

STRUCTURAL EQUATION MODELING (SEM) ANALYSIS BASED ON UTAUT2 THEORY ON E-COMMERCE ADOPTION

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Received: February 23, 2023. Accepted: March 30, 2023. Published: March 31, 2023

Abstract: E-commerce adoption with the UTAUT 2 model is a complex and multidimensional issue that connects multiple dimensions. A statistical method that can explain the relationship between one latent variable and another variable is Structural Equation Modeling (SEM). This study aims to create a structural model of e-commerce adoption using SEM based on indicators in the UTAUT2 theory. The data used in this study is primary data obtained through a survey of MSME actors in Batam City using a questionnaire with the purposive sampling method. The sample used was 200 MSMEs. The analysis results show that the R^2 value on the Behavioral Intention variable was 88.6%, and the Use Behavior variable was 76.8%. Q^2 value of 97.4% indicates that the exogenous latent variable strongly affects the endogenous latent variable. The goodness of the fit value suggests that the SEM model in this study can explain empirical data or field data by 83%. The hypothesis testing results are that Behavioral intention significantly affects effort expectancy, facilitating condition, performance expectancy, and price value. Related to indirect effect, variables that affect user behavior through behavioral intention are significantly the variables of effort expectancy, facilitating condition, habit, performance expectancy, and price value.

Keywords: SEM, E-Commerce, UTAUT2

INTRODUCTION

SEM is one of the statistical analysis techniques used to build and test statistical models in the form of causal models [1]. SEM analysis combines regression, factor, and path analysis to simultaneously calculate the relationship between latent variables, measure the loading value of latent variable indicators, and calculate path models of these latent variables. SEM is a multivariate technique that will show how to represent a series or series of causal relationships in a path diagram [2].

Variables in SEM are exogenous or endogenous [8]. Estimation or estimation of SEM model parameters is carried out by the Ordinary Least Square (OLS) method. Partial regression modeling will work on the SEM algorithm in two stages. The initial stage is by estimating the construct score. Then the second stage estimates the endogenous latent variable's outer loading, path coefficient, and R^2 values [9].

Model evaluation in SEM includes two stages: evaluation of the outer model or measurement of the model and evaluation of the inner model or structural model [10,11,12]. Evaluation of the outer model includes composite reliability, reliability indicators, convergent validity, and discriminant validity [10,13,14]. SEM is a model for forming relationships between variables in linear regression equations in a stratified manner [6]. The indicators used must be reflective in testing and predicting the coefficients of structural models for obtaining causal relationships between latent variables [7].

Evaluation of the inner model includes checking the relationship between constructs, evaluating values (coefficient of determination), and checking t-test values with the bootstrapping method [15].

In this study, SEM analysis was used to see the factors that influence the adoption of e-commerce in MSMEs in Batam City. E-Commerce causes changes in consumer lifestyles and opens up many business opportunities [3]. Retaining customers will result in enormous profits [4]. It can be realized, one of which is by utilizing e-commerce. One business activity that spearheads Indonesia's economy is Micro, Small, and Medium Enterprises (MSMEs). MSMEs must adapt and use technological advances to maintain and improve their performance. Batam City is one of the regions in Indonesia with the rapid development of MSMEs. It can be seen from the data published through the <http://umkm.depkop.go.id/> website, which shows the number of MSMEs in Batam City as many as 81575 MSMEs. E-commerce can open up opportunities for MSMEs to market and grow business networks in all parts of the world. MSME players must be part of the global community by utilizing information technology through e-commerce [5].

Technology adoption in a business requires approaches, including the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2). UTAUT2 is one of the latest technology adoption models developed by Venkatesh, et al. in 2012. UTAUT2 contains exogenous, endogenous, and moderation variables. Based on this, this study aims to apply structural equation modeling to

determine the factors that influence the adoption of e-commerce in MSMEs in Batam City using the UTAUT2 theory.

