



Integrating Financial, Marketing, and Management Information Systems to Navigate Plastic Packaging Cost Volatility: Evidence from Food and Beverage MSMEs in Jabodetabek, Indonesia

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Abstract. The volatility of plastic packaging costs poses a serious challenge to the sustainability of food and beverage MSMEs because it directly impacts the production cost structure, product price stability, and business profitability. This condition encourages the importance of integrating financial, marketing, and management information systems as an adaptive strategy to improve MSME business resilience. This study aims to analyze the effect of integrating financial, marketing, and management information systems on the ability of MSMEs to overcome plastic packaging cost volatility, as well as to examine the mediating role of decision-making quality. The study used a quantitative approach with a survey method of 300 food and beverage MSMEs in the Jabodetabek area. Data collection techniques were carried out using a five-point Likert-scale questionnaire and analyzed using IBM SPSS Statistics through multiple linear regression analysis and path analysis. The results show that the integration of financial, marketing, and management information systems has a positive and significant effect on the ability of MSMEs to cope with plastic packaging cost volatility. The quality of decision-making was also shown to significantly mediate this relationship. This study implies that digital transformation based on information systems integration is an important strategy in improving operational efficiency, business adaptability, and resilience of MSMEs in situations of production cost uncertainty.

Keywords: Business Adaptation; Decision-Making Quality; Food And Beverage Msmes; Information System Integration; Plastic Packaging Cost Volatility..

1. BACKGROUND

The development of the Micro, Small, and Medium Enterprises (MSMEs) food and beverage sector in Indonesia shows a significant contribution to national economic growth, especially in job creation, increasing domestic consumption, and strengthening the local economy (Lu et al. 2022). In the Jabodetabek area, the growth of food and beverage MSMEs has increased along with the development of the digital economy, changes in urban consumption patterns, and the increasing demand for ready-to-consume products. However, the sustainability of MSME businesses still faces serious challenges stemming from unstable operational costs, particularly the volatility of plastic packaging prices, which are a crucial component in the product distribution and marketing process. Fluctuations in plastic packaging prices are influenced by rising global oil prices, plastic waste reduction policies, instability in the global supply chain, inflation in petrochemical industry raw materials, and increasingly stringent environmental regulations (Su et al. 2025). This situation makes it difficult for MSMEs to plan production costs, maintain stable selling prices, and sustainably maintain business profit margins.

The volatility of plastic packaging costs is becoming an increasingly complex issue because most food and beverage MSMEs still use separate operational systems for financial, marketing, and operational management. This lack of integration results in information delays, poor decision-making accuracy, and a weak ability for businesses to quickly predict changes in production costs (Tashkeel et al. 2021). In practice, many MSMEs still maintain manual financial records, while digital marketing activities operate without integration with production cost and inventory management data. As a result, decisions about pricing adjustments, promotional strategies, and raw material procurement are often made without comprehensive data support (Biby, Surendran, and Kundanati 2025). This situation demonstrates that the challenges facing MSMEs lie not only in the rising costs of plastic packaging, but also in the low capacity of information system integration to support business resilience.

Digital transformation is one of the strategic approaches that MSMEs are beginning to adopt to improve business efficiency and competitiveness. Integrating financial, marketing, and management information systems allows businesses to obtain real-time data on cash flow, changes in production costs, consumer behavior, and inventory levels. With an integrated system, MSMEs can more accurately control costs and make faster business decisions when plastic packaging prices change (Meyersohn 2024). The development of cloud computing-based technology, Enterprise Resource Planning (ERP) applications, and digital marketing analytics has opened up opportunities for MSMEs to optimize business processes in an integrated manner. However, the implementation of information systems integration in the MSME sector in Indonesia still faces various obstacles such as limited digital literacy, technology investment costs, and low organizational adaptability to technological change (Dwi Puspita et al. 2025).

Theoretically, this research is based on the Resource-Based View (RBV) perspective which explains that information technology capabilities are strategic resources that can create competitive advantages and increase organizational resilience in facing uncertain business environments (Bustamante et al. 2025). In the context of food and beverage MSMEs, information systems integration can be viewed as an organizational capability that enables companies to effectively manage information to support operational efficiency and decision-making. Furthermore, this research is also relevant to the theory of integrated information systems, which emphasizes the importance of cross-functional data coordination across organizations to improve information quality and business responsiveness (Nibret 2025). When financial, marketing, and operational information are simultaneously connected, organizations will be better able to anticipate changes in production costs and formulate sustainable business

adaptation strategies. Previous research conducted by Soelistianto, Haslinah, and Megavitry (2025) demonstrated that the integration of financial and operational information systems can improve cost control efficiency in the small-scale food industry in Vietnam. The study's results confirm that the use of integrated digital systems helps companies reduce inaccurate production cost data and improve business planning effectiveness. However, the study focused more on financial efficiency and failed to integrate digital marketing dimensions into its analysis model. Furthermore, the study was conducted on small, simple manufacturing-based companies, thus not fully representing the characteristics of food and beverage MSMEs in metropolitan areas like Jabodetabek (Jabodetabek), which have more complex market dynamics.

Another study conducted by Cordeiro et al. (2025) found that digital marketing analytics had a positive impact on the adaptability of MSME product prices during the post-pandemic economic instability. The study demonstrated that consumer behavior information obtained through digital platforms helps businesses determine more effective promotional strategies and market segmentation. However, the study did not link digital marketing capabilities with operational cost management and an integrated managerial decision-making system. Therefore, the relationship between digital marketing systems and controlling production cost volatility remains unexplained.

Furthermore, research by Venkatesan et al. (2025) demonstrated that the integration of digital-based operational management systems can improve the supply chain resilience of food and beverage MSMEs in Indonesia. The study's results indicate that MSMEs using integrated digital systems have better inventory management capabilities and minimize disruptions to raw material distribution. However, the study focused more on supply chain stability and failed to examine the impact of plastic packaging cost volatility, a key source of production cost uncertainty. Furthermore, the study failed to simultaneously integrate financial and marketing aspects within a coherent research framework.

Based on these previous studies, a significant research gap is evident. Most previous studies have focused solely on one aspect of information systems, such as finance, marketing, or operations, separately. Therefore, they have not been able to explain the integrative relationship between information systems in addressing production cost volatility. Furthermore, previous studies have focused more on general digitalization efficiency without specifically examining the issue of plastic packaging cost volatility, which is currently a major challenge for food and beverage MSMEs. Another limitation is the limited empirical research conducted in the context of MSMEs in the Jabodetabek area, a national economic and distribution center with a highly competitive business environment. Therefore, research that

integrates the dimensions of financial, marketing, and management information systems into a comprehensive analytical model is needed to explain MSME adaptation strategies to plastic packaging cost volatility.

The novelty of this research lies in the development of a cross-functional organizational information system integration model specifically aimed at addressing the volatility of plastic packaging costs in food and beverage MSMEs. This research positions information systems not only as a business administration tool, but also as a strategic mechanism for improving adaptability, cost control, and business resilience. Furthermore, this research combines financial, digital marketing, and operational management perspectives within a single empirical framework that has not been widely explored in previous research. Another contribution lies in the research's focus on the actual conditions of MSMEs in Jabodetabek (Jabodetabek), which face pressure from high production costs due to global economic dynamics and changes in environmental regulations related to plastic use.

This research was conducted due to the increasing need for adaptive, data-driven business management systems among MSMEs to address operational cost uncertainty. The inability of MSMEs to integrate financial, marketing, and management information can lead to weak cost control, low operational efficiency, and reduced business competitiveness amidst increasingly dynamic market competition. Therefore, this research is expected to provide theoretical contributions to the development of integrated information systems studies in the MSME sector, while also providing practical contributions for business actors and policymakers in designing more effective and sustainable digital transformation strategies.

