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ARTICLE

Social Media in Micro, Small, and Medium Enterprises (MSMEs) Adoption of Functional Beverages in Solo Raya Using a Modified Technology-Organization-Environment-Individual (TOE-I) Model

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ABSTRACT

The increasing diversity of functional beverages directly contributes to the high number of micro, small, and medium enterprises (MSMEs), allowing businesses to innovate through digital marketing and social media adoption. Functional beverage MSMEs face customer, social, and competitor pressures while gain relative advantage. Although social media has been adopted, its utilization remains suboptimal. Therefore, this study aims to determine effect of technology, organization, environment, and individual factors on the social media adoption by functional beverage MSMEs in Solo Raya. A descriptive and quantitative methods was employed using a survey of 105 functional beverage producers in Solo Raya. The analysis uses technology-organization-environment (TOE) framework and the individual model. Data were analysed using Structural Equation Modeling with Partial Least Squares (SEM-PLS). The results show that technological, environmental, and individual factors significantly affect social media adoption, while organizational factors have no significant effect. Technology has a significant effect due to ease of use, promotional effectiveness, and relative advantage. Environmental factors, such as customer, social, and competitor pressures, also enable MSMEs to adopt social media in improving competitiveness. Knowledge and experience of individual businesses play an important role in the decision to adopt social media for business.

Keywords: Functional Beverage; MSME; Social Media Adoption; TOE-I Framework

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1. Introduction

Central Java Province is recorded as the largest contributor to micro, small, and medium enterprises (MSMEs) in Indonesia [1]. Within this province, Solo Raya is the area with a 17.37% contribution to the number of MSMEs in Central Java Province. The economic growth report of Surakarta City, as the regional center of Solo Raya, shows that the annual revenue of MSMEs reached 484 billion rupiah and was able to absorb 6,317 workers. One of the key business sectors is functional beverages, including *wedang* (hot beverage) ginger, *wedang ronde*, *asle*, *wedang secang*, herbal medicine, fresh milk, and fruit juice. In this era, customer tends to select functional beverages because of the back-to-nature trend. The covid-19 pandemic has provided many changes and motivated consumers to make choices to consume healthier goods and adopt a healthier lifestyle [2]. This shift presents a significant opportunity for the growth of functional beverage businesses, particularly in regions rich in cultural and natural resources, such as Solo Raya. Solo Raya is known as an area with high potential in the production of traditional drinks such as jamu, wedang, and various other herbal preparations. Therefore, it is important to conduct research on functional beverage MSMEs in Solo Raya to understand the extent to which business actors can adopt technology, especially social media, to expand marketing and increase competitiveness amid changes in consumer behavior that are increasingly aware of health.

What must be considered by MSME owners is that the products marketed must follow the traditions of modern customer, namely practical, attractive, and safe in terms of products and promotions [3]. As a traditional and conventional product, functional drinks often have challenges in competing with modern products in the market. This is the reason for the importance of social media adoption by functional drinks MSMEs and knowing what factors influence the adoption of social media by these MSMEs. Beyond the selected products, the increasing number and diversity of functional beverages affect the competitiveness of similar businesses. This allows business actors to innovate digital marketing with social media to increase sales and win in competition [4]. The development of social media technology has great potential to increase the performance of MSMEs [5]. Social media adoption provides different benefits, specifically in marketing to increase cost efficiency, facilitate interaction, improve brand image or awareness, enhance sales, and expand the market. However, functional beverage MSMEs face challenges in implementing social media, namely limited knowledge and skills, budget, tight competition, creativity, and individual openness. Most functional beverage MSMEs in Solo Raya have adopted social media but the use increases competitiveness and business growth [5]. This can be seen from the use of social media limited to simple promotions without a targeted marketing strategy, lack of interaction with customer, and minimal use of digital features such as analytics, paid advertising, and creative content to increase engagement and sales. Technology adoption is inseparable from the role of individuals, specifically regarding the level of knowledge and experience factors in the technology field [6].

Therefore, this research aims to analyze the effect of technology, organization, environment, and individuals on the social media adoption by functional beverage MSMEs in Solo Raya using PLS-SEM analysis. PLS-SEM is a multivariate analysis technique that can accommodate complex models, such as the TOE-I model. Through this analysis, it can also be seen which factors have the most influence on social media adoption predictively.

Although the TOE framework has been widely used in the study of technology adoption by MSMEs, there are still limitations in its application to the context of functional beverage MSMEs in Solo Raya. Most previous studies have focused on the public sector or more developed urban areas, thus paying less attention to the unique dynamics of MSMEs based on local traditions and culture such as jamu in Solo Raya. In addition, individual aspects, such as business owners' knowledge and experience in using social media, are often overlooked in a pure TOE framework. In fact, in owner-managed MSMEs with limited resources, individual factors play a crucial role in technology adoption decisions. Research by Pradifera et al. [7] shows that technological, organizational, and environmental factors influence the adoption of social media by MSMEs in Indonesia, but

has not explicitly integrated the individual aspect. Similarly, the study by Cvjetković[8] highlights the need for a more holistic approach in understanding technology adoption by MSMEs. Lina and Suwarni[9] emphasized the importance of top management support and customer pressure in the adoption of social commerce by MSMEs. Meanwhile, Lukitaningsih et al.[10] found that perceived usefulness and competitive pressure play a significant role in the adoption of social media marketing by MSMEs in Indonesia. The study by Fu et al.[11] also supports the importance of the TOE framework in understanding technology adoption by MSMEs. Therefore, research that combines technological, organizational, environmental, and individual factors (TOE-I) is needed to comprehensively understand the factors that influence the adoption of social media by functional beverage MSMEs in the region.

The TOE-I model was chosen because it is more representative of the real conditions of functional beverage MSMEs, which are usually managed by direct owners with limitations in human resources, infrastructure, and digital literacy. Unlike TAM, UTAUT, or DoI, which focus more on user perceptions, TOE-I accommodates the influence of external factors (social pressure and competition), internal organizational readiness, and individual capabilities, which are very relevant for small-scale MSMEs in the social media adoption process. The study by Amegbe et al.[12] shows that the TOE framework is effective in understanding the adoption of social media by MSMEs in developing countries, by highlighting the importance of technological, organizational, and environmental factors in improving marketing performance.

