Structural equation modeling of internet of things (IoT) adoption for Indonesian Village-Owned Enterprises (*BUMDes*)

Bustami Usman

Department of Government Studies, Universitas Syiah Kuala, Indonesia bustami.
usman@unsyiah.ac.id

Ilham Sentosa

Universiti Kuala Lumpur (UniKL) Business School, Malaysia

ilham@unikl.edu.my

Febri Nurrahmi

Department of Communication Studies, Universitas Syiah Kuala, Indonesia febri.
nurrahmi@unsyiah.ac.id

Abstract

This study seeks to examine the antecedents of Internet of Things (IoT) intention and adoption of Indonesian village-owned enterprises (*Badan Usaha Milik Desa*, BUMDes) by applying the Technology Acceptance Model (TAM). The respondents comprised 237 managers and staff of BUMDes in Aceh, Indonesia. A questionnaire was designed to examine perceived usefulness of IoT on the product and service empowerment, perceived ease of use of IoT, and perceived credibility on IoT, intention to use the technology, and adoption of IoT to the community empowerment in the village setting. The data were analyzed using

partial least squares structural equation modeling (PLS-SEM). The generated model of IoT showed three significant direct paths between perceived usefulness, perceived credibility on the IoT, and intention as well as between intention and adoption. The re-specified model of IoT adoption indicated two significant direct paths (perceived usefulness to intention and intention to adoption) and introduced three new paths (direct paths from perceived usefulness, perceived ease of use, and perceived credibility to adoption). The final model also established partial mediating effects of intention between Perceived Usefulness, Perceived Ease of Use, and IoT adoption. This study suggests the relevance of TAM to explain IoT adoption in Indonesian village-owned companies.

INTRODUCTION

Internet of Things (IoT) has become an increasingly important topic in this modern society. According to Rayes and Salam (2019), IoT is defined as "the network of things, with clear element identification, embedded with software intelligence, sensors, and ubiquitous connectivity to the Internet." In other words, IoT includes electronic devices that are able to connect to the Internet and share data with other Internet-enabled devices. With the increasing use of Internet and social media, the need to adopt IoT in business has also been enhanced. IoT is essential in advancing economic growth (Popescu, 2015) by increasing the revenue of the supply chain (Yan, 2017). Considering its importance for the macro-economy, a number of governments around the world started to introduce policies to encourage the adoption of IoT across various organizations in various industries. However, adopting IoT requires enormous investment and digital literacy. Therefore, many businesses have struggled to adopt IoT, especially small and medium enterprises (SMEs) (Zaidi & Faizal, 2017). IoT is more prevalent in major global cities where many big firms are located, making them significant drivers of urban development (Florida, 2002).

A similar trend is also prevalent in Indonesia. Such a trend is supported by the number of internet users in Indonesia that has increased tremendously in recent years. As of December 2019, Indonesia is positioned as the fourth largest

Internet user in the world, with 171.26 million internet users (Statista, 2020). This indicated a tremendous potential for IoT markets in Indonesia. However, the survival of IoT in this millennium mostly depends on how information technology (IT) has been used in daily operations. Information communication technology (ICT) is something that must be learned and practiced by IoT's users. A certain level of IoT literacy is needed, especially in the use of the Internet for business enhancement.

This study specifically examines the adoption of IoT by one of SMEs in Indonesia, namely village-owned companies (BUMDes). This business entity is a form of small and medium scale enterprises at the village level (Lubis, Rustam, & Muda, 2017) and is similar in nature to State-owned companies (BUMN) and local government-owned companies (BUMD) (Zulpahmi, Badaruddin, & Humaizi, 2020). As regulated in Village Law No. 6/2014, BUMDes is a business entity owned by the government and society at the village level or inter-village cooperation mechanism of formation through village deliberations. It is a village business institution managed by the community and village administration in an effort to strengthen the village economy and is formed based on the needs and potential of the village (Zulpahmi et al., 2020). BUMDes is a pillar of rural economic activity in the village, which functions as a social institution and commercial institution (Srirejeki, 2018). BUMDes plays a significant part in community economic empowerment at the village level.

In the context of Indonesia, the government of Indonesia has launched a smart village program encouraging all stakeholders at the village level, including BUMDes, to integrate digital technologies into all sectors in villages (Nurchim & Nofikasari, 2018). Such a requirement to adopt IoT is challenging for BUMDes operating in rural areas. The number of people accessing the Internet in rural areas is 50% lower than in urban areas, followed by the lack of digital skills and literacy among rural internet users compared to those in urban areas (Hadi, 2018). On the other hand, previous research has indicated that the adoption of technology has improved the performance of SMEs (Abd Rahman, Kamarulzaman, & Sambasivan, 2013), such as BUMDes.