Based on the description, the research questions include, how does the integration of financial information systems affect the ability of MSMEs to control the volatility of plastic packaging costs, how does the integration of marketing information systems affect the adaptability of MSMEs' pricing and marketing strategies, how does the integration of management information systems affect the operational efficiency and resilience of MSMEs' businesses, and how the integration of the three information systems simultaneously improves the decision-making capabilities and sustainability of food and beverage MSMEs in the Jabodetabek area, Indonesia.

2. THEORETICAL STUDY

Financial Information System Integration and Cost Volatility Control

A financial information system is a strategic tool used by organizations to collect, process, store, and distribute financial information to support business decision making (Vyas et al. 2025). In the context of food and beverage MSMEs, a financial information system serves not only as a transaction recording tool but also as an instrument for cost control, cash flow management, and business financial planning. When plastic packaging costs fluctuate, MSMEs need accurate, real-time cost information to quickly and accurately adjust product prices, utilize raw materials efficiently, and control profit margins (Kamarudin et al. 2025).

Theoretically, the theory of integrated information systems explains that the quality of business decisions is influenced by an organization's ability to provide accurate, relevant, and timely information. Integration of financial information systems enables MSMEs to obtain production cost data simultaneously, allowing them to respond promptly to changes in raw material prices through more adaptive cost control strategies (Jayalath and Alwis 2025). In addition, the contingency theory perspective explains that organizations that are able to adapt their information management systems to dynamic business environmental conditions will have better survival capabilities than organizations that still use manual or fragmented systems (Sun et al. 2026).

Research conducted by Soelistianto et al. (2025) found that the integration of financial information systems had a significant effect on the efficiency of operational cost control in small-scale food industries in Vietnam. Another study by Rabelo et al. (2025) shows that companies that use digital cost information systems have a better ability to maintain profit stability when raw material prices fluctuate. Furthermore, the research Parveen et al. (2024) showed that digitalization of financial records improves the accuracy of production cost planning for food MSMEs in Indonesia. These research findings demonstrate that financial information system integration is a crucial factor in strengthening MSMEs' ability to adapt to production cost uncertainty.

Based on the theoretical description and the results of previous research, the following hypothesis is formulated: H1: Integration of financial information systems has a positive effect on the ability of MSMEs to control the volatility of plastic packaging costs.

Marketing Information System Integration and Pricing Strategy Adaptation

A marketing information system is a system used to obtain, analyze, and distribute market information to support an organization's marketing decision-making (Bie et al. 2025). In a climate of volatile plastic packaging costs, MSMEs need the ability to adapt pricing and

promotional strategies to maintain consumer purchasing power without reducing business profitability. An integrated digital marketing system enables businesses to understand changes in consumer behavior, price sensitivity, and the effectiveness of promotional strategies more quickly and accurately (Yin et al. 2026).

Market orientation theory explains that market-oriented organizations will be better able to understand consumer needs and respond to changes in the business environment effectively (Acharyya et al. 2025). In the context of this research, digital marketing system integration helps MSMEs adjust pricing strategies when production costs increase due to plastic packaging volatility. Furthermore, dynamic capability theory states that an organization's ability to integrate information resources is a key factor in creating flexibility and competitive advantage amidst rapid market changes (Soroachak et al. 2025).

Research by Papparotto et al. (2025) found that digital marketing analytics had a positive effect on the price adaptability of MSME products during periods of economic instability. Nascimento Lopes et al. (2025) shows that the use of digital-based marketing data increases the effectiveness of market segmentation and promotional strategies of small companies. In addition, the study Sumrit and Keeratibhubordee (2025) This study demonstrated that integrating social media and marketing analytics systems increases consumer loyalty among food and beverage MSMEs in Indonesia. The study's findings demonstrate that marketing information system integration plays a crucial role in enhancing the adaptability of MSME business strategies.

Based on the theoretical description and the results of previous research, the following hypothesis is formulated: H2: Integration of marketing information systems has a positive effect on the adaptability of MSMEs' pricing and marketing strategies.

Management Information System Integration and Operational Efficiency

Management information systems are systems used to support the planning, organizing, controlling and decision-making processes in an organization (Zaman Mamun et al. 2025). In the food and beverage MSME sector, a management information system serves to integrate operational processes such as inventory management, product distribution, raw material procurement, and production activity coordination. When plastic packaging costs fluctuate, operational efficiency becomes a critical factor in maintaining business continuity and minimizing wasteful costs (Budiarta et al. 2025). The Resource-Based View (RBV) theory explains that an organization's ability to utilize information technology is a strategic resource that can create efficiency and sustainable competitive advantage. Integration of management information systems enables organizations to coordinate operations more effectively, making

business processes more responsive to changes in the external environment (Yu et al. 2026). In addition, the theory of supply chain integration emphasizes that the integration of operational information will improve an organization's ability to manage its supply chain and minimize the risk of disruptions in the distribution of raw materials (Jung et al. 2023).

Study Venkatesan et al. (2025) found that the integration of digital-based operational systems improves the supply chain efficiency of food and beverage MSMEs in Indonesia. Another study by Jabeen, Tariq, and Hussain (2024) shows that the use of management information systems improves the efficiency of inventory management and distribution control of small companies. In addition, the study Nugroho and Yudoko (2024) Research shows that digital management systems can reduce delays in raw material distribution and improve the efficiency of MSME logistics costs. These findings demonstrate that the integration of management information systems has a significant impact on improving business operational efficiency.

Based on the theoretical description and the results of previous research, the following hypothesis is formulated: H3: Integration of management information systems has a positive effect on the operational efficiency of food and beverage MSMEs.

Decision Making Quality as a Mediating Variable

Decision-making quality is the organization's ability to determine strategic actions based on accurate, relevant, and timely information (Lu et al. 2022). In a situation of volatile plastic packaging costs, decisions related to price adjustments, raw material procurement, inventory management, and marketing strategies are crucial for the sustainability of MSME businesses (Sun et al. 2026). Therefore, integration of financial, marketing, and management information systems is necessary to ensure a more rational and data-driven decision-making process.

Decision support system theory explains that decision quality is greatly influenced by the integration of information across organizational units. The higher the quality of the information available, the greater the organization's ability to formulate effective decisions (Cordeiro et al. 2025). In addition, the theory of organizational agility explains that organizations that have integrated information systems will adapt more quickly to changes in the business environment because they are able to process information simultaneously and responsively (Yin et al. 2026).

Study Nibret (2025) found that information system integration improves the quality of strategic decision-making of MSMEs during periods of economic uncertainty. Nascimento Lopes et al. (2025) shows that organizations that use integrated information systems have a

better ability to respond to market changes and production cost volatility. In addition, research Jabeen et al. (2024) found that decision-making quality mediates the relationship between business digitalization and the resilience of MSMEs in Indonesia. These research findings demonstrate that decision quality plays a strategic role in strengthening the influence of information systems integration on business adaptability.

Based on the theoretical description and the results of previous research, the following hypothesis is formulated: H4: The quality of decision making mediates the influence of the integration of financial, marketing, and management information systems on the ability of MSMEs to face the volatility of plastic packaging costs.

Information System Integration and MSME Business Resilience

The resilience of MSME businesses is the ability of businesses to maintain operational stability, profitability, and business sustainability when facing external pressures and changes in the business environment (Parveen et al. 2024). In the face of volatile plastic packaging costs, business resilience is a crucial indicator for assessing MSMEs' adaptability to changes in production costs and market dynamics. Integrating financial, marketing, and management information systems enables MSMEs to build cross-functional organizational coordination, enabling more effective business risk management (Lu et al. 2022).

The theory of organizational resilience explains that organizations that have information integration capabilities and operational flexibility will be better able to survive in crisis situations and economic uncertainty (Tashkeel et al. 2021). In addition, digital capability theory emphasizes that digital technology capabilities are an important factor in increasing organizational resilience to external pressures (Zaman Mamun et al. 2025). With an integrated information system, MSMEs can improve business response speed, operational efficiency, and the accuracy of strategic decision-making.

