Determinant factors influencing people to use motorcycle taxi online services using the Analytical Hierarchy Process

Dr. Jozef Raco* (jraco@unikadelasalle.ac.id)
Mr. Yulius Raton (yraton@unikadelasalle.ac.id)
Mr. Frankie Taroreh (ftaroreh@unikadelasalle.ac.id)
Mr. Octavianus Muaja (omuaja@unikadelasalle.ac.id)
Universitas Katolik De La Salle Manado – Indonesia
Kombos 1 Manado 95253 Indonesia

***Corresponding author**

Abstract

The advancement of technology and Smartphone applications offers a lot of opportunities and challenges for companies to increase their market share. Through this technology and its application, companies such as transportation industries can make a lot of money and bring their products and services closer, faster and more easily to customers. In addition the customers can gain access to companies' services and products on time. On the other hand the advancement of Smartphone technology disrupts the common transportation business practices. Communication and negotiation are becoming more virtual. This technology brings about huge benefits to both customers and companies. However the same technology causes a huge problem especially to other transportation companies as they might lose market if they do not use it. This technology helps many transportation industries to make business innovations such as offering lower prices, faster services and deliveries. This research focuses on transportation companies, specifically motorcycle taxis with online booking, which use a Smartphone application.

In Manado Indonesia there are three popular motorcycle taxi online companies that use a Smartphone online application, which are Gojek, Grab and Uber. A lot of people use an online motorcycle taxi rather than public transportation because of its convenience, affordable price, safety and speed compared to local public transport. This study aims to find out the determinant factors that influence people to use motorcycle taxi online services. This research is going to reveal the favorite motorcycle taxi online company and its criteria based on respondents' perspectives. This paper will use the Analytical Hierarchy Process both for data gathering and data analysis. The research findings will contribute to the local government in formulating laws and policies specifically on motorcycle taxi online service.

Keywords: *motorcycle taxi online service, analytical hierarchy process, transportation, Smartphone application.*

Biographical Notes: Jozef Richard Raco is a lecturer in Business Management at the Universitas Katolik De La Salle Manado. He received his Ph.D in Educational Management from the State University of Jakarta-Indonesia in 2010. He earned his Master of Science in Business Management from the University of East Anglia UK in 2002, Master's in Economics from the Asian Social Institute of Manila-Philippines and Bachelor's in Philosophy from the Most Sacred Heart of Jesus Major Seminary of Pineleng, Manado Indonesia in 1990. His research interests are entrepreneurship, spirituality and values in Management.

Yulius Raton is a lecturer in modeling and simulation of the Industrial Engineering Department at the Universitas Katolik De La Salle Manado Indonesia. He earned his Master's in Computer science from School of Information Technology Benarif, Indonesia in 2008.

Franki Taroreh is a lecturer in Accounting, Finance and Management of the Accounting Department at the Universitas Katolik De La Salle Manado Indonesia. He got his Maters' in Accounting Management from the Universitas Sam Ratulangi Manado, Indonesia in 2009.

Octavianus Muaja is a lecturer in Accounting and Management of the Accounting Department at the Universitas Katolik De La Salle Manado Indonesia. He got his Masters' in Financial Management from the Universitas Sam Ratulangi Manado, Indonesia in 2011.

Introduction

Buying and selling products using the internet is quite common nowadays. The advancement of Information Technology and the use of a Smartphone application in business transaction become our common experiences. It makes it a lot of easier for people to do business. Business transactions are done faster and save time. Through this technology the geographical location is no longer a barrier. Rainer, Turban and Potter (Keong, 2015) mentioned that there are five added-values of Smartphone technology and its applications, namely: ubiquity, convenience, instant connectivity, personalization and localization of products and services. One of the most popular industries that use a Smartphone technology application is motorcycle taxi online services. The use of these online services is increasing. Sodikin (2017) added that by December 2017 the number of people in the country using motorcycle taxi online services reached 15 million per week. Furthermore he wrote that by 2018 this number is expected to rise due to the change in people's behavior moving from conventional transaction, to online service systems which is through a Smartphone application. Conventional transaction or offline system has gradually been replaced by the online service (Liu, 2014). It is also happening in Manado city in Indonesia (Fig.1).

Figure 1. Map of Manado city – Indonesia

Source : google map

People in Manado are getting more familiar with online motorcycle taxi services than the offline one since it is more convenient, faster, cheaper and easier to access.

This paper is aiming to find out the dominant factors which influence people in Manado to use online motorcycle taxi. There are three motorcycle taxi online companies that operate in Manado that are namely Gojek, Grabike and Uberbike.

Figure 2: Grab bike

Source: google.co.id

Figure 3: Gojek

Source: google.co.id

Figure 4: Uberbike

Source:google.co.id

Literature review

The theory of Technology Acceptance Model (TAM) is commonly used to explain the behavior of people who are using IT based services such as Smartphone applications. This theory mentioned that if we want to determine the success of an online service system we have to see how people perceive its usefulness, ease of use and their attitude toward the usage of the system (Shah, et al, 2013). They added that perceived usefulness is understood as the degree to which a person believes that using a particular system would enhance his or her performance. Perceived ease of use indicates the degree to which a person believes that using a particular system would be free of effort. While attitude towards usage represents the degree to which an individual evaluates and associates the target system with his or her job. Many studies reveal that the Technological Acceptance Model has been widely used by information technology researchers to gain a better understanding of information technology (IT) adoption and its usage in organizations (Liu. 2014).

That theory works on motorcycle taxi online services because, as mentioned by Karema, (2013) motorcycle taxis can provide speed travel, easy maneuverability, ability to pass on poor and small size road (Kumar, 2011). Moreover a motorcycle taxi offers convenience trip and affordable prices for people's mobility because it allows the rider to weave through congestion especially during rush hours. It is suitable to those demanding flexible and door to door mobility (Qian, 2015). Through the Smartphone application, mobility becomes a much cheaper, direct, relatively quick and personal service with a reliable travel time. The motorcycle taxi is optimizing usage of road space by sharing a limited public space that a maximum of people can use it.