2. Theoritical Framework

The decision-making process in technology adoption can be understood using a framework that comprehensively evaluates the influencing factors. One such framework is the Technology-Organization-Environment (TOE) model, introduced by Tornatzky and Fleischer in 1990, which explains the implementation of innovation at the organizational level. Technology variables describe existing and relevant technologies. Organizational variables reflect the characteristics of the company in terms of scope, size, and resources. The environment describes the arena in which the company does business, competitors, and government[13].

For functional beverage MSMEs, social media enables entrepreneurs to interact directly with customers, share product information, and create content through blogs, networks, and online communities. The platform is also considered a new communication and collaboration tool permitting various inaccessible interactions with the general public[14]. The use of social media is optimized by consistently focusing on a medium for promotion and establishing direct interaction with customer[15].

Adoption refers to the acceptance, integration, and use of a new product, technology, method, or system. Social media adoption refers to the activity of using platform by conducting online promotions and commenting more interactively[16]. Additionally, social media adoption by MSMEs helps individuals operate their businesses more easily, effectively, and efficiently. The effect of using the platform as a promotional medium is on purchasing decisions by customer, where social media can increase brand recognition and feedback. Promotional activities can reach customers more effectively and help increase sales volume[17].

Based on the description above, social media adoption by functional beverage MSMEs is influenced by several factors that can be analyzed using various theoretical models. The technology-organization-environment (TOE) framework is the only theory that considers and combines three factors, including technology, organization, and environment. The technology factor describes the adoption and is relevant to business[18]. The organizational factor explains the effect of elements on the implementation of the latest and innovative technology by MSMEs[19]. The environmental factor represents external factors, including competitor, social, and customer or community pressure, influencing innovation adoption[20].

Individuals play a crucial role in the adoption and use of social media, which is influenced by various personal factors. Key influences include technological knowledge, openness to innovation, and a willingness to embrace change. Additional elements such as education,

experience, and digital skills serve as critical resources that can enhance business performance [21]. The higher the individual's understanding of the benefits and uses of technology for a business, the greater the opportunity for a business to adopt technology [22].

In addition to TOE, other methods such as Technology Acceptance Model (TAM), Unified Theory of Acceptance and Use of Technology (UTAUT), Diffusion of Innovation (DOI), Theory of Planned Behavior (TPB), Theory of Reasoned Action (TRA) are also used depending on the focus. TOE framework is the most validated theory for analyzing new technology adoption at organizational level [23]. In practice, however, the decision to adopt social media often depends heavily on the individual running the business [24]. This makes the TOE-Individual (TOE-I) modification especially relevant, as it incorporates individual-level factors such as technological knowledge, openness to innovation, digital skills, and personal experience. For MSMEs in Solo Raya—where business decisions are typically made directly by the owner or manager—individual readiness and adaptability play a crucial role in determining how well technologies like social media are implemented to support the growth and competitiveness of functional beverage businesses [25].

The Technology-Organization-Environment-Individual (TOE-I) framework is particularly relevant for functional beverage SMEs managed directly by owners with limited technological and managerial resources. This model integrates not only technological, organizational, and environmental dimensions, but also individual-level factors such as the owner's IT knowledge and experience, which are often crucial in small-scale operations. Unlike TAM or UTAUT, which focus mainly on user perceptions, TOE-I captures the broader contextual challenges faced by functional beverage SMEs in adopting digital platforms like social media. Qalati et al. [26] demonstrated the effectiveness of the TOE framework in analyzing social media adoption among SMEs in developing countries. Furthermore, studies by Ullah et al. [27] and Shahadat et al. [28] support that the TOE model provides a more holistic approach to understanding technology adoption in small enterprises.

3. Hypothesis Development

3.1. Technology

Technology factors indicate the technology used in an organization and the potential to provide benefits. In this research, the variable was analyzed through indicators of relative advantage, compatibility, complexity, and trialability [29]. The higher the relative advantage and suitability of the technology, the greater the possibility of social media adoption as a business strategy [30].

The relative advantage indicator is used to determine the advantages of new technology in terms of economy, convenience, and security [31]. The compatibility indicator assesses the fitness of technology in terms of needs, values, and systems [32]. The complexity indicator is used to show the difficulty in understanding the use. The complexity decreases the likelihood of adoption because users tend to avoid technology requiring high skills [33]. The trialability indicator refers to the ability to try new technology before the adoption [29].

H1. *Technological factors significantly affect social media adoption in functional beverage MSMEs in Solo Raya.*

3.2. Organization

Organizational factors describe the scope variables in a functional beverage MSMEs in Solo Raya. The factors include top management support, organizational size, resource flexibility, specialization, and managerial structure complexity [34]. Therefore, this research analyzed organizational factors using the dimensions of top management and entrepreneur innovativeness. Organizational support can affect innovative work behavior [35].

Based on the description above, top management support in organization is very important for technology adoption. This variable sets policies for innovation by adopting social media information technology in tactical or marketing operations [29]. The higher the level of innovation, the greater the probability of taking risks and advantage of new opportunities to support business growth [36].

H2. *Organizational factors significantly affect social media adoption in functional beverage MSMEs in Solo Raya.*

3.3. Environment

Environmental factors describe all external factors affecting the organization, including the conditions of operation. This research analyzed environmental factors from indicators of competitive, customer, and social pressure [37]. Environmental factors, including market structure and determinants originating from the external environment of MSMEs, can affect social media adoption. The more competitors and external pressures, the greater the likelihood of social media adoption to maintain business [29].

H3. *Environmental factors significantly affect social media adoption in functional beverage MSMEs in Solo Raya.*

3.4. Individual Factors

Individual factors play a crucial role in the adoption and use of social media, which continues to evolve. Key determinants include willingness to adopt, technological knowledge, openness to innovation, and adaptability to change [38]. These indicators determine the tendency to adopt information technology [39]. The uncertainty and risk in technology adoption process will be reduced when an individual has good skills and experience. User knowledge and skills are also believed to increase the speed of technology adoption. Moreover, higher levels of digital literacy and an understanding of the benefits of technology contribute to faster and more effective adoption [21].

H4. *Individual factors significantly affect social media adoption in functional beverage MSMEs in Solo Raya.*

Figure 1 shows the modified model of TOE-I method and the hypothesis.

