Railway and Roadway: Integration in Ground Access System of Soekarno-Hatta International Airport

by

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Abstract

The growth of air transportation gives negative impact in its ground access system in which the flow of people who accessing the airport creates road congestion. This problem is also supported with the highly dependence of people on private car use and leave public transport as unattractive mode to be used in accessing the airport. This thesis attempts to find out which travel attributes of transportation mode that influence the mode choice of people who accessing the airport as the ground access users and the differences between these users that are categorized into different groups based on travel purpose. Taking one case study at Soekarno-Hatta International Airport in Jakarta, Indonesia, the data are collected from this airport through survey process. Further, the statistical methods are conducted to get the results. First, six determined travel attributes; cost, travel time, walking distance, ease of transfer, ease of carrying luggage and comfort, significantly influence and give differences on the user's mode choice in which four of them; walking distance, ease of transfer, ease of carrying luggage and comfort, are being perceived very satisfactory for car. Second, there are significant differences between user groups in choosing particular mode in which put passenger as the group with high satisfaction level for bus, bus and train, and car compared to worker and visitor. The thesis concludes with potential steps in improving public transportation which give access to the airport that might help attract more people to use it and increase its mode share.

Keywords: private car, public transport, travel attributes, airport ground access users, Soekarno-Hatta International Airport

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1. INTRODUCTION

Airports are the attractive destination in most cities that often generate high level of people movements due to their functions. As air transportation keep growing, airports have become major generators of people and goods traffic (Suh et al., 2005). In addition to the growth of air transportation, the private car continues to dominate the modal split in accessing the airports (Humphreys and Ison, 2005). Thus, rising demand for air transportation has resulted in increased volumes of many airports ground access traffic (Budd et al., 2011). Therefore, getting people from and to the airport will seem to be an ideal role for public transport due to space efficiency it offers by using high-occupancy vehicle. Many types of public transport that are connected to the airport have been developed nowadays. Yet these connections do not carry a significant percentage of airport passengers and traffic congestion from and to certain airports continues to worsen (Caves and Gosling, 1999). If public transport is to play a role in improving airport access, the utility of and experience with existing public transport needs to be understood. This research will investigate the characteristics of existing public transport system of airport in the city of Jakarta and how can it be improved by introducing another public transport, a rail system, that currently in the stage of development. This research not only will address the effectiveness of the whole system of airport ground access in shifting mode shares from private car to public transport, but it will also provide a framework in how an integrated public transport should be employed.

1.1. The Problem

World's transportation growth is inevitable fact. Along with the growth of air passenger and network expansion where many routes are opened from and to new destination, air transportation, among others, has been increasing in recent years.

Even though there was a major accident like 9/11 in United States, many major airports still operating close to its current maximum capacity. It shows that air transportation still continuing its positive trends of growth despite any happened disruptions. The growth of traffic of air passenger itself, globally, is forecasted to be increased by 5.1% per year from 2012 to 2021 and consecutively 4.4% per year from 2021 to 2031 averaging 4.7% world annual traffic growth in 20 years (Airbus, 2012). Air transportation as one of transportation modes grants its user the swiftness in its services and with this great offer it makes the demand keeps growing over time unquestionably. Airlines start to expand their wings in accommodating this demand, including the airports which develop more their capacity. The more passengers an airport can serve the more people may use it . Generally it can be seen in any busy airports where queue or even delay becomes daily routine. However, this situation which many people back and forth from and to the airport has its own consequences. The rush not only happened in airports but also in the road that connecting both user's place and airport. Since the airport design required it have to be built not in the city periphery then the connection to the airport is different with the connection to the Central Business District (CBD), for instance, where the accessibility given is more abundant. For the airport itself, single or several highway connecting the city to the airport make the accessibility reasonably limited, especially when highway development or expansion going slow. What make it a problem is that the difference between each travel becomes nearly equal. In the case where a passenger who live in a big congested-city want to travel to another city 600 miles away, he or she may have to spend his or her time one or two hours on the road, stuck in traffic jam, in order to reach the airport while the air travel itself may be only 2 hours, which is nearly equal. This situation is obviously very unpleasant.

While public transportation that serving ground access to major airports in Europe gains more mode share than those in United States, the use of private car is still at the rate of 70 to 80%, and even more in several airports, in overall mode share (ACRP, 2008, Tsamboulas et al., 2011). Given this situation into many major airports then it can be seen that they are facing a serious challenge which involved airport ground access systems. The growing demand of air travel affects the traffic from and to the airports. The traffic rises as much as the growth of air transportation and makes airport access increasingly constrained. Meanwhile, the use of private car in accessing airport becomes heavily dependent (Coogan, 2008). In two continents, America and Europe, where many major and busiest airports exist, ground access trips to those airports which are highly undertaken by private car can be set as appropriate mark. In Europe, the use of private car in accessing major airports is estimated to be around 65% while at smaller airports, surprisingly, it is estimated to be around 99% (Reynolds-Feighan and Button, 1999, Humphreys and Ison, 2002). It can be seen that there might be no sufficient public transportation in the cities where small airports located, unlike developing transportation system that support big cities, so that almost airport trips rely on private car use. Furthermore, in the United States, the mode share of private car in airport ground access systems exceeds 80% in most major airports (ACRP, 2008, Leigh Fisher Associates, 2000). If this airport ground access problem is left unsolved, then it can be expected that airport ground access systems will become obstructed, leading to traffic congestion on access roads and deterioration of ground access time reliability along with the growth of air transportation (Caves and Gosling, 1999, Tsamboulas et al., 2011).

Traffic congestion literally is an intensiveness number of vehicles on a given segment. What make it worse is that there are many spaces wasted on that segment

due to single or low-occupancy private car use. The trend which people tend to use their private car for their own purpose, such as travelling from and to the airport, is generally high. In previous works, the answer to this problem was accommodating the use of private car by building more infrastructures and facilities for it (Hoel and Shriner, 1999). However, in recent years, airport ground access strategies have shifted into encouraging the use of public transportation due to several considerations, such as environmental constraints; the more private car utilization the more carbon dioxide it is emitted (de Neufville and Odoni, 2003). The emphasis towards public transportation utilization has challenged the airports around the world in order to produce ground access strategies. As response to this issue, notable examples are Airport Surface Access Strategy (ASAS) that are tasked by the government of the United Kingdom for all airports in England and Wales, and Intermodal Surface Transport Efficiency Act (ISTEA) in the United States. The aims of those policies are to encourage increased public transport usage to airports, and to improve the integration and widen the choice of transportation options for travel from and to the airports (DETR, 1998, 2000).

As the solution for airport ground access issues, the utilization of public transportation with its high-occupancy vehicle criteria has been applied. The use of public transportation in accessing the airports has traditionally focused on airport rail link and bus network connection (Bud et al., 2010). Those bus and train modes, in fact, have their own strengths and weaknesses despite both of them are competing in the share of trips made by public transportation. Airport rail link, with train utilization as high-occupancy vehicle on its right-of-way, are favored for its service which include sufficiently high passenger numbers and exclusive railway that can make ease in accessing airport (Kazda and Caves, 2008). Besides offering the smooth connection, airport rail link also provide most room for handling

baggage (Coogan, 2000). On the other hand, bus networks also have their own advantages like give more destinations in the city that served by the airport and best applied for airport with fewer than two million annual passengers for cost reasons (Humphreys and Ison, 2002). What can be seen then is the possibilities of integrating these two modes in order to achieve higher public transportation share while reduce the use of private car at the same time. The reduction of private car use can help in lowering the level of congestion in which make the disadvantage of being obstructed in traffic jam less severe. In the other hand, encouraging the use of public transport is solely for the benefit of the travellers themselves where advantages such as lower cost and faster travel time can be achieved.