Considering that this business entity is a new economic institution operating in rural areas and still needs a strong foundation for IoT adoption, this area has emerged as a necessary topic to be investigated. However, no attention has been paid to assess the adoption of IoT in BUMdes. Previous works on IoT adoption were conducted in other countries (Ibrahim, 2018; Jaafreh, 2018; Kim, Park, & Choi, 2017), leaving the determinants of IoT adoption in

BUMDes understudied. Therefore, this study aims to determine the factors affecting the IoT adoption in BUMDes by adopting the technology acceptance model. It attempts to investigate the empirical relationships between perceived usefulness, ease of use, credibility, and IoT adoption. Additionally, this study also investigates the mediating effect of intention on those relationships. By using the technology acceptance model (TAM), the results of this study are expected to fill a research gap by revisiting the relevance of TAM to explain IoT adoption in BUMDes. The findings are intended to inform BUMDes stakeholders to improve the adoption of IoT in their enterprises.

LITERATURE REVIEW

Technology acceptance model

Davis (1989) proposed the conceptual model for technology acceptance, called the technology acceptance model (TAM). TAM was put forward to explain the determinants of user behavior towards information technology (Saade, Nebebe, & Tan, 2007). TAM suggests that the user's intention to use to adopt technology can be explained by two factors: Perceived Ease of Use and Perceived Usefulness (Marangunil & Granil, 2015). It suggests that users are driven to adopt a new technology primarily because of its functions and secondarily because of the easiness of benefiting from those functions (Jaafreh, 2018). In this study, Perceived Credibility is added to extend TAM as a variable affecting Intention to Use. This model further suggests that intention is directly related to actual usage behavior (Davis, 1989; Davis, Bagozzi, & Warshaw, 1989; Marangunil & Granil, 2015). The following discusses the relationship between variables in the proposed model:

a.   *Perceived Usefulness and Intention to Use IoT*

Perceived usefulness is defined as the extent to which a person believes that using a particular system will enhance his or her job performance (Davis, 1989). There has been extensive research in the information systems community providing evidence of the significant effect of perceived usefulness on usage intention (Hamid, Razak, Bakar, & Abdullah, 2016; Kucukusta, Law, Besbes, & Legohérel, 2015). Davis (1989) found that Perceived Usefulness has a more substantial influence on Intention to Use than Perceived Ease of Use (Marangunić & Granić, 2015). Users are often willing to overlook some usage difficulties if the service provides the necessary functions.

b. *Perceived Ease of Use and Intention to Use IoT*

Perceived ease of use is defined as to which a person believes that using a particular system will be effortless (Davis, 1989). Perceived ease of use is hypothesized to be a predictor of intention. Extensive research over the past decade provides evidence concerning the significant effect of perceived ease of use on usage intention, either directly (Hamid et al., 2016; Kucukusta et al., 2015) or indirectly through its impact on perceived usefulness (Abdullah, Ward, & Ahmed, 2016). To prevent the "under-used" useful system problem, information systems need to be both easy to learn and easy to use. If the system is easy to use, it will be less threatening to the individual (Moon & Kim, 2001). This implies that perceived ease of use is expected to have a positive influence on users' perception of credibility and intention to use IoT.

c. *Perceived Credibility and Intention to Use IoT*

Perceived credibility is defined as to which one partner believes that the other partner has the required expertise to perform the job effectively and reliably (Ganesan, 1994). Previous research has found that Perceived Credibility contributed to the Intention to Use a new technology (Goyal, Maity, Thakur, & Srivastava, 2013; Koksal, 2016). Therefore, Perceive Credibility is considered in this study. Perceived credibility also refers to two critical dimensions, security and privacy. Security is defined as the protection of information or systems from unsanctioned intrusions or outflows, while privacy is the protection of various types of data collected (with or without the knowledge of the users) during users' interactions with the Internet (Hoffman, Novak, & Peralta, 1999). The usage intention of IoT could be affected by users' perceptions of credibility regarding security and privacy issues. Kim et al. (2017) discovered that security to be one of the significant determinants of customer acceptance of IoT.

d. *Intention to Use and IoT Adoption*

Intention is an indication of a person's readiness to perform a given behavior, and it is considered to be the immediate antecedent of behaviors (Bagozzi & Yi, 1988). Adoption or behavior is the manifest, observable response in a given situation with respect to a given target (Azjen, 1980). In this context, previous studies have also found a significant relationship between intention and IoT adoption (Jaafreh, 2018; Karahoca, Karahoca, & Aksöz, 2018).

