Evaluating the Effectiveness of Self-Service Technology on the Use of Ride-Hailing Services: A Confirmatory Factor Analysis

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Abstract

The immerse growth of ride-hailing usage in Malaysia builds the need for decision makers to understand the potential factors that affect the adoption and application of ride-hailing services. Self-service technology is recognized as one of the most critical factors influencing the individual behaviour when using the apps. Ensuring security, functionality and enjoyment along ride-hailing services are also a fundamental challenge to all service providers. There are relatively small number of studies have examined this latent factor. This study aims to evaluate latent factor of self-service technology that affect the individual behaviour. Specifically, the self-service technology is taken from the Theory of Acceptance Model. A structured survey is conducted among ride-hailing users in Malaysia. With the use of structured survey for data collection purpose, 395 prospective respondents provided valuable responses. For sampling technique, the simple random sampling was used. The survey consisted of two parts; the first part contains respondent profile regarding on their gender, age, an experience on using apps. The second part was a major part of the questionnaire consisting of security, functionality and enjoyment measures. Research results suggest that the latent factor of self-service technology with its domain (security, functionality and enjoyment) are fit and reliable using the confirmatory factor analysis. Finally, this study verifies that the effectiveness of self-service technology factor could be used for further research on ride-hailing services.

Keywords

Ride-hailing, self-service technology, confirmatory factor analysis, enjoyment, security, functionality

1. Introduction

The immerse growing of ride-hailing services provided by transportation network companies (TNCs) such as GrabCar, Uber, Big Blue Customer, Taxi Go, DOB, EZcab, Faszz, and Cioaz have profoundly influence mobility in Malaysia cities. The new additional modes have affected the utilization of other existing modes such as buses, trains, and taxis. To date, there are 31 companies were listed and approved by the Land Public Transport Agency (APAD) that customer usually use to book rides through mobile apps. As the rises of ride-hailing services in Malaysia, it is important to further develop an understanding of the potential factors that induce to travel demand. While many studies have aimed to examine the potential factors in ride hailing services but there is almost no research focus about the usefulness of mobile apps. Due to these facts, this study is aimed to identify the potential factor and examine their relationships toward Grabcar application.

2. Literature Review

The increase demand of ride-hailing services has resulted in an enormous publication that aims to understand the potential factors that influence the customers for keep using adopting these services. Despite the popularity and effectiveness of ride-hailing services, most of the studies are not focus on mobile apps. As a matter of facts, the authors have summarized the results and variable of interest from prior studies between year of 2016-2020 as depicted in Appendix I.

Given to the summary in the Appendix I, three factors namely Enjoyment, Security and Functionality not critically discussed in most of the published papers. To reduce the literature gaps, these factors were selected for further investigations.

1. Methodology

To ensure extensive and robust development of the structured questionnaire, we followed Churchill (1979) recommendations for establishing four-phase process of developing a comprehensive measurement scale. These steps have been carefully undertaken through a pre-test and pilot test. First, the items were generated through depth literature review that highlight the self-service technology construct. Second, the items were redefined by performing critical assessment of the experts in the field suggestions. Third, the items were determined measurement construct through exploratory factor analysis and reliability assessment. At this phase, the pilot test is conducted to fulfil the research requirement. Lastly, the items were finalized by evaluating the measurement scale through Confirmatory Factor Analysis (CFA). The CFA method is recognized as the method of choice for evaluating the measurement model as it can ascertain the applied researchers to gain more information through the values of factor loading, fitness indexes, reliabilities and validities (Afthanorhan et al., 2019; Rahlin et al., 2019).

Our study population consisted of homogenous customers who had experiences in using ride-hailing services within the past 6 months. Self-service technology was broadly conceptualized in this study to cover varying degrees of enjoyment, security and functionality of mobile apps in terms of the customer experiences. Random sampling technique would be a best choice given the large population of customers. The data used in the study were obtained through online survey. The enumerators were recruited with assistance from ride hailing agencies headquarters in Kelantan, Terengganu, and Pahang to gain information.

To check the suitability of the sample size requirement for this study, we apply three different approaches: 1. Hair approach, 2. Cohen statistical power and 3. Krejcie & Morgan table. Hair approach suggest that the acceptable range for the sample size is between 105 to 210. This approach is only appropriate for the SEM method as it was calculated by the number of observed variables in the model estimation (Afthanorhan et al., 2020; Hair & Sarstedt, 2019). Whereas the Cohen statistical power suggest at least 152 samples is required to get the actual power of 0.952 or 95.2% (Figure 2). As this study involves with the large number of population (customer who experiences with mobile apps), we also refer the Krejcie and Morgan table to gain valid information about sample size. Given to that table, the minimum requirement for sample size is 384. Due to these facts, we send the questionnaire to more than 384 respondents.

