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ARTICLE

Determinants of Social Media Adoption by Millennial Farmers to Improve Business Performance: Perspectives from the Technology-Organization-Environment (TOE) Framework

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ABSTRACT

To attract millennials to the agricultural sector, it is necessary to modernize agriculture using social media. Social media plays an important role as a marketing tool for farmers. The utilization of social media platforms can assist farmers in enhancing the effectiveness of their agricultural product marketing efforts, with the objective of increasing their income. This study aimed to determine the effect of social media adoption on the business performance of millennial farmers in Central Java using the technology-organization-environment (TOE) framework. The method used in this study was a quantitative descriptive approach with data collected from 120 millennial farmers located in 10 districts in Central Java. The data analysis method was carried out using SEM-PLS with the SmartPLS 3.0 application. The results of the analysis showed that business performance was influenced by social media adoption, and millennial farmers' business turnover increased by 25% after using social media. Technological factors and organizational factors had a significant effect on social media adoption, while environmental factors were not significant. This study provided information on the factors that influence the business performance of millennial farmers in Central Java Province, which can help farmers in developing strategies to improve business performance and assist the government in developing programs to attract the millennial generation to the agricultural sector.

Keywords: Social Media Adoption; Business Performance; Millennial Farmers; TOE Framework

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1. Introduction

The millennial generation, which is frequently referred to as Generation Y, was born between 1981 and 1996, and has unique characteristics that make them adaptable to technology, including agricultural technology [1]. In Indonesia, millennial farmers are individuals aged 19–39 who are active and open to technological innovations [2–4]. In 2022, only 21.9% of the 38.7 million farmers in Indonesia were classified as millennial farmers, according to data from the Central Statistics Agency (BPS) [5]. This indicates that the proportion of young farmers in Indonesia remains relatively small, despite their significant potential in disseminating technology in the agricultural sector [6].

Central Java province has a diverse agricultural sector that significantly contributes to the Gross Domestic Product (GDP) [7, 8]. In 2018, the number of millennial farmers in Central Java was 975,600 (33.7%) out of 2.88 million farmers in the province. The data indicated that merely one in three farmers in Central Java is a millennial farmer [9]. The agriculture sector in Central Java remains predominantly influenced by the elder generation [10]. Farmer regeneration is a major challenge, given the dominance of Generation X and the elderly in this sector [11].

Agriculture modernization through mechanization-based technology and smart farming approaches is key to attracting the younger generation to the agricultural sector, one of which is by using social media [12]. Social media is positioned as a tool to support the success of farmer entrepreneurship [13]. Social media use as an online marketing tool can enhance the bargaining power of agricultural products, achieve marketing efficiency, expand market share, and increase income [14–16]. Millennial farmers can improve their business performance through online marketing using social media [17, 18].

The adoption of social media as a marketing platform among farmers is very low. In Central Java, only 7.59% of farmers and fishers have adopted social media [19]. Millennial farmers in this province have not yet leveraged social media to support their business development. They use social media merely as a communication tool [20], to seek information on waste management [21], and to send messages or business content [22]. This indicates a significant untapped potential for millennial farmers to optimize social media for their businesses. Challenges in adopting social media for marketing among millennial farmers include limited technological adoption skills, lack of capital, and privacy risks [23].

Low adoption of social media causes problems such as low internal business communication [24] and a lack of marketing ability [25]. These impacts can negatively affect a business's potential growth and financial performance [26, 27]. The slow adoption of social media for marketing purposes is attributed to various factors, including an unhealthy business environment, poor management, and slow technology diffusion [28].

SMEs are independently operated business entities [29]. The criteria for micro enterprises include having an annual turnover of less than IDR 300 million (USD 19,320), small enterprises have turnovers less than IDR 2.5 billion per year (USD 161,016), while medium enterprises are those with turnovers exceeding IDR 2.5 billion per year [29]. In agriculture, SMEs are also referred to as agricultural enterprises, encompassing activities ranging from pre-production, production, post-production, processing, to marketing services [30]. SMEs are crucial to Indonesia's economy, particularly in rural areas, as they create employment opportunities [31]. The adoption of technology by SMEs fosters business innovation and enhances performance growth in the corporate sector [32].

Business performance serves as a measure of SME success [33]. Business performance can be assessed both financially (turnover, profit, assets) and non-financially (business expansion, product development, customer loyalty, and innovation) [34]. However, SME performance in Central Java has been negatively impacted by the multidimensional effects of the COVID-19 pandemic. SMEs in Central Java have experienced a decline in performance, marked by an average turnover reduction of 78.4% and a market demand decrease of 96.4% [35]. Business performance of SMEs can be improved through online marketing. SME entrepreneurs can enhance their business performance and expand their market share by leveraging social media platforms for online marketing. SMEs can use social media for the latest marketing information, thereby enhancing the role of social media as a

marketing tool and a catalyst for business growth [36].

Various studies have shown that social media adoption can enhance business processes and company performance [37]. The adoption of enterprise social media has a positive impact on the performance of a firm and provides benefits [38, 39]. Social media adoption also positively affects an organization's social capital, which, in turn, contributes to business performance [40]. Social media adoption can improve business performance through the TOE (technology-organization-environment) method [41, 42].

These studies examined the impact of social media adoption on SMEs business performance in general [37–42]. However, there is no research specifically investigating the impact of social media adoption on the business performance of millennial farmers. A gap exists in studies addressing how social media adoption influences the business performance of millennial farmers, especially in Central Java.

