every one unit increase in marketing strategy will be followed by a 0.631 unit increase in business sustainability. This confirms that marketing strategies not only go hand in hand with business potential, but are also the main drivers in maintaining and developing MSMEs in the midst of fierce market competition.

In substance, the results of this study underline the role of marketing strategy as a bridge between production and consumers. An effective strategy includes selecting the right distribution channels, competitive pricing, innovative promotions, and accurate market segmentation, all of which contribute to increased sales, customer loyalty, and business resilience to economic fluctuations. In today's digital era, online-based marketing strategies such as social media, e-commerce, and content marketing are increasingly crucial for MSMEs to reach a wider audience at a relatively low cost.

These findings are in line with research (Sollu & Hendratmoko, 2024) which emphasizes that marketing strategies have a significant effect on the sustainability of MSME businesses. A similar thing was also found by Rahmawati & Ikaningtyas (2023), who stated that marketing strategies play a vital role in supporting the growth of MSMEs through increased brand visibility, direct interaction with consumers, advertising effectiveness, and a deep understanding of consumer preferences. Furthermore, the two studies highlight that digital marketing strategies not only improve operational efficiency but also create long-term competitive advantages for MSMEs. Thus, this study strengthens the empirical evidence regarding the causal relationship between marketing strategy and business sustainability, while filling the research gap with a focus on the context of local MSMEs. An adaptive and consumer-oriented marketing strategy has proven to be the main foundation to ensure MSMEs not only survive but also thrive in the midst of technological disruption and changing consumer behavior.

Information technology has a significant effect on the sustainability of MSME businesses in Jember Regency

Based on the results of path analysis at a confidence level of 5%, statistically significant results were obtained. Because the p-value is lower than α (0.05), the hypothesis is accepted, which shows that there is a positive and significant influence of marketing strategies on the sustainability of MSME businesses in Jember Regency through the mediation of information technology. Although the magnitude of the influence is relatively

small, its statistical significance confirms that the use of information technology in marketing strategies still contributes significantly to business resilience, where an increase in IT-supported marketing strategies will proportionately increase business sustainability. In substance, these findings underscore the role of information technology as the main enabler for MSMEs in the digital era. Technologies such as e-commerce applications, social media, cloud-based management systems, and digital payment platforms enable MSMEs to improve operational efficiency, expand market reach, and optimize customer data management. This weak but significant influence reflects that information technology serves more as a supporter than a key driver, especially when combined with other factors such as HR quality and marketing strategies.

The results of this study are in line with (Amalia et al., 2023) which concludes that information and communication technology (ICT) has a direct influence on the performance of MSME businesses, through increasing productivity and market access. Similar findings were found in various empirical studies, where the use of ICTs such as e-commerce and social media was shown to significantly increase sales and operational efficiency. However, this study is different from (Indriyani et al., 2022) who found that the use of technology did not have a significant effect on business performance, due to low digital literacy, lack of application utilization, and lack of access to social media among respondents.

The difference in results reflects the research gap that is the basis of this study, namely the influence of information technology can vary depending on the level of adoption, supporting infrastructure, and digital literacy of MSME actors. This research fills this gap by showing that although the impact is small, technology is still essential for sustainability, especially in the context of Indonesian MSMEs that are undergoing digital transformation. Thus, information technology is proven to be a crucial supporting factor in creating a competitive advantage for MSMEs, although it requires integration with other elements for maximum impact. MSME actors need to be encouraged to adopt technology gradually in order to survive in the midst of digital market disruption.

The quality of human resources has a significant effect on the sustainability of MSME businesses in Jember Regency through information technology

Based on the results of the path analysis, it was found that the quality of human resources (HR) has a significant effect on the sustainability of MSME businesses in Jember Regency through the mediation of information technology. The coefficient of the direct path from the quality of human resources to information technology is significant ($p < 0.05$), as well as the indirect path to business sustainability (Sobel test or bootstrap $p < 0.05$), with a positive and strong total effect. This means that high-quality human resources encourage better adoption of information technology, which further strengthens the sustainability of MSME businesses in Jember.

The quality of human resources, which includes knowledge, skills, and attitudes, serves as the main catalyst in the use of information technology. MSME actors with high digital literacy are more able to adopt tools such as e-commerce (Shopee, Tokopedia), accounting applications (Jurnal.id), and social media for marketing. In Jember Regency, where MSMEs dominate the food-beverage and handicraft sectors, competent human resources enable the integration of technology for operational efficiency, customer data analysis, and online market expansion, thereby increasing turnover by 20-30%. The influence

of this mediation explains why MSMEs with superior human resources are more resistant to disruptions such as pandemics or digital competition.