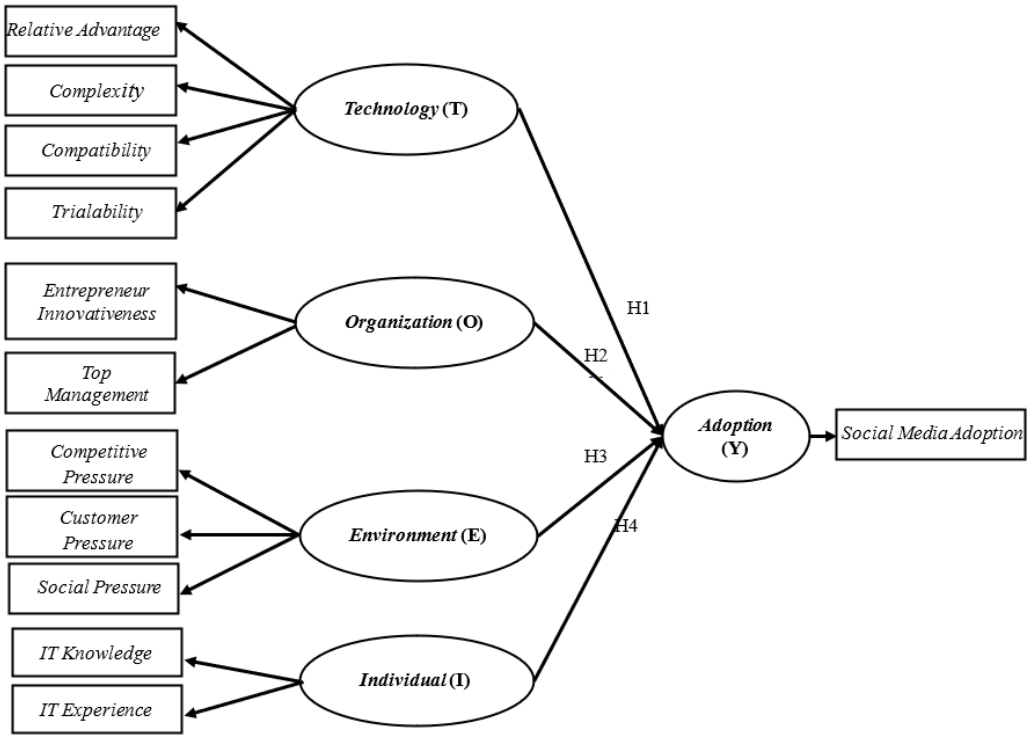

Figure 1. Modified Model of TOE-I Approach.

4. Materials and Methods

The descriptive and quantitative methods used in this research focus on collecting and analyzing numerical data [40]. Furthermore, the analysis results are described to provide an overview of the relationship, hypotheses testing, and identify the symptoms of a population [41].

The location was determined purposively based on several considerations related to certain criteria [41].

Therefore, this research was located in Solo Raya, which includes Surakarta City, Karanganyar Regency, Sragen Regency, Sukoharjo Regency, Klaten Regency, Boyolali Regency, and Wonogiri Regency. The number of MSMEs area was quite high with a contribution reaching 17.37% in Central Java. The use of purposive sampling and limited locations in Solo Raya limits the generalizability of the findings to other regions or MSME sectors. The results of this study are more representative of local conditions, so further studies are needed with a wider scope and a more representative sampling approach.

A purposive sampling method was used to determine the samples affected by the objectives [42]. The criteria for functional beverage MSMEs determined as respondents are businesses that have a workforce of 1–4 people for micro businesses, 5–19 people for small businesses, and 20–99 people for medium businesses. In addition, MSMEs have also adopted social media including WhatsApp, Instagram, Facebook, or Tiktok applications. Hair [43], the minimum sample size should be 10 times the number of independent variables or the maximum number of arrows pointing to latent variables in the PLS path model. The respondents were distributed evenly with each regency/city containing 15 individuals resulting in a total of 105. Sampling is done without giving equal chances to each member of the population to be selected [44]. Sampling used the purposive non-probability method [37,38]. The primary data were obtained directly, including specific information regarding the characteristics of respondents, such as name, age, education level, social media use, length of business, reasons for running a business, and factors influencing the adoption, such as technological, organizational, environmental, and individual factors. All data related to these questions were provided in the questionnaire sheet [40]. The purpose of using a questionnaire is to obtain information that is relevant to the research problem and objectives and to obtain information with high reliability and validity [45]. The secondary data included information on MSMEs in Central Java Province and Solo Raya area obtained from Central Statistics Agency (BPS), Institute for Development of Economics and Finance (INDEF), and other online sources.

Data collection was obtained through interviews, observation, recording, and documentation methods [46] from June to October 2024. The measurement of questionnaire variables used a five-point Likert scale where the value was 1 for "strongly disagree" to 5 for "strongly agree" [40]. The data were analyzed using SEM-PLS through SmartPLS 4 software. Additionally, the data analysis was carried out in three stages, including 1) instrument testing, analysis of validity and reliability of items, 2) data testing to evaluate the measurement and structural model, and 3) hypothesis testing through bootstrapping to examine the path analysis and the effect of loading factors on each variable [47].

Research instrument testing was carried out by measuring validity and reliability of the data. Meanwhile, validity testing was conducted to determine validity of questionnaire by analyzing loading factor and Average Variance Extracted (AVE) value [48]. The analysis can proceed to the subsequent stage, which includes examining AVE value when indicators have loading factor of ≥ 0.70 [49]. Based on the instrument testing results seen in **Tables A1** and **A2**, the indicators meet the criteria and are valid. Therefore, the indicators can represent more than 70% of the latent variables effect and are used for data collection [50].

According to Efendi et al. [49], a variable was said to have high validity when the value was above 0.50. Therefore, the indicators were valid and could explain more than 50% of the variance. Reliability testing was carried out on the instruments used in this research to determine the consistency of the indicators by examining Cronbach's alpha and composite values [51]. Cronbach's alpha could be considered reliable when the value was ≥ 0.60 in applied research [42]. Efendi et al. [49], stated that the role of thumbs in the composite reliability value was greater than 0.70, hence, the actual reliability of a variable was accepted.

The instrument testing results showed that all indicators met the requirements for validity and reliability in the data collection process. **Table 1** shows the variables and indicators used in this research.

Table 1. Variables and Indicators Used.