The Hypotheses of this study

Based on TAM theory, the research framework consisted of three exogenous and two endogenous variables. Three exogenous variables were hypothesized to have a direct influence on intention to use information technology. Intention was then hypothesized to have a direct impact on the adoption of internet technology. Intention is also assumed to be a mediator between the three exogenous variables and internet adoption (endogenous). The research hypotheses are as follows.

H1 : Perceived usefulness is significantly and positively related to intention.

H2 : Perceived ease of use is significantly and positively related to intention.

H3 : Perceived credibility is significantly and positively related to intention

H4 : Intention is significantly and positively related to adoption.

H5 : Intention mediates the relationship between perceived usefulness and adoption.

H6 : Intention mediates the relationship between perceived ease of use and adoption.

H7 : Intention mediates the relationship between perceived credibility and adoption.

H8 : Perceived Usefulness, Perceived Ease of Use, Perceived Credibility, Internet Intention, and Internet Adoption have a significant interaction in the structural model.

Previous studies

To date, studies of IoT adoption in SMEs are scarce, let alone the IoT adoption in BUMDes. This study has indicated three previous studies related to this object of study. First, Kim et al. (2017) investigated the adoption of smart home services by analyzing 269 questionnaire responses. They employed a new model combining VAM (Value-based Adoption Model) and TAM. They found that Perceived Value was more affected by Perceived Benefit than Perceived Sacrifice. They further discovered that Privacy Risk and Innovation Resistance were found to limit Perceived Value, while Perceived Value greatly influenced

Intention to Use.

Second, Jaafreh (2018) surveyed 72 business leaders and staff working in SMEs in the Kingdom of Saudi Arabia to confirm the robustness of TAM. He also extended TAM by adding National Culture dimensions to study the influencing factors on IoT adoption. His findings confirmed the relevance of the model and discovered that the national culture affected user behavior toward acceptance and rejection of new technology.

Third, Ibrahim (2018) surveyed 400 employees from 43 SMEs in the Malaysian state of Selangor to investigate the effects of the moderating variables (age, gender, and experience) on the use of innovations related to ICT. Using the unified theory of acceptance and use of technology (UTAUT) perspective, he found that the four key predictors (performance expectancy, effort expectancy, social influence, and facilitating conditions) significantly influenced technology adoption. He also found that gender and age acted as moderating variables between the four predictors and technology innovation use.

The aforementioned previous studies are relatively comprehensive in explaining factors that affected ICT-related innovation adoption by SMEs. However, their studies were situated in a context that is entirely different from this study. The previous research was conducted in South Korea (Kim et al., 2017), KSA (Jaafreh, 2018), and Malaysia (Ibrahim, 2018), which is completely different from the context of this study. BUMDes is a form of SMEs operating in rural areas of Indonesia where most people lack digital skills and literacy and do not have access to the Internet. Hence, previous findings could not be exercised in the context of BUMDes in Indonesia.

In addition, the fundamental difference between this study and previous studies is the use of theory. Ibrahim (2018) used the UTAUT perspective, while Jaafreh (2018) using TAM with national cultures, and Kim et al. (2017) used a new model combining VAM and TAM. This study employed TAM with an additional antecedent variable (Perceived Credibility). TAM is more appropriate to this study among other technology adoption models since it has become a key model in understanding users' behavior toward the technology. Previous research has confirmed TAM as a valid model to explain and predict technology acceptance behavior (Abdullah et al., 2016).

METHODS

The questionnaire was adapted from Wang, Wang, Lin, and Tang

(2003), consisting of 31 observed items, including perceived usefulness (six items), perceived ease of use (six items), perceived credibility (eight items), internet intention (five items) and internet adoption (eight items). The scaling used in this research is the 7-points Likert scale (1-strongly disagree, 2-disagree, 3-slightly disagree, 4-neutral, 5- slightly agree, 6-agree, and 7-strongly agree). The questionnaire also covered the demographic variables, including gender, race, age, education, and monthly income.