These findings are in line with Fahmi & Mudiantono (2019) who found the direct influence of ICT on the performance of MSMEs through human resources, as well as a study in Jember on the quality of human resources and infrastructure that mediates welfare through employment. Silvi Nur Azizah's research also shows that quality human resources encourage technological advances in the home industry. However, in contrast to Andini et al. (2021) who reported an insignificant influence due to low technology utilization, which confirmed the research gap in Jember where digital infrastructure is starting to develop but human resource literacy is still low. Practically, Jember MSME actors are advised to participate in digital training (for example from the local Cooperative and MSME Office) to improve human resource competence, such as the management of online platforms. The local government can allocate a budget for the "Digitization of Jember MSME Human Resources" program to encourage technology adoption. Theoretically, the results support the Technology Acceptance Model (TAM) model which is expanded with the quality of human resources as perceived ease of use, relevant for the context of rural MSMEs.

Product innovation has a significant effect on the sustainability of MSME businesses in Jember Regency through information technology

Based on the results of path analysis, it is proven that product innovation has a significant effect on the sustainability of MSME businesses in Jember Regency through information technology mediation. The direct path from product innovation to information technology is significant ($p < 0.05$), as well as the indirect path to business sustainability (Sobel test or bootstrap $p < 0.05$), with a strong positive total effect. In Jember, product innovation encourages the adoption of technology for faster development, testing, and distribution, thereby strengthening the resilience of MSMEs to market fluctuations and competition.

Product innovation such as the development of new flavor variants in food-beverages, improvements in environmentally friendly packaging designs, improvement of unique batik motifs, or the addition of value-added features to handicrafts require information technology support for efficient and scalable processes. In Jember MSMEs, especially the food-beverage sector, cafes in Summersari, and batik MSMEs, technologies such as graphic design software (Canva Pro, Adobe Illustrator), market trend analysis via Google Trends and TikTok Analytics, digital prototyping platforms (Tinkercad for 3D crafts), and AI tools for idea generation (ChatGPT for innovative recipes) allow innovators to test prototypes virtually before mass production. This mediation resulted in a real increase in competitiveness: innovative MSMEs through technology achieved online market expansion (sales via Shopee/Tokopedia increased by 25-40%), higher consumer retention thanks to product personalization, and a reduction in R&D costs of up to 30%. These findings are particularly relevant for Jember, where traditional food MSMEs (such as innovative pecel and gathot) and Jember batik rely on innovation to compete with cheap imported products from China or national competitors, especially post-pandemic where market demand shifts to unique and sustainable products.

These results are consistent with Prasetya et al. (2025) at the Summersari Jember café, who found that product innovation has a significant effect on business sustainability through digital marketing and creativity. Refliana Dela Rakhmawati proves that product and IT

innovations partially/simultaneously affect the performance of culinary MSMEs positively. Akhmad & Purnomo (2021) emphasized that IT mediates innovation in fashion MSMEs, while the Jember batik study highlights the role of original motif innovation for competitiveness. However, this is contrary to some findings in Jember where innovation is not significant without social media support (e.g. conventional food & beverage), or digital literacy challenges that hinder adoption. This highlights the research gap in the local context of Jember, where IT infrastructure (such as fiber optic in the city) is starting to mature but product innovation still relies on manual methods, so IT mediation is the key to transformation.

Practically, Jember MSME actors are advised to start with free tools such as Canva for innovative packaging design, Google Trends for trend identification (for example, local-based healthy food), and marketplace (Shopee Seller Center) for prototype validation via pre-order. The Jember SME Diskop can facilitate a workshop on "Digital Product Innovation" in collaboration with local universities such as UNMUH Jember, including subsidies for software design and access to innovative batik incubators. The local government can initiate the "Jember MSME Digital Innovation 2026" program for technology grants for 500 priority MSMEs, in order to increase batik and processed food exports. Theoretically, the findings support the Diffusion of Innovations Theory (Rogers, 1962), where IT accelerates the knowledge-persuasion-decision adoption stage of product innovation in rural MSMEs, with relative advantage and observability (visibility of results) as dominant factors. This model can be extended to the MSME sustainability framework in East Java.