Variable	Indicator	Code	Statement
Technology (T)	*Relative Advantage*	TRA1	Social media helps to improve my business image.
		TRA2	Social media helps to minimize marketing and promotion costs.
		TRA3	Social media helps my business to be more effective.
		TRA4	Social media helps me to promote effectively.
		TRA5	Social media helps me to increase sales.
	Complexity	TCx1	Social media platform is easy for me to learn.
		TCx2	Social media platform is easy to use.
		TCx3	Social media is flexible to use for interaction.
		TCx4	Social media is easy to understand.
	Compatibility	TCb1	Social media usage is in line with my beverage business.
		TCb2	Social media usage is in line with the technology infrastructure (e.g. cellphone, laptop, PC) that I have.
	Trialability	TT1	I can easily integrate social media with existing business platforms (e.g., online store, catalog).
		TT2	I can try social media first before fully using it for my business.
Organization (O)	*Entrepreneur Innovativeness*	OEI1	I like to try using trending social media platforms.
		OEI2	If I hear about new information technology, I will find a way to use it.
		OEI3	I enjoy implementing new information technology.
	Top Management	OTM1	Social media adoption is important for my business.
		OTM2	I have competent employees.
Environment (E)	*Competitive Pressure*	ECP1	I feel that using social media to compete in the market is a strategic need.
		ECP2	I believe that if I do not adopt social media, I will lose in business competition.
		ECP3	Social media helps my business's ability to win the competition.
		ECP4	Social media helps my business generate higher profits.
	Customer Pressure	ECsP1	I know that my customer is ready to transact business through social media platform.
		ECsP2	I feel the need to adopt social media for business activities to maintain competitiveness and profitability.
	Social Pressure	ESP1	Social media is a popular application, hence I also want to use it as a business platform.
		ESP2	I follow others in social media adoption.
		ESP3	I chose to adopt social media because many other businesses are already using it.
Individual (I)	*IT Experience*	IK1	I have extensive technical knowledge of information technology or social media-like technology.
		IK2	I understand how to operate social media for my beverages sales and promotions.
	IT Knowledge	IE1	I feel familiar with social media as a tool for business.
		IE2	I can quickly learn and apply new information technology.
Adoption (Y)	*Social Media Adoption*	Y1	I adopt social media to support promotional activities.
		Y2	Social media adoption supports product sales activities more easily.

Source: [29,30,37,52].

4.1. Evaluation of Measurement Model (Outer Model)

Measurement model testing was used to measure specific relationships between endogenous and exogenous latent variables with the indicators [53]. Testing on the outer model provided a value on reliability with the criteria of Cronbach's alpha value > 0.60 [42] and composite reliability > 0.70. Validity testing consisted of convergent validity measured from loading factor and AVE values, which could be more than 0.70 and 0.50, respectively. Furthermore, the discriminant validity testing was calculated from cross-loading with the criteria that loading factor was higher than the indicators of other variables and Fornell-Larcker criterion value [54].

4.2. Evaluation of Structural Model (Inner Model)

Structural model evaluation reviews the feasibility of the model structure created with various theories [55]. A variable is considered substantial, moderate, and weak

with R^2 value of 0.67, 0.33, and 0.19, respectively [56]. The following criterion is based on Predictive Relevance (Q^2) value. A Q^2 value greater than 0 shows that the model has predictive relevance. Meanwhile, a value of 0.50 indicates small, medium, and large predictive accuracy for each model on PLS path [54].

4.3. Full Collinearity VIF

Full Collinearity VIF is a method to detect overall multicollinearity in the SEM-PLS model, including the potential for common method bias [57]. A full VIF value exceeding 3.3 indicates the presence of collinearity and possible bias from a single data source. The use of Full Collinearity VIF has been recommended in various recent studies to ensure overall model validity, especially in survey-based research [58].

4.4. Hypothesis Testing

Hypothesis testing is used to determine the effect between hypothesized variables using the bootstrapping procedure [59]. The criteria are when the significance level is 5% and the p-value $\leq$ 0.05. Therefore, the hypothesis is accepted (Ha accepted, H0 rejected) when the p-value $<$ 0.05 but rejected (H0 accepted, Ha rejected) when the p-value $\geq$ 0.05 [54]. The mathematical hypothesis relationship model is as follows.

$$Y = \beta 1T + \beta 2O + \beta 3E + \beta 4I + \varepsilon \quad (1)$$

Description:

H1 Testing	H2 Testing	H3 Testing	H4 Testing
Ho : $\beta 1 = 0$	Ho : $\beta 2 = 0$	Ho : $\beta 3 = 0$	Ho : $\beta 4 = 0$
Ha : $\beta 1 \neq 0$	Ha : $\beta 2 \neq 0$	Ha : $\beta 3 \neq 0$	Ha : $\beta 4 \neq 0$

5. Results

5.1. Respondents' Characteristics

Most respondents belong to productive age and possess an increased potential to run a more adaptive business [60]. These respondents are female and tend to be creative, specifically in making, innovating, sustaining innovation, and expanding market access [60]. The functional beverage business in Solo Raya is managed by high school graduate entrepreneurs. Tovan et al. [21] stated that the success of MSMEs was supported by the level of education as well as training and government support. **Table 2** shows the distribution of MSMEs based on the type of functional beverage.

Table 2. Distribution of MSMEs Based on Type of Functional Beverages.

Region	Types of Functional Beverages		
	Natural	Traditional	Modern
Wonogiri	5	8	2
Surakarta	5	7	3
Sukoharjo	5	7	3
Karanganyar	8	5	2
Klaten	7	7	1
Boyolali	6	4	5
Sragen	10	4	1
Total	46	42	17

Source: Primary Data Analysis (2024).

Natural functional beverages without processing include fresh milk, young coconut, and fruit juices. Traditional functional beverages are types of products processed using hereditary methods [61] such as herbal medicines and temulawak, *wedang uwuh* (Spiced Herbal Beverage). Meanwhile, modern functional beverages are the least cultivated because the manufacturing requires a formulation stage to obtain various physiological functions [62]. Examples are yogurt, kombucha, and infused water, requiring technical skills and knowledge for the process.

Functional beverage MSMEs in Solo Raya use social media, including WhatsApp, Instagram, Facebook, and TikTok, as marketing and promotion media, developing businesses, and monitoring distribution systems [63]. WhatsApp application is commonly used daily as a communication medium and is relatively easy for all ages. The selection of the type of social media is adjusted to the ease of operation of owner and customer habits [64]. **Table 3** shows social media adopted by respondents in this

research processed using hereditary methods such as herbal medicines and temulawak, *wedang uwuh* (Spiced Herbal Beverage). Meanwhile, modern functional beverages are the least cultivated because the manufacturing requires a formulation stage to obtain various physiological functions [62]. Examples are yogurt, kombucha, and infused water, requiring technical skills and knowledge for the process.