Table 1: Measurement

Variable	Code	Measurements
Perceived Usefulness (4 items)	PU2	Using IoT would improve my job performance
	PU3	Using IoT would increase my productivity
	PU4	Using IoT would enhance my effectiveness on
	PU5	the job
		Using IoT would make it easier to do my job
Perceived Ease of Use (5 items)	EOU2	I would find it easy to use IoT to obtain
	EOU3	decision-making information
	EOU4	My interaction with IoT was clear and
	EOU5	understandable
	EOU6	I found the IoT to be flexible to interact with
		It would be easy for me to become skilful at using IoT.
		I found the IoT easy to use
Perceived Credibility (5 items)	CRE1	IoT has privacy
	CRE2	I feel confident in my activities with IoT.
	CRE3	When using IoT, I am sure that certain managerial and technical procedures exist to
	CRE4	secure all the data on this system
	CRE6	IoT has a good security system
		When using IoT, I am sure of the consistency of information processing on this system.

Variable	Code	Measurements
Internet Intention (5 items)	INT1	I think it would be very good to use IoT for my company activities in addition to traditional
	INT2	methods
	INT3	In my opinion it would be very desirable to use IoT for my company activities in addition to traditional methods
	INT4	It would be much better for me to use IoT for
	INT5	my company activities in addition to traditional methods
		Using IoT for my company activities is a good idea
		Overall, I like using the IoT's for my company activities
Internet Adoption (6 items)	IA1	IoT nowadays is a prominent strategy
	IA2	IoT is safe
	IA3	IoT is saving cost and time
	IA4	IoT applications supporting the company
	IA5	business processes
	IA6	How much would you say your profit/earn of your business through IoT each month?
		I have been using IoT

The respondents were Young Creative Entrepreneurs (YCE) working at BUMDes who operated their businesses in Aceh province. A questionnaire containing the measures of the constructs was administered to 305 owners of various products. The questionnaires were distributed to the respondents using the proportionate stratified random sampling method. Out of the desired sample size of 305, 245 were returned, indicating a response rate of 80.32%. As such, the response rate for this study is adequate for structural equation modeling (SEM) analysis.

Rigorous data screening procedures were conducted on the raw SPSS data, such as outliers detection as well as reliability, normality, and validity tests. The 245 datasets were coded and saved into IBM SPSS version 25 and analyzed using IBM SPSS AMOS version 25. In this study, a test for multivariate outliers was conducted using the techniques described by Tabachnick, Fidell, and Ullman (2012). The Mahalanobis distance was calculated based on the 31

observed items. The criterion of p < 0.001 and critical value of [?]2 = 59.70 were used. The tests conducted identified eight cases with Mahalanobis values (D2) above 59.70. It implies that the Mahalanobis analysis succeeded in identifying the multivariate outliers, which later were deleted permanently, leaving 237 datasets for further analysis. Several statistical validity tests and analyses were then conducted, including reliability and composite reliability tests, validity tests using confirmatory factor analysis (CFA) for construct validity, discriminant validity for multicollinearity treatment, descriptive analysis, correlation, and structural equation modeling analysis. The steps in SEM analysis were CFA analysis, measurement model analysis of exogenous and endogenous constructs, discriminant analysis, composite reliability analysis and direct/ indirect impact analysis (mediating effect), and finally testing the goodness of fit for the hypothesized and generated model (Al-Jader & Sentosa, 2015; Rengiah & Sentosa, 2015).

RESULTS AND DISCUSSION

The profile of the companies involved in this study indicates that the BUMDes utilized the Internet predominantly for financial services, such as paying bills, salaries, and invoicing (35%), making order information (24.1%), electronic e-mail (23.6%), marketing (23.6%), submitting tenders to customers (23.6), document transferring (19%), purchasing raw materials (8.4%), interaction with the government (5.1%), voice or audio communication (5.1%) and video conferencing (5.1%). The respondents were in the following business sectors: health or pharmaceutical (29.5%), IT business services (29.5%) and others (24.1%); retail government (15.6%), public services (13.5%), education (6.8%), manufacturing (5.1%), and insurance (5.1%). The size of employees in the BUMDes involved were less than 10 employees (84.4%), 11-50 (13.5%), and more than 51 employees (1.7%). Most of the BUMDes were located in urban areas (75.5%), while the remaining were in suburban (17.7%) and rural areas (6.8%). There were slightly more female (60.8%) than male respondents (39.2%) in this study. The kinds of technology the YCEs used were communication systems, such as groupware and e-mail (34.2%), transactional systems for accounting finance, marketing, etc. (24.5%), desktop suites, such as word processing, productivity (15.2%), inter-organizational information systems, such as EDI, Electronic Business (15.6%), decision support systems for accounting, finance, marketing, etc. (12.2%), enterprise systems, such as ERP and CRM (3.4%), and others (8.4%). The positions of the respondents