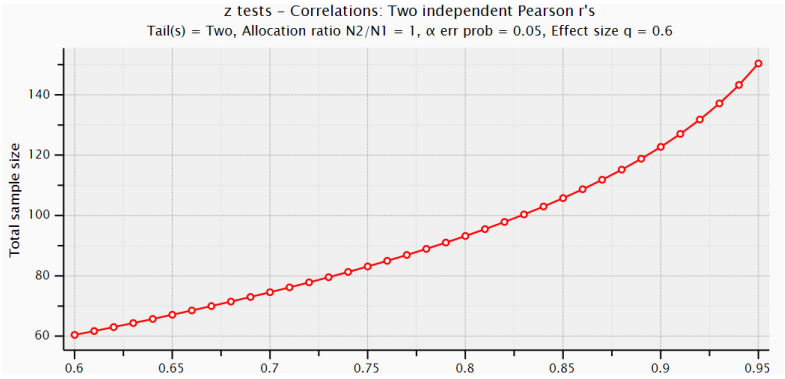

Figure 1. Interpolation plot from G Power Software

Using online survey and with the help from our industry partners, a total of 420 questionnaires were answered within the past 6 months (Figure 1). To ensure high quality data collection, this panel was inspected through descriptive statistics, and it was found that 25 questionnaires were invalid due to incomplete answers (missing values) and have lining cases problems. All the participants involved with this survey are given 15 minutes to answer and the identities remained anonymous.

3.1 Findings

Phase 1 – Preliminary Item Generation

Initially, the items were extracted from previous studies to explain the measurement constructs and identify the suitability of each item under construct. For this purpose, a comprehensive literature review is performed and then

each item was screening to ensure the meaning of those measurement items can be clearly explain the construct of interest.

Phase 2 – Purification of measurement item

At this phase, three experts were appointed to validate the instrument. Each expert was assigned according to their expertise to evaluate the requirement of instrument validities in the basis of content validity, criterion validity and face validity. The content validity was checked by expert in technology management area while criterion validity was verified by statistician to examine the suitability of each measurement item with the scale used. After making suggested adjustment to items, seven items per construct were retained after the expert assessments. Then, face validity was conducted by assistance of 10 volunteers to identify the understandable of measurement items. All valid measurement items were included in subsequent analysis.

Phase 3 – Determination of sub-construct

After measurement items were refined based experts' suggestions, all items were scored on a ten-point Likert scale (1=strongly disagree, 10 strongly agree). To determine the number of sub-constructs and eliminate meaningless items through pilot testing, the Exploratory Factor Analysis (EFA) method was performed. (Bahkia et al., 2019). There are 100 respondents were selected for EFA method. From EFA output, three components were yielded using varimax rotation with principal component analysis method. In addition to that, the meaningfulness of measurement items was inspected through the value of factor loadings. In this case, all measurement items having more than 0.60 of factor loading as recommended by Hair et al. (2017) and Afthanorhan and Aimran (2020). Our analysis also explained that 73.25% of the total variance and the Kaiser Meyer Olkins (KMO) value was 0.935 meet the acceptable limit of 0.60. Then, the three sub-constructs were renamed based suitability of measurement items namely Functionality, Security and Enjoyment. To verify the sub-construct reliability, the Cronbach Alpha method was used. The Cronbach alpha coefficient suggest that all sub-constructs (Functionality= 0.910; Enjoyment = 0.895; and Security = 0.915) are more than 0.70

Phase 4 – Measurement model evaluation

Before executing the statistical model, the relationship between observed and unobserved variables was established using the Confirmatory Factor Analysis (CFA) method. The goal of CFA method is to determine relationships between constructs within the research model and the relationships between indicators with latent variable. Though the EFA methods ever used for same construct, but the fitness indexes were not yielded. As a result, CFA method always be used as the last resort for model evaluation in any empirical research. A newly modified latent variables based on EFA suggestions were further validated using data from field work. First, CFA method was performed in IBM SPSS-AMOS 25.0 to finalize the model by determining their reliabilities and validities through composite reliability, convergent validity and discriminant validity. The CFA process the model using maximum likelihood estimator to generate outputs (Anderson & Gerbing, 1988; Afthanorhan, Awang, & Aimran, 2020) (figure 2).