RESEARCH METHODS

In this study, primary data and secondary data were used. Primary data was obtained through a survey of MSME actors in Batam City. The secondary data used as a population is all MSMEs in Batam City in 2022, namely 81575 MSMEs (source: <http://umkm.depkop.go.id/>). The sampling technique that will be used in this study is purposive sampling because the selection of samples is based on the assessment of several characteristics of sample members that are adjusted to the purpose of the study. The characteristics of the sample selection used in this study were:

- a. Batam City MSME players who are familiar with online shopping activities through e-commerce.
- b. Batam City MSME players who have marketed a product through social media at least once.

The determination of the number of samples is adjusted to the ideal criterion of sample size for SEM modeling analysis which is 100-200 and the absolute minimum is 50, or the minimum sample magnitude is 5-10 times the manifest variable or an indicator of the overall latent variable [6]. Based on this approach, the minimum number of samples to be used in this study was determined to be 200 MSMEs.

In this study, data collection was carried out using a questionnaire consisting of eight variables: performance expectancy, effort expectancy, social influence, facilitating condition, hedonic motivation, price value, habit, behavioral intention, and user behavior. Each of the items in the study was measured using a Likert Scale with values of 1 (strongly disagree) to 5 (strongly agree).

The following are the stages of SEM analysis [7].

1. Structural model design (Inner model)

Inner Model Equations:

$$Y = \beta Y + \gamma X + e$$

2. Measurement models design (Outer Model)

Outer Model Equations:

$$x = \lambda_X X + u$$

$$y = \lambda_Y Y + v$$

3. Parameter estimation

Parameter estimation in SEM uses the least square method through an iteration process that will stop if convergent conditions have been reached. The steps in SEM parameter estimation:

- a. Latent variable estimation
- b. Outside approximation
- c. Inside approximation
- d. Update the Outer weight

6. Model Evaluation

7. Tested the hypothesis

a. Inner Model hypothesis (exogenous)

The effect of exogenous latent variables on endogenous variables. $H_0: \gamma_i = 0$ vs $H_1 = \gamma_i \neq 0$

Statistic test:

$$t = \frac{\hat{\gamma}}{SE(\hat{\gamma})}$$

$\hat{\gamma}$ is the pathway coefficient of the effect of exogenous variables on endogenous variables. $SE(\hat{\gamma})$ is the error standard of the coefficient $\hat{\gamma}$.

b. Inner Model hypothesis (endogenous)

The effect of endogenous latent variables on endogenous variables. $H_0: \beta_i = 0$ vs $H_1 = \beta_i \neq 0$

Statistic test:

$$t = \frac{\hat{\beta}}{SE(\hat{\beta})}$$

$\hat{\beta}$ is the pathway coefficient of the effect of endogenous latent variables on endogenous variables. $SE(\hat{\beta})$ is the error standard of coefficient $\hat{\beta}$

c. Outer Model hypothesis

$H_0: \lambda_i = 0$ vs $H_1 = \lambda_i \neq 0$

Statistic test:

$$t = \frac{\hat{\lambda}}{SE(\hat{\lambda})}$$

$\hat{\lambda}$ is the path coefficient of the loading factor $E(\lambda)$ is the error standard of koefisien λ

RESULTS AND DISCUSSION

The initial stage in SEM is conducted by outer model evaluation. The outer model or measurement model is a stage to evaluate the validity and reliability of a construct. There are two construct validity tests in the PLS measurement model. They are convergent validity and discriminant validity. The outer model was evaluated using the parameters AVE, community, outer loading, cross-loading, Cronbach alpha, and composite reliability [16].

Validity was used to measure how far the measured variable can measure what should be measured. Validity testing in this study used convergent validity tests and discriminant validity tests. The rule of thumb for convergent validity tests is outer loading > 0.70 and average variance extracted (AVE) > 0.5 (table 2). If the loading score < 0.70 , then the indicator can be removed from the construct because it is not loaded into the construct that represents it [14]. Based on the data in Table 1, all question items have a loading value bigger than 0.7. These results indicate that all indicators used in this study are valid.

From Table 2, it can be seen that the AVE value in each variable is above 0.5, so it can be concluded that there is no convergent validity problem in the tested model so that the indicators in this research model have good discriminant validity.