1.2. Case Selection

Soekarno-Hatta International Airport is the main airport in the capital city Jakarta and its adjoining cities, known for Jakarta Metropolitan Area. Although there are three airports located in Jakarta, Soekarno-Hatta International Airport is the only one airport serving all of air passenger due to the other two airports intended for different purpose. Halim Perdanakusuma International Airport is operated for Very Very Important Person or VVIP, charters and military flights while Kemayoran Airport is no longer operated. In 2011, Soekarno-Hatta International Airport was the 12th busiest airport, in term of passenger, in the world with total passengers as much as 51.5 million, increased by 16.2% from the previous year 2010. Dubai International Airport was the 13th and Denver International Airport was the 11th (ACI, 2013). Similarly to the most airports' ground access strategies, Soekarno-Hatta International Airport has applied several services for accessing the airport, including bus transit system and taxi/shuttle service. In order to use the bus, air passengers have to travel to bus stop which located at several locations in the city.

In contrast to the bus transit system, shuttle service provides more flexible, door-to-door, travel. Meanwhile, airport rail link for Soekarno-Hatta International Airport is still in planning process. Since ground access is limited to bus transit system and other shuttle services of which operated without bus only lanes or dedicated lanes on roads leading to the airport, the trips undertaken will fully depend on traffic. If the availability of public transportation itself is traffic dependent then it is no different than the use of private car, yet ground access strategies have not been able to solve the problem. However, there is rail network that connecting different parts of the city of Jakarta and its adjoining cities. The function of this network for air passengers is to tackle ground access problem by giving air passengers more time reliability since it is not traffic dependent. The only weakness of rail network is that there is no station inside the terminal building of Soekarno-Hatta International Airport but it still offers attractive point where bus stop is also located in the station area so that air passengers can make a transfer and continue their trip from and to the airport. Thus, this potential solution should be able to give contribution via the integration of existing public transportation.

1.3. Research Question and Objective

Intriguing by the problem that is delivered in this research, the general research question is "to what extent can public transportation system contribute in modal shift of the airport ground access users?" While the general question is intended for a broad sense, this research also has two specific questions; "to what extent can travel attributes influence mode choice of airport ground access users?" and "what are the differences between the groups of airport ground access users on their mode choice?" Thus, the objective of this research is to set recommendation in how an effective public transportation system in accessing the airport could be achieved, so

that the airport ground access users can or want to change their mode choice from private car to public transport. In order to bridging the question and the objective, this research will evaluate the preference of travel mode of people who travel from and to the airport. Due to the vast range of someone's preference that influencing his or her mode choice, several important attributes that have been seriously discussed in prior researches are used to narrowing the scope of the research. The use of this approach will help to solve the outlined problem by recognizing what makes private car the dominant mode as well as what makes public transport, bus and train, unattractive. Later, the revealed results can be applied in how mode share of public transportation should be improved.

1.4. Thesis Structure

This thesis is organized into six chapters. After the introduction in Chapter 1, literature reviews related to the research are presented in Chapter 2. The reviews summarize the results of prior researches focusing on airport ground access strategies. These strategies include the system and the user of public transport. Chapter 3 provides the methodology of this research. The reasons why people travel and the travel behaviour they conduct are to be explained in this chapter as the theoretical framework. Application of Revealed Preference (RP) technique and the attributes that become the driven factor of mode choice, based on the reviewed researches, are specified in this chapter. Then these attributes can be used for designing the instrument of survey. Moreover, the contents of Chapter 3 also include the statistical methods that are needed for analyzing the research. The next chapter discusses the case study of this research. The location of the airport relatively to the surrounding region and the condition of available public transportation are mainly discussed in Chapter 4. Furthermore, this chapter also explains how data collection

is done at the airport. Chapter 5 takes the research a step further. The results from the survey are presented in the form of collective data. These data are analyzed to determine the nature of airport ground access users and their mode preference. From this analysis, the opportunity in improving public transport share is developed. Chapter 6 is the final chapter where conclusions about the entire thesis are drawn. A summary and general conclusion from the research is presented. In addition to conclusion, recommendation for future work that is related to airport ground access system and reflection of thesis work are expressed in the last chapter.

2. LITERATURE REVIEW

The literature review are more focused on mode shares of transportation, travel attributes and nature of airport ground access users in a particular relation to each other.

2.1. Airport Ground Access Mode Shares and Travel Attributes

One of the stimuli for this research is that public transport is needed for accessing the airport in the answer of resolving traffic congestion from and to it. However, the provision of public transport alone might not achieve positive result in increase of mode shares without emphasizing the advantages it can be offered. Coogan (1995) showed an increase in mode shares by utilizing rail transit in European airports. His research is conducted in several major airports in Europe and United States where rail networks are available in connecting the airports and the cities. Mainly based on paperworks documentation, the data are collected from the airports for particular years in which the numbers of people using train from and to the airports are recorded. Known as airport rail links, they are more likely to attract significant mode shares due to the extensive availability of public transit and rail network. Coogan explains, as shown in Table 1, that mode shares for European rail links are typically twice as high as those for American airport rail links due to the fact that European travelers are more likely to use rail to get to their final destination. In other words, since American travelers usually require a private car at some point within a trip from and to the airport, they have a lower probability of using an airport rail link. His research prompts the question of how high a mode share is achievable simply from an airport rail link in developing countries where the lack of an extensive rail system and high car ownership rates exist. Furthermore, Coogan's research does not provide a framework for determining whether or not an airport

rail link will be able to be improved by integrating it with other public transport such as bus transit. His research sought to explain the differences between American and European airport rail link mode share without attempting to explain in detail whether the gap can be filled and how it would be. However, he suggests working towards narrowing the gap by performing research such as that presented here, an attempt to build an integration of bus system on the limited rail system in order to increase mode share in future airport ground access system plans.

Table 1 Mode Shares Comparison between Europe and United States

Europe	Mode Share	United States	Mode Share
Zurich	34%	Washington National	15%
Munich	30%	Atlanta Hartsfield	9%
Frankfurt	29%	Boston Logan	6%
London Gatwick	26%	Chicago O'Hare	5%
Amsterdam Schiphol	25%	Philadelphia	5%

source: Coogan, 1995

Prior to Coogan's research, Harvey (1986) already performed significant work in the field of airport access. Harvey attempted to model airport access choice for departing passengers in San Francisco Bay Area, United States. He obtained survey data for these passengers and then estimated a model to reflect the relative importance of factors that led to their decision about which mode to use to access the airport. Five utility functions were estimated for five distinct access modes; drive, drop-off, transit, airporter, and taxi. Harvey also estimated two different models for two samples, business (passengers indicating business or convention as their trip purpose) and non-business (others) passengers. The difference between the two models is that business model does not account for differences in airport access mode choice that may be associated with longer or shorter flight times and times-related cost. There are sixteen variables used in the models, some of them consider travel time for each mode, public transit accessibility, travel cost for each

mode, pieces of luggage per person for transit, and sex of passenger. From the models, Harvey reached several conclusions about airport access relevant to this research. First, he showed that travel time and travel cost are both strong explanatory variables in airport access mode choice. Second, time sensitivity for airport access time was found to be high relative to typical travel time sensitivities, especially for business travelers. This sensitivity was found to increase with the length of the flight travelers were trying to catch. Moreover, the value of time for air travelers accessing airports was found to be at least as high as the average wage and often higher. And the third, travelers carrying more than one piece of luggage are less likely to use public transit.

Harvey's work is helpful in terms of looking at the potential for proposed integration of public transport (rail and bus). His analysis used survey data from three different airports in the San Francisco area. Of these three airports, at the time of Harvey's research, one had a rail link which had an off-airport train station and the others served by bus transit. This research, in line with it, focuses on the one integrated system that combining each public transport in order to account for potential advantage. Variables used in his research in determining mode choice by passengers at Bay Area airports may be applicable to other airports. Moreover, Harvey looks at airport access from the perspective of the individual. The survey asked individuals to indicate the mode of transportation they used to access the airport. This method is valuable, but it misses some points that could help an airport authority and a metropolitan area determine the integrated system of public transport and how to build it. His perspective also misses to explain the tendency of certain airport characteristics to affect mode share, for instance the hub airport serves more business travel so that time sensitivity of business model passengers will be higher thus whether or not rail transit is preferred over bus transit. Airport

characteristics may have an important effect on airport ground access system and mode share achieved from it that will hopefully be uncovered in this work.