Table 3. Distribution of Social Media Adopted by Respondents.

Based on the Type of Social Media Adopted		
Description	**Total**	**Percentage (%)**
WhatsApp	100	95.24
Instagram	44	41.90
Facebook	30	38.57
TikTok	14	13.33
Based on the Number of Social Media Adopted		
Description	**Total**	**Percentage (%)**
1	48	45.71
2	37	35.24
3	13	12.38
4	7	6.67

Source: Primary Data Analysis (2024).

More than 50% of functional beverage MSMEs use 1 type of social media. According to [14], this is conducted to promote and market business merchandise products. The difference in the number of social media adoptions carried out by functional beverage MSMEs is affected by the understanding of technology. Limited expertise in operating social media and limited human resources are obstacles for MSMEs in adopting social media technology [65].

5.2. Evaluation of Measurement Model (Outer Model)

5.2.1. Validity Testing

The loading factor value of the indicators used on the questionnaire is higher than 0.70, as reported in **Table A1**. Therefore, indicators are declared valid and can represent more than 70% [49] of technology, organization, environment, and individual variables. Meanwhile, all the indicators have AVE value > 0.50 due to validity. AVE value exceeding 0.5 shows that the value explains more than 50% of the variance of each indicator [49].

Cross-loading value of all indicators in each latent variable can be seen in **Table A3**, which shows a higher value than the correlation of the indicator. Therefore, the variables of technology, organization, environment, and individual can be explained by each of the constituent indicators. This shows that each indicator is unique and does not represent other variables [53]. Each AVE square root value for each variable or Fornell Larker-Criterion can be seen in **Table A4**. In this context, the variable explains more of the indicators than others [48].

5.2.2. Reliability Testing

Reliability testing is conducted to determine the consistency or stability of data since the data is reliable to describe actual conditions in the field [48]. Measurements with high-reliability values can produce reliable data. Reliability testing includes Cronbach's alpha and composite reliability, as seen in **Table A5**.

Based on the analysis results, the indicators have a Cronbach's alpha value > 0.60. Therefore, the indicators have a composite reliability value > 0.70, indicating that the variables have quite high internal consistency [66]. The results show that all indicators are said to be reliable. The instrument used meets reliability standards and the measurement results can be consistent in measuring technology, organization, environment, and individual variables. The model also produces valid results and can be used as a basis for decision-making or recommendations related to social media adoption by functional beverage MSMEs since indicators are declared reliable.

5.3. Evaluation of Structural Model (Inner Model)

Structural model evaluation is used to assess the suitability of exogenous to endogenous latent variables [67]. The evaluation examines R^2 and Q^2 values, as reported in **Table 4**.

Table 4. R^2 and Q^2 Values.

Variable	(R^2)	(Q^2)	Category
Adoption	0.456	0.404	Moderate, predictive relevance medium

Source: Primary Data Analysis using SmartPLS4 (2024).

Based on table, variable adoption had an R^2 value of 0.456, which was in the moderate in explaining the latent variable. This shows that adoption has a significant but not dominant effect in explaining technology, organization, environment, and individual by 45.6% [68]. Other factors outside the model contribute to defining social media adoption by functional beverage MSMEs. These could include factors such as perceived digital risks, access to digital infrastructure, government support for digitalization, entrepreneurial motivation, or the level of digital trust among MSME owners. Considering the local context of functional beverage MSMEs, cultural attitudes toward technology and informal business practices may also play a role in influencing adoption decisions. Therefore, future research should consider integrating additional constructs or moderating variables to enhance the model's explanatory power and provide a more comprehensive understanding of digital adoption behavior among MSMEs. Based on Q^2 value, adoption has medium predictive relevance or a moderate ability to predict variables [48]. This value shows that the model has quite good predictive ability but is not fully strong.

5.4. Full Collinearity VIF

Full collinearity VIF is a test conducted to validate the SEM-PLS model in survey-based research [69]. VIF test results are reported in **Table 5**.

Table 5. Collinearity Statistics (VIF).

Variables	VIF
Technology	2.341
Organization	2.313
Environment	2.280
Individual	1.698
Adoption	1.420

Source: Primary Data Analysis using SmartPLS4 (2024).

The table shows the Full Collinearity VIF test results of the four variables in the SEM-PLS model, where all VIF values are below the threshold of 3.3. This indicates that there is no full multicollinearity problem and no indication of common method bias (CMB) in the model [58]. According to Kock and Hadaya [69], a full collinearity VIF value below 3.3 indicates that the data is free from distortion caused by too strong relationships between constructs. The highest VIF value is 2.341 (technology variable), which is still within safe limits and indicates that each construct does not distort each other significantly. This result indicates that the model used is structurally valid and the data is not influenced by a single source of bias [57].

5.5. Hypothesis Testing (Bootstrapping)

Mathematical relationship model based on bootstrapping results is presented as follows:

$$Y = 0.278\,T + 0.20\,O + 0.271\,E + 0.235\,I + \varepsilon \qquad (2)$$

The accepted hypothesis shows that the independent variable in the hypothesis affects the dependent variable (**Table 6**).

The technology factor (T) has the greatest influence on social media adoption with a coefficient value of 0.278 ($p = 0.005$), which is included in the category of moderate influence approaching strong and significant [8]. This indicates that aspects such as relative advantage, compatibility, ease of use, and technological trialability are dominant factors in encouraging functional beverage MSMEs to adopt social media. Furthermore, environmental factors (E) also show a significant influence with a coefficient value of 0.271 ($p = 0.013$), which is almost equivalent to technological factors. This suggests that external pressures from consumers, competitors, and the surrounding community are also important drivers in social media adoption decision-making [70]. Individual factors (I), which include the experience and knowledge of business owners, also have a significant influence ($\beta = 0.235$; $p = 0.014$), but with a lower influence strength than technological and environmental factors [7]. Meanwhile, organizational factors (O) did not have a significant effect ($\beta = 0.020$; $p = 0.880$), possi-

bly because most MSMEs are personally managed by the owner without the support of a formal organizational structure or adequate internal resources. Thus, it can be concluded that technological factors have the most significant influence on the adoption of social media by functional beverage MSMEs, followed by environmental and individual factors, while organizational factors make a very small and insignificant contribution.