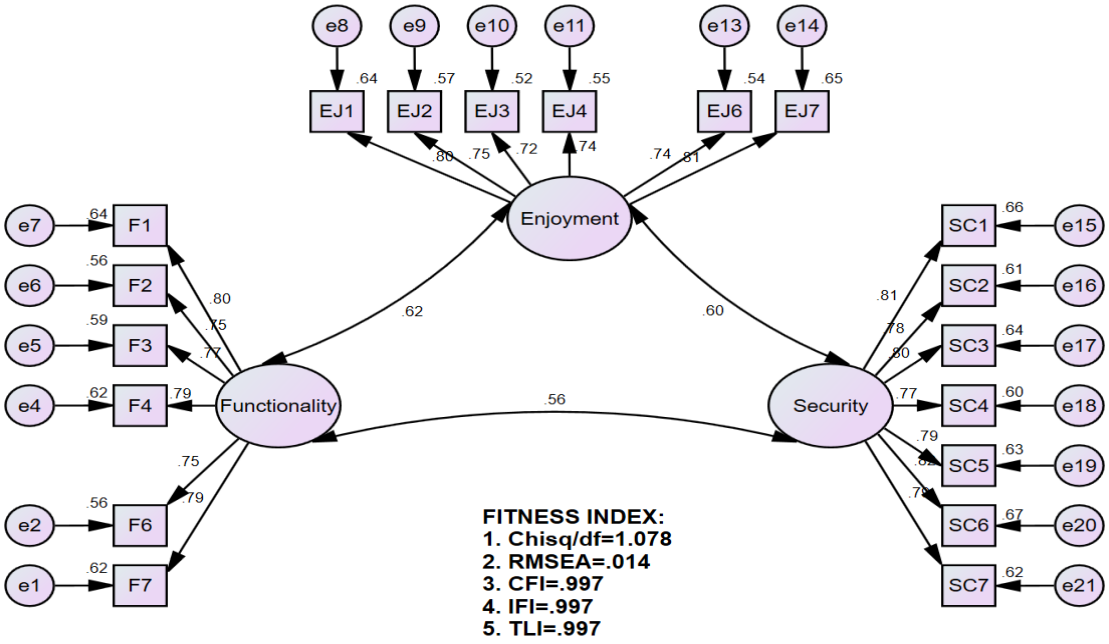

Figure 2. CFA model

Table 1. Convergent validity (AVE) and Composite Reliability

Functionality	**Factor Loading**	**Composite Reliability (CR)**	**Average Variance Extracted (AVE)**
I can use the service of Grab application anytime	0.80		
The service provided by Grab application is competent	0.75		
The service provided by Grab application is coherent	0.77		
I satisfy with the function of Grab application	0.79		
I am understanding with the Grab application process	Deleted		
The Grab application function is clear	0.75		
The items designed in Grab application can be easilyhandled	0.79	0.899	0.599
Enjoyment	**Factor Loading**	**Composite Reliability**	**Average Variance Extracted**
The operation provided by Grab application is attractive	0.86	0.892	0.579
I feel exciting being able to handling Grab application	0.75		
The additional function in Grab application is thoughtful	0.72		
The information available from Grab service is adequate	0.74		
The Grab application display is fair	Deleted		

The Grab application image is satisfactory	0.74		
I adore with the Grab application	0.81		
Security	**Factor Loading**	**Composite Reliability**	**Average Variance Extracted**
The account transaction in Grab application is safe	0.81	0.924	0.633
I am sure with the Grab application security	0.78		
The payment balance in Grab application is safe	0.80		
The Grab application privacy policy is clear	0.77		
I can contact the Grab driver safely	0.79		
I frequently use the Grab pay	0.81		
With Grab application, I can redeem my payment	0.75		

Table 2. Discriminant Validity

	Enjoyment	**Functionality**	**Security**
Enjoyment	**0.761**		
Functionality	0.617	**0.774**	
Security	0.603	0.555	**0.796**

2. Discussion and Conclusion

Table 1 present the CR and AVE outcomes for each constructs. The outcomes were generated from the value of factor loadings after deleting poor factor loading (below than 0.60). The CR is represents for reliability assessment while AVE method is represented under convergent validity (Table 2). Both methods were shown valid and reliable as meet the acceptable limit of 0.60 and 0.50 respectively (Alkhawaja, Halim, & Afthanorhan, 2021). Thus, the authors confirmed that the proposed model was reliable and valid for further investigations. Also, the future research should consider this model for further development when involves the ride hailing services.