Based on this background, this study aimed to analyze the influence of technological, organizational, and environmental factors on the adoption of social media in marketing agricultural products by millennial farmers in Central Java. This study would also evaluate how social media adoption affects millennial farmers' business performance. The results of the study are expected to make a positive contribution to sustainable agricultural development and improve the welfare of millennial farmers in Central Java. With the increasing use of the internet and social media in Central Java, this study can provide valuable insights for the government in formulating policies that support technology adoption in the agricultural sector. Furthermore, the results are expected to assist millennial farmers in leveraging social media more effectively to boost their business performance and strengthen food security at the regional level.

2. Theoretical Framework

The underlying theoretical framework of this study is based on the Technology-Organization-Environment (TOE) framework. The Technology-Organization-Environment (TOE) framework, developed by Tornatzky in 1990 [43], is designed to provide a detailed understanding of the behavioral intentions and implementation of innovations at the organizational level. Its strengths over other behavioral models are its ability to capture the impact of various internal and external factors on adoption decisions, based on three contextual areas: technology, organization, and environment. The TOE framework is extensively supported by research to elucidate the innovation adoption process within organizations [44]. It is commonly used to study the adoption of innovative technologies and has proven to be a valid model [45]. Different innovations influence social media adoption to varying degrees within the TOE framework. Similarly, factors that influence the adoption may vary across different national or cultural contexts and industries [46].

The technology dimension involves new products or services that enhance the development of technical knowledge within a relevant technical environment [47]. In the TOE framework, technological variables are evaluated through indicators, such as relative advantage, cost-effectiveness, compatibility, and interactivity [48]. Relative advantage seeks to identify factors influencing the rate of innovation diffusion and its acceptance within a community [49]. Cost-effectiveness is marked as the benefit derived from using a particular item at a lower cost [50]. Compatibility refers to the alignment between technology and its users in achieving specific objectives [51]. Interactivity is defined as the extent to which multiple parties can communicate and engage with each other, the communication medium, and messages, as well as how these interactions are synchronized [52, 53].

The organizational context pertains to the descriptive aspects of technology use related to organizational structure, such as company size, managerial structure, and scope [54]. Within the TOE framework, organizational variables are influenced by indicators such as entrepreneurial orientation and top management [48]. Entrepreneurial orientation is characterized by five dimensions, including innovation, risk-taking, proactiveness, competitive aggressiveness, and autonomy. Entrepreneurs who integrate these dimensions into their practices tend to achieve optimal business performance [55]. Top management plays a crucial role as a driving force, translating technological vision into real-

ity; they act not only as leaders but also as key catalysts in the technological change process within an organization [56].

A business environment encompasses all the determining factors that interact with a business, including the impacts and processes within which the business operates [57]. Based on the TOE framework, environmental variables are influenced by indicators such as competitive intensity, competitive pressure, and the bandwagon effect [48]. Competitive intensity refers to the pressure resulting from the loss of competitive advantage. Competitive intensity experienced by a company can be characterized by the degree to which the company influences the survival prospects of its competitors [58]. Competitive pressure is defined as the extent of the pressure a company experiences from its rivals or competitors within the same industry [59, 60]. In the technology adoption context, the bandwagon effect describes the phenomenon where business owners adopt new technologies because their competitors or similar businesses also adopt similar technologies [61].

3. Literature Review

3.1. Social Media Adoption among Millennial Farmers

Social media serves as a platform that users create to facilitate their sharing of knowledge and opinions with external audiences [62]. The adoption of social media represents a strategic marketing approach designed to support the sustainability and growth of small and medium-sized enterprises [63]. Social media marketing involves leveraging social media platforms and technologies, along with their features, to achieve marketing objectives, in conjunction with other marketing communication tools [64]. It is anticipated that online marketing through social media adoption will become a prominent trend for promoting products and services in the future, particularly in the post-COVID-19 period, which has affected business growth [65]. Social media platforms can be employed in various online systems, such as ratings, voting, and user testimonials, which are instrumental in maintaining customer engagement [66]. Social media adoption in online marketing is influenced by various factors, including customer relationships [67], brand impact [68], and customer feedback [69].

Millennial farmers use social media to promote agricultural development and share current market price information [70]. Moreover, they employ social media to stimulate interest in the digital marketplace. Enhancements in the production and marketing of agricultural commodities have the potential to encourage other young individuals to engage in modern agriculture [71]. In addition to technological progress, millennial farmers use social media as a promotional tool (through platforms such as WhatsApp groups, Facebook, Instagram, and blogs) to maintain their visibility as significant actors within the agricultural sector [72].

Previous research has explored the benefits, challenges, and implementation of social media for SMEs [73–75]. The studies have investigated the application of social media in the performance of small and medium enterprises (SMEs) in developing countries, identifying social media as a platform for distributing information, and revealing that its adoption positively impacts SME performance [73]. Other studies highlight that technology, organizational, and environmental factors are key to SMEs' successful adoption of social media in Nigeria [74]. Research conducted in Jordan has shown that social media adoption impacts business performance when examined using the TOE and the technology acceptance model (TAM) frameworks [75]. However, all these studies have focused on SMEs and have not investigated millennial farmers as a subject of study. This leaves a gap in understanding the impact of social media adoption on the business performance of millennial farmers. Additionally, indicators such as market competition, costs associated with social media operations, and the age of the business are rarely included in research models. This present study seeks to address these gaps.