Table 6. Hypothesis Testing Results.

Relationship	Path Coefficient	P-Values	Category
T → Y	0.278	0.005***	H1 accepted
O - Y	0.020	0.880ns	H2 rejected
E - Y	0.271	0.013**	H3 accepted
I - Y	0.235	0.014**	H4 accepted

Source: Primary Data Analysis using SmartPLS4, 2024.
Description:
* : Significant at 90% confidence level with $\alpha = 0.1$
** : Significant at 95% confidence level with $\alpha = 0.05$
*** : Significant at 99% confidence level with $\alpha = 0.01$
ns : Not significant

6. Discussion

6.1. H1: The Effect of Technology on Social Media Adoption in Functional Beverage MSMEs in Solo Raya

Table 5 shows that H1 is accepted since technology significantly affects social media adoption in functional beverage MSME in Solo Raya. According to Dharmawan et al.[40], technology factors significantly affect social media adoption in MSMEs. In fact, respondents adopt social media because the platform offers relative advantages in the form of effectiveness in promotional activities, interaction facilities, and ease of use with existing devices, such as laptops and smartphones. In addition, MSME owners in Solo Raya generally have an open attitude towards change, especially those that provide direct benefits to business operations, such as social media. Moreover, social media and digital devices such as smartphones have become part of the daily lives of business actors, so technology adoption is more natural and does not require special training.

The relative advantage of social media plays a significant role in its adoption among functional beverage MSMEs in Solo Raya, as most business owners are motivated by the clear and immediate benefits that technology can bring to their operations. As highlighted by Alghamdi[71], relative advantage has positive and significant influence on technology implementation decision. In the case of Solo Raya's MSMEs, business owners see social media as a practical tool to enhance visibility, attract customers, and boost daily sales. With limited labor and capital, social media is an effective solution for promotion without huge costs and without the need for a dedicated marketing team.

Ease of operation and compatibility with the media have affected the adoption of social media to support promotional activities and communication with customer effectively. This is in line with Nawi et al.[72], where social media positively affects respondents and helps promotional activities become more efficient. For functional beverage MSMEs, platforms like social media allow for massive product exposure, helping them reach a broader market and support long-term business growth[73].

WhatsApp is the most widely used application by respondents because the platform is low-complexity. Respondents can quickly respond to customer without interacting directly, improving communication between business actors and customer[74]. Instagram is the second most widely used and respondents adopted the application to upload photos and videos for product promotions.

There are five criteria in innovation adoption, namely relative advantage, suitability, complexity, ease to try, and ease of observation[75]. Social media is a platform accessed without considering the education or age of users[14]. This accessibility gives MSMEs in Solo Raya a greater opportunity to market their functional beverages more broadly and connect with a wider customer base. Chatterjee and Kar[76] reported that social media adoption for marketing had a positive effect

and significantly impacted business. The relative advantages of adopting social media, namely improving image, minimizing costs, business effectiveness, and increasing sales, can be felt by business owners.

6.2. H2: The Effect of Organizations on Social Media Adoption in Functional Beverage MSMEs in Solo Raya

Based on **Table 5**, H2 is rejected and the organizational variable does not significantly affect social media adoption. This is in line with the results of research conducted by Mahirah et al.[77], which states that the organizational variable does not have a significant effect on social media adoption. However, unlike Tripopsakul[29], that organizational variable significantly affect social media adoption. This was because 91.43% of respondents had less than 5 employees. Therefore, the decision to adopt social media is based on the personal decisions of owners.

Organizational variables do not have a significant effect on social media adoption in functional beverage MSMEs in Solo Raya due to the internal characteristics of MSMEs that tend to have simple and informal organizational structures. Many of these MSMEs are managed directly by the owner without any division of roles or special divisions, so that decision-making does not go through organizational mechanisms, but is based on the initiative and capacity of individual owners. This high reliance on the personal decisions of the owner makes organizational factors such as size, structure or internal policies less relevant. In addition, limitations in terms of human resources, technological know-how and budget also lead to the absence of adequate organizational support for social media implementation. The main focus of these MSMEs is directed more towards product innovation, particularly the development of beverage variants, rather than strengthening digital marketing strategies. In the absence of strategic organizational policies that encourage digitalization, social media adoption becomes more dependent on individual motivation and knowledge, rather than on the strength or influence of the overall organizational structure.

The entrepreneur innovativeness indicator is related to the innovative nature possessed by respondents in facing tight market competition. According to Sofiyan et al.[78], innovation affects the performance of a business through the application of science to increase the capacity of business. However, in reality, functional beverage MSME respondents in Solo Raya more focus on implementing innovation in terms of product variations, not on the technology used. This is related to functional beverage products that have various types, so that MSME functional beverage in Solo Raya more often explore new product functional beverage variants that become new innovations in their market. Approximately 24.76% of MSMEs also explore 10 new functional beverage variants in the market. For example, respondents can process tea of one variant into various products through combinations with other natural ingredients, including chamomile, chrysanthemum, rosella, and telling. Ref.[79] explained that developing more innovative products could increase the competitiveness of a business by creating innovative characters and values.

Top management as an indicator does not significantly affect social media adoption. This is because owner from functional beverage MSMEs in Solo Raya cannot manage social media in terms of capital or human resources. According to Awa et al.[34], MSMEs have limitations in implementing information technology because owners and employees lack in-depth knowledge and manpower, as well as the thought of running business without using technology.

As shown in **Table 3**, promotional innovation using social media is classified as less than optimal. Approximately 45.71% of respondents only adopted 1 type of social media for business activities. This is because most small-scale businesses have a limited number of workers. Therefore, adoption decision is only based on owners[39].

6.3. H3: The Effect of Environmental on Social Media Adoption in Functional Beverage MSMEs in Solo Raya

The analysis results show that H3 is accepted since environmental variable significantly affects social media adoption. According to Tripopsakul[29], environment significantly and positively affects social media adoption in MSMEs. Environmental variable is affected by govern-

ment support, uncertainty, and customer pressure. One of them is MSMEs in Solo Raya, which are often involved in social networks or local business communities. In this culture, businesses tend to adapt to trends and pressures from the surrounding environment, including consumer expectations and competitors who have first adopted social media.