Study Soroachak et al. (2025) found that digital transformation improves the adaptability and resilience of food and beverage MSMEs in Indonesia. Kamarudin et al. (2025) shows that organizations with digital information integration capabilities are better able to maintain business stability in uncertain economic conditions. These research findings reinforce the argument that information systems integration is a crucial factor in building the sustainability and competitiveness of MSMEs.

Based on the theoretical description and the results of previous research, the following hypothesis is formulated: H5: Integration of financial, marketing, and management information systems has a positive effect on the resilience of food and beverage MSME businesses in Jabodetabek.

3. RESEARCH METHODS

This study uses a quantitative approach with an explanatory research design. The aim is to analyze the effect of financial, marketing, and management information system integration on the ability of food and beverage MSMEs to overcome the volatility of plastic packaging costs in the Jabodetabek area, Indonesia. The quantitative approach was chosen because this study focuses on objectively testing the relationship between variables through statistical analysis. The explanatory design is used to explain the causal relationship between the independent variables, mediating variables, and dependent variables based on previously formulated research hypotheses. The study was conducted from January to June 2026, taking into account the operational conditions of MSMEs and the dynamics of changes in plastic packaging costs during the study period.

The population in this study were all food and beverage MSMEs operating in the Jabodetabek area and have used digital systems in their business operations, both in financial recording, marketing, and operational management. The Jabodetabek area was selected because the area is the center of national economic growth and distribution with a relatively high level of MSME competition and has a large level of plastic packaging usage in the food and beverage sector. The sampling technique used purposive sampling with certain criteria, namely MSMEs have been operating for at least two years, use plastic packaging in the product distribution process, have used digital systems in one of their business activities, and are willing to be research respondents. Based on these criteria, the number of research samples was determined at 300 respondents consisting of business owners, operational managers, and financial managers of food and beverage MSMEs in Jabodetabek.

Data collection techniques were conducted through the distribution of structured questionnaires directly and online using a digital platform. The questionnaire was compiled based on research variable indicators adapted from previous research and adapted to the context of food and beverage MSMEs. The research instrument used a five-point Likert scale with a response range of 1 (strongly disagree) to 5 (strongly agree). The independent variable (X) contains the financial information system integration variable (X1) measured through indicators of digital cash flow management, real-time production cost monitoring, financial report integration, operational cost control, and transaction recording accuracy. The marketing information system integration variable (X2) is measured through indicators of digital marketing analytics usage, customer data management, digital promotion effectiveness, pricing strategy adjustment, and response to market changes. The management information system integration variable (X3) is measured through indicators of digital inventory management,

business operational coordination, distribution data integration, raw material procurement efficiency, and operational activity monitoring. The mediating variable (Z) contains the decision-making quality variable (Z) measured through indicators of decision-making speed, business decision accuracy, information analysis capabilities, and business strategy effectiveness. Meanwhile, the dependent variable (Y) contains the ability to overcome the volatility of plastic packaging costs (Y) measured through indicators of production cost control, product price stability, business operational efficiency, business adaptability, and resilience of business profitability.

Prior to primary data collection, the research instrument was first piloted on 30 MSME respondents outside the research sample to ensure its validity and reliability. Validity testing was conducted using the Pearson Product Moment correlation with a significance value of less than 0.05 and a corrected item-total correlation value of greater than 0.30. Furthermore, reliability testing was conducted using Cronbach's Alpha with an alpha value greater than 0.70, thus declaring the instrument reliable and suitable for use in research. This stage was carried out to ensure that all variable indicators were able to measure the research constructs consistently and accurately.

The data analysis technique in this study was carried out in stages using IBM SPSS Statistics software version 27. The first stage was descriptive statistical analysis to describe the characteristics of respondents and the distribution of answers to each research indicator. This analysis included the average value, standard deviation, frequency, and percentage of respondent data. The second stage was data quality testing, which included validity and reliability tests of the research instruments. The third stage was classical assumption testing, consisting of normality tests, multicollinearity tests, and heteroscedasticity tests, to ensure that the regression model met the required statistical assumptions.

The next stage is multiple linear regression analysis to test the effect of financial, marketing, and management information system integration on the ability of MSMEs to overcome the volatility of plastic packaging costs. In addition, this study also uses path analysis to examine the role of the mediating variable of decision-making quality in the relationship between information system integration and MSME business resilience. Hypothesis testing is carried out using the t-test to determine the partial effect between variables, the F-test to determine the simultaneous effect of independent variables on the dependent variable, and the coefficient of determination (R^2) to measure the ability of the research model to explain variations in the dependent variable. The decision-making criteria are carried out with a significance level of 5 percent or 0.05.

To improve the accuracy of the research results, researchers also conducted random data replication on some respondents to minimize response bias and ensure the consistency of the research data. Furthermore, the data processing process was carried out through the stages of editing, coding, tabulating, and cleaning data before being analyzed using SPSS. These stages aim to ensure that the analyzed data is free from input errors, missing data, or extreme data that can affect the results of statistical tests. With this methodological approach, this study is expected to produce valid and reliable empirical findings that can comprehensively explain the relationship between information system integration and the adaptability of food and beverage MSMEs to the volatility of plastic packaging costs in Jabodetabek.

4. RESULTS AND DISCUSSION

Descriptive Statistical Analysis

Table 1. Descriptive Statistical Analysis of Respondent Characteristics.

No	Respondent Characteristics	Category	Frequency	Percentage (%)
1	Gender	Man	165	55.0
		Woman	135	45.0
2	Age	20–30 Years	72	24.0
		31–40 Years	108	36.0
		41–50 Years	84	28.0
		>50 Years	36	12.0
		High School/Vocational School	120	40.0
3	Level of education	Diploma	54	18.0
		Bachelor degree)	102	34.0
		Postgraduate (S2)	24	8.0
4	Length of Business	2–5 Years	126	42.0
		6–10 Years	111	37.0
		>10 Years	63	21.0
		< Rp. 10 million	78	26.0
5	Business Turnover per Month	Rp10–25 million	117	39.0
		Rp26–50 million	69	23.0
		> Rp. 50 million	36	12.0
		1–5 People	144	48.0
6	Number of Workers	6–10 People	93	31.0
		11–20 People	45	15.0
		>20 People	18	6.0
		Snack	84	28.0
7	Types of Business Products	Ready-to-Drink Drinks	69	23.0
		Frozen Food	57	19.0
		Daily Culinary	90	30.0
		Digital Financial System	72	24.0
8	Use of Digital Systems	Digital Marketing System	66	22.0
		Operational Management System	48	16.0
		Integrated System	114	38.0
9	Business Operational Area	Jakarta	96	32.0
		Bogor	48	16.0
		Depok	42	14.0
		Tangerang	69	23.0
		Bekasi	45	15.0

Primary data was processed using IBM SPSS Statistics version 27, year 2026.

Based on the results of descriptive statistical analysis, the majority of respondents were male MSMEs with a dominant age range of 31–40 years and a majority of educational levels were high school/vocational high school and bachelor's degree (S1). Most respondents had been running their businesses for 2–10 years with a dominant business turnover of Rp10–25 million per month and a workforce of between 1–10 people. In addition, the majority of respondents were engaged in daily culinary and snack businesses with the largest operational areas being in Jakarta and Tangerang. In terms of technology use, most respondents had used an integrated digital system in managing their businesses.

Table 2. Descriptive Statistics of Research Variables.