3.2. Business Performance

Business performance indicates a company's success in meeting its objectives, encompassing profitability, agility, and budgetary efficiency [76]. The evaluation of business performance involves analyzing the financial and non-financial aspects of the company [77]. The term "business performance" refers to the degree to which a

company effectively utilizes its resources to achieve its business goals efficiently [78]. Evaluating and measuring business performance is crucial as it provides insights into the effectiveness and efficiency of a company's operational processes [79].

Measuring business performance facilitates the analysis of factors impacting performance from financial and operational perspectives [80]. Business performance is determined by transaction volume within business processes [81]. Another critical determinant of business performance is the number of customers, as an increase in customer volume typically enhances business performance [82]. Moreover, other factors such as service quality [83] and customer interactions through social media [84] affect business performance. Therefore, business performance is influenced by transaction volume, the number of customers, service quality, and customer interactions [81–84].

4. Materials and Methods

4.1. Basic Methods of Research

The quantitative descriptive method is a research approach that focuses on collecting numerical data to describe characteristics, patterns, and phenomena within a specific population or environment. This method involves measuring variables as they naturally occur without the researcher's manipulation or intervention [85]. The research location of Central Java Province, which has the highest potential number of millennial farmers, totaling 975,600 farmers or 33.7% of the 2.88 million farmers in Central Java Province, was purposively selected [86].

Data were collected through observations, face-to-face interviews, and record-keeping. The study used both primary and secondary data. Primary data include details, such as respondents' names, ages, genders, education levels, business establishment years, types of businesses, turnovers, social media usage, capital, market reach, marketing methods, production processes, and responses to research-related questions gathered through interviews and observations. Secondary data include information on Central Java's agricultural potential, monographs, and general regional conditions, obtained from the Central Statistics Agency, the Agricultural Office, and online sources.

Integration of these data sets was critical for validating findings and enhancing the robustness of the analysis. Secondary data were utilized to benchmark the trends observed in the primary data collection. For instance, trends in social media adoption rates reported by the Indonesia Internet Service Provider Association were compared with survey results to assess consistency and discrepancies. This comparative analysis supported the substantiation of conclusions regarding the drivers and impacts of social media adoption among millennial farmers.

4.2. Sample Determination

Purposive sampling method ensures that particular types of cases, which could potentially be included, are represented in the final sample of the research study [87]. This study used a criterion sampling approach to set a specific criterion that should be followed for participants to take part in the study. These participants will be handpicked for such reasons because the criterion is set to enable the relevant data to be collected. This method of sampling is very strong in quality assurance since the data to be generated will be from reliable sources [88]. This study used a purposive sampling method, selecting participants from the entire population without considering specific subgroups. The sample included millennial farmers aged 19–29 who have been involved in agriculture for at least two years, including activities such as food crop farming, horticulture farming, fisheries, and livestock farming, covering the entire process from production to distribution.

The sample size for this study was 120 participants, based on the theory of a variable-to-sample ratio of 1:15, which means at least 15 samples are needed for each variable [89]. Thus, a minimum of 75 samples was required for the study. The population consists of all Millennial Farmer Ambassadors in Central Java, totaling 189 individuals based on the Decree of the Minister of Agriculture of Indonesia Number 434/KPTS/SM.020/M/8/2021 [90]. Sampling was conducted in 10 regencies in Central Java with the highest number of Millennial Farmer Ambassadors. The sample

used in this study represents 63.5% of the total population. The following is the distribution of regencies with the highest number of Millennial Farmer Ambassadors are shown at **Table 1** and demographic statistics are shown at **Table 2**.

Table 1. Distribution of research respondent samples in each regency.

Number	Regency	Number of Population (of People)	Number of Samples (of People)
1.	Magelang	53	51
2.	Semarang	23	20
3.	Temanggung	13	13
4.	Sukoharjo	8	7
5.	Banyumas	7	5
6.	Purbalingga	7	6
7.	Wonosobo	5	3
8.	Purworejo	6	5
9.	Tegal	6	5
10.	Klaten	5	5
Sum			**120**

Source: Primary data analysis, 2024.

Table 2. Respondents' descriptive statistics (n = 120).

Variable	Group	Frequency	Percentage (%)
Gender	Male	111	92.5
	Female	9	7.5
Age	20–24	22	18.3
	25–29	38	31.7
	30–34	32	26.7
	35–39	28	23.3
Education	Elementary/secondary	74	61.7
	Undergraduate	32	26.7
	Master's	3	2.5
	Other	11	9.2
Respondent's role	Owner	120	100
	Manager	0	0

Source: Primary data analysis, 2024.

Table 2 provides a detailed breakdown of the demographic characteristics of 120 millennial farmers who participated in the study. The vast majority of respondents are male (92.5%), highlighting a significant gender disparity in this sector. The age distribution indicates a relatively young cohort, with the largest group aged 25–29 years (31.7%), followed by those in the 30–34 age bracket (26.7%), suggesting that younger individuals are actively engaged in farming. Education levels vary widely, with a significant number (61.7%) having only elementary or secondary education, and a smaller fraction having attained undergraduate (26.7%) or master's degrees (2.5%). All respondents are the owners of their farming businesses, which significantly enhances the reliability and depth of the data collected. Owners, by virtue of their position, possess a holistic understanding of their business operations and are intimately aware of both the strategic and day-to-day aspects of their enterprises.