Mandalapu and Sproule (1995) performed another research based on alternatives of transit access. They examined three general airport access alternatives; an exclusive airport rail link to the CBD, an extension of an existing rail network to the airport, and a shuttle bus or people mover connection to a nearby rail line. The research used Multi Criteria Analysis (MCA) with travel time, cost, reliability, baggage convenience, accessibility, and parking as the criteria. These criteria were assigned values and weights based on quantitative and qualitative data collected by the researchers. The values were multiplied by the weights to give final values for each alternative, which is really a measure of attractiveness on a relative scale. Each alternative was compared using a range of distances, demands, business or vacation traveler ratios, and baggage handling facilities. They concluded that rail link alternatives are more attractive if an airport has more business passengers and rail extensions and shuttle bus are more attractive for low demands.

2.2. Airport Ground Access Users

While related research in the field of airport ground access has focused mainly on air passengers, Tsamboulas et al. (2011) performed a research on different point of view. They worked on mode choice based on specifically airport employees commuting pattern due to it is believed that the issue of private car dependency is even more evident in the case of airport employees. Airport employees represent a particular challenge for airports due to their dependency on the private car in relation with the frequency and peak hour nature of their trips as well as the characteristics of their employment. They also argued airport employees' mode choice is often undervalued mainly because of their lower number when compared

to air passengers annually. Nevertheless, airport employees represent frequent round trips from and to airport, and unlike air passengers, they do not have the inconvenience of luggage. The characteristics of airport employees' trips have certain unique constraints and follow unusual patterns. Major airports operate 24 hours a day and many airport employees have shift patterns that involve travelling outside the usual commuting hours and the regular workdays in the week which are incompatible with many public transport services. Apart from the nature of employment at airports, public transport services often fail to serve worker trip destinations that are typically dispersed across the airport site and located away from the terminal building. For instance, there is often a long distance between the terminal buildings and the office or service areas where most of the public transport network ended. This situation exposes problems for airport employees who need to make trips to different areas of the airport during the course of the day and forces their mode choice to be different from those who make typical journey-to-work travel so that private car becomes dominant. With higher percentage of airport employees travelling by private car than its equivalent of air passengers as an indication, the modal split between both in selected United Kingdom and United States airports is shown in Table 2. It can be seen that the share of private car exceeds 80% in most cases.

Considering the importance of airport employees' unique characteristics as well as the effect of their mode choice decisions on airport ground access traffic, Tsamboulas et al. (2011) presented the attempt to identify and quantify the factors affecting airport employees' mode choice. They developed a logit model based on data collected from the Athens International Airport which offers a wide range of ground access modes. According to the model application results, the most important factors affecting airport employees mode choice are the total trip cost, the

total trip time, personal income as well as the individual perceptions of a specific mode namely the comfort and easy access to the bus stop or rail station. The main conclusion in their research is a rail system service, metro or suburban rail in this case, with competitive fares and travel times could attract an important share from the private car. Thus, it is known that travel cost and time are the most valuable attributes in determining mode share so far. Despite the focus is on airport employees' mode share, it is highly possible that both attributes would also affect the mode choice of other public transport user like air passengers which has been shown previously by Harvey (1986).

Table 2 Airport Employees Mode Split at United Kingdom and United States Airports

Airport	Car and Taxi (%)	Rail and Bus (%)	Other (%)
Heathrow*	77 (65.3)	17 (34.4)	6.0
Gatwick*	84.5 (67.5)	11.3 (32)	4.2
Manchester*	87 (79.9)	8 (20.1)	5.0
Stansted*	96 (66.2)	2 (33.8)	2.0
Birmingham*	87 (87)	13 (13)	-
Boston*	79.3	16.8	4.1
Denver	83.8	14.2	2.0
Los Angeles	97.2	2.5	0.3
Phoenix Sky Harbor	85.0	1.7	13.3
Salt Lake City	94.0	5.0	1.0
Sacramento	99.0	-	1.0
Seattle Tacoma	89.0	2.0	9.0

* airport with dedicated rail services
percentage in brackets is the air passengers' mode split
source: Tsamboulas et al. (2011)

While there are different focuses on public transport users in determining their mode choice, Budd et al. (2011) did a research that define airport ground access users as a whole. They categorized the users into three groups; passengers, employees and visitors. This is considered important to categorize airport ground access users into distinct groups as each group has different ground access characteristics and requirements. A successful ground access strategy is the one that

fulfill these various characteristics and requirements. Table 3 summarizes the different categories of airport ground access users and their characteristics. The differences between three groups of the users can vary considerably between airports and depends on factors such as the size of airport, the operational time of airport, the location of airport and the type of service airport offers. The key aspect of airport ground access management relates to mode choice as well as the factors that influence this choice. They argued that mode choice is a product of public perception of cost, comfort and convenience.

Table 3 Categorizations of Groups of Airport Ground Access Users

	Passengers	**Employees**	**Visitors**
Purpose	Originating, Destined	Airline, Airport, Government, Concessionaries, Contractors, Services Company	Greeters, Senders, Sightseers
Frequency of Trip	Infrequent	Frequent	Infrequent
Quantity of Trip	One way	Up to one third of total access trips	Round trip
Quantity of Traveller	Large number of people	Relatively small number of people	May outnumber passengers
Destinations at Airport	One or two main areas (terminal)	Dispersed across the airport site	One or two main areas (terminal)
Specific Characteristics	Time and cost dependent	Can result in several peak hours in traffic per day	Convenience reasons, e. g. kiss and fly

source: de Neufville and Odoni (2003), Humphreys and Ison (2002), Marsden et al. (2006), Kazda and Caves (2008), Humphreys and Ison (2005) in Budd et al. (2011)

Passengers are generally time sensitive, at least in terms of the trip to the airport and require a ground access mode that is affordable, efficient and reliable in time. Their research suggests that trip time and cost, trip distance and baggage handling easiness are key factors in passenger mode choice. In particular to developing countries, private car is the most common mode in accessing the airport.

The passengers use private car preferably because they perceive comfort, availability, flexibility, reliability, easiness in carrying heavy luggage and short door-to-door trip time it provide. For similar reasons, taxi use is also generally higher for passengers in these countries. Furthermore, passengers typically only accessing a few key buildings at the airport like the terminal building.

Employee trips, as another airport ground access user group, can account for one third of access trips at an airport, but can be much higher if an airport acts as the headquarters for a large aviation company or as the base for maintenance facilities. Employee trip characteristics can vary considerably from passenger trips. Employee trips represent a large number of trips from and to the airport, around 500 single trips per full time employee per year, by a relatively small number of people while passenger trips represent a few trips by a relatively large number of people. In addition to a large number of trips, airport employees often work in shift patterns and it can lead to high peak hours of employees' traffic at the changeover period. In line with the research performed by Tsamboulas et al. (2011), employees are more likely to rely on their private car for accessing the airport than passengers. Public transport networks are often perceived inadequate in providing comfortable and reliable transport for employees who may travelling at uncommon hours and work in parts of the airport that relatively far away from the terminal building where most of the public transport network ended. The work of Budd et al. also indicates that employees may be unwilling to use public transport even when they live close to the airport. Around 25,000 people are employed at Gatwick Airport with one third of them live in the nearby towns of Horley, about 1 mile/1.6 km away, and Crawley, about 2 mile/3.2 km away. Despite these relatively short distances, the employees that use public transport to travel from and to work are only 11%. Thus, it is suggested that passengers and employees may be more likely to use public

transport for longer distance trips as the time and effort that are spent in accessing public transport networks will be less than shorter trips in proportional.

In the other hand, the visitors more or less share the same characteristics with the passengers since it is common for passengers to be driven to the airport by a friend or relative and then picked up again after they have returned from their trip. This pattern makes the visitors as if the passengers themselves. The trips from this user are more likely to use private mode for convenient reason and require round trips from and to the airport for every flight made by passenger.