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Appendix

Appendix 1. Summarization related works in the field of Self-Service Technology

Author	Sample Size	Variables	Method	Findings
Yusra & Agus (2018)	123 participants	1. Functionality 2. Enjoyment 3. Security/privacy 4. Assurance 5. Design 6. Convenience 7. Customization 8. Customer Satisfaction 9. Customer Loyalty	Smart Partial Least Square (SmartPLS)	All independent variables have significant impact on Customer Loyalty through Customer Satisfaction as a mediator
Hamenda (2018)	219 respondents	1. Service Quality 2. Price Fairness 3. Ethical Practice 4. Customer Satisfaction 5. Perceived Value	Partial Least Square (PLS)	Service Quality, Price Fairness and Ethical Practice have significant impact on Customer Satisfaction through Perceived Value
Hashim et al., (2020)	220 respondents	1. Perceived Usefulness 2. Perceived Ease-of-Use 3. Trust 4. Perceived Security Risk 5. Behavioral Intention to Use	IBM SPSS version 24	Trust is the most influential factor that affects Behavioral Intention to Use
Kim & Park (2019)	400 respondents	1. Functionality 2. Enjoyment 3. Security 4. Customization 5. Convenience 6. Perceived Value 7. Satisfaction with the Airport 8. Satisfaction with SSTs 9. Bahavioral Intention	Structural Equation Modeling	Functionality, Enjoyment, Customization and Convenience have significant effect on Behavioral Intention through Perceived Value and Customer Satisfaction
Singh (2018)	57 respondents	1. Functionality 2. Enjoyment 3. Design-Convenience-Assurance 4. Security/privacy 5. Customization 6. Customer Behavioral Intentions	Multivariate Analysis of Variance (MANOVA)	Functionality, Design and Convenience of the Self-Service Kiosks (SSKs) must be a prime focus for the service providers in order to increase the adaptability of their SST systems

Suryawardani & Wulandari (2020)	400 respondents	1. Price 2. Promotion 3. E-Service Quality 4. Customer Satisfaction 5. Customer Loyalty	Structural Equation Modeling	Price, Promotion, E-Service Quality and Customer Satisfaction have significant effect on Customer Loyalty
Ubaidillah et al., (2019)	330 respondents	1. Perceived Safety and Security 2. Perceived Price and Advantage 3. Perceived Convenience 4. Perceived Accessibility 5. Intention to Use Grab E-Hailing Services	IBM SPSS version 22	Perceived Price and Advantage, Convenience and Accessibility have significant effect on Intention to Use Grab E-Hailing Services
Bismo et al., (2018)	100 respondents	1. Service Quality 2. Customer Satisfaction 3. Customer Loyalty	SPSS	Service Quality has significant impact on Customer Satisfaction but not significant on Customer Loyalty
Ayodeji & Rjoub (2020)	735 respondents	1. Retrospective Waiting Time (RWT) 2. Perceived Waiting Time (PWT) 3. Prospective Waiting Time (PRWT) 4. Waiting Time Satisfaction (WTS) 5. Self-Service Technology (SST) 6. Customer Loyalty	Partial Least Square-Structural Equation Modeling (PLS-SEM)	SST and WTS have significant effect on Customer Loyalty, while WTS partially mediates the relationship between RWT, PRWT, PWT and SST with Customer Loyalty
Otieno & Govender (2016)	318 respondents	1. Convenience 2. Reliability 3. Ease of Use 4. Fulfilment Performance	Structural Equation Modeling (SEM)	Convenience and Ease of Use have significant impact on Fulfilment Performance
Taufik & Hanafiah (2019)	402 respondents	1. Perceived Ease of Use 2. Perceived Usefulness 3. Need for Human Interaction 4. Tourist Adoption & Behaviour of SST	Structural Equation Modeling (SEM)	Perceived Ease of Use and Usefulness are positively associated with attitude toward SST use
Schmitz et al., (2016)	197 respondents	1. Perceived Usefulness 2. Perceived Ease of Use 3. Intentions of Use 4. Entertainment 5. Security 6. Actual Use	Partial Least Square-Structural Equation Modeling (PLS-SEM)	Perceived Usefulness and Ease of Use have significant effect on Intentions of Use
Simsek & Demirbag (2017)	348 respondents	1. Perceived Service Quality 2. Customer Satisfaction 3. Word-of-Mouth	Structural Equation Modeling	Word-of-Mouth and Repurchase Intention are significantly influenced by Customer Satisfaction