4.3. Instrument Development

The questionnaire is divided into three sections. The first section explained the objective, context, and profile of the research. The second section provided the respondents' characteristics, which cover names, ages, genders, education levels, business establishment years, types of businesses, turnovers, social media usage, capital, market reach, marketing methods, and production processes. The third section described the constructs' measurement items using a 5-point Likert scale (1 for strongly disagree and 5 for strongly agree). With the adoption of experts' advice and previous research, the statement items were modified to make them relevant. The items and their sources are shown in **Table 3**.

4.4. Data Analysis Methods

This study was conducted in Central Java Province, Indonesia, by selecting 10 regencies in Central Java Province that have the largest population of millennial farmer ambassadors[90]. The data collection period lasted from May to July 2023. Data were collected through face-to-face interviews with the Millennial Farmers who were part of the study sample. The questionnaire consisted of five sections. Section A included 17 questions about respondent characteristics. Section B covered five questions on respondents' socioeconomic status. Section C contained 10 questions on respondents' social media proficiency. Section D had five questions on the performance of the Millennial Farmers' businesses. These four sections provided qualitative data about the respondents. Section E included 28 items on the factors influencing the adoption of social media and its impact on business performance. This section used a five-point Likert scale, ranging from 1 for "strongly disagree" to 5 for "strongly agree".

Table 3. Categories of variables and indicators used.

Variable	Indicator	Symbol	Description
Technology	Relative advantage [42, 67]	T1	Social media can improve my business image
		T2	Social media allows me to increase business productivity
		T3	Social media allows me to achieve certain targets
	Cost effectiveness [38, 42]	T4	Social media can reduce my business marketing costs
		T5	Social media can save time and effort in marketing, branding and customer service
		T6	Social media is more cost and time efficient than traditional media
	Compatibility [38, 42, 44]	T7	Social media is compatible (aligned) with my business processes and operations
		T8	I find it easy to integrate social media with existing strategies
		T9	Social media adoption is compatible with my business processes and operations
	Interactivity [38, 42, 53]	T10	Social media provides features for interactive communication with customers
Organization	Top management [42, 44, 53]	O1	I consider social media adoption to be important for organizations
		O2	I support the use of social media among business organizations
	Entrepreneurial orientation [36, 44]	O3	My business often tries new ideas
		O4	My business is looking for new ways to do things
		O5	My business is creative in its operating methods
Environment	Competitive intensity [48]	E1	Social media will give companies a stronger competitive advantage
	Competitive pressure [42, 44, 60]	E2	Social media will enable companies to generate high profits
		E3	Social media will increase the company's ability to outperform competitors
	Bandwagon effect [42, 48]	E4	I follow other people in adopting social media in their business
		E5	I chose to adopt social media because many other businesses are already using it
Adoption of social media	Customers relationship [48, 53]	ASM1	I use social media to maintain relationships with customers and clients
	Business brand [48]	ASM2	I use social media to communicate my business brand online
	Feedback [48]	ASM3	I use social media to get feedback from customers
		ASM4	I use social media to answer questions from customers
Business Performance	Increase in transactions [38, 44]	BP1	Social media has an influence on increasing my business sales transactions
	Increase in customers [44]	BP2	Social media has an influence on increasing the number of customers
	Increase in brand visibility [42]	BP3	Social media has an influence on increasing brand visibility
	Service Improvement [42]	BP4	Social media has an influence on improving service quality

Source: Primary data analysis, 2024.

The data were analyzed with structural equation modeling (SEM) with a partial least squares (PLS) approach, using SmartPLS 3 software. SEM is a multivariate technique that enables researchers to test complex relationships between variables, variable and construct, and between constructs [91]. The data analysis was conducted in three stages: (1) instrument testing, by assessing reliability and validity; (2) data testing, by evaluating the measurement model (outer model) and the structural model (inner model); and (3) bootstrapping testing, to test hypotheses by examining the path coefficients between independent and dependent variables [89]. Instrument testing utilized composite reliability (CR) to measure reliability, as well as average vari-

ance extracted (AVE) and loading factor (LF) to assess validity. In terms of validity and reliability, the AVE, CR, and LF values should be 0.5, 0.7, and 0.7, respectively [89]. The instrument testing was conducted with 30 respondent data samples. The results indicated that indicator O3 was excluded due to its loading factor being below the acceptable threshold of 0.7, with a value of only 0.687. Consequently, this indicator was not included in the data testing process.

4.5. Measurement Model (Outer Model) Testing

Testing the measurement models (outer model) refers to evaluating indicators of latent variables. The outer loading or outer weight reflects the weight or contribution of each indicator in measuring the associated latent variable [89]. These indicators determine the strength or weakness of a latent variable. The outer model testing involves two main assessments: validity and reliability. The validity testing includes checking convergent validity, where the average variance extracted (AVE) value must be greater than 0.5, and discriminant validity, where the AVE for each construct must exceed the squared correlations between constructs [89]. The reliability was assessed using composite reliability (CR) and Cronbach's alpha (CA), with both values needing to be greater than 0.7 [89]. The outer model focuses on evaluating how changes in the environment affect model parameters. This model is useful for testing the model portability, which refers to its reliability when applied in different conditions [92].