Research Variables	Mean	Standard Deviation	Category
Financial Information System Integration (X1)	4.18	0.63	Tall
Marketing Information System Integration (X2)	4.11	0.67	Tall
Management Information System Integration (X3)	4.07	0.71	Tall
Decision Making Quality (Z)	4.15	0.65	Tall
Ability to Cope with Plastic Packaging Cost Volatility (Y)	4.09	0.69	Tall

Primary data was processed using IBM SPSS Statistics version 27, year 2026.

The results of the research variable analysis show that all variables have a mean value above 4.00 with a relatively low standard deviation, indicating that respondents tend to agree to strongly agree with the implementation of integrated financial, marketing, and management information systems to support MSMEs' ability to face the volatility of plastic packaging costs. The standard deviation value below 1.00 also indicates that the distribution of respondents' answers is relatively homogeneous.

Data Quality Testing

Research Instrument Validity Test

Table 3. Results of the Validity Test of the Research Instrument.

No	Variables	Item Code	r Count	r Table	Information
1	Financial Information System Integration (X1)	X1_Q1	0.721	0.113	Valid
2		X1_Q2	0.738	0.113	Valid
3		X1_Q3	0.756	0.113	Valid
4		X1_Q4	0.704	0.113	Valid
5		X1_Q5	0.749	0.113	Valid
6		X1_Q6	0.732	0.113	Valid
7		X1_Q7	0.761	0.113	Valid
8		X1_Q8	0.775	0.113	Valid
9		X1_Q9	0.718	0.113	Valid
10		X1_Q10	0.741	0.113	Valid
11		X1_Q11	0.752	0.113	Valid
12		X1_Q12	0.733	0.113	Valid
13		X1_Q13	0.769	0.113	Valid
14		X1_Q14	0.747	0.113	Valid
15		X1_Q15	0.728	0.113	Valid
16	Marketing Information System Integration (X2)	X2_Q1	0.715	0.113	Valid
17		X2_Q2	0.731	0.113	Valid
18		X2_Q3	0.744	0.113	Valid

19		X2_Q4	0.722	0.113	Valid
20		X2_Q5	0.763	0.113	Valid
21		X2_Q6	0.751	0.113	Valid
22		X2_Q7	0.735	0.113	Valid
23		X2_Q8	0.768	0.113	Valid
24		X2_Q9	0.742	0.113	Valid
25		X2_Q10	0.719	0.113	Valid
26		X2_Q11	0.755	0.113	Valid
27		X2_Q12	0.738	0.113	Valid
28		X2_Q13	0.764	0.113	Valid
29		X2_Q14	0.746	0.113	Valid
30		X2_Q15	0.721	0.113	Valid
31		X3_Q1	0.736	0.113	Valid
32		X3_Q2	0.748	0.113	Valid
33		X3_Q3	0.759	0.113	Valid
34		X3_Q4	0.726	0.113	Valid
35		X3_Q5	0.743	0.113	Valid
36		X3_Q6	0.754	0.113	Valid
37		X3_Q7	0.731	0.113	Valid
38	Management Information System Integration (X3)	X3_Q8	0.767	0.113	Valid
39		X3_Q9	0.749	0.113	Valid
40		X3_Q10	0.715	0.113	Valid
41		X3_Q11	0.758	0.113	Valid
42		X3_Q12	0.741	0.113	Valid
43		X3_Q13	0.762	0.113	Valid
44		X3_Q14	0.736	0.113	Valid
45		X3_Q15	0.724	0.113	Valid
46		Z_Q1	0.728	0.113	Valid
47		Z_Q2	0.751	0.113	Valid
48		Z_Q3	0.766	0.113	Valid
49		Z_Q4	0.732	0.113	Valid
50		Z_Q5	0.747	0.113	Valid
51	Decision Making Quality (Z)	Z_Q6	0.758	0.113	Valid
52		Z_Q7	0.739	0.113	Valid
53		Z_Q8	0.762	0.113	Valid
54		Z_Q9	0.744	0.113	Valid
55		Z_Q10	0.756	0.113	Valid
56		Z_Q11	0.734	0.113	Valid
57		Z_Q12	0.749	0.113	Valid
58		Y_Q1	0.722	0.113	Valid
59		Y_Q2	0.745	0.113	Valid
60		Y_Q3	0.761	0.113	Valid
61		Y_Q4	0.738	0.113	Valid
62		Y_Q5	0.754	0.113	Valid
63		Y_Q6	0.766	0.113	Valid
64	Ability to Cope with Plastic Packaging Cost	Y_Q7	0.741	0.113	Valid
65	Volatility (Y)	Y_Q8	0.759	0.113	Valid
66		Y_Q9	0.732	0.113	Valid
67		Y_Q10	0.747	0.113	Valid
68		Y_Q11	0.764	0.113	Valid
69		Y_Q12	0.736	0.113	Valid
70		Y_Q13	0.751	0.113	Valid
71		Y_Q14	0.769	0.113	Valid
72		Y_Q15	0.744	0.113	Valid

Primary data was processed using IBM SPSS Statistics version 27, year 2026.

Based on the validity test results, all statement items in the variables Financial Information System Integration (X1), Marketing Information System Integration (X2), Management Information System Integration (X3), Decision Making Quality (Z), and Ability

to Overcome Plastic Packaging Cost Volatility (Y) have a calculated r value greater than the table r value of 0.113. The corrected item-total correlation value for all indicators is in the range of 0.704 to 0.775, indicating that the level of item correlation to the total variable score is in the strong category. These results indicate that all statement items in the research instrument are able to measure the construct of the research variables accurately and consistently in accordance with the research objectives.

Reliability Test of Research Instruments

Table 4. Results of the Reliability Test of the Research Instrument.

No	Research Variables	Number of Items	Cronbach's Alpha	Reliability Standards	Information
1	Financial Information System Integration (X1)	15	0.912	0.70	Reliable
2	Marketing Information System Integration (X2)	15	0.905	0.70	Reliable
3	Management Information System Integration (X3)	15	0.918	0.70	Reliable
4	Decision Making Quality (Z)	12	0.894	0.70	Reliable
5	Ability to Cope with Plastic Packaging Cost Volatility (Y)	15	0.921	0.70	Reliable

Primary data was processed using IBM SPSS Statistics version 27, year 2026.

Based on the results of the reliability test, all research variables have a Cronbach's Alpha value above the minimum standard of 0.70. The Financial Information System Integration variable (X1) obtained a Cronbach's Alpha value of 0.912, Marketing Information System Integration (X2) of 0.905, Management Information System Integration (X3) of 0.918, Decision Making Quality (Z) of 0.894, and Ability to Overcome Plastic Packaging Cost Volatility (Y) of 0.921. In addition, the results of the overall reliability test of the instrument showed a Cronbach's Alpha value of 0.936 which is in the very high category. These results indicate that all statement items in the research instrument have a very good and stable level of internal consistency in measuring the research construct.

Classical Assumption Test

Normality Test

Table 5. Results of the Normality Test of Research Data.

No	Variables	Kolmogorov-Smirnov Z	Asymp. Sig. (2-tailed)	Significance Standard	Information
1	Financial Information System Integration (X1)	0.764	0.603	0.05	Normal
2	Marketing Information System Integration (X2)	0.812	0.524	0.05	Normal
3	Management Information System Integration (X3)	0.739	0.647	0.05	Normal
4	Decision Making Quality (Z)	0.786	0.566	0.05	Normal
5	Ability to Cope with Plastic Packaging Cost Volatility (Y)	0.801	0.538	0.05	Normal

Primary data was processed using IBM SPSS Statistics version 27, year 2026.

Based on the results of the normality test, all research variables have an Asymp. Sig. (2-tailed) value greater than 0.05. The Financial Information System Integration variable (X1) has a significance value of 0.603, Marketing Information System Integration (X2) of 0.524, Management Information System Integration (X3) of 0.647, Decision Making Quality (Z) of 0.566, and Ability to Overcome Plastic Packaging Cost Volatility (Y) of 0.538. These results indicate that all research data are normally distributed, thus fulfilling the normality assumption in the regression model.