Another theory which supports this study is the theory of perceived benefits, perceived privacy and trust (Zhang.G. et al, 2017). Zhang explained that perceived benefits are important to understand the customers' behavior. He added that perceived benefits in online services are quite numerous mainly because of their convenience, ease of use, system quality, attitude, value creation, users' satisfaction, trust and commitment. Furthermore he stated that when users perceived benefits, they will generate positive attitude and emotion that will strengthen their trust in operators.

Secondly, perceived privacy referred to the perceived risk due to users disclosing their personal information on the systems. All data about the customers are guaranteed safe. The perceived privacy is considered as one of the important aspects of perceived risk. Some researches revealed that when users perceived risk, they would feel worried and anxious and this would lead to their decline in trust toward the operator. In this context as customers using motorcycle taxi online services disclose their personal information they will perceive high privacy risk. So the more privacy risk they perceive, the more worried and anxious they feel and the more reluctant they are to trust motorcycle taxi online services.

Trust is defined as the users' belief that the operator is behaving ethically. The more trust users perceive, the more positive behavior they will generate and the more likely they are to promote and recommend the company to their friends.

Through the literature review the researchers identified some factors considered as reasons for people to use motorcycle taxi online services. These factors were classified as criteria and sub criteria for this research. These criteria are: convenience, price, safety, and speed. The sub criteria of convenience are: pick and drop on site, easy to access, personal, predictable time. The sub-criteria of price are: affordable price, fixed (nonnegotiable price), flexible payment (cash or credit). The sub-criteria of safety are: traceable route, identified driver, complete document of the vehicle, acknowledged headquarter. The sub-criteria of speed are: real time service, access all roads, direct trip, and maneuverability.

Methodology

This study uses the Analytical Hierarchy Process (AHP) for data gathering and analysis. This method was introduced by Thomas Saaty in the 1970s and commonly used to the research related to a decision making process where many and complex variables and factors are involved. This method is also a combination of qualitative and quantitative technique. Sinuany-Stern et.al (2006) wrote that there are reasons to use the AHP method. First it is applicable to many disciplines. Second it is widely and ease to use. This method allows researchers to take into account all important criteria and to organize them into a hierarchy. This method uses consistency validation where the researcher can eliminate redundant data and an algorithm checks to see if your input is consistent. Sinuany-Stern et al (2006) added that the AHP has become more popular because it provides an opportunity for a richer involvement of the decision makers in the evaluating procedure. It is much more widely taught in management workshop and textbooks. Banuelas and Anthony (2004) mentioned that the AHP is used by many researchers because it helps them understand the context of the problem and make it easy for them to structure the problem to be solved. It assists the researcher in managing the relationship between people and their deferential willingness and ability to adjust to the changed circumstances of the desired state of the problem. It helps the researchers reach a consensus, generate new insights and have more confidence in the results. It provides them with more than one method to tackle real-world problems.

The Analytical Hierarchy Process starts with the establishment of the hierarchical structure. The hierarchy structure displays the criteria, sub criteria and alternatives. It then weights the elements of different levels. And the calculation of the weight of the elements on different levels is completed through the following steps:

a. Formation of a hierarchical structure. Through the hierarchy structure the problems were broken down.
b. Establishment of pair-wise comparison matrix

c. Calculation of the priority vector
d. Calculation of the maximum Eigen value
e. Examination of the consistency

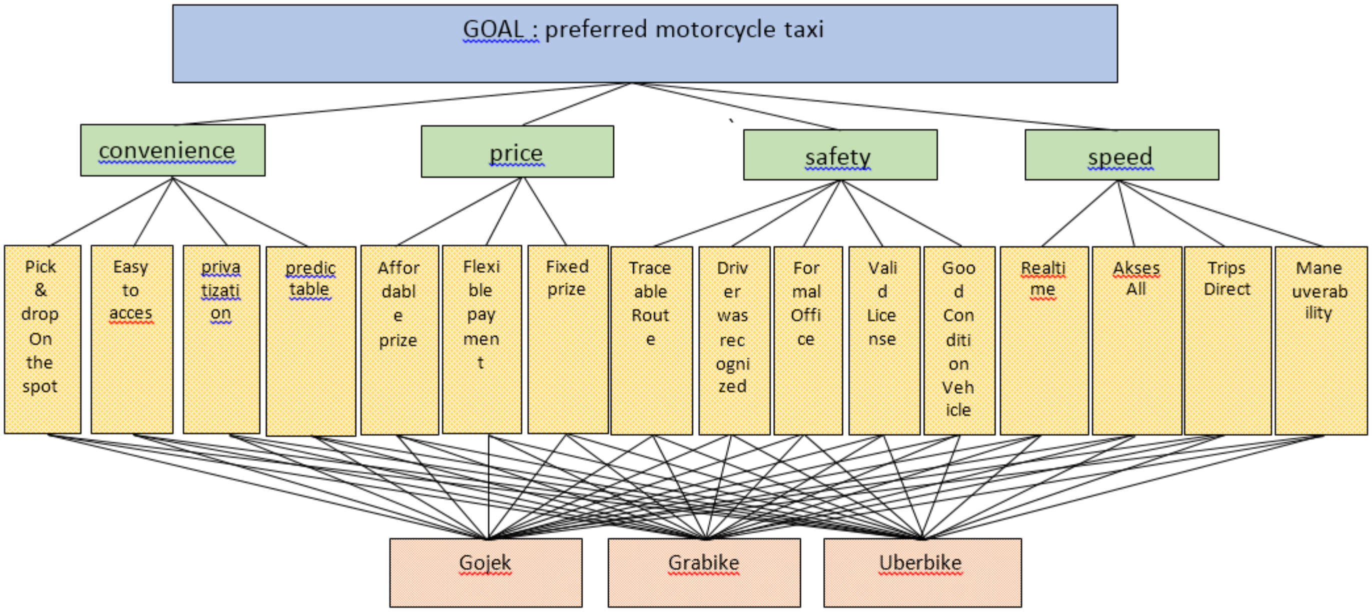
Data collection was done through a questionnaire with AHP format. The questionnaire was distributed to 50 respondents that were selected purposely. There are some criteria for selecting respondents. First the respondents were regular users of motorcycle taxi online services. In other words the respondents have direct experiences of the service (Raco & Tanod, 2014). They were also willing to participate in this study and allow the researcher to publish the data.