4.6. Structural Model (Inner Model) Testing

The inner model evaluation is used to test the relationships between latent variables based on R-Square (R^2) and Q-Square (Q^2) values. R-Square (R^2) test is conducted to define the degree of determination between exogenous latent variables and endogenous latent variables. An R^2 value is considered substantial if it is 0.67 or higher, moderate if it is 0.33, weak if it is 0.19, and overfitting if it is 0.90 or more [89]. Q-Square (Q^2) test measures the model's predictive relevance. A Q^2 value greater than 0 indicates predictive relevance, while a value less than 0 suggests no predictive relevance. Q^2 values greater than 0; 0.21; and 0.50 represent prediction accuracy of small, medium, and great, respectively, within the PLS path model [89].

4.7. Hypothesis Testing

In SEM analysis using PLS, hypotheses can be tested through resampling methods, such as bootstrapping. Hypothesis testing is performed using a t-test with a critical value of 1.96, and results are considered significant if the p-value is ≤ 0.05 [89]. This study uses t-statistics and t-table values with an error level of 0.05 or 5%. If the t-statistic (t_0) is greater than the t-table value ($t\alpha$) and the p-value is less than alpha (α), then H_0 is rejected and H_1 is accepted. Conversely, if the t-statistic (t_0) is less than the t-table value ($t\alpha$) and the p-value is greater than alpha (α), then H_0 is accepted and H_1 is rejected.

5. Results

5.1. Evaluation of Measurement Model (Outer Model)

5.1.1. Validity Test

Validity testing is conducted to ensure that the data and each statement in the questionnaire accurately represent the variables studied [93]. In this study, the validity was evaluated using both discriminant validity (DV) and convergent validity (CV) models. Discriminant validity (DV) is evaluated using cross-loading (CL) values, while convergent validity (CV) is assessed using the average variance extracted (AVE) values. The CL value for each indicator should have a higher loading value on the measured construct compared to other constructs. This ensures that the indicator is more related to the intended construct than to other constructs [94]. The CL values used to test the DV model are shown at **Tabel 4**.

Table 4 demonstrates that the cross-loading (CL) value for each construct indicator is higher compared to those of other constructs. Specifically, the CL values for indicators ASM1, ASM2, ASM3, and ASM4 for the ASM construct exceed those for other constructs. This pattern was also identified for the CL values of other con-

Table 4. Cross-loading test results.

	Adoption of Social Media (ASM)	Business Performance (BP)	Environment (E)	Organization (O)	Technology (T)
ASM1	**0.799**	0.525	0.419	0.482	0.558
ASM2	**0.860**	0.542	0.360	0.510	0.563
ASM3	**0.815**	0.468	0.329	0.439	0.494
ASM4	**0.714**	0.512	0.306	0.398	0.420
BP1	0.465	**0.846**	0.400	0.380	0.546
BP2	0.533	**0.840**	0.439	0.410	0.602
BP3	0.509	**0.835**	0.411	0.394	0.559
BP4	0.634	**0.858**	0.408	0.502	0.643
E1	0.348	0.386	**0.739**	0.316	0.477
E2	0.369	0.403	**0.779**	0.357	0.495
E3	0.317	0.369	**0.765**	0.312	0.507
E4	0.316	0.292	**0.739**	0.356	0.337
E5	0.313	0.381	**0.726**	0.387	0.403
O1	0.376	0.373	0.365	**0.746**	0.318
O2	0.366	0.390	0.456	**0.712**	0.491
O4	0.476	0.405	0.385	**0.796**	0.382
O5	0.528	0.395	0.259	**0.826**	0.407
T1	0.458	0.544	0.388	0.358	**0.747**
T2	0.474	0.543	0.420	0.377	**0.805**
T3	0.433	0.553	0.426	0.408	**0.776**
T4	0.513	0.615	0.454	0.407	**0.790**
T5	0.388	0.452	0.537	0.348	**0.708**
T6	0.486	0.516	0.482	0.421	**0.728**
T7	0.517	0.479	0.476	0.364	**0.714**
T8	0.461	0.525	0.422	0.422	**0.762**
T9	0.500	0.508	0.438	0.297	**0.765**
T10	0.561	0.532	0.450	0.458	**0.746**

Source: Primary data analysis using SmartPLS 3, 2024.

structs such as BP, E, O, and T. These findings indicate that each indicator is appropriately aligned with its corresponding variable, reflecting the intended construct more accurately than others. Consequently, the discriminant validity in this study is deemed satisfactory. The results of the discriminant validity test are shown at **Table 5**.

Table 5. Discriminant validity test results.

Variable	ASM	BP	E	O	T
ASM	0.799				
BP	0.642	0.845			
E	0.445	0.490	0.750		
O	0.576	0.505	0.460	0.771	
T	0.641	0.700	0.595	0.513	0.755

Source: Primary data analysis using SmartPLS 3, 2024.

Table 5 also indicates that the loading factor values for each indicator exceed 0.7 (loading factor > 0.7) [89]. This suggests that each indicator is valid for reflecting its respective variable. A high loading factor signifies a very strong correlation between the indicator and the variable it represents [95].

The second validity test was conducted using the convergent validity (CV) model, assessed based on the average variance extracted (AVE) values. The AVE value must be greater than 0.5 (AVE > 0.5) as a critical threshold indicating the strength of convergent validity [89]. The AVE values used to evaluate the CV model shown at **Table 6**.

Table 6. The results of the average variance extracted test.

Variable	AVE	Information
Technology	0.569	Valid
Organization	0.595	Valid
Environment	0.562	Valid
Adoption of social media	0.638	Valid
Business performance	0.714	Valid

Source: Primary data analysis using SmartPLS 3, 2024.