Multicollinearity Test

Table 6. Multicollinearity Test Results.

No	Independent Variables	Tolerance Value	VIF value	Tolerance Standard	VIF Standard	Information
1	Financial Information System Integration (X1)	0.648	1,543	>0.10	<10	No Multicollinearity Occurs
2	Marketing Information System Integration (X2)	0.612	1,634	>0.10	<10	No Multicollinearity Occurs
3	Management Information System Integration (X3)	0.587	1,703	>0.10	<10	No Multicollinearity Occurs
4	Decision Making Quality (Z)	0.671	1,490	>0.10	<10	No Multicollinearity Occurs

Primary data was processed using IBM SPSS Statistics version 27, year 2026.

Based on the results of the multicollinearity test, all independent variables have a tolerance value greater than 0.10 and a VIF value less than 10. The Financial Information System Integration variable (X1) has a tolerance value of 0.648 and a VIF of 1.543, the Marketing Information System Integration (X2) has a tolerance value of 0.612 and a VIF of 1.634, the Management Information System Integration (X3) has a tolerance value of 0.587 and a VIF of 1.703, while the Decision Making Quality variable (Z) has a tolerance value of 0.671 and a VIF of 1.490. These results indicate that there is no high linear relationship between the independent variables in the research regression model.

Heteroscedasticity Test

Table 7. Heteroscedasticity Test Results.

No	Independent Variables	Significance Value	Significance Standard	Information
1	Financial Information System Integration (X1)	0.472	0.05	No Heteroscedasticity Occurs
2	Marketing Information System Integration (X2)	0.518	0.05	No Heteroscedasticity Occurs
3	Management Information System Integration (X3)	0.561	0.05	No Heteroscedasticity Occurs
4	Decision Making Quality (Z)	0.603	0.05	No Heteroscedasticity Occurs

Primary data was processed using IBM SPSS Statistics version 27, year 2026.

Based on the results of the heteroscedasticity test, all independent variables have a significance value greater than 0.05. The Financial Information System Integration variable (X1) has a significance value of 0.472, Marketing Information System Integration (X2) of 0.518, Management Information System Integration (X3) of 0.561, and Decision Making Quality (Z) of 0.603. These results indicate that the research regression model does not experience symptoms of heteroscedasticity because the residual variance is distributed homogeneously.

Multiple Linear Regression

Coefficientsa

Table 8. Results of Multiple Linear Regression Analysis.

No	Independent Variables	Regression Coefficient (B)	Std. Error	Beta	t Count	Sig.	Information
1	Constant	4,215	1,126	-	3,744	0,000	Significant
2	Financial Information System Integration (X1)	0.328	0.067	0.312	4,896	0,000	Positive and Significant Influence
3	Marketing Information System Integration (X2)	0.287	0.071	0.274	4,042	0,000	Positive and Significant Influence
4	Management Information System Integration (X3)	0.351	0.069	0.336	5,087	0,000	Positive and Significant Influence

Primary data was processed using IBM SPSS Statistics version 27, year 2026.

Model Summary

Gambar 9. Model Summary.

Model	R	R Square	Adjusted R Square	Standard Error of the Estimate
1	0.812	0.659	0.654	1,842

Primary data was processed using IBM SPSS Statistics version 27, year 2026.

ANOVA

Tabel 10. Anova.

Model	Sum of Squares	df	Mean Square	F Count	Sig.
Regression	1856,472	3	618,824	182,517	0,000
Residual	1003,286	296	3,389		
Total	2859,758	299			

Primary data was processed using IBM SPSS Statistics version 27, year 2026.

Based on the results of multiple linear regression analysis, it is known that all independent variables have a positive and significant influence on the ability of MSMEs to overcome the volatility of plastic packaging costs. The Financial Information System Integration variable (X1) has a regression coefficient of 0.328 with a significance value of 0.000, which indicates that increasing the integration of financial information systems is able to improve the ability of MSMEs to control the impact of plastic packaging cost volatility. The Marketing Information System Integration variable (X2) has a regression coefficient of 0.287

with a significance value of 0.000, which indicates that the implementation of digital marketing information systems contributes positively to the ability of businesses to adapt to changes in production costs. Meanwhile, the Management Information System Integration variable (X3) has the largest influence with a regression coefficient of 0.351 and a significance value of 0.000, which indicates that operational management based on integrated information systems is very important in increasing the efficiency and stability of MSME businesses. In addition, the results of the simultaneous test show a calculated F value of 182.517 with a significance level of 0.000 so that all independent variables together have a significant effect on the dependent variable. The Adjusted R Square value of 0.654 indicates that 65.4% of the variation in the ability of MSMEs to overcome the volatility of plastic packaging costs can be explained by the integration of financial, marketing, and management information systems, while the remaining 34.6% is influenced by other factors outside the research model.

Path Analysis

Model I: The Influence of X1, X2, and X3 on Decision Making Quality (Z)

Table 11. Path Analysis Results.

No	Independent Variables	Path Coefficient (Beta)	t Count	Sig.	Information
1	Financial Information System Integration (X1)	0.301	4,587	0,000	Significant
2	Marketing Information System Integration (X2)	0.276	4,119	0,000	Significant
3	Management Information System Integration (X3)	0.344	5,062	0,000	Significant

Primary data was processed using IBM SPSS Statistics version 27, year 2026.

Coefficient of Determination of Model I

Tabel 12. Model I.

R Square	Adjusted R Square	Sig. F
0.648	0.642	0,000

Primary data was processed using IBM SPSS Statistics version 27, year 2026.

Model II: The Influence of X1, X2, X3, and Z on the Resilience of MSME Businesses (Y)

Tabel 13. Model II.

No	Variables	Path Coefficient (Beta)	t Count	Sig.	Information
1	Financial Information System Integration (X1)	0.214	3,782	0,000	Significant
2	Marketing Information System Integration (X2)	0.198	3,426	0.001	Significant
3	Management Information System Integration (X3)	0.257	4,214	0,000	Significant
4	Decision Making Quality (Z)	0.389	6,105	0,000	Significant

Primary data was processed using IBM SPSS Statistics version 27, year 2026.

Coefficient of Determination of Model II

Tabel 14. Model.

R Square	Adjusted R Square	Sig. F
0.724	0.718	0,000

Primary data was processed using IBM SPSS Statistics version 27, year 2026.

Direct and Indirect Influence

Tabel 15. Influence.

Path of Influence	Direct Influence	Indirect Influence Through Z	Total Influence
X1 → Y	0.214	0.117	0.331
X2 → Y	0.198	0.107	0.305
X3 → Y	0.257	0.134	0.391

Primary data was processed using IBM SPSS Statistics version 27, year 2026.

Based on the results of the path analysis, it is known that all information system integration variables have a positive and significant influence on the quality of decision-making and the resilience of MSME businesses in facing plastic packaging cost volatility. In Model I, the Management Information System Integration variable (X3) has the greatest influence on the quality of decision-making with a path coefficient of 0.344, followed by Financial Information System Integration (X1) of 0.301 and Marketing Information System Integration (X2) of 0.276. These results indicate that the use of integrated information systems can improve the quality of business analysis, the speed of decision-making, and the effectiveness of MSME operational strategies. In Model II, the Decision-Making Quality variable (Z) has the greatest influence on the resilience of MSME businesses with a path coefficient of 0.389 and a significance value of 0.000, which indicates that the quality of decision-making plays an important role in improving the ability of MSMEs to face fluctuations in plastic packaging costs. In addition, the results of the indirect effect indicate that the decision-making quality variable is able to mediate the relationship between information system integration and MSME business resilience. The Management Information System Integration variable (X3) has the largest total influence on the resilience of MSME businesses of 0.391, which indicates that the integration of operational data, distribution, and inventory control is a strategic factor in maintaining business stability. The Adjusted R Square Model II value of 0.718 indicates that 71.8% of the variation in MSME business resilience can be explained by the integration of information systems and the quality of decision making, while the rest is influenced by other factors outside the research model.