Results

Through the literature and previous studies, the researchers determined 4 factors considered as the criteria for this study. These criteria are convenience, price, safety and speed. Each criterion has sub-criteria. The sub-criteria of convenience are: pick and drop on the spot, easy to access, privatization, predictable time to arrive. The sub-criteria of price are affordability, flexibility payment, fixedness price. The sub-criteria of safety are traceability route; driver can be recognized, having a formal office, having valid license and good condition of the vehicle.

The online hailing motorcycle companies (Gojek, Grabike and Uberbike) operating in Manado Indonesia, were the three alternatives used in this research. The criteria, the sub-criteria and the alternatives were organized in hierarchical form as shown in Fig.5

Figure 5: The hierarchical structure of the study



Subsequently the AHP questionnaire was transformed into a pairwise comparisons form based on the hierarchy structure of the criteria, sub-criteria and the alternatives. Table 1 below shows a typical nine-point scale for an AHP questionnaire introduced by Saaty.

Table 1. Saaty's 9 point scale / The definition and explanation of the AHP 9 point scale

Intensity of relative importance	Definition
1	Equal Importance
3	Moderate importance of one over another
5	Essential or strong importance
7	Demonstrated importance
9	Absolute importance
2,4,6,8	Intermediate values between the two neighboring scales

The respondents were asked to tick the desired answers from a scale of 1 to 9, using Saaty scale, for a total of eighteen questions.

The questionnaires, as appeared in table 2 and table 3, were distributed to 50 respondents who have previous experience of the service and the information for this study (Raco & Tanod, 2014). Only 15 respondents returned the questionnaire and the researchers considered that number as sufficient for analysis. For this research the qualification of the respondents are of bigger importance than their number, as they have the important information needed by researchers, having first hand experience as using the motorcycle taxi online services and as they are willing to participate in this research and allow the researchers to publish the findings.

Table 2. Weighting criteria by paired comparison using questionnaire format by respondent 1.

Criteria	Criteria Weighting Score																	Criteria
	More importance than								Equal	Less importance than								
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Convinience	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Price
Convinience	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Safety
Convinience	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Speed
Price	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Safety
Price	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Speed
Safety	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Speed

Table 3. Weighting sub-criteria with respect to the convenience by paired comparison using questionnaire format by respondent 1

SubCriteria	Sub-Criteria Weighting Score																	Subcriteria
	More importance than								Equal	Less importance than								
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Pick & Drop	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Easy to Acces
Pick & Drop	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Privatization
Pick & Drop	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Predictable
Easy to Acces	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Privatization
Easy to Acces	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Predictable
Privatization	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Predictable

Once the data was collected, the researchers used geometric mean calculation to get the mean and to eliminate deviation. The formula of the geometric mean, formula 1, ca be described as follows:

$$GM = \sqrt[n]{(x_1)(x_2)\ldots(x_n)} \quad (1)$$

$with:$
$GM: Geometric\ Mean$
$x_1: weighting\ by\ first\ respondent$
$x_n: weighting\ by\ n^{th}\ respondent$
$n: number\ of\ respondents$

The result of geometric mean calculation are showen on the table 4 and table 5 below :

Table 4. The results of weighting criteria by 15 respondents and calculation the associated geometric mean (GM) in paired comparison

Criteria	Respondent 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Criteria	GM
Convenience	1	1	1	1	1	1	1	1	1	3	1	3	3	1	3	Price	1.340394
Convenience	3	1	2	3	3	1	3	3	3	1	3	1	1	1	1	Safety	1.748740
Convenient	3	1	3	3	1	3	3	1	2	5	1	3	1	1	3	Speed	1.946809
Price	7	5	7	7	7	5	5	5	3	5	1	1	5	3	3	Safety	3.984481
Price	9	7	6	7	7	7	5	3	3	1	1	3	3	5	3	Speed	3.918220
Safety	1	3	2	1	1	3	3	3	2	1	1	1	4	3	1	Speed	1.735062

Table 5. The results of weighting sub criteria with respect to convenience by 15 respondents and calculation of the associated geometric mean (GM) in paired comparison.

Subcriteria	Respondent 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Subcriteria	GM
Pick & Drop	1	1	1	1	1	1	1	3	3	1	1	3	1	3	1	Easy to Access	1.340394
Pick & Drop	1	3	1	3	1	3	3	4	3	3	3	2	2	3	3	Privatization	2.325666
Pick & Drop	1	5	1	3	1	3	5	7	5	2	4	1	2	7	5	Predictable	2.773081
Easy to Access	7	7	5	5	5	4	5	7	7	4	3	2	3	1	7	Privatization	4.285987
Easy to Access	5	5	3	5	7	3	5	5	7	5	3	5	3	5	7	Predictable	4.666980
Privatization	1	3	3	3	1	1	1	2	1	7	3	3	1	3	3	Predictable	1.990972

Once the geometric mean was calculated, the researchers established the pairwise comparison matrix. All the criteria do not bear the same importance. Therefore, the next step in the AHP process is to derive the relative priority weights for the criteria, sub-criteria and alternatives. To perform the pair-wise comparison, using the formula (2 and 3), we need to create a comparison matrix of the criteria, subcriteria and alternative involved in the decision from the results before, using the formula below:

$$A = (a_{ij})_{n\,x\,n} \quad (2)$$

Saaty added that each element of the matrix is representing ratio and weight of the criteria

$$A = \left(w_i/w_j\right)_{nxn} = \begin{bmatrix} w_1/w_1 & w_1/w_2 & \dots & w_1/w_n \\ w_2/w_1 & w_2/w_2 & \dots & w_2/w_n \\ \vdots & \vdots & \vdots & \vdots \\ w_n/w_1 & w_n/w_2 & \dots & w_n/w_n \end{bmatrix} \qquad (3)$$

$$with:\ a_{ij} = \frac{1}{a_{ji}}, for\ i \neq j, and\ a_{ii} = 1, all\ i$$

The pairwise comparison matrix for the criteria is showen in table 6, while table 7 presents the pairwise comparison matrix for the sub criteria.