were owners (20.7%), CEO (3.4%), operation manager (5.1%), line manager (11.8%), and staff (59.1%). In terms of age, nearly half of the respondents were less than 25 years old (47.7%) and 26-40 years old (43.9%), while the remaining were more than 41 years old (8.4%). Their educational backgrounds were high school (38%), diploma (30.8%), bachelor's degree (19.4%), and master's degree (11.8%). Among the respondents, 22.8% of them had professional qualifications in IT. The total business capital of the YCEs were in the following categories: less than IDR 15,000,000 (27.8%), IDR 15,000,000–30,000,000 (17.3%); IDR 30,000,000–60,000,000 (11.8%); IDR60,000,000–150,000,000 (12.2%), and IDR150,000,000–300,000,000 (30.8%).

Table 2: Demographic profile of respondents *(n = 237)*

Demographics	Frequency	Valid Percent
Company utilise the Internet product for:		
1. Electronic mail		
2. Document transferring		
3. Financial: paying bills, salaries, invoicing, etc.	56	23.6
4. Marketing	45	19
5. Submitting tenders to customers	83	35.0
6. Purchasing raw materials, office supplies, etc.	56	23.6
	16	6.8
7. Making order information available to customers	20	8.4
	57	24.1
8. Interaction with government	12	5.1
9. Voice/Audio communication (VOIP)	12	5.1
10. Video conferencing	12	5.1

Demographics	Frequency	Valid Percent
Business sector		
1. Education	16	6.8
2. Manufacturing	12	5.1
3. Retail Government	37	15.6
4. Public Services	32	13.5
5. Banking/Finance	-	-
6. Insurance	12	5.1
7. Construction	-	-
8. Health/Pharmaceutical	25	10.5
9. Business Services/IT business services	70	29.5
10. Other	57	24.1
Number of Employees		
1. Less than 10	201	84.8
2. 11 – 50	32	13.5
3. More than 51	4	1.7
Company location		
1. Urban	179	75.5
2. Sub Urban	42	17.7
3. Rural	16	6.8
Gender		
1. Male	93	39.2
2. Female	144	60.8

Demographics	Frequency	Valid Percent
Level of applications		
1. Desktop suites (e.g. Word processing, productivity)		
2. Communication systems (e.g. groupware, e-mail)		
3. Transactional systems for accounting finance, marketing, etc.	36	15.2
4. Decision support systems for	81	34.2
accounting, finance, marketing, etc.	58	24.5
5. Enterprise systems (ERP, CRM)	29	12.2
6. Inter-organisational Information	8	3.4
systems (EDI, Electronic Business)	37	15.6
7. Other	20	8.4
Job Position		
1. Founder/Owner	49	20.7
2. CEO	8	3.4
3. Operation Manager	12	5.1
4. Line Manager	28	11.8
5. Staff	140	59.1
Age		
1. Less than 25 years old	113	47.7
2. 26 – 30 years old	104	43.9
3. More than 31 years old	20	8.4
Education Background		
1. High School	90	38.0
2. Diploma	73	30.8
3. Bachelor's degree	46	19.4
4. Master's degree	28	11.8
5. Doctoral Degree	-	-
Professional qualification in IT		
1. No	183	77.2
2. Yes	54	22.8

Demographics	Frequency	Valid Percent
The amounts of business capital		
1. ≤IDR15,000,000	66	27.8
2. >IDR15,000,000–30,000,000	41	17.3
3. >IDR30,000,000–60,000,000	28	11.8
4. >IDR60,000,000–150,000,000	29	12.2
5. >IDR150,000,000–300,000,000	723	30.8

The hypothesized model shows the results that do not support the model fit (p<.05). This is expected as the hypothesized model is usually strictly confirmatory. Thus, the modification index was used to fit the data to the generated model. For that purpose, some items were removed. The remaining numbers of items for each construct were as follows: Perceived Usefulness (4 items), Perceived Ease of Use (5 items), Perceived Credibility (5 items), Internet Intention (5 items), and Internet Adoption (6 items).

Table 3 shows that the composite reliability (CR) coefficient value of each variable was greater than 0.70. Hence, all variables had acceptable reliability coefficients. Table 3 also shows that the AVE values of each variable were greater than 0.5. Convergent validity can be established when composite reliability is 0.7 or higher, and the AVE is 0.5 or higher (Kim et al., 2017). CR and AVE in this measurement exceeded the minimum level, indicating a good convergent validity.