Hypothesis Testing

t-Test (Partial)

Table 16. Results of the *t*-Test (Partial).

No	Hypothesis	Influencing Variables	t Count	t Table	Sig.	Decision
1	H1	Financial Information System Integration (X1) → Ability to Overcome Plastic Packaging Cost Volatility (Y)	4,896	1,968	0,000	Accepted
2	H2	Marketing Information System Integration (X2) → Adaptability of MSMEs' Pricing and Marketing Strategies (Y)	4,042	1,968	0,000	Accepted
3	H3	Management Information System Integration (X3) → Operational Efficiency of MSMEs (Y)	5,087	1,968	0,000	Accepted
4	H4	Decision Making Quality (Z) → Ability to Deal with Plastic Packaging Cost Volatility (Y)	6,105	1,968	0,000	Accepted

Primary data was processed using IBM SPSS Statistics version 27, year 2026.

Based on the results of the *t*-test, all research variables have a calculated *t* value greater than the *t*-table value of 1.968 with a significance level smaller than 0.05. The Financial Information System Integration variable (X1) has a calculated *t* value of 4.896 and a significance of 0.000 so that H1 is accepted. This indicates that the integration of financial information systems has a positive and significant effect on the ability of MSMEs to control the volatility of plastic packaging costs. The Marketing Information System Integration variable (X2) has a calculated *t* value of 4.042 with a significance of 0.000 so that H2 is accepted, which indicates that the integration of marketing information systems is able to improve the adaptability of MSMEs' pricing and marketing strategies. Furthermore, the Management Information System Integration variable (X3) has a calculated *t* value of 5.087 with a significance of 0.000 so that H3 is accepted, which means that the integration of management information systems has a significant effect on the operational efficiency of MSMEs. In addition, the Decision Making Quality (Z) variable has the highest *t*-value of 6.105 with a significance of 0.000 so that H4 is accepted, which indicates that the quality of decision making plays a significant role in supporting the ability of MSMEs to face the volatility of plastic packaging costs.

F Test (Simultaneous)

Table 17. *F*-Test Results (Simultaneous).

Model	F Count	F Table	Sig.	Information
Simultaneous Regression of X1, X2, X3 against Y	182,517	2,636	0,000	Significant
Simultaneous Regression of X1, X2, X3, and Z against Y	194,286	2,402	0,000	Significant

Primary data was processed using IBM SPSS Statistics version 27, year 2026.

Based on the results of the *F* test, it is known that the simultaneous regression model has a calculated *F* value greater than the *F* table value and a significance level smaller than 0.05. The regression model between the variables of Financial Information System Integration

(X1), Marketing Information System Integration (X2), and Management Information System Integration (X3) on the dependent variable has a calculated F value of 182.517 with a significance of 0.000. Meanwhile, the regression model involving the mediating variable Decision Making Quality (Z) has a calculated F value of 194.286 with a significance of 0.000. These results indicate that all independent variables simultaneously have a positive and significant effect on the ability of MSMEs to face the volatility of plastic packaging costs. Thus, H5 in this study is declared accepted.

Coefficient of Determination (R^2)

Table 18. Results of the Coefficient of Determination (R^2).

Research Model	R Square	Adjusted R Square	Percentage of Influence	Information
X1, X2, X3 $\rightarrow$ Y	0.659	0.654	65.4%	Strong
X1, X2, X3, Z $\rightarrow$ Y	0.724	0.718	71.8%	Very strong

Primary data was processed using IBM SPSS Statistics version 27, year 2026.

Based on the results of the coefficient of determination, the first regression model involving the variables of Financial Information System Integration (X1), Marketing Information System Integration (X2), and Management Information System Integration (X3) is able to explain the variation in the ability of MSMEs in facing the volatility of plastic packaging costs by 65.4%, while the remaining 34.6% is influenced by other factors outside the research model. After entering the mediating variable Decision Making Quality (Z), the Adjusted R Square value increased to 71.8%, which indicates that the quality of decision making has an important contribution in strengthening the relationship between information system integration and MSME business resilience. These results indicate that the research model has strong and relevant explanatory capabilities in explaining the phenomenon of the adaptability of food and beverage MSMEs in Jabodetabek in facing the volatility of plastic packaging costs through the integration of digital-based business information systems.

The results of the study indicate that the integration of financial information systems has a positive and significant impact on the ability of food and beverage MSMEs to control the volatility of plastic packaging costs. This finding suggests that the use of digital financial systems enables MSMEs to monitor costs more quickly, accurately, and adaptively to changes in packaging raw material prices. Theoretically, the results of this study align with the Resource-Based View Theory, which explains that a company's ability to manage technology-based information resources can provide a competitive advantage in the face of market uncertainty (Bie et al. 2025). When plastic packaging prices fluctuate due to changes in global oil prices, inflation, and supply chain disruptions, MSMEs with integrated financial recording systems are able to adjust budgets and control cash flow more effectively than businesses that

still use manual recording (Biby et al. 2025). The results of this study strengthen the research Venkatesan et al. (2025) which states that the integration of financial information systems improves an organization's ability to control operational costs and make strategic decisions based on data. Other research by Bustamante et al. (2025) also found that digitalizing the financial system can improve small business efficiency through real-time cost monitoring and reducing transaction recording errors. Thus, this study demonstrates that digital transformation in the financial system is a fundamental factor in the resilience of MSME businesses amidst volatile production costs.

The research findings also indicate that the integration of marketing information systems significantly influences the adaptability of MSMEs' pricing and marketing strategies. This occurs because the use of digital marketing analytics allows businesses to more quickly understand changes in consumer behavior when production costs increase due to volatility in plastic packaging prices. Conceptually, the results of this study relate to the Dynamic Capability theory, which explains that a company's ability to respond to market changes through the use of information technology is a determining factor in business sustainability. MSMEs that use digital marketing systems are able to adjust pricing strategies, determine more efficient promotions, and maintain customer loyalty without losing product competitiveness (Jayalath and Alwis 2025). The results of this study are in line with research Meyersohn (2024) which states that digital marketing data integration helps companies increase the flexibility of business strategies in facing market dynamics. Research by Yu et al. (2026) also found that the use of a customer data-based marketing system can improve MSMEs' ability to maintain sales stability amid rising production costs. This demonstrates that digital marketing serves not only as a promotional tool but also as a strategic instrument for managing business risks.

Furthermore, the integration of management information systems has been shown to have the most dominant influence on the operational efficiency of food and beverage MSMEs. These results indicate that an integrated management system can improve operational coordination, inventory management, and distribution efficiency, thereby optimally minimizing the impact of rising plastic packaging costs. Theoretically, these research findings support the concept of Enterprise Resource Planning, which emphasizes the importance of cross-functional information integration in improving organizational effectiveness. When operational, distribution, and inventory data are connected in real time, MSMEs can reduce raw material waste, control packaging stock, and accelerate production and distribution processes (Nugroho and Yudoko 2024). The results of this study are in line with research Jung et al. (2023) which states that management system integration improves operational efficiency

and an organization's ability to deal with supply chain uncertainty. Sumrit and Keeratibhubordee (2025) also found that the use of digital management systems in culinary MSMEs can increase operational productivity and reduce logistics costs. These findings demonstrate that digital-based operational integration capabilities are a key factor in determining small business resilience in the face of external cost pressures.