Tabel 6. Pairwise comparison matrix of criteria with respect to the goal

	Convenience	Price	Safety	Speed
Convenience	1	1.340393566	1.748740032	1.946808583
Price	0.746049537	1	3.984480723	3.918219967
Safety	0.571840286	0.250973733	1	1.735062341
Speed	0.513661183	0.255217933	0.576348167	1

Tabel 7. Pairwise comparison matrix of sub criteria.

CONVENIENCE	Pick & Drop	Easy to Access	Privatization	Predictable	
Pick & Drop	1	1.340393566	2.325666399	2.773081111	
Easy to Access	0.746049537	1	4.285986976	4.666980055	
Privatization	0.429984283	0.233318488	1	1.990971857	
Predictability	0.360609719	0.214271325	0.50226727	1	
PRICE	Affordable	Fixed	Flexible		
Affordable	1	3.395261313	4.71769398		
Fixed	0.29452814	1	2.377160938		
Flexible	0.211967967	0.420669877	1		
SAFETY	Traceable Route	Driver Recognized	Formal Office	Valid License	G.C. Vehicle
Traceable Route	1	2.232099863	2.448222887	2.634262426	2.105674
Driver Recognized	0.448008629	1	2.634262426	2.172572128	2.14800863
Formal Office	0.408459542	0.3796129	1	1.885191985	1.60845954
Valid License	0.3796129	0.460283913	0.530449953	1	1.3796129
G.C. Vehicle	0.474907322	0.465547478	0.621712871	0.724841004	1
SPEED	Realtime	All Acces	Direct Trips	Maneuverability	
Realtime	1	1.800059738	2.854418322	1.761066482	
All Access	0.555537118	1	1.998494699	1.648231337	
Direct Trips	0.350334074	0.500376609	1	1.44105564	
Maneuverablity	0.567837734	0.60671095	0.693935732	1	

Table 8 and table 9 below present the pairwise comparison matrix for alternatives.

Tabel 8. Pairwise comparison matrix of alternatives (part I)

CONVENIENCE			
Pick & Drop	Go-ride	Grab-bike	Uber - bike
Go-ride	1	0.428826137	2.96719735
Grab-bike	2.331947413	1	3.325733936
Uber-bike	0.337018365	0.300685509	1
Easy to Acces	Go-ride	Grab-bike	Uber - bike
Go-ride	1	0.398647063	4.016908774
Grab-bike	2.508484553	1	4.648119937
Uber-bike	0.24894765	0.215140748	1
Privatization	Go-ride	Grab-bike	Uber - bike
Go-ride	1	0.428826137	3.191825287
Grab-bike	2.331947413	1	3.091682043
Uber-bike	0.313300356	0.323448526	1
Predictable	Go-ride	Grab-bike	Uber - bike
Go-ride	1	0.985061205	3
Grab-bike	1.015165347	1	2.5642542
Uber-bike	0.333333333	0.389976938	1
PRICE			
Affordable	Go-ride	Grab-bike	Uber - bike
Go-ride	1	0.291768854	1.152453457
Grab-bike	3.427370629	1	1.909587062
Uber-bike	0.867714001	0.523673427	1
Fixed	Go-ride	Grab-bike	Uber - bike
Go-ride	1	0.398647063	2.191799867
Grab-bike	2.508484553	1	2.934753372
Uber-bike	0.456246036	0.340744135	1
Flexible	Go-ride	Grab-bike	Uber - bike
Go-ride	1	0.8547514	3.191825287
Grab-bike	1.169930813	1	3.191825287
Uber-bike	0.313300356	0.313300356	1
SAFETY			
Traceable Route	Go-ride	Grab-bike	Uber - bike
Go-ride	1	0.40423228	2.191799867
Grab-bike	2.473825195	1	2.473825195
Uber-bike	0.456246036	0.40423228	1

Tabel 9. Pairwise comparison matrix of alternatives (part II)

SAFETY			
Driver Recognized	Go-ride	Grab-bike	Uber - bike
Go-ride	1	0.580532829	2.728217132
Grab-bike	1.722555471	1	2.728217132
Uber-bike	0.366539741	0.366539741	1
Formal Office	Go-ride	Grab-bike	Uber - bike
Go-ride	1	1.087595747	2.728217132
Grab-bike	0.919459278	1	2.728217132
Uber-bike	0.366539741	0.366539741	1
Valid License	Go-ride	Grab-bike	Uber - bike
Go-ride	1	0.679183244	2.728217132
Grab-bike	1.4723567	1	2.728217132
Uber-bike	0.366539741	0.366539741	1
G.C. Vehicle	Go-ride	Grab-bike	Uber - bike
Go-ride	1	0.366539741	2.191799867
Grab-bike	2.728217132	1	2.728217132
Uber-bike	0.456246036	0.366539741	1
SPEED			
Realtime	Go-ride	Grab-bike	Uber - bike
Go-ride	1	0.8547514	3.433458398
Grab-bike	1.169930813	1	3.433458398
Uber-bike	0.291251527	0.291251527	1
All Access	Go-ride	Grab-bike	Uber - bike
Go-ride	1	0.794597405	3.156925178
Grab-bike	1.258498951	1	3.156925178
Uber-bike	0.316763922	0.316763922	1
Direct Trips	Go-ride	Grab-bike	Uber - bike
Go-ride	1	0.679183244	2.728217132
Grab-bike	1.4723567	1	2.728217132
Uber-bike	0.366539741	0.366539741	1
Manueverability	Go-ride	Grab-bike	Uber - bike
Go-ride	1	0.231427707	2.934753372
Grab-bike	4.321003791	1	6.512527832
Uber-bike	0.340744135	0.153550208	1

The next step consist in obtaining the normalized pairwise comparison matrix (PCM), as written in formula 4 and 5, and generating the priority vector (formula 6) awarding to the following :

a. Sum each column in the pairwise comparison matrix

$$a_{ij} = \sum_{i=1}^{n} a_{ij} \quad (4)$$

b. Create the normalized pairwise matrix .

$$X_{i,j} = \frac{a_{ij}}{\sum_{i=1}^{n} a_{ij}} \quad (5)$$

c. The priroty vector by dividing the sum of the normalized column matrix by the number of criteria/sub criteria/alternatives.

$$W_{i,j} = \frac{\sum_{j=1}^{n} X_{ij}}{n} \quad (6)$$

The results are shown in the table 10, 11, 12, 13 and 14 below :