		4. Repurchase Intention 5. Negative Feedback		
Chonsalasin et al., (2020)	1,600 respondents	1. Customer Expectation 2. Perceived Service Quality 3. Perceived Value 4. Customer Satisfaction 5. Customer Trust 6. Customer Commitment 7. Attractiveness of Competitors 8. Perceived Risk 9. Switching Costs 10. Airline Image 11. Customer Loyalty	Structural Equation Modeling	Customer Satisfaction is influenced by Customer Expectation, Perceived Service Quality and Perceived Value; Customer Loyalty is influenced by Customer Satisfaction, Trust, Perceived Value, Commitment and Airline Image
Ul-Hamed et al., (2018)	450 respondents	1. E-Payment 2. E-Traceability 3. Website Design 4. Information and Communication Technology (ICT) 5. E-Logistic Customer Satisfaction Level	SPSS version 20	Information and Communication Technology (ICT) is behaving like a bridge between E-Payment, E-Traceability and Website Design in order to increase E-Logistic Customer Satisfaction Level
Lin et al., (2016)	297 respondents	1. Individual Factor 2. Exogenous Factor 3. Perceived Usefulness 4. Perceived Ease of Use 5. Attitude 6. Behavior Intention	Post Hoc Statistical Tests	Perceived Ease of Use was mainly affects the Attitude and Behavior Intention further by Usefulness and prove the Perceived Ease of Use is an important mediator variable of Technology Acceptance Model
Hapsari et al., (2016)	200 respondents	3. Service Quality 4. Perceived Value 5. Customer Satisfaction	Structural Equation Modeling	Service Quality has significant impact on Customer Satisfaction through Perceived Value
Rahim (2016)	503 respondents	1. Reliability 2. Responsiveness 3. Assurance 4. Customization 5. Employees 6. Facilities 7. Flight Patterns 8. Passenger Satisfaction 9. Customer Loyalty	Statistical Package for Social Sciences (SPSS) version 21	All independent variables have significant impact on Customer Loyalty through Passenger Satisfaction
Setiawan & Sayuti (2017)	200 respondents	1. Service Quality 2. Trust 3. Company Image 4. Customer Satisfaction 5. Customer Loyalty	Statistical Package for Service Solution (SPSS)	All independent variables have significant impact on Customer Satisfaction and Customer Loyalty
Aw et al., (2019)	280 respondents	1. Perceived Innovativeness	Partial Least Squares-	Perceived Personalization, Perceived Usefulness of

		2. Perceived Personalization 3. Perceived Usefulness of Rating System 4. Service Personal Values 5. Perceived Value 6. Trust 7. Technology Readiness 8. Continuance Intention	Structural Equation Modeling (PLS-SEM)	Rating System and Service Personal Values have significant impact on Perceived Value and Trust; Trust mediates the relationship between Perceived Personalization, Perceived Usefulness of Rating System, Service Personal Values and Perceived Value; Perceived Value has significant impact on Continuance Intention; and Technology Readiness moderates the relationship between Perceived Personalization and Perceived Value
Perera et al., (2019)	**Qualitative:** 10 respondents **Quantitative:** 200 respondents	1. Learnability 2. Subjective Norms 3. Security 4. Perceived Behavioral Control 5. Perceived Benefits 6. Design 7. Intention to Use Self-Service Ticketing	**Qualitative:** Draw.io Software **Quantitative:** Statistical Package for Social Sciences (SPSS)	Self-Service Ticketing facility is needed to improve the efficiency in operations
Masran & Adis (2019)	333 respondents	1. Personality Differences 2. Privacy Experiences 3. Privacy Awareness 4. Cultural Differences 5. Demographic 6. Perceived Ease of Use 7. Perceived Usefulness 8. Privacy Concern 9. Trust 10. Actual Disclosure Behaviour	Structural Equation Modeling (SEM)	A new conceptual framework is developed to consolidate the theories for a better understanding of consumers' Actual Disclosure Behaviour of their Privacy Concern in using SST