Table 3: Convergent Validity

Variables	Composite reliability	AVE
Perceived Usefulness	0.973	0.955
Perceived ease of use	0.976	0.961
Perceived Credibility	0.860	0.649
Internet Intention	0.897	0.680
Internet Adoption	0.972	0.949

Subsequently, a generated model (the same paths as the hypothesized model) was derived with a goodness of fit achieved (p>.05). Thus, the generated

model indicates better goodness of fit indices when some observed variables were deleted. Additionally, a re-specified model was derived whereby new paths have been suggested by modification indices and goodness of fit were achieved (p>.05). The hypotheses tested were based on the findings from the generated and re-specified model. Additionally, the analysis of the competing model or original model (TAM) was also conducted to examine the soundness of the root model, also showing p>.05 (Fig. 5).

Direct influences of the exogenous on the respective endogenous variables in the two structural models are shown in Table 4a-4c. Based on Standardized Beta estimates and critical ratio (CR=t-values) values of >1.96, H1, H3, and H4 were supported in all generated and re-specified models. Therefore, it can be concluded that Perceived Usefulness is significantly and positively related to Intention; Perceived Credibility is significantly and positively related to intention; and Intention is significantly and positively related to Internet Adoption. Perceived Ease of Use is not significantly but positively related to Intention; thus, it was excluded. In the re-specified model, we also found three new paths, as suggested by modification indices results. These three new paths were assigned as H1a, H2a, and H3a, as in Table 5b. However, these three paths showed no significant impact on internet adoption. Thus, H1a, H2a, and H3a were rejected.

Table 4a: Direct Impact of Generated Model

H	Relationships between Exogenous and Endogenous			Std. Estimate	S.E.	C.R.	P-value
H1	Internet Intention	<~	Perceived Usefulness	0.340	0.103	2.943	0.003
H2	Internet Intention	<~	Perceived Ease of Use	0.186	0.156	1.050	0.294
H3	Internet Intention	<~	Perceived Credibility	0.425	0.220	2.078	0.038
H4	Internet Adoption	<~	Internet Intention	0.923	0.191	7.176	0.000

Table 4b: Direct Impact of Re-specified Model

H	Relationships between Exogenous and Endogenous			Std. Estimate	S.E.	C.R.	P-value
H1	Internet Intention	<~	Perceived Usefulness	0.316	0.103	2.943	0.032
H2	Internet Intention	<~	Perceived Ease of Use	0.137	0.156	1.050	0.553
H3	Internet Intention	<~	Perceived Credibility	0.392	0.220	2.078	0.120
H4	Internet Adoption	<~	Internet Intention	0.432	0.191	7.176	0.001
H1a (new)	Internet Adoption	<~	Perceived Usefulness	0.178	0.144	1.630	0.103
H2a (new)	Internet Adoption	<~	Perceived Ease of Use	0.135	0.211	0.840	0.401
H3a (new)	Internet Adoption	<~	Perceived Credibility	0.218	0.300	1.170	0.242

Table 4c: Direct Impact of Competing Model of TAM

Exogenous	Endogenous	Std. Estimate	S.E.	C.R.	P	Relationships
Perceived Usefulness	Internet Intention	0.418	0.102	3.578	0.000	Significant
Perceived Ease of Use	Internet Intention	0.495	0.104	4.104	0.000	Significant
Internet Intention	Internet Adoption	0.947	0.206	7.093	0.000	Significant

The indirect influences of exogenous variables on Internet Adoption through Intention are shown in Table 5a to 5c. In the generated model, two indirect estimates were significant but reduced compared to direct impacts (Table 5a-5c). Thus, H5 and H7 were supported. This means that Intention partially mediated the relationships between Perceived Usefulness and Perceived Credibility with Internet Adoption. Thus, H5 to H7 were supported, meaning that Intention is a partial mediator. In contrast, Intention did not mediate the relationship between Perceived Ease of Use and Internet Adoption.