Table 6 depicts that each variable has an AVE value greater than 0.5, indicating that the variables are valid [89]. A valid AVE value signifies a substantial amount of variance captured by the construct, reflecting a strong influence among the variables [96].

5.1.2. Reliability Test

Reliability testing is conducted to measure the reliability and consistency of a test in assessing data. Reli-

ability refers to the degree of consistency of an instrument [97]. In this study, reliability was assessed using composite reliability (CR) and Cronbach's alpha (CA). Reliability is considered valid if CR > 0.7 and CA > 0.7 [89]. The CR and CA values used to evaluate reliability are shown at **Table 7**.

Table 7. Composite reliability and Cronbach's alpha test results.

Variable	Composite Reliability	Cronbach's Alpha	Information
Technology	0.875	0.930	Reliable
Organization	0.909	0.854	Reliable
Environment	0.840	0.865	Reliable
Adoption of social media	0.890	0.875	Reliable
Business performance	0.920	0.909	Reliable

Source: Primary data analysis using SmartPLS 3, 2024.

Table 7 indicates that each variable has a CR value exceeding 0.7 and a CA value above 0.6. These CR values suggest that the data demonstrate strong analytical consistency and reliability. This means that the research findings are stable, respondents clearly understand the questions posed, and the questions are both relevant and consistent [98].

5.2. Evaluation of Structural Model (Inner Model)

Evaluating the structural model, also known as the inner model, is crucial in understanding the relationships between latent variables within a research framework. This evaluation involves assessing the model's predictive capability and the hypothesized path coefficients. Key metrics for evaluating the structural model include the coefficient of determination (R^2) and predictive relevance (Q^2). The R^2 value reflects the proportion of variance in the dependent variables explained by the independent variables, while Q^2 assesses the model's predictive accuracy [89]. The structural model framework used in this study are shown at **Figure 1**.

Figure 1 illustrates the evaluation of the structural model in this study. The independent variables—technology (T), organization (O), and environment (E)—influence the first dependent variable 1, social media adoption (ASM). The ASM variable, in turn, affects the second dependent variable 2, business performance (BP). **Table 8** presents the results of the inner model evaluation, including the R^2 and Q^2 values, using the SEM-PLS approach. The following section details the findings of the inner model testing.

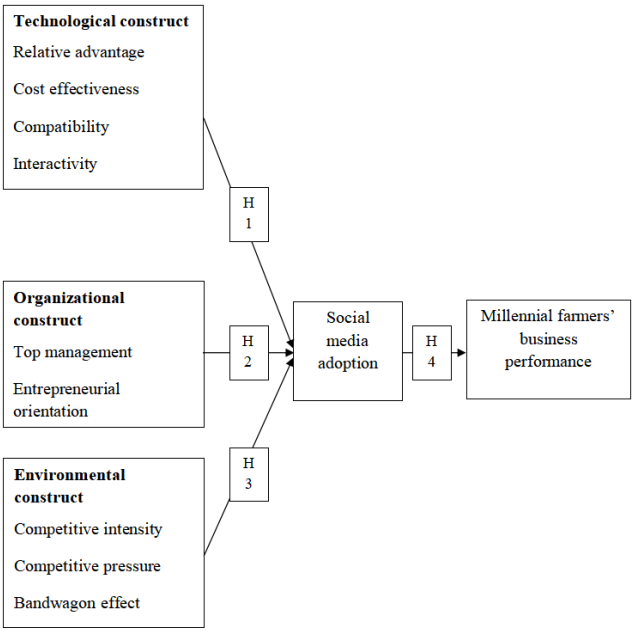

Figure 1. Conceptual model.

Table 8 presents the results for model determination and predictive relevance. The R^2 value for social media adoption is 0.494, indicating that 49.4% of the variance in social media adoption among millennial farmers in Central Java is explained by the combined effects of technology, organization, and environment. Similarly, the R^2 value for business performance is 0.412, suggesting that 41.2% of the variance in business performance is attributed to social media adoption. Both R^2 values are considered moderate ($0.33 < R^2 < 0.67$), reflecting a reasonable level of model explanatory power [89]. The Q^2 values further support the model's predictive relevance, with Q^2 values of 0.480 for social media adoption and

Table 8. R^2 and Q^2 value test results.

Variable	R^2	Q^2	Information
Adoption of social media	0.494	0.480	Moderate, having predictive relevance
Business Performance	0.412	0.407	Moderate, having predictive relevance

Source: Primary data analysis using SmartPLS 3, 2024.

0.407 for business performance. These values, which are greater than zero ($Q^2 > 0$), indicate strong predictive capability [89].

5.3. Hypothesis Testing (Bootstrapping)

Hypothesis testing in this study was performed using resampling bootstrapping, evaluating the path coefficients of the variables. The analysis was conducted at a significance level of 0.05 (5%), with a t-statistic threshold of 1.96 and p-value < 0.05. The direction and significance of the relationships among the variables—technology, organization, environment, social media adoption, and business performance—were assessed by examining the path coefficients and t-statistics. If the t-statistic (t_0) exceeds the t-table ($t\alpha$) and the p-value is less than alpha (α), then H_0 is rejected and H_1 is accepted. Conversely, if the t-statistic (t_0) is less than the t-table ($t\alpha$) and the p-value is greater than alpha (α), then H_0 is accepted and H_1 is rejected. The results of the path coefficient tests are summarized in the **Table 9**.

Table 9. Hypothesis test results.