Tabel 10. Normalized PCM and Priority Vector of Criteria with respect to the goal

	Convenience	Price	Safe	Speed	Priority Vector
Convenience	0.353163336	0.470877721	0.239239831	0.226370699	0.322413
Price	0.263477344	0.351298106	0.545104748	0.455602158	0.403871
Safety	0.201953023	0.088166597	0.136806973	0.201749303	0.157169
Speed	0.181406297	0.089657576	0.078848448	0.116277841	0.116548

Tabel 11. Normalized PCM and Priority Vector of Sub Criteria (part I)

CONVENIENCE	Pick & Drop	Easy to Access	Privatization	Predictable		Priority Vector
Pick & Drop	0.394221728	0.480775307	0.286626712	0.265849135		0.356868
Easy to Access	0.294108938	0.358682196	0.528226386	0.447413027		0.407108
Privatization	0.169509147	0.083687188	0.123244982	0.190870056		0.141828
Predictable	0.142160187	0.076855309	0.06190192	0.095867782		0.094196
PRICE	Affordable	Fixed	Flexile			Priority Vector
Affordable	0.663791958	0.705006193	0.582801548			0.650533
Fixed	0.195505411	0.207644163	0.293663192			0.232271
Flexible	0.140702632	0.087349644	0.123535259			0.117196
SAFETY	Traceable Route	Driver Recognized	Formal Office	Valid License	G.C. Vehicle	Priority Vector
Traceable Route	0.368869156	0.491918048	0.338402482	0.312974205	0.255488544	0.353530487
Driver Recognized	0.165256565	0.22038353	0.36411756	0.258121221	0.260625147	0.253700805
Formal Office	0.150668127	0.083660431	0.138223723	0.223977861	0.195159833	0.158337995
Valid License	0.14002749	0.101438994	0.073320767	0.118809046	0.167393096	0.120197879
G.C. Vehicle	0.175178663	0.102598997	0.085935468	0.086117668	0.12133338	0.114232835

Tabel 12. Normalized PCM and Priority Vector of Sub Criteria (part II)

SPEED	Realtime	All Access	Direct Trips	Maneuverability		Priority Vector
Realtime	0.40425128	0.460709464	0.435998819	0.301018818		0.400495
All Access	0.224576591	0.255941208	0.305260557	0.281731924		0.266878
Direct Trips	0.141622998	0.128066994	0.152745242	0.246319415		0.167189
Maneuverablity	0.229549131	0.155282334	0.105995382	0.170929843		0.165439

Tabel 13. Normalized PCM and Priority Vector of Alternatives (part I)

CONVENIENCE				
Pick & Drop	Go-ride	Grab-bike	Uber - bike	Priority Vector
Go-ride	0.272556372	0.247946371	0.406859359	0.309120701
Grab-bike	0.635587126	0.578197899	0.456021565	0.556602196
Uber-bike	0.091856503	0.173855729	0.137119076	0.134277103
Easy to Access	Go-ride	Grab-bike	Uber - bike	Priority Vector
Go-ride	0.2661392	0.2470257	0.41561271	0.309592536
Grab-bike	0.667606072	0.619660152	0.480921483	0.589395902
Uber-bike	0.066254728	0.133314149	0.103465807	0.101011561
Privatization	Go-ride	Grab-bike	Uber - bike	Priority Vector
Go-ride	0.274329775	0.244725411	0.438226412	0.319093866
Grab-bike	0.639722609	0.570686789	0.424477096	0.544962165
Uber-bike	0.085947616	0.184587801	0.137296491	0.135943969
Predictable	Go-ride	Grab-bike	Uber - bike	Priority Vector
Go-ride	0.425803944	0.414755952	0.457020692	0.432526863
Grab-bike	0.432261408	0.421045869	0.390639077	0.414648785
Uber-bike	0.141934648	0.164198179	0.152340231	0.152824353
PRICE				
Affordable	Go-ride	Grab-bike	Uber - bike	Priority Vector
Go-ride	0.188854394	0.160715026	0.28371294	0.21109412
Grab-bike	0.647274004	0.550829961	0.47010537	0.556069778
Uber-bike	0.163871602	0.288455013	0.24618169	0.232836102
Fixed	Go-ride	Grab-bike	Uber - bike	Priority Vector
Go-ride	0.252223948	0.229187697	0.357754153	0.279721933
Grab-bike	0.632699876	0.574913798	0.479021932	0.562211869
Uber-bike	0.115076176	0.195898505	0.163223914	0.158066198
Flexible	Go-ride	Grab-bike	Uber - bike	Priority Vector
Go-ride	0.402701131	0.394248614	0.432282819	0.409744188
Grab-bike	0.471132461	0.461243601	0.432282819	0.454886294
Uber-bike	0.126166408	0.144507785	0.135434361	0.135369518

Tabel 14. Normalized PCM and Priority Vector of Alternatives (part II)