2.3. Concluding Remark

From the previous works, research in transportation that is related to airport ground access has given the understanding of how this system is organized and operates. In the part of transportation mode, the literature describes the shares between modes that are used for accessing the airports and how much share that is gained for any given and available mode. The mode shares are mainly divided into two groups, namely private and public transportation. This is done to see to what extent the attractiveness of public transport and the dependence on private transportation in terms of carrying air passengers. Further in-depth research of the mode shares explores the so-called travel attributes in which each attribute is the factor that is perceived from using particular transportation mode such as time and cost. These attributes contribute to the mode shares based on people preferences when they use each mode. As someone perceives that private car give shorter travel time and public transport such as bus and train is less convenience to use thus he or she is prefer to use car then the mode choice is determined and mode share of car increase. The other researches are not only addressed the transportation modes that are used for travelling from and to the airport but also discuss the users of these

modes and travel patterns. The users of airport ground access, more specifically, are categorized into groups based on their purpose when travelling from and to the airport. However, these researches miss the connection of airport ground access users and their mode shares. Due to each group of these users have different purpose, the characteristics of travel are also different so that the differences between user groups provide distinct choice of transportation modes. Neither of the researches discusses the differences of mode shares of user groups in accessing the airports nor the travel attributes that are preferred by each of user group from each transportation mode so that they will use it. Thus, this thesis is proposed to fill in the gap from prior researches.

3. METHODOLOGY

3.1. Theoretical Framework

In recent years, the efforts to solve traffic congestion have focus in reducing the use of private car and encouraging the use of public transport. However, transportation problem solving is not an easy task. Many determining factors influence the success of the process. Economic development and transport interventions, among others, are the prominent factors (Dijst et al., 2013). Economic growth gives impact in population size. The increase and the spread of dwelling area in one city or region thus will boost the volume of traffic. Moreover, households with economic capacity above the average are more likely to own and use private car as their daily travel mode (Dieleman et al., 2002). In the other hand, the population increase is often not accompanied by sufficient transportation infrastructure. Transport interventions that will give opportunity for people to travel without inducing more traffic congestion should be developed effectively. The balance of supply and demand plays an important role in this case. In facing transportation problem, there is another factor that has to be considered which is people choose their modes for travelling. It is needed to get a thorough understanding in how people make their choice in order to increase the effectiveness of transport improvement. However, there are several fields of knowledge that have different perspectives on this behaviour, namely psychology, economics and geography. In this research, utility theory based on economics perspective is selected for the theoretical framework.

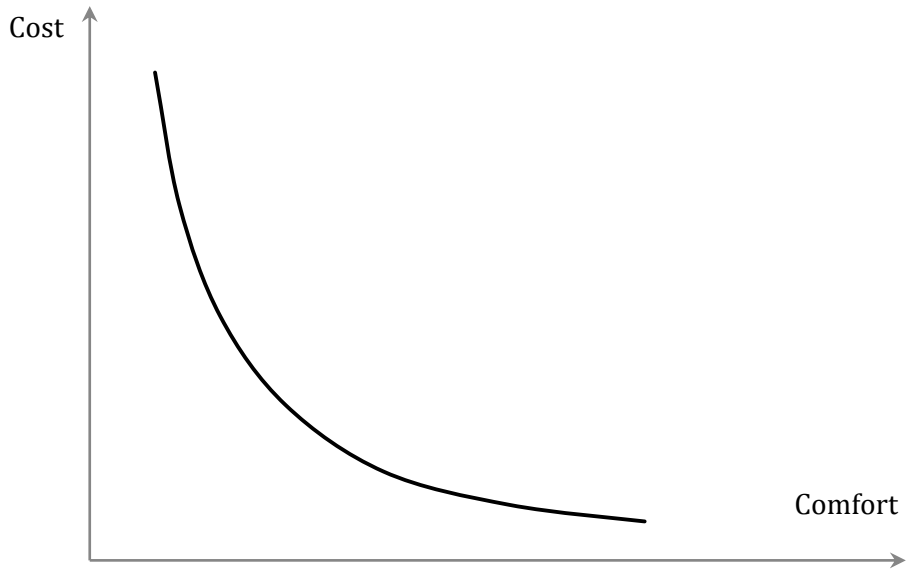
Utility theory has many attractive features in economics discipline, for instance in describing the consumer choice process so that a company or firm can design a product or service which the market will view it as an attractive object and buy it. Alternatively, there is an urge to influence choice by changing the consumer's utility function. An example of this changing in utility function is the strategy of

public transport authority who wants to encourage the use of public transport by increasing the perceived cost of using private car despite the comfort it offers. The utility function in economics is used to represent the preferences of consumers by giving the summary scores for the choices that various attributes are weighted according to their importance (Dijst et al., 2013). These preferences mean that if the consumer have the choice of different set; A, B and C, they will arrive at certain ranking, for instance B is preferred over C which is preferred over A. Preference in the economic perspective deals with consumers wants that relate to satisfying needs. However, these wants are limitless and in contrast with the actual capability of consumers. People might want to travel by their own car, but many of them can not afford to buy it. Thus, only the wants that are accompanied by sufficient economics capability are considered, not just simply the needs. This consideration determines which transportation strategies and interventions that should be taken, for instance subsidies are given to public transport that serve big city with average income population in order to ensure that people with low income can still make the trip. In the field of transportation, the choices of this preference-based approach are the transport modes like bus, train or private car with various attributes like cost, time, comfort and many others. Figure 1 shows the utility function in the form of curve that contains these attributes, for instance cost and comfort, being valued by the user of the transport modes.

The illustration of the utility function in figure below shows the indifferent judgement of the user. It can be seen from the curve describing the combinations between the two attributes that being valued equally. At one point, the curve contains high cost and low comfort, and there are also other choices with opposite combinations. Furthermore, the main point of utility theory is that the consumers or users try to maximize their utility by optimally allocating what they have, which is

given by their income for instance, to what they needs, which is given by their preferences as represented in the utility function. A business traveller who make high income and greatly appreciate time will maximize his or her utility when using high speed vehicle like private jets which, in the other hand, is costly.

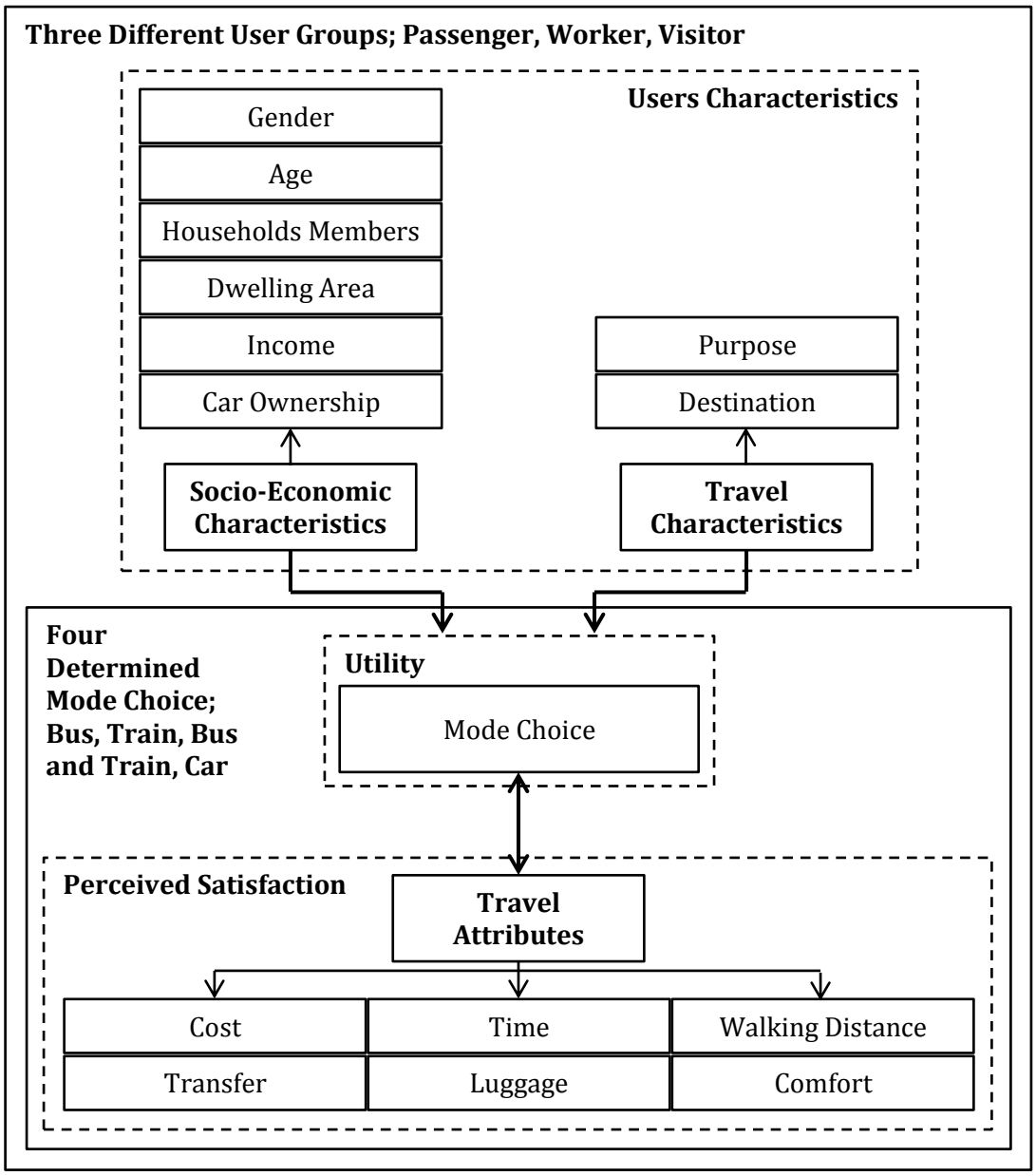
Figure 1 Illustration of the Utility Function with Two Attributes