Based on the description above, Pangesti and Adyaksana [80] showed that customer pressure indicators had a major effect in implementing innovation based on bargaining power. MSMEs comply with the request when customer has sufficient influence to demand the adoption of technology. This can also support the success of MSMEs by achieving excellence to remain competitive. Customer relying on social media to interact, search for product information, and make purchases is forced to be active on digital platforms to maintain a competitive advantage and meet changing expectations for digital and personal experiences [81].

Functional drinks, which are traditional products, are required to adapt to the times, especially in terms of marketing. Although the products they sell are traditional drinks, functional drinks MSMEs must adopt social media. If this is not implemented, MSMEs are considered backward and will lose their customers. Business competition pressures functional beverage MSMEs to adopt social media as a marketing strategy [82]. Business competition pressures functional beverage MSMEs to adopt social media as a marketing strategy.

The digitalization programs are supported by the government or business community with a primary focus on education [83]. Therefore, MSMEs can adopt information technology to support business activities. the digitalization program could help MSMEs face challenges in the form of limited infrastructure and low digital literacy to expand customer reach, strengthen branding, and build trust.

6.4. H4: The Effect of Individual Factors on Social Media Adoption in Functional Beverage MSMEs in Solo Raya

Based on the results, H4 is accepted since individual factor variables have a significant effect on social media adoption in functional beverage MSMEs in Solo Raya. According to Ahmad et al. [84], individual variables have a significant effect on the level of information technology adoption. This is because the knowledge, skills, and experience of individual business actors can drive decision-making in adopting technology. The indicator that makes the greatest contribution is individual knowledge. High knowledge and experience drive individual needs in adopting technology [84]. People in Solo Raya are known to have a high work ethic and are open to changes that bring practical benefits. This culture supports business owners to continuously learn and adapt to evolving digital trends, including the use of social media for promotion and customer interaction.

An individual at a productive age tends to be more receptive to technological innovation due to high thinking and working abilities. Individual knowledge is key in technology adoption because adequate knowledge can drive innovation performance toward understanding technology [85]. Extensive technical knowledge of information or social media-like technology greatly affects social media adoption. In line with Ammenwerth et al. [6], knowledge and ability to use social media can provide benefits for business actors. This knowledge identifies current trends and opportunities used by MSMEs. Extensive technical knowledge includes the ability and understanding of individuals to manage and use social media optimally for business purposes. Basic technological knowledge possessed by individuals includes an understanding of hardware in the form of downloading applications and system updates. The higher the knowledge and experience in using social media, the greater the opportunity to optimally adopt social media [21]. Online marketing knowledge can target markets with a wider reach, opening up opportunities for increased income.

Young adults are the most active age group in terms of digital technology utilization, such as the use of online communication platforms, online entertainment, social networking and social media [86]. Based on the data obtained, the majority of functional drinks MSME owners in Solo Raya are 41 to 47 years old. In terms of educational background, the majority of MSME owners have the last level of education of senior high school. These findings are the reason that individual variables have a significant influence on social media adoption in func-

tional beverage MSMEs in Solo Raya. This is because individual business owners are familiar with the use of social media.

7. Conclusions

In conclusion, social media adoption by functional beverage MSMEs in Solo Raya was affected by several technological (relative advantage, complexity, compatibility, and trial), environmental (competitor pressure, customer pressure, and social pressure), and individual factors (IT knowledge and experience). However, this research did not show a significant effect on organizational factors (innovation of business owners and top management). The results provided insight into the role of technological, organizational, environmental, and individual factors in social media adoption for MSMEs. Recommendations that can be given regarding product marketing are that it is hoped that functional beverage MSMEs in Solo Raya can take advantage of the latest features on social media platforms, namely digital advertising, stories, live streaming on Instagram, Facebook, and TikTok applications to increase relative benefits such as supporting marketing and expanding market networks and utilizing the WhatsApp Business application as a communication medium that is suitable for business, easy and effective. In addition, the Government can provide technological and educational support through intensive mentoring related to the practice of using social media and preparing marketing strategies for businesses effectively, as well as digital mentoring programs that are expected to encourage functional beverage MSMEs to be able to utilize modern technology as the main marketing media and product development. Individuals or owners of functional beverage MSMEs can increase their knowledge and experience of information technology, especially social media by always adapting to changes in digital trends so that the use of social media can run more effectively and optimally.

This research was only conducted with the TOE-Individual approach so that there are limitations on the variables used. Based on this, future research can add new variables and indicators, namely financial and psychological aspects to gain a comprehensive understanding of social media adoption in functional beverage MSMEs. This research is also only limited to the Solo Raya area, so further research is expected to expand the scope of research to the regional level in order to identify results with different locations.

Author Contributions

M.N., formulates the research objective, conducts the data collection, conclusion and develops the overall research. E.W.R., compiles the research background, previous research, and acts as supervisor. I.K., formulates research gaps and acts as supervisor. All authors have read and agreed to the published version of the manuscript.

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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 Departement of Agribusiness, 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.

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.

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Conflicts of Interest

All authors disclosed no any conflict of interest.

Appendix A

Table A1. Loading Factor Values in the Outer Model.

Variables	Indicator	*Outer Loading*	Code	Outer Loading
Technology	Relative Advantage	0.863	TRA1	0.816
			TRA2	0.857
			TRA3	0.813
			TRA4	0.914
			TRA5	0.845
	Complexity	0.815	TCx1	0.860
			TCx2	0.891
			TCx3	0.718
			TCx4	0.869
	Compatibility	0.843	TCb1	0.874
			TCb2	0.875
	Trialability	0.800	TT1	0.915
			TT2	0.851
Organization	Entrepreneur Innovativeness	0.847	OEI1	0.856
			OEI2	0.869
			OEI3	0.886
	Top Management	0.867	OTM1	0.909
			OTM2	0.891
Environment	Competitive Pressure	0.830	ECP1	0.791
			ECP2	0.870
			ECP3	0.892
			ECP4	0.861
	Customer Pressure	0.838	ECsP1	0.881
			ECsP2	0.854
	Social Pressure	0.815	ESP1	0.826
			ESP2	0.790
			ESP3	0.909
Individual	IT Knowledge	0.891	IK1	0.887
			IK2	0.832
	IT Experience	0.863	IE1	0.916
			IE2	0.934
Adoption	Social Media Adoption	0.898	Y1	0.896
		0.858	Y2	0.860

Source: Primary Data Analysis using SmartPLS4, 2024.