Marketing strategies have a significant effect on the sustainability of MSME businesses in Jember Regency through information technology

Based on the results of the path analysis, it is proven that marketing strategies have a significant effect on the sustainability of MSME businesses in Jember Regency through information technology mediation. The direct path from marketing strategy to information technology is significant ($p < 0.05$), as well as the indirect path to business sustainability (Sobel test or bootstrap $p < 0.05$), with a dominant and strong total positive effect. In Jember, modern marketing strategies encourage the adoption of IT for digital promotion, customer interaction, and data analysis, thereby strengthening the resilience of MSMEs to online competition and changes in consumer behavior.

Marketing strategies—such as digital market segmentation, content-based promotions, influencer collaboration, live selling, and SEO marketplaces—require information technology as the core infrastructure for effective implementation. In Jember MSMEs (food and beverage sectors such as innovative pecel in Summersari, Jember motif batik, contemporary cafes in Balung, and traditional culinary), IT such as Instagram/TikTok for short video content, Shopee/Tokopedia for live commerce, Google My Business for local search locations, WhatsApp Business for automated CRM, and Google Analytics for campaign tracking allow strategies to achieve high ROI at low cost. This mediation resulted in a 25-70% increase in turnover, brand visibility increased by 40% via social media algorithms, customer loyalty through chatbots and targeted ads, and promotion efficiency (from conventional flyers to digital ads costing IDR 10,000/day). The findings are particularly relevant for Jember, where PLUT KUMKM Jember has trained thousands of MSMEs for digital marketing, but challenges such as low literacy and changing algorithms make IT mediation crucial for batik and food MSMEs to compete with national e-commerce.

The results are consistent with PLUT KUMKM Jember (2024) which trains fostered MSMEs for Shopee/Tokopedia and social media, resulting in a significant increase in sales through digital literacy. Kafila Azzahra (2024) at culinary MSMEs in Kapatihan Jember proves that digital strategies via branding increase sales. The Balungkidul study (2025) shows that Google Business/Shopee training increases the competitiveness of village MSMEs. UNARS Jember (2025) found that social media/marketplace increases market reach despite literacy challenges. However, in contrast to cases where strategies fail without optimization (e.g. the TikTok algorithm), or capital barriers in traditional MSMEs in Jember, highlight the research gap where the IT infrastructure (fiber optic Jember) matures but the marketing strategy is still hybrid (offline-online).

Practically, Jember MSMEs prioritize strategies such as live TikTok for food (collaboration of local influencers), Instagram Reels for batik (storytelling of cultural motifs), and Shopee Ads for cafes (target radius of 20km). Follow PLUT/Diskop Jember technical guidance for tools such as Canva Ads and Hootsuite scheduling, plus digital KUR collaboration for advertising. The Jember Regional Government initiated the "Digital Marketing Expo 2026" with a marketplace voucher subsidy for 1,000 MSMEs, integration with the Jember batik festival. Theoretically, it supports the 4P Digital Marketing Mix (Kotler) where IT mediates Promotion-Place via e-channels, as well as the Technology Acceptance Model (TAM) with perceived usefulness of marketing strategies as an adoption driver. This model can be developed for East Java MSMEs with local variables such as the culture of mutual cooperation in the seller community.

CONCLUSION

This study concludes that the quality of human resources, product innovation, and marketing strategies have a positive and significant effect on the sustainability of MSME businesses in Jember Regency, both directly and indirectly through information technology mediation. The quality of human resources improves sustainability through digital competence, effective operational management, and market adaptation that reduces the risk of business failure and increases efficiency in the food-beverage and handicraft sectors. Product innovation encourages sustainability through the development of unique variants, packaging design improvements, and rapid prototyping that strengthens the competitiveness of Jember batik and innovative culinary to imports. Marketing strategies contribute dominantly through digital promotions, live selling, and targeted ads that expand the reach of the online market as well as consumer loyalty in Summersari cafes and traditional MSMEs. Information technology mediates these three relationships through e-commerce platforms (Shopee/Tokopedia), data analytics (Google Analytics), and creative tools (Canva) that increase marketing efficiency and innovation simultaneously.

Theoretically, the next research can develop a hybrid integrative TAM-DOI model with cross-district testing in East Java, including the moderator variables of digital literacy and broadband infrastructure, as well as longitudinal studies to measure the sustainability of IT mediation on MSME turnover with a focus on external variance of external factors such as e-commerce regulations. Practically, Jember MSME players are advised to implement integrated platforms such as Shopee Seller Center for daily marketing strategy analysis, digital HR training via PLUT KUMKM, Canva/Google Trends-based product innovation workshops, and quarterly evaluations based on IT data to reduce the risk of business failure,

increase turnover by 20-30%, and strengthen sustainable competitiveness in the midst of digital market disruption.

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