source: Dijst et al., 2013

The application of utility function in this research is focused on the categorization of the airport ground access users, namely passenger, worker and visitor. This selection is based on the prior research that has been reviewed in the Chapter 2. Since each group of users represents different preference in mode choice for travelling from and to the airport then there should be several travel attributes of the chosen modes that influence the preference of the users the most. These influencing attributes are reflected by the users' satisfaction towards transportation modes. Figure 2 describes the theoretical framework of the research.

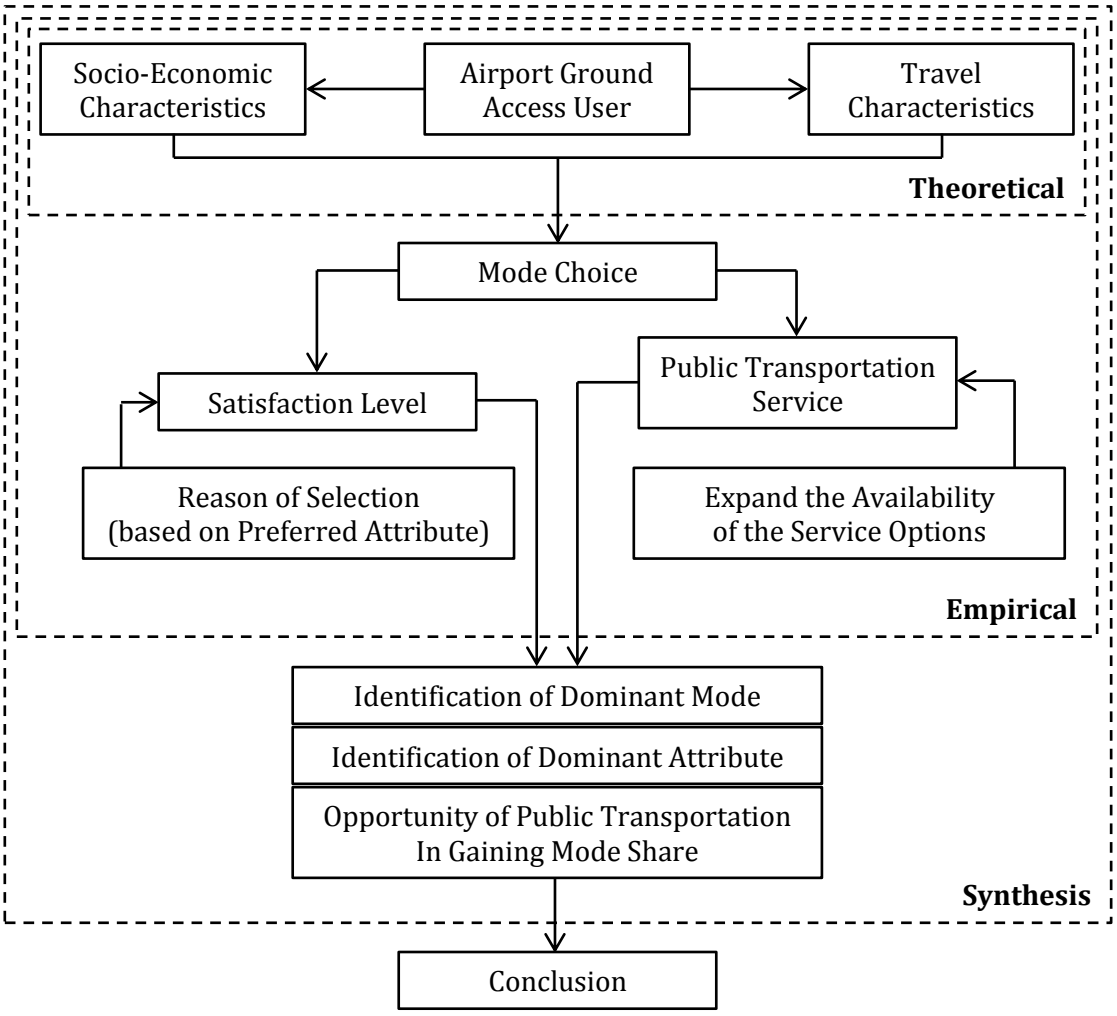
Figure 2 Research Theoretical Framework



The overall mode choice, which is the dependent variable, is determined by users characteristics and perceived satisfaction of the users towards the chosen mode. However, it is expected to change the mode choice by utilizing the satisfaction of any given users. For example, train fares can be lowered to encourage the use of train where the users prefer in using car rather than train because they are more satisfied with the cost attribute of car. Another step that can be developed in order

to answer the other question is to classify the users characteristics based on the user groups, namely passenger, worker and visitor, and specify how they are related to each other in choosing the mode towards certain attributes. For instance, if passengers choose the bus because they are satisfied by the cost attribute then does the same tendency applies to workers and visitors. In addition to this theoretical framework, research conceptualization is developed in order to make distinction over theoretical part, empirical part and the synthesis between them so that the conclusion of this research can be drawn. Figure 3 describes the conceptualization of the research.

Figure 3 Research Conceptualization



In applying utility theory to transportation, there are important issues that have to be considered. First, transportation reflects many decision with varying preferences in why and how people travelling and what travel mode they choose. Secondly, the choices of the people who are travelling are often involving sociological and psychological aspects rather than physical. Third, in collecting the information, it should not be too difficult or too complex so that people can give their thoughtful answers which reflect actual reality. Therefore, these three issues are used in preparing the research design.

3.2. Research Design

It requires certain knowledge of the circumstance of the trip and the socioeconomic status of the traveller which can be obtained from surveys in addition to the theoretical framework that has been constructed (Ben-Akiva and Bierlaire, 1999). There are methods that widely used for data collection in this case. Revealed Preference (RP) is one of available methods (Houthakker, 1950). In several cases, the RP technique is preferred since it represents data collected on choices that are made in reality. It is also in line with the case that is conducted in this research where actual travel behaviour is needed in determining mode choice and preference of airport ground access users.

Survey to the airport ground access users is conducted in the empirical stage. The selected case, Soekarno-Hatta International Airport, where survey is conducted consists of three terminal buildings and various office buildings. Groups of passenger and visitor can be found mainly in terminal building while group of worker is concentrated in office building nearby. A questionnaire, shown in the Appendix 1, is used as the survey instrument to gather primary data from the respondents; passengers, visitors and workers. Questionnaire is formally classified

as standard instrument for measuring people perceived reality and considered as the most appropriate tool for gathering information about viewpoints of the respondents (Morgan et al., 1995). The respondents are to be asked to participate in the survey by filling in the questionnaire which is handed manually and accompanied by the surveyor during the process to provide necessary information.