Table A2. Average Variance Extracted (AVE) Value in the Outer Model.

Indicator	AVE	Description
TRA	0.722	Valid
TCx	0.701	Valid
TCb	0.765	Valid
TT	0.781	Valid
OEI	0.757	Valid
OTM	0.810	Valid
ECP	0.730	Valid
ECsP	0.753	Valid
ESP	0.711	Valid
IK	0.739	Valid
IE	0.856	Valid
Y	0.771	Valid

Source: Primary Data Analysis using SmartPLS4, 2024.

Table A3. Cross Loading Values in the Outer Model.

Code	TRA	TCx	TCb	TT	OEI	OTM	ECP	ECsP	ESP	IK	IE	Y
TRA1	**0.816**	0.447	0.646	0.458	0.494	0.511	0.634	0.485	0.451	0.457	0.353	0.602
TRA2	**0.857**	0.413	0.589	0.464	0.378	0.369	0.545	0.486	0.310	0.277	0.206	0.390
TRA3	**0.813**	0.390	0.613	0.450	0.444	0.292	0.592	0.495	0.405	0.247	0.204	0.466
TRA4	**0.914**	0.468	0.660	0.440	0.459	0.449	0.579	0.535	0.478	0.339	0.360	0.573
TRA5	**0.845**	0.462	0.614	0.425	0.356	0.495	0.565	0.625	0.352	0.307	0.320	0.467
TCx1	0.387	**0.860**	0.397	0.647	0.539	0.369	0.277	0.307	0.352	0.485	0.342	0.351
TCx2	0.417	**0.891**	0.395	0.613	0.481	0.346	0.241	0.369	0.253	0.504	0.379	0.375
TCx3	0.478	**0.718**	0.503	0.521	0.369	0.187	0.253	0.402	0.352	0.224	0.335	0.393
TCx4	0.437	**0.869**	0.491	0.613	0.426	0.326	0.233	0.498	0.418	0.411	0.444	0.431
TCb1	0.671	0.455	**0.874**	0.388	0.314	0.364	0.506	0.592	0.234	0.419	0.362	0.446
TCb2	0.614	0.478	**0.875**	0.495	0.245	0.418	0.502	0.480	0.410	0.307	0.365	0.374
TT1	0.508	0.768	0.486	**0.915**	0.524	0.350	0.362	0.455	0.405	0.360	0.418	0.399
TT2	0.413	0.464	0.398	**0.851**	0.240	0.223	0.280	0.213	0.206	0.144	0.185	0.309
OEI1	0.488	0.542	0.350	0.454	**0.856**	0.338	0.376	0.431	0.404	0.413	0.335	0.309
OEI2	0.492	0.417	0.300	0.379	**0.869**	0.449	0.517	0.274	0.603	0.472	0.353	0.445
OEI3	0.335	0.464	0.191	0.350	**0.886**	0.432	0.257	0.316	0.396	0.497	0.372	0.372
OTM1	0.553	0.388	0.499	0.417	0.459	**0.909**	0.521	0.475	0.374	0.501	0.434	0.446
OTM2	0.337	0.271	0.298	0.170	0.381	**0.891**	0.421	0.396	0.333	0.497	0.240	0.381
ECP1	0.534	0.143	0.462	0.315	0.338	0.410	**0.791**	0.501	0.427	0.311	0.277	0.453
ECP2	0.644	0.242	0.497	0.323	0.404	0.464	**0.870**	0.448	0.488	0.372	0.164	0.440
ECP3	0.582	0.272	0.483	0.278	0.375	0.469	**0.892**	0.515	0.455	0.330	0.157	0.351
ECP4	0.580	0.367	0.528	0.343	0.388	0.452	**0.861**	0.451	0.405	0.392	0.198	0.353
ECsP1	0.563	0.524	0.554	0.458	0.432	0.396	0.469	**0.881**	0.528	0.336	0.372	0.525
ECsP2	0.508	0.286	0.508	0.215	0.233	0.449	0.505	**0.854**	0.337	0.295	0.140	0.352
ESP1	0.439	0.425	0.289	0.411	0.537	0.374	0.410	0.368	**0.826**	0.261	0.323	0.499
ESP2	0.327	0.308	0.275	0.208	0.403	0.228	0.356	0.480	**0.790**	0.136	0.195	0.334
ESP3	0.423	0.316	0.361	0.293	0.432	0.386	0.535	0.431	**0.909**	0.265	0.372	0.410
IK1	0.345	0.402	0.382	0.243	0.481	0.483	0.328	0.289	0.230	**0.887**	0.542	0.447
IK2	0.313	0.441	0.329	0.277	0.429	0.471	0.387	0.344	0.225	**0.832**	0.371	0.367
IE1	0.281	0.352	0.370	0.335	0.343	0.279	0.248	0.257	0.319	0.419	**0.916**	0.338
IE2	0.348	0.474	0.398	0.327	0.406	0.415	0.184	0.299	0.340	0.571	**0.934**	0.450
Y1	0.537	0.411	0.456	0.383	0.373	0.422	0.469	0.534	0.488	0.386	0.393	**0.896**
Y2	0.496	0.404	0.362	0.327	0.390	0.386	0.343	0.350	0.365	0.457	0.359	**0.860**

Source: Primary Data Analysis using SmartPLS4, 2024.

Table A4. Fornell-Larcker Criterion Values in the Outer Model.

	E	I	O	T	Y
E	**0.714**				
I	0.434	**0.783**			
O	0.647	0.609	**0.761**		
T	0.695	0.538	0.631	**0.716**	
Y	0.581	0.514	0.516	0.603	**0.878**

Source: Primary Data Analysis using SmartPLS4, 2024.

Table A5. Results of Cronbach's Alpha and Composite Reliability on the Outer Model.

Indicator	Cronbach's Alpha	Composite Reliability	Description
Relative Advantage	0.903	0.928	Reliable
Complexity	0.855	0.903	Reliable
Compatibility	0.692	0.867	Reliable
Trialability	0.724	0.877	Reliable
Entrepreneur Innovativeness	0.840	0.904	Reliable
Top Management	0.766	0.895	Reliable
Competitor Pressure	0.876	0.915	Reliable
Customer Pressure	0.672	0.859	Reliable
Social Pressure	0.795	0.880	Reliable
IT Knowledge	0.649	0.850	Reliable
IT Experience	0.833	0.923	Reliable
Adoption	0.704	0.871	Reliable

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