Hypothesis	T-Statistic	P-Values	Notes
Technology → Social media adoption	5.056	0.000	S
Organization → Social media adoption	3.916	0.000	S
Environment → Social media adoption	0.232	0.817	NS
Social media adoption → Business performance	12.153	0.000	S

Source: Primary data analysis, 2024.
Note: S = Significant; NS = Non-significant.

The hypothesis testing results presented in **Table 9** indicate that technology (t-statistic = 5.056, p-value = 0.000) and organization (t-statistic = 3.916, p-value = 0.000) significantly impact social media adoption among millennial farmers in Central Java. In contrast, the environment (t-statistic = 0.232, p-value = 0.817) does not considerably affect social media adoption. Additionally, social media adoption significantly enhances business performance (t-statistic = 12.153, p-value = 0.000). These findings suggest that technology and organizational factors are crucial for social media adoption, positively affecting business performance, whereas environmental factors have a lesser impact. Structural measurements in this study are shown at **Figure 2**.

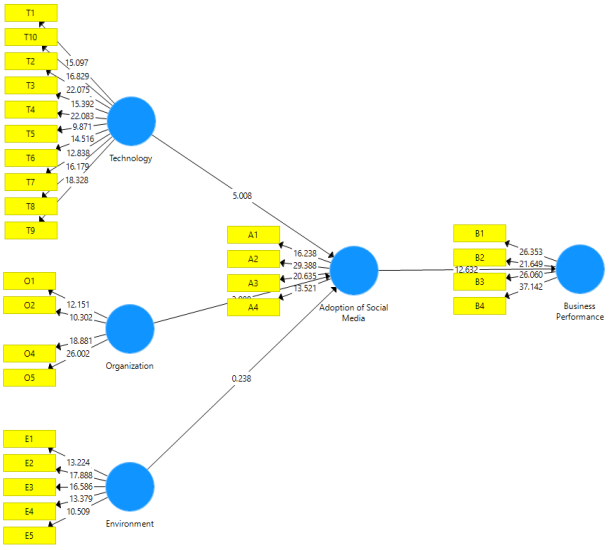

Figure 2. Structural measurement.

6. Discussion

6.1. Respondents' Business Profile

In this section, respondents' business profiles are studied. The business characteristics of the millennial farmers in Central Java Province revealed distinct patterns that may significantly influence business performance. The data shown at **Table 10**, the sample is dominated by micro businesses that have been running for 5 years.

A total of 120 respondents met the criteria and were deemed suitable for the sample. **Table 10** shows that the average allocation for social media marketing in millennial farmers' businesses is less than 25% of the total monthly operational budget. This is in line with the optimal range for online marketing expenses, which is generally between 1–10% of the total promotional budget[99] and no more than 36% of the overall budget[100]. Excessive budget allocation for social media marketing can lead to inefficiencies and mismanagement of company resources, which is a potential cause of business failure[101]. Therefore, it is important to regularly evaluate the social media marketing budget to ensure it aligns with current social media trends[102].

6.2. Effect of Technology on Social Media Adoption

Based on the data analysis, technology has a significant and positive impact on social media adoption, with a p-value of 0.000, indicating that hypothesis H_1 is accepted. This finding is consistent with the reports of previous studies that technology factors influence social media adoption in SMEs[103, 104]. For millennial farmers, social media adoption is particularly influenced by technology factors, including relative advantage[105] and cost-effectiveness[106]. Technology factors provide millennial farmers with relative advantages by facilitating accurate and factual information access through social media[107]. Additionally, technology factors offer advantages in social media marketing by reducing marketing costs compared to traditional promotional methods[108].

Technology compatibility with existing business strategies is also a crucial factor in the social media adoption process[109]. When technology aligns well with business operations and integrates seamlessly, the barriers to social media adoption are lower, and marketing strategies become more structured[110]. The dimension of interactivity within the technology context significantly influences social media adoption. Technology facilitates interaction among various parties, enabling the exchange of information. Business interactions can enhance trust in a business[111]. Moreover, interactivity is a key characteristic of the millennial generation, who are more attracted to platforms that offer constant, continuous interaction[112].

6.3. Effect of Organization on Social Media Adoption

The results show a p-value of 0.000 for the relationship between organizational factors and social media adoption, indicating a significant and positive relationship, which means hypothesis H_2 is **accepted**. This finding aligns with previous research, which shows that organizational context significantly and positively impacts social media adoption by small businesses[113–115]. Millennial farmers often exhibit strong leadership qualities, enabling them to effectively manage a business organization through conflict management and networking[116]. Furthermore, farmer organization plays a key role in knowledge sharing, which helps agricultural individuals achieve greater efficiency in their farming processes[117].

Millennial farmers, as both business owners and members of top management, view social media adoption as essential for business development, which promotes broader use of social media among them[105, 106]. When millennial farmers in top management demonstrate commitment and provide strong support for social media use, it fosters a technology-friendly organizational culture that aligns with the company's key strategies[118]. Also, the high educational level of millennial farmers makes them more likely to use social media regularly, including for business purposes[119]. Support from top management is vital for providing the necessary resources for social media implementation, such as training[120], technological infrastructure, and adequate budgets[121].

Table 10. Respondents' business profile.