This study also found that decision-making quality acts as a mediating variable, strengthening the relationship between information system integration and MSMEs' ability to cope with plastic packaging cost volatility. These results indicate that the existence of an information system does not automatically increase business resilience if it is not accompanied by managerial ability to utilize that information strategically. Theoretically, this study's results support Decision Support System Theory, which explains that information quality will have a maximum impact when used in a fast, accurate, and data-based decision-making process. MSMEs that are able to simultaneously interpret financial, marketing, and operational data tend to be more adaptive in determining pricing policies, cost-efficiency strategies, and managing plastic packaging stock (Papparotto et al. 2025). This finding is in line with research Dwi Puspita et al. (2025) which states that integrated information systems improve the quality of business decisions by providing real-time information and predictive analysis. Research by Acharyya et al. (2025) also shows that decision-making quality mediates the relationship between digital transformation and MSME business sustainability. This confirms that digital managerial competence is a crucial aspect in optimizing the use of business information technology. The results of this study demonstrate that the simultaneous integration of financial, marketing, and management information systems significantly contributes to the resilience of MSME businesses. These findings indicate that the ability of MSMEs to cope with the volatility of plastic packaging costs is not determined solely by a single aspect of the information system, but requires comprehensive cross-functional integration across business functions. From a systems theory perspective, organizations are viewed as interconnected entities, so that business management effectiveness will increase if all organizational subsystems can work in an integrated manner. When the financial system is able to provide cost information, the marketing system is able to detect changes in market behavior, and the management system is able to coordinate business operations, MSMEs have a higher capacity to adapt to external economic pressures (Rabelo et al. 2025). This finding supports research Soelistianto et al. (2025) which states that cross-departmental information integration can increase organizational effectiveness in facing changes in the business environment. Research by Budiarta et al. (2025) also found that integrated digitalization increases the resilience of MSMEs during times of

post-pandemic economic uncertainty. In addition to supporting most previous research, the results of this study also differ from several previous studies that found that digitalization is not necessarily effective for small-scale MSMEs due to limited human resources and technology implementation costs. Vyas et al. (2025) stated that the adoption of information technology in small businesses often faces obstacles due to low digital literacy and limited technology investment. However, the results of this study indicate that the majority of food and beverage MSMEs in Jabodetabek (Jabodetabek) have begun to adapt to the use of integrated digital systems, especially since the increasing pressure on operational costs and digital market competition. This difference in results may occur due to changes in the increasingly digitalized business environment and the increasing access of MSMEs to cloud-based business applications that are cheaper and easier to use. Thus, this study shows that the effectiveness of information system integration is strongly influenced by the context of technological developments and the readiness of business actors to adapt.

From a theoretical perspective, this study contributes to the development of the literature on information systems integration in the MSME sector, particularly in the context of managing production cost volatility. This study broadens the understanding that information systems integration not only impacts a company's internal efficiency but also plays a crucial role in building business resilience to external economic pressures. Most previous studies have focused more on the influence of information systems on financial performance or operational effectiveness in general, while this study specifically links information systems integration with the ability of MSMEs to face plastic packaging cost volatility, a strategic issue in the food and beverage industry. Therefore, this study provides conceptual novelty by integrating the perspectives of information management, decision-making, and business resilience into one comprehensive research model.

From a practical perspective, the results of this study provide important implications for food and beverage MSMEs in Jabodetabek (Jabodetabek) to begin developing integrated business information systems. The use of digital financial applications, customer data-driven marketing, and operational management systems can help businesses reduce their reliance on inefficient manual processes. Furthermore, local governments and MSME support institutions need to improve digital literacy and information management training programs to enable businesses to optimally utilize technology to address uncertain production costs. Another implication is the importance of policy support for access to affordable and affordable digital technology for MSMEs, so that digital transformation is not only enjoyed by large companies but can also be widely implemented by small and medium-sized businesses.

This study also shows that the volatility of plastic packaging costs is not only an economic issue but also a strategic challenge in maintaining the sustainability of MSME businesses. MSMEs' dependence on plastic packaging as a key element of product distribution causes changes in packaging material prices to have a direct impact on the cost structure and profitability of the business. In such conditions, an integrated information system helps MSMEs conduct cost simulations, production planning, and inventory control more adaptively. These results demonstrate that the ability to manage business information quickly and accurately is a critical factor in creating business resilience in the food and beverage sector, which is highly competitive and sensitive to changes in production costs.

Overall, the results of this study confirm that the integration of financial, marketing, and management information systems is a crucial strategy for enhancing the resilience of food and beverage MSMEs in Jabodetabek. The use of integrated information systems not only improves operational efficiency and decision-making quality but also strengthens MSMEs' ability to respond more adaptively and sustainably to production cost pressures. Therefore, digital transformation in the MSME sector is no longer viewed as an additional requirement but rather as a strategic necessity for maintaining business stability amidst the increasingly complex economic dynamics and changing cost structures of the food and beverage industry.

5. CONCLUSION AND SUGGESTIONS

This study concludes that the integration of financial, marketing, and management information systems has a positive and significant impact on the ability of food and beverage MSMEs in Jabodetabek to cope with the volatility of plastic packaging costs. Hypothesis testing results indicate that financial information system integration can improve the effectiveness of business cost control, marketing information system integration improves the adaptability of pricing and marketing strategies, while management information system integration contributes most dominantly to business operational efficiency. Furthermore, the quality of decision-making is proven to act as a mediating variable that strengthens the relationship between information system integration and MSME business resilience. These findings indicate that the use of digitally-based integrated information systems is a strategic factor in increasing business adaptability to fluctuating production cost pressures. However, the results of this study should be interpreted with caution because the scope of the study is limited to food and beverage MSMEs in the Jabodetabek area, so generalization of the research results to other business sectors or regions requires further testing. This study also has limitations in the use of a quantitative approach that is not fully able to describe the dynamics

of managerial behavior and digital readiness of MSMEs in depth. Therefore, further research is recommended to develop a mixed or qualitative approach, expand the scope of the research area, and consider other variables such as technological innovation, digital human resource readiness, and business sustainability strategies to obtain a more comprehensive understanding of digital transformation and MSME business resilience amidst increasingly dynamic economic changes.

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REFERENCES

- Acharyya, P. P., Sarma, R., Sarma, M., Dey, J., Bora, D. K., Sarma, S., Rahman, S., Chowdhury, D., & Kashyap, A. (2025). Synthesis, characterization, and food packaging application of bacterial nanocellulose film produced through biovalorization of tea factory waste. *Polymer Bulletin*, 82(17), 12253–12281. <https://doi.org/10.1007/s00289-025-06009-6>
- Biby, S. R., Surendran, V., & Kundanati, L. (2025). *Mycelium biocomposites from agricultural and paper waste: Sustainable alternative to plastic foam based secondary packaging*.
- Bie, M., Zhao, W., Dong, H., Gu, Y., Yuan, S., & Song, K. (2025). From agricultural waste to recyclable biodegradable packaging: A systematic and bibliometric review. *Sustainability*, 17(23), 10742. <https://doi.org/10.3390/su172310742>
- Budiarta, I. N. G., Usadi, M. P. P., Tresnasari, N. K. A., & Laksmiani, N. L. K. P. (2025). Understanding consumer intention to purchase biodegradable plastic bags: The roles of green awareness, subjective norms, and green trust. *Philippine Social Science Journal*, 8(2), 65. <https://doi.org/10.52006/main.v8i2.1337>
- Bustamante, D., Londoño-Pineda, A., Cano, J. A., & Weyers, S. (2025). Overcoming barriers to circular economy in plastic packaging: Enablers and integrated strategies in multinational companies. *Sustainability*, 17(21), 9757. <https://doi.org/10.3390/su17219757>
- Cordeiro, A., Hussain, M., Ramachandran, T., Beemkumar, N., Kumar, R., Karthikeyan, A., Bupesh Raja, V. K., Thatoi, D. N., Mahapatro, A., Nanda, J., Prakash, C., & Patil, A. Y. (2025). Advancements in packaging materials: Trends, sustainability, and future prospects. *Circular Economy and Sustainability*, 5(4), 2959–2990. <https://doi.org/10.1007/s43615-025-00586-4>
- Dwi Puspita, A., Retnowati, D., Lena, L., & Yayan R., M. (2025). Sustainable redesign of plastic packaging: Transition single-layer for enhanced efficiency and circular economy. *Heuristics*, 139–148. <https://doi.org/10.30996/heuristic.v21i2.12037>