The questionnaire that is used for this research is developed based on the information obtained from literature review. The language for the questionnaire is arranged in English and later translated into Indonesian. However, the English version of questionnaire is still used in the survey in the case when the participating respondent is non-Indonesian. There are four sections of questionnaire which cover socio-economic characteristics, travel characteristics, travel attributes and satisfaction levels. The latter section consists of multiple choice items of likert scales (Rodeghier, 1996). The results of survey, thus, will be analyzed in the next chapter in order to answer the research questions.

Table 4 Travel Attributes Description

Travel Attribute	Description
Cost	The fares of public transportation and the cost of gasoline, toll ticket and parking ticket of private car
Travel Time	The relative amount of time for a one-way trip either going to or from the airport
Walking Distance	The relative amount of distance it takes to get to the chosen mode from either origin or destination point
Ease of Transfer	The simplicity to change to another mode
Ease of Carrying Luggage	The simplicity and the space that the chosen mode has to store the luggage
Comfort	The convenience that is offered in the term of cleanliness, the availability of air conditioner and reliability

In developing the research design and based on the theoretical framework, six travel attributes are chosen. These attributes are important and determined significant in the researches of Harvey (1986), Mandalapu and Sproule (1995),

Tsamboulas et al. (2011) and Bud et al. (2011). The description of travel attributes is given in Table 4.

3.3. Analytical Methods

Due to the data collection technique is solely based on questionnaire answers then the data are generally in the form of numbers. Thus, statistical and descriptive analysis will be employed as analytical methods in this research. Statistics can be called as the body of analytical and computational methods in dealing with observation results toward representative sample of population (Delorme, 2006). In the other hand, descriptive analysis is intended to explain groups of information, including numbers and figures, in the content of statistics analysis. There are two of statistical methods that will be used in analyzing the data, namely Analysis of Variance (ANOVA) and Chi Square (χ^2).

This research is mainly focus on the users of airport ground access and it brings several parameters that have to be compared. Based on literature review and theoretical framework, these users are categorized into three groups namely passenger, worker and visitor, so that there are three parameters to compare. If t-test is used for comparison then it will be three separate t-tests for comparing passenger and worker, worker with visitor and passenger with visitor. However, the use of ANOVA test is considered more suitable for comparing means of three or more parameters in single test to avoid the errors in performing multiple t-tests where in each of t-test there is 5% chance, for p=0.05, of the conclusion being wrong. ANOVA test overcomes this problem by detecting significant differences between the groups as a whole. The basis of ANOVA test is the F (Fisher) variable which is obtained from the distribution of mean square between-sample groups

($MS_{BetweenGroups}$) to the mean square within-sample groups ($MS_{WithinGroups}$) and defined as follow:

$$F = \frac{MS_{BetweenGroups}}{MS_{WithinGroups}}$$

For several data samples of the same size, between-groups variance and within-groups variance are defined as follow:

$$MS_{BetweenGroups} = \frac{N_i(M_i)^2 + N_j\left(M_j\right)^2 + \cdots + N_n(M_n)^2 - N_G(M_G)^2}{N_G - 1}$$

$$MS_{WithinGroups} = \frac{(N_i - 1)(SD_i)^2 + \left(N_j - 1\right)\left(SD_j\right)^2 + \cdots + (N_n - 1)(M_n)^2}{N_T - N_G}$$

M_i, M_j and M_n are the means of sample i, j and n and N_i, N_j and N_n are the number of values in samples i, j and n. M_G is the average of all values from all sample groups and N_G is the number of samples. SD_i, SD_j and SD_n are the standard deviations of group i, j and n while N_T represents the total number of observations. The result of ANOVA test is obtained by opposing calculated F value against critical F value which can be looked up in the table of F distribution of critical values. The significant difference is only reached when calculated F value is greater than critical F value.

The use of χ^2 test is to find out whether the actual data differ from a random distribution. The example of random distribution is when there are five attributes of travel and the groups of users are asked to choose which attribute they preferred then the proportion of attribute chosen should be equal for 20% in each attribute. For this case, it might not be surprisingly if there is 1% difference between chosen attributes, but it might be hard to find enough evidence to say that those choose non-randomly. The answer for this problem is given by χ^2 test. The basis of χ^2 test is

χ^2 variable which is calculated by comparing the expected frequencies e_i to the observed frequencies O_i and defined as follow:

$$\chi^2 = \sum_{i}^{n} \frac{(O_i - e_i)^2}{e_i}$$

The degrees of freedom is equal to *(n – 1)* where *n* is the number of rows in the data table. After the χ^2 value and the degrees of freedom have been calculated, the critical χ^2 value can be looked up in the table of χ^2 distribution of critical values for a given level of significance. If calculated χ^2 value is greater than critical χ^2 value then it can be concluded that the sample data differ from a random distribution.

4. CASE STUDY

The data are collected at Soekarno-Hatta International Airport due to it is the largest airport and the biggest public transport market in Indonesia. It is also chosen because of the wide transportation network coverage in which serves people from different part of the city. Soekarno-Hatta International Airport acts not only as an international gateway of Indonesia but also as a primary hub airport for domestic flights and it make this airport as the main destination for travelling by air transportation. As the largest airport in the country, Soekarno-Hatta International Airport also attracts various attention related to its development and problems. Due to its capacity already exceeding the limit of 38 million passenger annually (Angkasa Pura II, 2013), Soekarno-Hatta International Airport is planning to expand the capacity of its terminal buildings and add one more runway. The problem that emerges from this development is that it is not planned along with its supporting infrastructure like ground transportation infrastructure. Accessibility to Soekarno-Hatta International Airport has been stagnant for recent years. There is no significant expansion in this sector. One big planning project still being discussed in the governmental level is the addition of airport rail link from the center of Jakarta to Soekarno-Hatta International Airport area.

4.1. Location Relative to Cities and Provinces

Soekarno-Hatta International Airport is located about 20 km west of the city center of Jakarta. It is administratively within the city of Tangerang, province of Banten. Soekarno-Hatta International Airport is the largest airport in the three nearby provinces it serves, namely Banten, West Java and DKI Jakarta itself. Jakarta (Jakarta Province), Tangerang (Banten Province), Bekasi, Bogor, Depok and Bandung (West Java Province) are, among others, big cities where the residents often use Soekarno-

Hatta International Airport as the airport for their needs of air transportation. As a big airport, Soekarno-Hatta International Airport is located quite close to populated areas such as the city of Tangerang and West Jakarta municipality. In addition, Jakarta is the center of business and commerce in Indonesia. Many business travellers, even tourists, make Jakarta as their main destination and Soekarno-Hatta International Airport as their arriving and departing point. Figure 4 shows the location of Soekarno-Hatta International Airport.

Figure 4 Location of Soekarno-Hatta International Airport (SHIA)

4.2. State of Public Transportation

Jakarta Metropolitan Area is one the most motorized cities in Indonesia. Car ownership in this area is above the average and the residents are relatively car dependent. However, the availability of sufficient public transportation is always encouraged by the government in order to reduce traffic congestion that is caused by increased motorization and Soekarno-Hatta International Airport is included in

this plan. Public transportation in accessing Soekarno-Hatta International Airport is distributed into several modes. Bus transit has direct connection to the terminal buildings in Soekarno-Hatta International Airport area. This transit system that is operated by DAMRI (Indonesian Bureau of Motor Transport) serves direct connection from 17 different points that is spread across area, not only in the area of Jakarta but also in five nearby cities, to Soekarno-Hatta International Airport and vice versa. There is also connection to Soekarno-Hatta International Airport by using intercity shuttle bus that is served by private operators. This shuttle bus generally intended for air passengers from slightly distant cities. Another public transport mode that offering direct connection to the airport is taxi. This option is usually chosen when people are in hurry or being very sensitive to the amount of time. In the other hand, train is the only mode that does not serve direct connection to the airport. However, there is a bus stop in the Gambir station located in the center of Jakarta that serve direct connection the airport. Rail network in Jakarta Metropolitan Area is quite huge in the demand of transportation. It serves commuter from outside Jakarta to the city center. The use of train in accessing the airport is take place indirectly. Due to some stations are located near dense residential areas, people often use train to the center of Jakarta and continue their trip using bus which is available every half an hour.