SAFETY				
Traceable Route	Go-ride	Grab-bike	Uber - bike	Priority Vector
Go-ride	0.254448314	0.223522368	0.386859321	0.288276668
Grab-bike	0.629460651	0.552955265	0.436637647	0.539684521
Uber-bike	0.116091035	0.223522368	0.176503032	0.172038811
Driver Recognized	Go-ride	Grab-bike	Uber - bike	Priority Vector
Go-ride	0.323719384	0.29815675	0.422557873	0.348144669
Grab-bike	0.557624597	0.51359154	0.422557873	0.49792467
Uber-bike	0.118656019	0.18825171	0.154884253	0.153930661
Formal Office	Go-ride	Grab-bike	Uber - bike	Priority Vector
Go-ride	0.437445507	0.443168583	0.422557873	0.434390655
Grab-bike	0.40221333	0.407475465	0.422557873	0.41074889
Uber-bike	0.160341163	0.149355951	0.154884253	0.154860456
Valid License	Go-ride	Grab-bike	Uber - bike	Priority Vector
Go-ride	0.352249552	0.332001571	0.422557873	0.368936332
Grab-bike	0.518636988	0.488824737	0.422557873	0.4766732
Uber-bike	0.12911346	0.179173692	0.154884253	0.154390468
G.C. Vehicle	Go-ride	Grab-bike	Uber - bike	Priority Vector
Go-ride	0.238979281	0.211496209	0.370235401	0.273570297
Grab-bike	0.651987369	0.577007581	0.460846165	0.563280372
Uber-bike	0.10903335	0.211496209	0.168918434	0.163149331
SPEED				
Realtime	Go-ride	Grab-bike	Uber - bike	Priority Vector
Go-ride	0.406308783	0.39829927	0.436442699	0.413683584
Grab-bike	0.475353164	0.465982589	0.436442699	0.459259484
Uber-bike	0.118338053	0.13571814	0.127114602	0.127056932
All Access	Go-ride	Grab-bike	Uber - bike	Priority Vector
Go-ride	0.388309873	0.376343639	0.431636556	0.398763356
Grab-bike	0.488687568	0.473628075	0.431636556	0.464650733
Uber-bike	0.123002558	0.150028286	0.136726888	0.136585911
Direct Trips	Go-ride	Grab-bike	Uber - bike	Priority Vector
Go-ride	0.352249552	0.332001571	0.422557873	0.368936332
Grab-bike	0.518636988	0.488824737	0.422557873	0.4766732
Uber-bike	0.12911346	0.179173692	0.154884253	0.154390468
Manueverability	Go-ride	Grab-bike	Uber - bike	Priority Vector
Go-ride	0.1766239	0.167098482	0.280910728	0.208211037
Grab-bike	0.763192542	0.722033174	0.623370588	0.702865435
Uber-bike	0.060183558	0.110868344	0.095718683	0.088923528

Based on the calculation, as shown in table 10, the researchers found that the criteria which has the highest value was price (40%) followed by convenience (32%), safety 16% and speed (12 %).

Consistency

The purpose of a consistency test is to ensure whether the calculation fits the condition of transitivity in priority. A consistency ratio (CR) is used to verify the credibility and reasonability of the evaluation and to check whether there is inconsistent causality or conflicts in subjective judgments. The CR is acceptable if it does not exceed 0.1 or less than 10%. The definition of the consistency index is shown in the formula (7).

Since the numeric values are derived from the subjective preferences of individuals, it is impossible to avoid some inconsistencies in the final matrix of judgments. The question is how much inconsistency is acceptable. For this purpose, AHP calculates a consistency ratio (CR) comparing the consistency index (CI) of the matrix in question (the one with our judgments) versus the consistency index of a random-like matrix (see formula 8). A random matrix is one where the judgments have been entered randomly and therefore it is expected to be highly inconsistent. Saaty provides the calculated RI value for matrices of different sizes as shown in Table 15. In AHP, the consistency ratio is defined as CR where CR = CI/RI (formula 8). Saaty has shown that a consistency ratio (CR) of 0.10 or less than 10% is acceptable to continue the AHP analysis. If the consistency ratio is greater than 0.10, it is necessary to revise the judgments to locate the cause of the inconsistency and correct it.

The value of Random Index for different numbers of criteria is shown in the table 15 below.

Table 15. Random index value

N	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
R.I	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.48	1.56	1.57	1.59

The principle eigen value (λmax) is obtained as follows :

- Multiply each element of the priority vector with the sum of each corresponding column in the pairwise matrix .
- The principal eigen value is obtained by summing the results from the first step above.

The consistency Index is obtained as follows : $CI = \frac{\lambda_{max} - n}{(n-1)}$ (7)

The last step is the calculation of the Consistency Ratio as follows $CR = \frac{CI}{RI}$. (8)

RI values refer to table 15 above.

Table 16 below is used to calculate the consistency

Tabel 16. PCM and Priority Vector of the Criteria

	Convenience	Price	Safe	Speed	Priority Vector
Convenient	1	1.340393566	1.748740032	1.946808583	0.322413
Price	0.746049537	1	3.984480723	3.918219967	0.403871
Safety	0.571840286	0.250973733	1	1.735062341	0.157169
Speed	0.513661183	0.255217933	0.576348167	1	0.116548
SUM	2.831551007	2.846585232	7.309568921		

The consistency calculation for the criteria unfolds as follows

$$(\lambda max) = (0{,}322413 * 2.831551007) + (0.403871 * 2.846585232) + (0.157169 * 7.309568921) + (0.116548 * 8.600090891) = 4.213738$$

$$CI = \frac{\lambda_{max} - n}{(n-1)} = \frac{4.213738 - 4}{3} = 0.071246$$

$$CR = \frac{CI}{RI} = \frac{0{,}071246}{0{,}90} = 0.079162$$

The result of λmax, CI and CR for sub criteria and alternatives appear in table 17, 18, 19 and 20 below:

Table 17. Values of λmax, CI and CR for Criteria

CRITERIA	Priority Vector	λmax	CI	CR
Convenience	0.322413	4.213738	0.071246	0.079162
Price	0.403871			
Safety	0.157169			
Speed	0.116548			

Table 18. Values of λmax, CI and CR for Sub Criteria

CONVENIENCE	**Priority Vector**	λmax	**CI**	**CR**
Pick & Drop	0.356868	4.173601	0.0578671	0.0642968
Easy to Access	0.407108			
Privatization	0.141828			
Predictable	0.094196			
PRICE	**Priority Vector**	λmax	**CI**	**CR**
Affordable	0.650533	3.04731	0.023655	0.040784
Fixed	0.232271			
Flexible	0.117196			
SAFETY	**Priority Vector**	λmax	**CI**	CR
Traceable Route	0.353530487	5.208284	0.052071	0.046492
Driver Recognized	0.253700805			
Formal Office	0.158337995			
Valid License	0.120197879			
G.C. Vehicle	0.114232835			
SPEED	**Priority Vector**	λmax	**CI**	**CR**
Realtime	0.400495	4.095874	0.031958	0.035509
All Access	0.266878			
Direct Trips	0.167189			
Maneuverablity	0.165439			

Table 19. Values of λmax, CI and CR for Alterntive (part I)