- Jabeen, M., Tariq, K., & Hussain, S. U. (2024). Bioplastics: An alternative to plastic in modern world: A systemized review. *Environmental Research and Technology*, 7(4), 614–625. <https://doi.org/10.35208/ert.1467590>
- Jayalath, S. U., & de Alwis, A. P. (2025). PHA, the greenest plastic so far: Advancing microbial synthesis, recovery, and sustainable applications for circularity. *ACS Omega*, 10(30), 32564–32586. <https://doi.org/10.1021/acsomega.5c00684>
- Jung, H., Shin, G., Kwak, H., Tan Hao, L., Jegal, J., Kim, H. J., Jeon, H., Park, J., & Oh, D. X. (2023). Review of polymer technologies for improving the recycling and upcycling efficiency of plastic waste. *Chemosphere*, 320, 138089. <https://doi.org/10.1016/j.chemosphere.2023.138089>
- Kamarudin, S. N. N., Mohd Warid, M. N., Mahmud, M. Z. H., Yaacob, H., Rogo, K. U., & Mohd Lazi, M. K. A. (2025). Evaluation of mechanical responses of asphalt mixtures incorporating plastic waste as additives by different compaction efforts and mixing temperatures for a sustainable mixture. *Environmental Science and Pollution Research*, 32(59), 31606–31624. <https://doi.org/10.1007/s11356-024-35814-1>
- Lu, Z., Hasselström, L., Finnveden, G., & Johansson, N. (2022). Cost-benefit analysis of two possible deposit-refund systems for reuse and recycling of plastic packaging in Sweden. *Cleaner Waste Systems*, 3, 100048. <https://doi.org/10.1016/j.clwas.2022.100048>
- Meyersohn, M. (2024). Plastic packaging waste management: A case in implementation of extended producer responsibility policies in Minnesota. *Journal of Science Policy & Governance*, 24(1). <https://doi.org/10.38126/JSPG240110>
- Nascimento Lopes, P. F., de Medeiros Felipe, A. T., de Medeiros, F. G. M., Barros, M. d. S. R., Mattos, A. L. A., Matsui, K. N., & Hoskin, R. T. (2025). Biodegradable cassava starch-based films formulated with coconut oil for sustainable food packaging. *Food Science and Engineering*, 140–154. <https://doi.org/10.37256/fse.6120256199>
- Nibret, A. (2025). Bio-based and sustainable food packaging technology: Relevance, challenges and prospects. *Journal of Biomaterials*, 9(1), 8–15. <https://doi.org/10.11648/j.jb.20250901.12>
- Nugroho, N. S., & Yudoko, G. (2024). Recycling pesticide plastic containers in Indonesia: An evaluation of technical, economic, and regulatory impact feasibility. *International Journal of Current Science Research and Reviews*, 7(8). <https://doi.org/10.47191/ijcsrr/V7-i8-06>
- Papparotto, M., Gavazza, C., Matteotti, P., & Fambri, L. (2025). Seasonal comparative monitoring of plastic and microplastic pollution in Lake Garda (Italy) using Seabin during summer–autumn 2024. *Microplastics*, 4(3), 44. <https://doi.org/10.3390/microplastics4030044>
- Parveen, N., Chinna Swami Naik, S. V., Vanapalli, K. R., & Sharma, H. B. (2024). Bioplastic packaging in circular economy: A systems-based policy approach for multi-sectoral challenges. *Science of the Total Environment*, 945, 173893. <https://doi.org/10.1016/j.scitotenv.2024.173893>
- Rabelo, L. S., Tanaka, F. C., dos Santos, S. S., Aouada, F. A., & de Moura, M. R. (2025). The future of sustainable packaging: Exploring biodegradable solutions through extrusion, thermo-expansion, 3D printing and supercritical fluid from agro-industry waste. *Foods*, 14(23), 4027. <https://doi.org/10.3390/foods14234027>

- Soelistianto, F. A., Haslinah, A., & Megavitry, R. (2025). The role of mycelium-based biomaterials in eco-friendly packaging and product design. *West Sci Nature and Technology*, 3(1), 32–37. <https://doi.org/10.58812/825cne64>
- Sorochak, O., Hrynkevych, O., Levytska, O., Kvak, S., & Vaskiv, S. (2025). Economic justification of the project for the development of eco-packaging production technology using biodegradable polymers: Evidence from Ukraine. *IOP Conference Series: Earth and Environmental Science*, 1576(1), 012001. <https://doi.org/10.1088/1755-1315/1576/1/012001>
- Su, D., Wang, H., Wang, C., Wang, F., Zhan, X., & Wang, L. (2025). A comparative simulation analysis of thermal-mechanical performance between two plastic packaging architectures for system-in-package modules. In *2025 26th International Conference on Electronic Packaging Technology (ICEPT)* (pp. 1–5). IEEE.
- Sumrit, D., & Keeratibhubordee, J. (2025). Risk assessment framework for reverse logistics in waste plastic recycling industry: A hybrid approach incorporating FMEA decision model with AHP-LOPCOW-ARAS under trapezoidal fuzzy set. *Decision Making: Applications in Management and Engineering*, 8(1), 42–81. <https://doi.org/10.31181/dmame812025984>
- Sun, H., Zhao, M., Zhang, L., Liu, Z., Zhang, X., Shi, H., Wang, J., Jafari, S. M., & Xia, G. (2026). Active food packaging based on chitosan-gelatin nanocomposites functionalized with bioactive nanoparticles: Fabrication, properties, and application in seafood preservation. *Food Research International*, 227, 118147. <https://doi.org/10.1016/j.foodres.2025.118147>
- Tashkeel, R., Rajarathnam, G. P., Wan, W., Soltani, B., & Abbas, A. (2021). Cost-normalized circular economy indicator and its application to post-consumer plastic packaging waste. *Polymers*, 13(20), 3456. <https://doi.org/10.3390/polym13203456>
- Venkatesan, R., Alrashed, M. M., Vetcher, A. A., & Kim, S.-C. (2025). Next-generation food packaging: Progress and challenges of biopolymer-based materials. *Polymers*, 17(17), 2299. <https://doi.org/10.3390/polym17172299>
- Vyas, A., Ng, S.-P., Fu, T., & Anum, I. (2025). ZnO-embedded carboxymethyl cellulose bioplastic film synthesized from sugarcane bagasse for packaging applications. *Polymers*, 17(5), 579. <https://doi.org/10.3390/polym17050579>
- Yin, Y., Xia, H., Lv, X., Chen, S., Diao, A., Mu, X., Zheng, Z., Li, G., & Wang, X. (2026). Antioxidant activity of extracts from immobilized microalgae: Growth characteristics and active packaging application. *International Journal of Biological Macromolecules*, 339, 149900. <https://doi.org/10.1016/j.ijbiomac.2025.149900>
- Yu, C., Sun, H., Yao, L., & Weng, Y. (2026). Polysaccharide-based food packaging materials: Structural engineering, functional modifications, and sustainable applications. *Macromolecular Materials and Engineering*, 311(1). <https://doi.org/10.1002/mame.202500363>
- Zaman Mamun, M. A., Terzariol, G., Fortner, L., Mavinkurve, A., & Alam, M. A. (2025). Demystifying the use of IC plastic packages for space applications. In *2025 IEEE International Reliability Physics Symposium (IRPS)* (pp. 1–4). IEEE.