The reliability test in this study was conducted by using two methods. They are Cronbach's alpha and Composite reliability. The rule of thumb for Cronbach's alpha and Composite

reliability should be bigger than 0.7, although 0.6 is still acceptable. If both of them have met the requirements that have a value bigger than 0.7, then the data is reliable [16,17].

Table 1. Outer Loading

Variable	Items	Outer Loading	Description
Performance Expectancy (PE)	PE1	0.898	Valid
	PE2	0.901	Valid
	PE3	0.888	Valid
	PE4	0.916	Valid
Effort Expectancy (EE)	EE1	0.795	Valid
	EE2	0.922	Valid
	EE3	0.853	Valid
	EE4	0.789	Valid
Social Influence (SI)	SI1	0.833	Valid
	SI2	0.934	Valid
	SI3	0.877	Valid
	SI4	0.921	Valid
Facilitating Condition (FC)	FC1	0.923	Valid
	FC2	0.856	Valid
	FC3	0.786	Valid
	FC4	0.888	Valid
Hedonic Motivation (HM)	HM1	0.868	Valid
	HM2	0.925	Valid
	HM3	0.872	Valid
Price Value (PV)	PV1	0.843	Valid
	PV2	0.911	Valid
	PV3	0.886	Valid
	PV4	0.987	Valid
Habit (H)	H1	0.814	Valid
	H2	0.845	Valid
	H3	0.825	Valid
	H4	0.845	Valid
Behavioral Intention (BI)	BI1	0.875	Valid
	BI2	0.234	Valid
	BI3	0.564	Valid
Use Behavior (UB)	UB1	0.872	Valid
	UB2	0.923	Valid
	UB3	0.868	Valid
	UB4	0.943	Valid

Table 2. Average Variance Extracted (AVE) Test Results

Variable	Average Variance Extracted (AVE)
Performance Expectancy (PE)	0.879
Effort Expectancy (EE)	0.830
Social Influence (SI)	0.804
Facilitating Condition (FC)	0.863
Hedonic Motivation (HM)	0.772
Price Value (PV)	0.895
Habit (H)	0.799
Behavioral Intention (BI)	0.867
Use Behavior (UB)	0.788

Table 3. Cronbach" s alpha and composite reliability

Variable	Composite Reliability	Cronbach's Alpha
Performance Expectancy (PE)	0.889	0.832
Effort Expectancy (EE)	0.930	0.898
Social Influence (SI)	0.804	0.789
Facilitating Condition (FC)	0.875	0.833
Hedonic Motivation (HM)	0.872	0.828
Price Value (PV)	0.885	0.842
Habit (H)	0.899	0.878
Behavioral Intention (BI)	0.887	0.867
Use Behavior (UB)	0.898	0.871

This study's reliability test can be seen from the composite reliability and Cronbach's alpha. Table 3 shows that the composite reliability value for all constructs is above 0.70, and the value of Cronbach's alpha is bigger than 0.6. Therefore, it can be concluded that all constructs in this study are reliable or meet the reliability test.

After the outer model is conducted to assess its validity and reliability, the inner model is then tested. Structural models in SEM were evaluated using R^2 . The percentage effect of all independent variables on the value of the dependent variable is shown by the magnitude of the R^2 coefficient of determination between one and zero. R^2 value that is close to one will give a large percentage of influence [15]. The following is the value of R^2 on the construct to be presented in Table 4.

Table 4. R Square (R^2)

Variable	R^2
Behavioral Intention (BI)	0.886
Use Behavior (UB)	0.768

Based on Table 4, the R^2 value in the Behavioral Intention variable is 0.886, which means that the Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Condition, Hedonic Motivation, Price Value, and Habit variables can provide a percentage of effect of 88.6% on Behavioral Intention. The R^2 value in the Use Behavior variable is 0.768, which shows that the Facilitating Condition, Habit, and Behavioral Intention variables can provide a percentage effect of 76.8% on Use Behavior.