Meanwhile, there is also transportation network inside Soekarno-Hatta International Airport area which is operated by its management. This network is the bus feeder that connecting three passenger terminals. Known as the yellow bus, the feeder is available for anyone in the airport area and free of charge. The yellow bus is usually used by passengers on flight transfer that require them to move to another terminal. Nevertheless, workers who work in the terminal building and have mobile activity are also using this bus.

4.3. Data Collection

The service of surveyors was used in the data collection process in Soekarno-Hatta International Airport area. The process itself was done in two weeks, started in the fourth week of May until the first week of June. In order to obtain random respondents that represent each of user groups, namely passenger, worker and visitor, the data collection process was done in the main areas of the airport including passenger terminals and office buildings. The surveyors distributed and gathered the questionnaires directly and accompanied the respondents during filling in the questionnaires in case any unclear questions. Due to Soekarno-Hatta International Airport also serving international flights and foreigner travellers are included as the target of respondents, the questionnaire is not only arranged in Indonesian but also in English. Responses that are obtained from the respondents vary with user groups. The groups of worker and visitor are mainly keen on filling in the questionnaire while the group of passenger is rather difficult to work with and even refuse to be involved in data collection process. This constraint might be caused by the rushing pattern of air passenger when catching the flights or get annoyed by long delay time. However, there are other passengers who would like to filling in the questionnaires. Furthermore, simple random sampling was used as the sampling strategy in the data collection. Each respondent is chosen randomly in the airport area and such that each respondent has the same probability of being chosen for the sample. This sampling was done without replacement in which the respondents can only be selected one time for inclusion in the sample.

5. ANALYSIS

From the survey that has been done in Soekarno-Hatta International Airport by the surveyors for the given time, there are data that have successfully collected from a total of 50 respondents. The survey process itself was done in several main areas like the terminal and office buildings. The respondents were asked to filling in the questionnaires and agreed to completely participate in the survey process. However, these data are considered too limited due to the small sample size. A small sample size can bring its own problem that may result in the lack of statistical representation thus may not give very reliable answers. As this research mainly comparing groups of user and mode choice with perceived satisfaction to find their relationship, the statistically important differences will be hard to find with this limitation. The awareness of this problem of small sample size leads to the consideration of the appropriate and possible methods. This reasoning is to ensure that this research can answer the questions. Thus, the characteristics of the data are examined in order to facilitate the choice of statistical tests that are used to analyze these data. Based on the questionnaire and the collected data, the variables are measured in two different data types. The users characteristics are measured as nominal variables while the perceived satisfaction of travel attributes comes to particular consideration. Utilizing the likert scale from very satisfied to very dissatisfied, the type of satisfaction measurement is ordinal in the sense that very satisfied reflects more satisfaction than satisfied. This is categorized as an ordinal variable due to it can not be stated for sure that the interval between dissatisfied and very dissatisfied is equivalent to the interval between dissatisfied and more or less satisfied. However, in the social and behavioral sciences, this condition can be assumed that the intervals are equally spaced where scientists have found that it is alright to treat ordinal variable as though it is interval variable and conduct

statistical test that is appropriate for interval variable (Norman, 2010). Thus, the statistical tests for the analysis of this research can be selected appropriately after examining the data characteristics. There are certain statistical tests which are only meaningful and appropriate for certain data characteristics (Norman, 2010, Rodeghier, 1996). It is generally inappropriate to compute the mean for nominal variables. For example, a mean of 1.5 from the assigned value of 1 for male and value of 2 for female on gender variable is not make sense and can not be interpreted. Descriptive statistic in the form of percentage, 75% of the sample is male, is more appropriate in examining nominal variables. There are also guidelines when examine the relationship between group of variables. As for group that confront nominal variables, nominal versus nominal, chi square test is the most appropriate measure. Moreover, in the case where nominal variables are confronted with interval variables, ANOVA test is the appropriate measure in order to find out if the mean value of these two variables is related to each other. Therefore, chi square test and ANOVA test are selected as the statistical tests in analyzing the data of this research.

This chapter will discuss the results and the following analysis that divided into different subchapter based on the research questions. First subchapter is to be discussed in answering the first question which is the influence of travel attributes satisfaction level on the mode choice of the user and second subchapter is to be discussed in answering the second question which is the mode choice differences on user groups based on their satisfaction level. However, the descriptive statistic of users characteristics of the respondents will be discussed first in the form of percentage and subsequently the chi square test of mode choice to examine whether the respondents' choice following random distribution or not. Thus, if the test results indicate that the mode choice of the user groups does not randomly selected,

or chosen by the user's preference in the other words, then the data are valid and the analysis can proceed to the sections where the research questions will be answered.

In describing the users characteristics of the respondents, the collected data from the the first two sections of the questionnaire are used. These sections are aimed to collect data on the users, in term of socio-economic, characteristics and travel characteristics. In terms of gender, 68% of respondents are male and 32% of respondents are female. In terms of age, there are six options ranging from under 20 to above 59. Most respondents are in the age of 30 to 39 with 46% of all respondents. The least of age of respondents is above 59 with 0% of all respondents. The member of household is asked along with its working member. Household members between 4 to 6 people and working members between 1 to 3 people is the most with, consecutively, 70% and 72% of all respondents. The least of household members and working members are, both of them respectively, between 7 to 9 people with 4% and 2% of all respondents that were asked. Most of respondents, 46%, are live in Jakarta and only 2% of them are live abroad. In terms of income, there are also six options ranging from under US$200 to above US$999 and an option for those who do not want to answer about their income. Most of respondents have income between US$200 to US$399 with percentage of 38%. No one have income under US$200 and 18% of all respondents do not want to answer this question. From 50 respondents, 74% of them have the terminal building as their destination while the remaining 26% are heading to the place other than the terminal buildings. When the respondents were asked about the number of people they are travelling with, at the same 36% of respondents answered they are travelling with 1 or 2 people. The least number of people travelled is 3 people that is answered by 10% of respondents. The amount of luggage that is carried by most

respondents is as much as 1 luggage with a percentage of 34%. There are only 8% of respondents, which is the least, who carry more than 2 luggages. Table 5 shows the data of both socio-economic and travel characteristics in number of frequencies and percentage. In overall, the majority of the respondents are male, 30 to 39 years old, have total household members of 4 to 6 people and working household members of 1 to 3 people, live in Jakarta, own a car, have income in the range of 200 to 399 US Dollars, going to terminal building, travelling alone or with one other person, and/or carrying only one luggage.

Table 5 Users and Travel Characteristics

	Number	Percentage
Gender		
Male	34	68
Female	16	32
Age		
<20	1	2
20-29	16	32
30-39	23	46
40-49	8	16
50-59	2	4
>59	-	-
Household		
Household Members		
1-3	13	26
4-6	35	70
7-9	2	4
Working Members		
1-3	36	72
4-6	13	26
7-9	1	2
Dwelling		
Jakarta	23	46
West Java	12	24
Indonesia	14	28
Abroad	1	2
Car Ownership		
Yes	27	54
No	23	46
Income		
<US$200	-	-

	Number	Percentage
US$200-399	19	38
US$400-599	8	16
US$600-799	7	14
US$800-999	3	6
>US$999	4	8
Do not want to answer	9	18
Destination		
Terminal Building	37	74
Others	13	26
Number of People Travelling		
1	18	36
2	18	36
3	5	10
>3	9	18
Amount of Luggage		
None	14	28
1	17	34
2	15	30
>2	4	8

The next part of the collected data is the categorization of groups of airport ground access users in Soekarno-Hatta International Airport. Since the respondents vary in their travel purpose, this purpose represents the type of airport ground access user. Thus, it can make the distinction of the user groups for the use of this research. For those who have the purpose for flight are categorized as passenger. Worker is the one with the purpose to work in the building within the airport area. People who send or greet the passenger are categorized as visitor. Table 6 shows the distribution of each user group. Passenger is the group with the most member portion, 44%, while visitor is the least, 26%.