Variable	Group	Frequency	Percentage (%)
Classification business	Micro	88	73.3
	Small	27	22.5
	Medium	5	4.2
Business age	<3	18	15
	3–<5	34	28.3
	5–<10	54	45
	>10	14	11.7
Budget allocated for SM	<25%	99	82.5
	26–50%	19	15.8
	>50%	2	1.7
Social media used*	Whatsapp	120	100
	Facebook	102	85
	Instagram	62	51.7
	Others	24	20
Percentage increase in turnover due to the use of social media	No increase	0	0
	<25%	56	46.7
	26–50%	38	31.7
	51–100%	25	20.8
	>100%	1	0.8

Source: Primary data analysis, 2024;
Note: *—Respondents can choose more than one option.

6.4. Effect of Environment on Social Media Adoption

Based on the data analysis, the environmental factor has a p-value of 0.817, indicating that it does not significantly affect social media adoption. Thus, hypothesis H_3 is rejected. This result aligns with previous research, which found that environmental context does not significantly impact social media adoption, particularly in business entities [122]. The environmental factor does not have an impact because small businesses process information independently and develop efficient digital business systems that do not rely on their environment [123].

In this study, the environmental context was assessed using three indicators, including competitive intensity, competitive pressure, and bandwagon effect. Competitive intensity does not significantly impact social media adoption. This finding is consistent with previous research, which suggests that business owners are more likely to perceive competitive intensity not from competitors, but from customer expectations [124].

The indicator of competitive pressure also does not significantly impact social media adoption. This finding is consistent with earlier studies, which revealed that competitive pressure does not affect the decision to adopt social media among small businesses [125, 126]. This is because small businesses focus on other technological aspects that contribute more to their competitive advantage, making competitive pressure less relevant [127, 128].

The indicators of competitive intensity and competitive pressure could potentially encourage social media adoption but their impact is not significant. This study found that millennial farmers benefit from a strong community supported by the Millennial Farmers Forum, established by the Central Java Provincial Government to provide a platform for interaction and information exchange among millennial farmers. This organization fosters friendships among millennial farmers, reducing the level of competition between them. Millennial farmers in Central Java adhere to the principles of mutual assistance within the organization, even when they work in similar sectors and commodities. This collaborative spirit and empathy contribute to a healthy agricultural ecosystem among millennial farmers in the region. Consequently, there is less pressure from competitors to

adopt social media and competitive pressure remains minimal [129].

The bandwagon effect does not significantly impact social media adoption among millennial farmers. This is because the real impact of social media adoption lies in everyday use, such as content management and business activities [130]. The influence of the bandwagon effect on the environmental dimension is minimal, suggesting that the popularity of social media among competitors is not a key factor driving small businesses to adopt social media [131]. Moreover, the bandwagon effect is unlikely to be sustained without being balanced by business opportunity optimization [132].

6.5. Effect of Social Media Adoption on Business Performance

The results reveal a p-value of 0.000 for the relationship between social media adoption and the business performance of millennial farmers, indicating a significant and positive relationship. Thus, H_4 is accepted. This is consistent with previous research that has found a positive relationship between social media adoption and business performance [133–136]. Social media adoption influences business performance in both financial and non-financial aspects [137]. The impact of social media adoption extends to economic, environmental, and social aspects of business performance [138].

Millennial farmers take advantage of social media as a powerful tool to enhance their businesses, especially for disseminating business information [139]. Social media serves as an effective marketing instrument for farmers, contributing to effective company performance [140]. By adopting social media, businesses can boost brand recognition and increase customer interest, leading to higher sales and, consequently, better overall business performance [141]. Utilizing social media for online marketing can significantly enhance a company's financial performance, operational efficiency, and promotional efforts [142]. The COVID-19 pandemic has notably impacted various aspects of life in Central Java, including food security [143], tourism [144], and the performance of small businesses [145]. Despite these challenges, millennial farmers' business performance can be improved through social media adoption. This study indicates that social media adoption has led to revenue increases for millennial farmers' businesses, ranging from 25% to 100% (see **Table 10**).

7. Conclusions

The improvement in the business performance of millennial farmers is driven by factors related to social media adoption, including technological factors (such as relative advantage, cost-effectiveness, compatibility, and interactivity) and organizational factors (such as top management and entrepreneurial orientation). However, environmental factors (including competitive intensity, competitive pressure, and the bandwagon effect) do not significantly affect social media adoption. This study contributes new insights into how social media adoption impacts the business performance of millennial farmers. The implications of this study are as follows: increasing social media adoption as a marketing platform for millennial farmers can be achieved by enhancing digital marketing budget allocation, improving business strategies that align with digital marketing approaches such as word-of-mouth and audiovisual promotion, and optimizing millennial farmer groups and communities to reduce competition among them. Furthermore, government support is crucial in fostering social media adoption through environmental factors, such as providing adequate internet infrastructure, to help millennial farmers improve cost efficiency, business productivity, and relative advantages, ultimately contributing to their well-being.

Author Contributions

M.D., formulates the research objective, conducts the data collection, and develops the overall research. W.R., compiles the research background, previous research, and acts as supervisor. I.K., formulates research gaps and acts as supervisor. K., performs review, research objective, and conclusion.

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Institutional Review Board Statement

Ethical review and approval were waived for this study due to privacy agreement has been collected during the survey and written consent being obtained at the Research Group of Management and Innovation of Agribusiness (RG MIA), Universitas Sebelas Maret, Indonesia.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study. Written informed consent has been obtained from the participant to publish this paper.

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Data Availability Statement

Authors where data supporting the results reported in a published article can be found by contacting corresponding author, and can be access for education only.

Conflicts of Interest

The authors declare that there are no conflicts of interest related to this research or article in any form.

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