An assessment of the overall goodness of the model between the latent variables is carried out with a value of Q^2 which is the goodness value of the combined model of the endogenous latent variable [18].

$$Q^2 = 1 - (1 - R_1^2)(1 - R_2^2) = 0.974$$

Based on the calculation of the value Q^2 , it can be stated that all latent variables have a strong effect on Behavioral Intention and Use Behavior. The Q^2 value of 0.974 or 97.4% indicates that the exogenous latent variable strongly affects the endogenous latent variable. To measure the goodness of the model in the overall structural model that is formed starting from indicators to latent variables and between latent variables, we can use the Goodness of Fit assessment.

$$GoF = \sqrt{AVE \times R^2}$$

$$GoF = \sqrt{0.833 \times 0.827} = 0.83$$

The GoF value obtained at 0.83, belongs to the high category. The value of 0.83 indicates that the structural model formed in this study can explain empirical data or field data [19].

After obtaining the R^2 that is owned by the proposed model, the next process is hypothesis testing. Hypothesis testing is conducted by looking at the p-value to determine the significance value of the model and the original sample, which is the beta score used to see the predictive properties of exogenous variables against endogenous variables [14]. The positive value of the beta coefficient indicates a positive effect property, while the negative value indicates the negative effect of the exogenous variable on the endogenous variable. The data analysis method conducted for hypothesis testing in this study used the bootstrap resampling method. Here are the hypothesis testing results [20,21].

Hypothesis testing is conducted on direct and indirect effects. Hypothesis testing on both direct and indirect effects can be seen from the significance values on each path coefficient.

Table 5 shows the direct effect of exogenous variables on endogenous variables. From the table, there are four not significant direct effects. The effect of Effort Expectancy, Facilitating Condition, Performance Expectancy, and Price Value on Behavioral Intention has a P-Value of ≤ 0.05 ,

therefore it is concluded that the relationship between variables has a significant effect. On the other hand, the relationship between Habit, Hedonic Motivation, and Social Influence on

Behavioral Intention has a p-value of > 0.05 , so it can be concluded that the relationship between variables in the model does not have a significant effect.

Table 5. Direct Effect

Path	coefficient path	P-Value	Result
BI → UB	0.3025	0.0056	Significant
EE → BI	0.1747	0.0181	Significant
FC → BI	0.1883	0.0227	Significant
FC → UB	0.4316	0.0000	Significant
H → BI	0.1314	0.1035	Not Significant
H → UB	0.3568	0.0340	Not Significant
HM → BI	-0.0193	0.7222	Not Significant
PE → BI	0.1293	0.0348	Significant
PV → BI	0.2995	0.0000	Significant
SI → BI	0.1158	0.1783	Not Significant

Table 6. Indirect Effect

Path	coefficient path	P-Value	Result
EE → UB	0.1042	0.0328	Significant
FC → UB	0.0570	0.0481	Significant
H → UB	0.2089	0.0298	Significant
HM → UB	-0.0058	0.7483	Not Significant
PE → UB	0.0673	0.0391	Significant
PV → UB	0.0906	0.0320	Significant
SI → UB	0.0350	0.2633	Not Significant

Table 6 shows the indirect effect of exogenous variables on endogenous variables through mediation variables. From these results, two indirect effects are insignificant, namely the indirect effect of the Hedonic Motivation variable on the Use Behavior variable through Behavioral Intentions. Furthermore, the effect of Social Influence variables on Use Behavior and Behavioral intention variables.

CONCLUSION

The results of this study showed the R^2 for the Behavioral Intention variable of 0.886 and the Use Behavior variable of 0.768. Q^2 value of 0.974 indicates a strong effect on the final variable. An overall model assessment yielded a Goodness of Fit of 0.83. It shows that the structural model formed in this study can explain empirical data or field data by 83%. Effort expectancy, facilitating condition, performance expectancy, and price value positively and significantly affect behavioral intention. The variables of habit, hedonic motivation, and Social Influence did not have a significant effect on the variables of behavioral intention. For indirect effect, the variables that affect Use behavior through behavioral intention are significantly the variables effort expectancy, facilitating condition, habit, performance expectancy, and price value.

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