Table 5a: Indirect Effect (Mediating Effect) of Internet Intention of the Generated Model

H	Exogenous	Mediated	Endogenous	Path	Indirect Effect Estimate	Mediating Hypothesis
H5	Perceived Usefulness	Internet Intention	Internet Adoption	PU → Intention → Adoption (0.340 * 0.923)	0.314	Partial Mediating
H6	Perceived Ease of Use	Internet Intention	Internet Adoption	EOU→ Intention → Adoption (0.186 * 0.923)	0.171	Not Mediating
H7	Perceived Credibility	Internet Intention	Internet Adoption	CRE → Intention → Adoption (0.425 * 0.923)	0.392	Partial Mediating

Conversely, Table 5b showed no mediating effects of Intention on all hypothesized paths for the re-specified model. This is because the indirect effects were smaller than the direct effects (Table 4a-4c). Interestingly, in TAM competing model, intention only served as a partial mediator, not a full mediator, as suggested by Davis (1989).

Table 5b: Indirect Effect (Mediating Effect) of Internet Intention of the Re-specified Model

H	Exogenous	Mediated	Endogenous	Path	Indirect Effect Estimate	Mediating Hypothesis
H5	Perceived Usefulness	Internet Intention	Internet Adoption	PU → Intention → Adoption (0.316 * 0.432)	0.136	Not Mediating
H6	Perceived Ease of Use	Internet Intention	Internet Adoption	EOU→ Intention → Adoption (0.137 * 0.432)	0.059	Not Mediating
H7	Perceived Credibility	Internet Intention	Internet Adoption	CRE → Intention → Adoption (0.392 * 0.432)	0.169	Not Mediating

Table 5c: Indirect Effect (Mediating Effect) of Internet Intention of Competing Model

H	Exogenous	Mediated	Endogenous	Path	Indirect Effect Estimate	Mediating Hypothesis
H5	Perceived Usefulness	Internet Intention	Internet Adoption	PU → Intention → Adoption (0.418 * 0.947)	0.395	Partial Mediating
H6	Perceived Ease of Use	Internet Intention	Internet Adoption	EOU→ Intention → Adoption (0.495 * 0.947)	0.468	Partial Mediating

Table 6 illustrates the overall comparison between four structural models (hypothesized, generated, re-specified, and TAM competing models) derived from the study. It showed that the goodness of fit of the structural models (generated model, re-specified and competing models) achieved better goodness of fit compared to the hypothesized model. Among the three models, the re-specified model achieved the highest absolute fit, indicating by its highest p-value (p=0.144). In addition, it showed that the hypothesized and generated models both produced three significant direct impacts (Perceived Usefulness and Internet Intention; Perceived Credibility and Intention; and Internet Intention and Internet Adoption). The re-specified model yielded two significant direct impacts (Perceived Usefulness and Intention; Intention and Internet Adoption). It also indicates that Intention and Adoption consistently showed a significant positive effect in all structural models. Similarly, the TAM competing model supported all three direct and significant impacts, i.e., Perceived Usefulness to Intention, Perceived Ease of Use to Intention, and Intention to Adoption. Concerning the indirect or mediating effects, Intention partially mediated the path between Perceived Usefulness and Adoption in the three structural models (hypothesized, generated, and competing model). Intention acted as a partial mediator between Perceived Credibility and Adoption in the two structural models (hypothesized and generated model). However, Intention was not a mediator between Perceived Ease of Use and Adoption in all structural models, except a partial mediator in the TAM competing model. Table 6 also shows the nested model comparisons between the four structural models. All Chi-square and df change between models were more than 3.84 or > 1df respectively. Thus, the nested model tests could be substantiated (Hair, Black, Babin, & Anderson,

2013; Sentosa, Bambang, Ming, & Kamaria, 2012; Tabachnick et al., 2012).

Table 6: Comparison between Hypothesized, Generated, Re-specified, and Competing Model

H	Endogenous	Mediation	Exogenous	Hypothesized Model			Generated Model			Re-Specified Model			Competing Model of TAM		
				Std. Estimate	P	Hypothesis Status	Std. Estimate	P	Hypothesis Status	Std. Estimate	p	Hypothesis Status	Std. Estimate	p	Hypothesis Status
H1	Perceived Usefulness	-	Internet Intention	0.305	Sig	Supported	0.340	Sig	Supported	0.316	Sig	Supported	0.418	Sig	Supported
H2	Perceived Ease of Use	-	Internet Intention	0.203	Not sig.	Rejected	0.186	Not sig	Rejected	0.137	Not sig.	Rejected	0.495	Sig	Supported
H3	Perceived Credibility	-	Internet Intention	0.437	Sig	Supported	0.425	Sig	Supported	0.392	Not sig.	Rejected	-	-	-
H4	Internet Intention	-	Internet Adoption	0.927	Sig	Supported	0.923	Sig	Supported	0.432	Sig	Supported	0.947	Sig	Supported
H5	Perceived Usefulness	Internet Intention	Internet Adoption	0.282	Sig	Supported	0.314	Sig	Supported (Partial)	0.136	Not sig.	Rejected (Not Mediating)	0.395	Sig	Supported (Partial)
H6	Perceived Ease of Use	Internet Intention	Internet Adoption	0.188	Not sig.	Rejected	0.171	Not sig	Rejected (Not Mediating)	0.059	Not sig.	Rejected (Not Mediating)	0.468	Sig	Supported (Partial)
H7	Perceived Credibility	Internet Intention	Internet Adoption	0.405	Sig	Supported	0.392	Sig	Supported (Partial)	0.169	Not sig.	Rejected (Not Mediating)	-	-	-