CONVENIENCE				
Pick & Drop	**Priority Vector**	λmax	**CI**	**CR**
Go-ride	0.309120701	3.076077	0.038038	0.065584
Grab-bike	0.556602196			
Uber-bike	0.134277103			
Easy to Access	**Priority Vector**	λmax	**CI**	**CR**
Go-ride	0.309592536	3.090713	0.045356	0.0782
Grab-bike	0.589395902			
Uber-bike	0.101011561			
Privatization	**Priority Vector**	λmax	**CI**	**CR**
Go-ride	0.319093866	3.108248	0.054124	0.093318
Grab-bike	0.544962165			
Uber-bike	0.135943969			
Predictable	**Priority Vector**	λmax	**CI**	**CR**
Go-ride	0.432526863	3.003773	0.001887	0.003253
Grab-bike	0.414648785			
Uber-bike	0.152824353			
PRICE				
Affordable	**Priority Vector**	λmax	**CI**	**CR**
Go-ride	0.21109412	3.073063	0.036532	0.062986
Grab-bike	0.556069778			
Uber-bike	0.232836102			
Fixed	**Priority Vector**	λmax	**CI**	**CR**
Go-ride	0.279721933	3.055329	0.027665	0.047698
Grab-bike	0.562211869			
Uber-bike	0.158066198			
Flexible	**Priority Vector**	λmax	**CI**	**CR**
Go-ride	0.409744188	3.003228	0.001614	0.002783
Grab-bike	0.454886294			
Uber-bike	0.135369518			

Table 20. Values of λmax, CI and CR for Alterntive (part II)

SAFETY				
Traceable Route	**Priority Vector**	λmax	**CI**	**CR**
Go-ride	0.288276668	3.083656	0.041828	0.072117
Grab-bike	0.539684521			
Uber-bike	0.172038811			
Driver Recognized	**Priority Vector**	λmax	**CI**	**CR**
Go-ride	0.348144669	3.038791	0.019395	0.03344
Grab-bike	0.49792467			
Uber-bike	0.153930661			
Formal Office	**Priority Vector**	λmax	**CI**	**CR**
Go-ride	0.434390655	3.000896	0.000448	0.000773
Grab-bike	0.41074889			
Uber-bike	0.154860456			
Valid License	**Priority Vector**	λmax	**CI**	**CR**
Go-ride	0.368936332	3.019325	0.009663	0.01666
Grab-bike	0.4766732			
Uber-bike	0.154390468			
G.C. Vehicle	**Priority Vector**	λmax	**CI**	**CR**
Go-ride	0.273570297	3.086801	0.043401	0.074829
Grab-bike	0.563280372			
Uber-bike	0.163149331			
SPEED				
Realtime	**Priority Vector**	λmax	**CI**	**CR**
Go-ride	0.413683584	3.003269	0.001635	0.002818
Grab-bike	0.459259484			
Uber-bike	0.127056932			
All Access	**Priority Vector**	λmax	**CI**	**CR**
Go-ride	0.398763356	3.006935	0.003467	0.005978
Grab-bike	0.464650733			
Uber-bike	0.136585911			
Direct Trips	**Priority Vector**	λmax	**CI**	**CR**
Go-ride	0.368936332	3.019325	0.009663	0.01666
Grab-bike	0.4766732			
Uber-bike	0.154390468			
Manueverability	**Priority Vector**	λmax	**CI**	**CR**
Go-ride	0.208211037	3.081301	0.04065	0.070087
Grab-bike	0.702865435			
Uber-bike	0.088923528			

Based on the information of the table 17, 18, 19 and 20 above, we got the value of the consistency ratio. For criteria we got 0.079162 which is < 0,1 or less than 10%. For sub-criteria we got 0.06 for convenience; price 0.04; safety 0.04; speed 0.03. Each sub-criteria was less than 10% which means that the findings are consistent. The consistency ratio of the alternatives appeared in the table 19 and 20 shows that the results are < 0.1. It means that the results are consistent. It means that the research findings are consistent and that the researchers may continue the process of decision-making using AHP.

Overall Priorities

The next step is to determine overall priority for the alternatives. The calculation was done by first calculating weighted priorities of the alternatives with respect to the criteria and the sub criteria of each element, then summing the results to get the value of overall priorities of the alternatives.

Example calculation below can be found on determining the weighted priorities of the alternatives with respect to the convenience sub-criteria and criteria. To facilitate the calculation priority vector and the scalar are listed in the table 21, 22 and 23 below.

Table 21. Priorities matrix of the alternatives with respect to the convenience sub criteria (w_{AC})

CONVENIENCE	Pick & Drop	Easy to Access	Privatization	Predictable
Go-ride	0.309120701	0.309592536	0.319093866	0.432526863
Grab-bike	0.556602196	0.589395902	0.544962165	0.414648785
Uber-bike	0.134277103	0.101011561	0.135943969	0.152824353

Tabel 22. Priority vectors of the convenience sub criteria with respect to the convenience criteria (w_{ScC})

CONVENIENCE	Priority Vector
Pick & Drop	0.356868
Easy to Acces	0.407108
Privatization	0.141828
Predictable	0.094196

Table 23. Priority scalar of the convenience criteria with respect to the goal

CRITERIA	Priority Vector
Convenience	0.32241

The calculation of the weighted priorities of alternatives with respect to the convenience sub-criteria and criteria is as follows :

$$\begin{bmatrix} \text{Go}-\text{ride} \\ \text{Grab}-\text{bike} \\ \text{Uber}-\text{bike} \end{bmatrix} = \{(w_{AC})\cdot(w_{Scc})\}\cdot(w_c) \quad (9)$$

$$\begin{bmatrix} \text{Go}-\text{ride} \\ \text{Grab}-\text{bike} \\ \text{Uber}-\text{bike} \end{bmatrix} = \left\{\begin{bmatrix} 0.309120701 & 0.309592536 & 0.319093866 & 0.432526863 \\ 0.556602196 & 0.589395902 & 0.544962165 & 0.414648785 \\ 0.134277103 & 0.101011561 & 0.135943969 & 0.152824353 \end{bmatrix}\cdot\begin{bmatrix} 0.356868 \\ 0.407108 \\ 0.141828 \\ 0.094196 \end{bmatrix}\right\}\cdot 0.32241$$

$$\begin{bmatrix} \text{Go}-\text{ride} \\ \text{Grab}-\text{bike} \\ \text{Uber}-\text{bike} \end{bmatrix} = \begin{bmatrix} 0.103930356 \\ 0.178916791 \\ 0.039565853 \end{bmatrix}$$

The calculation to get the other values of the weighted priorities associating criteria and the sub criteria are done in the same way and the result are listed in the table 24 below. Overall priority is obtained by the summing of the row in the table 24 below.