The Goodness of Fit Index:

Chi-Square	540.394	299.122	289.512	141.000
Chi-square Δ		241.272	9.61	148.512
df	427	268	265	115
df Δ		159	3	150
Ratio	1.266	1.116	1.092	1.226
P-Value	0.000	0.093	0.144	0.050
GFI	0.874	0.910	0.913	0.937
RMSEA	0.034	0.022	0.020	0.987

R^2:

Intention	77.5%	78.9%	62.4%	75.1%
Adoption	85.9%	85.2%	77.2%	89.8%

This study attempts to examine the empirical relationships between technology usage perception and credibility with IoT adoption among BUMDes administrators. Additionally, this study also investigates the mediating effect of Intention to Use on those relationships as hypothesized based on the conceptual

underpinning of TAM. The finding indicates that Perceived Usefulness is significantly and positively related to Internet Intention. This finding is in line with previous studies in the information systems community and provided evidence of the significant effect of Perceived Usefulness on Intention to use new technology (Hamid et al., 2016; Jaafreh, 2018; Kucukusta et al., 2015; Venkatesh & Davis, 2000). This implies that YECs working in BUMDes have the intention to use IoT for increasing their productivity, enhancing effectiveness, and improving the BUMDES performance.

The present study found Perceived Ease of Use is insignificantly but positively related to Intention. Polatoglu and Ekin (2001) reported a similar result in their study. They argue that ease of use may not be utilized if it is not perceived as useful; thus, we conclude that the YCE's perceived usefulness of IoT is the key construct for adoption among entrepreneurs. Contrastingly, numerous studies had found a positive and significant relationship between the two variables (Hamid et al., 2016; Kucukusta et al., 2015; Moon & Kim, 2001; Venkatesh & Davis, 2000). The possible explanation for this difference could be that most managers and staff of BUMDes still find internet technology challenging to understand. Hence, they need to undergo more trainings to improve this situation.

Perceived credibility is also found to be significantly and positively related to intention. This finding is supported by previous studies (Goyal et al., 2013; Koksal, 2016). Those YCE owners who feel that the Internet has high security, privacy, and trustworthiness of information would definitely have a high intention of using IoT.

Lastly, intention is found to be significantly and positively related to internet adoption. A previous study has found similar findings (Jaafreh, 2018; Karahoca et al., 2018). The direct path from Intention to Adoption is the most consistent finding across all models; thus, it can be deduced that those in BUMDes who have the intention to use the IoT would definitely adopt IoT in the future.

This study also found partial mediating effects of Intention on the relationships between Perceived Usefulness, Perceived Credibility, and Perceived Ease of Use with IoT Adoption. The additional findings on the new paths in the re-specified model support mediating effects for these relationships. Our findings found substantial partial mediating effects. This could imply that the adoption of the Internet may not be a direct process. Often, intention is profoundly necessary to enhance the relationship concerned.

CONCLUSION

This research investigates the predictors and mediating effects of intention on internet adoption YCEs in BUMDes using TAM conceptual underpinning theory. The findings supported the TAM theory, whereby all the hypothesized paths were supported. The generated model found three significant direct paths between Perceived Usefulness, Perceived Credibility, and Intention as well as between intention and adoption. The re-specified model produces two significant direct paths (Perceived Usefulness to Intention and Intention to Adoption) and introduces three new paths (direct paths from Perceived Usefulness, Perceived Ease of Use, and Perceived Credibility Adoption). The model also manages to establish partial mediating effects of Intention on the relationships between exogenous variables and internet adoption. Future research should investigate other underpinning TAM theory, such as TAM2 (Venkatesh & Davis, 2000) and extended TAM (Hsu Meng, Chiu Chao, & Ju Teresa, 2004). The importance of BUMDes cannot be denied, but unfortunately it is still very much under-researched.

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