Table 24. Overall priorities for the alternatives with respect to the sub criterion and criterion

alternatives	**Convenience**	**Price**	**Safety**	**Speed**	**Overall Priority**
Go-ride	0.103930356	0.101095116	0.05259123	0.042916202	**0.300532904**
Grab-bike	0.178916791	0.220367408	0.079181145	0.058729942	**0.537195287**
Uber-bike	0.039565853	0.082408475	0.025396626	0.014901973	**0.162272926**

The results of overall priority calculation, as mentioned in table 24, showed that Grab bike obtained 54% and can be considered as the highest priority, followed by Go-ride with 30% and Uber-bike with 16 %.

We can conclude that the dominant factor influencing people to use motorcycle taxi online service is price. The favorite motorcycle online service as perceived by the customers is Gab-bike.

The complete results following convention and stating the local priorities can be seen in the table 25 below.

Table 25. Overall priorities of the alternatives with respect to the sub-criteria and criteria

Priority of Criteria	Priority of Sub Criteria		Priority of Alternatives			Weighted Priority of Alernatives		
	SubCriteria	**priorities**	**Go-ride**	**Grab-bike**	**Uber-bike**	**Go-ride**	**Grab-bike**	**Uber-bike**
Convenience	Pick & Drop	0.356868	0.309120701	0.556602196	0.134277103	0.103930356	0.178916791	0.039565853
0.322413	Easy to Acces	0.407108	0.309592536	0.589395902	0.101011561			
	Privatization	0.141828	0.319093866	0.544962165	0.135943969			
	Predictable	0.094196	0.432526863	0.414648785	0.152824353			
Price	Affordable	0.650533	0.21109412	0.556069778	0.232836102	0.101095116	0.220367408	0.082408475
0.403871	Fixed	0.232271	0.279721933	0.562211869	0.158066198			
	Flexible	0.117196	0.409744188	0.454886294	0.135369518			
Safety	Traceable Route	0.35353	0.288276668	0.539684521	0.172038811	0.05259123	0.079181145	0.025396626
0.157169	Driver Recognized	0.2537008	0.348144669	0.49792467	0.153930661			
	Formal Office	0.1583379	0.434390655	0.41074889	0.154860456			
	Valid License	0.1201978	0.368936332	0.4766732	0.154390468			
	G.C. Vehicle	0.1142328	0.273570297	0.563280372	0.163149331			
Speed	Realtime	0.400495	0.413683584	0.459259484	0.127056932	0.042916202	0.058729942	0.014901973
0.116548	All Access	0.266878	0.398763356	0.464650733	0.136585911			
	Direct Trips	0.167189	0.368936332	0.4766732	0.154390468			
	Maneuverablity	0.165439	0.208211037	0.702865435	0.088923528			
Overall Priorities of Alternatives						**0.3005329**	**0.53719529**	**0.162272926**

Conclusion

The study shows that price is considered at the dominant factor for a customer looking for motorcycle service online followed convenience, safety and speed. It means that most customers are price sensitive. The element of price which is dominant for customers was affordability. The customers considered that affordable price is the most important factor for them to use online motorcycle service. Out of the three online motorcycles taxi service providers that operate in Manado, the Grab-bike is preffered by customers. The researchers also found out in the field that Grab-bike motorcycle taxi online services always provide discount prices for customers. The study is considered valid since the consistency ratio of each criteria, sub-criteria and alternative is less than 0.1 or (10%).

References

Banuelas, R., Anthony, J. (2004). Modified Analytical Hierarchy Process to incorporate uncertainty and managerial aspects. *Int. J. Prod. Res*, Vol 42, No.18, pp. 3851-3872

Karema, F.M. (2013). The Role of Commercial Motorcycles in Rural Economy. A Case Study of Laikipia East Sub-County Kenya. University of Nairobi. {Online} http://geography.uonbi.ac.ke/sites/default/files/chss/arts/geography/2015%20Abstract%20KAREMA%20FREDRICK%20MWANGI.pdf (accessed 12 January 2018).

Keong, W. E. Y. (2015). Factors Influencing Malaysian Taxi Drivers Behavioral Intention to Adapt Mobile Taxi Application. *International Journal of Economics, Commerce and Management*, Vol III, Issue 11, pp. 139-156

Kumar, A. (2011). Understanding the Emerging Role of Motorcycles in African Cities. {Online) https://www.ssatp.org/sites/ssatp/files/pdfs/Topics/urban/DP13-Role Motorcycles%5B1%5D.pdf (accessed 10 January 2018).

Liu, Z.Y. (2014). An Analysis of Technology Acceptance Model. Exploring user acceptance and intension of taxi-hailing app in Shanghai. University of Gothenburg. {Online} https://gupea.ub.gu.se/bitstream/2077/38592/1/gupea_2077_38592_1.pdf (accessed 20 December 2017).

Qian, J. (2015). Disciplined Mobility and Migrant Subalternity: Scetching the Politics of Motorcycle Taxis in Guangzhou. *Urban Studies*, 52 (15), pp. 2922 – 2947

Raco, J.R. and Tanod, R.H.M. (2014). 'The phenomenological method in entrepreneurship, *Int. J. Entrepreneurship and Small Business*, Vol. 22, No.3, pp. 276-28

Shah, G.U.D., Bhatti, M.N., Iftikhar, M., Qureshi M.I., Zaman, Kh. (2013). Implementation of Technology Acceptance Model in E-learning Environment in Rural and Urban areas of Pakistan. *World Applied Sciences Journal*, 27 (11), pp. 1495-1507.

Sinuany-Stern, Z., Israeli, Y., Bar-Eli, M. (2006). Application of analytical hierarchy process for the evaluation of basketball teams, *Int. J. Sport Management and Marketing* , Vol 1, No.3, pp. 193-207.

Sodikin, A (2017). Kompas daily news, 14 December 2017, p. 6

Zhang, G., Ma, L.,Zhang, X. (2017). In: *Wahan International Conference on e-Business*. Association for Information Systems, pp 231-240.