Table 6 Groups of Airport Ground Access Users

Group	Number	Percentage
Passenger	22	44
Worker	15	30
Visitor	13	26

After presenting the number and the groups of airport ground access user, the mode choice of all respondent is shown in Table 7. The mode choice is presented for every determined users characteristics. Car is the dominant mode that has 42% share in overall, followed by bus with 24% share and combination of bus and train with 12% share. There are others transportation modes that are chosen by the respondents, namely intercity shuttle bus and taxi with total percentage of 14% for both of them. Train is the mode that rarely chosen by the respondents with only 8% of all chosen modes. Besides representing the mode choice in overall, Table 7 also indicates the mode choice of each particular group of airport ground access user. Car is still the dominant mode except for worker group. The most chosen mode by the worker group is bus. The passenger group is the group with the most varies mode choice except for travelling with only the train.

Table 7 Mode Choice in Overall

Mode Choice	Passenger		Worker		Visitor		Total	
	N	%	N	%	N	%	N	%
Bus	4	18	5	33	3	23	12	24
Train	-	-	4	27	-	-	4	8
Bus and Train	3	14	2	13	1	8	6	12
Car	9	41	4	27	8	62	21	42
Others								
Intercity Shuttle Bus	4	18	-	-	-	-	4	8
Taxi	2	9	-	-	1	8	3	6

A test that is performed for mode choice of respondents is the chi square test. This test is intended to find out whether the mode choice of the respondents is based on their preference and differ from a random distribution. Table 8 shows the result of chi square test. Since the data of worker and visitor mode choice are only 15 and 13 in number then the two groups are combined so that the minimum number to perform chi square test can be met. The *P-Value* of each group of users indicates the probability that the respondents choose their mode choice randomly.

For the given significance level of α, *P-Value* that is below 0.05 is considered statistically significant in 95% confidence. Both of the group of passenger and group of worker and visitor has *P-Value* below α. It means that the respondents, both in passenger group and worker and visitor group, choose their mode choice based on their preference and there is small probability, below 5%, that they chose their mode randomly.

Table 8 Chi Square Test of Mode Choice between Each Group of Users

User Groups	*P-Value*	α	Significance
Passenger	0.03	0.05	Yes
Worker and Visitor	4.92×10^{-4}		Yes

Due to the significant results are obtained from the test result then the data are valid although the sample size is small. The results indicate that the mode choice of the user groups is based on their preference and in relation to theoretical framework of this research, as shown in Figure 2, the users' preference is affected by their perceived satisfaction towards travel attributes of each mode; bus, train, bus and train, car. Therefore, the other tests can be conducted in order to answer the research questions in how the mode choice of the respondents as the users is influenced by perceived satisfaction of travel attributes and the differences on mode choice between the user groups related to their perceived satisfaction. The following first subchapter will discuss the first part of these questions.

5.1. Travel Attributes Influence on Airport Ground Access User Mode Choice

Before examine the influence of travel attributes on mode choice of the users, the perceived satisfaction towards these attributes will be determined first in order to find out which attribute that satisfy users the most. In determining the perceived satisfaction level of Soekarno-Hatta International Airport ground access users, six

attributes are used namely cost, travel time, walking distance, ease of transfer, ease of carrying luggage and comfort. The satisfaction level section of the questionnaire is presented in multiple choices ranging from 1 to 6 in likert type scale that consecutively expressing the perceived level of very satisfied, satisfied, more or less satisfied, more or less dissatisfied, dissatisfied and very dissatisfied. In order to analyze the perceived satisfaction level, the data are weighted according to the level range. The weights are +3 for very satisfied, +2 for satisfied, +1 for more or less satisfied, -1 for more or less dissatisfied, -2 for dissatisfied and -3 for very dissatisfied. After getting weighted, the data of each attribute are calculated to find the mean score. Thus, the preferred attribute from each mode can be obtained by comparing the mean score of each others. The highest mean score indicates the highest satisfaction level of travel attribute while the lowest mean score indicates the opposite. Table 9, Table 10 and Table 11 show the satisfaction level of the group of passenger, worker and visitor while Table 12 shows the satisfaction level of all respondents as the users in overall.

For passenger group, in using bus, the highest satisfaction level of travel attribute is given by cost attribute. The cost in using bus in accessing Soekarno-Hatta International Airport is approximately US$ 2 for single trip and this is considered the cheapest cost than using train or car which requires the user to pay more than US$ 2. Meanwhile, the lowest satisfaction level is given by ease of carrying luggage and ease of transfer. Bus in Jakarta is known for being crowded by its passenger thus no space left for placing the luggage and some type of bus also does not have luggage compartment and make the need for carrying luggage in using bus much harder. Furthermore, the passengers that need to transfer to another bus might also be distracted by the condition of transfer shelter where frequently has long queue. In addition to that, the headway between buses

sometimes does not suit the schedule so that it can bring inconvenience for the passengers when they catching a flight. In using train, travel time attribute gives the highest satisfaction level. Compared to road transportation, train in Jakarta generally has shorter travel time for the same distance due to no traffic jam involved in rail transportation. Passengers who appreciate travel time the most are more likely use train as their mode. Meanwhile, the lowest satisfaction level in using train is given by walking distance attribute. Train stations in Jakarta are mainly located in the city center and make walking distance seem inconvenience to be done so that passengers are required to use feeder transportation in accessing the stations before they can use the train. However, although walking distance is perceived dissatisfactory in using train, this attribute gives the highest satisfaction level for using combination of bus and train. This might be caused by the location of bus stop itself where located near dense populated area such as residential area and passengers tend to use bus first and make a transfer to the train and later transfer to bus located on train station that has direct lane to Soekarno-Hatta International Airport. Meanwhile, comfort and easiness in carrying luggage are the attributes with lowest satisfaction level in using the combination of bus and train. Making a trip with combination of two different modes is considered uncomfortable by the passengers. This is due to the schedule between bus and train is not well synchronized and the bus feeder to the train station is not as clean as the direct bus to the airport. The easiness in carrying luggage once again become the attribute with lowest satisfaction level due to this mode combination include bus in which also has the same attribute with lowest satisfaction level. In addition, travelling with two different modes while carrying luggage is less preferred by the passengers who have to unload and load their luggage several times. In using car, there are four attributes that give high satisfaction level, namely comfort, ease of carrying luggage, ease of

transfer and walking distance. These attributes show all the convenience and comfort that car could offer. Car can be used anytime by its owner and walking distance to it is relatively very short while it is parked in the garage. Moreover, there is no transfer needed in using a car and luggage can be stored conveniently in car trunk. Meanwhile, the lowest satisfaction level in using a car is given by cost attribute. Passengers perceived car as an expensive mode in which they have to spend more in gasoline, parking ticket and toll ticket, even in Jakarta people have to pass more than one toll road to access the airport.

Table 9 Satisfaction Level of Passenger Group

Attributes	Bus	Train	Bus and Train	Car
	Mean			
Cost	7.00	7.17	5.83	2.33
Travel Time	3.17	7.67	4.67	2.67
Walking Distance	3.00	0.83	6.17	9.00
Ease of Transfer	1.17	5.33	5.33	9.33
Ease of Carrying Luggage	1.17	2.50	3.67	9.50
Comfort	2.67	5.67	3.33	9.67

For worker group, in using bus, cost is the attribute that give the highest satisfaction level as the same as the passenger group gets. The reason is more or less the also the same as the cost in using bus is the cheapest one in Jakarta. Meanwhile, there are three attributes that have negative mean score which means that these attributes not only give the lowest satisfaction level but also the worker group dissatisfied with these attributes, consider dissatisfaction levels are weighted by negative scores. Workers are uncomfortable in using bus due to its unreliability towards their destination points in Soekarno-Hatta International Aiport. Every bus that has access to the airport does not have bus stop near office buildings so that workers who use bus and do not work in the terminal buildings have to walk or use taxi to get to their office buildings. Travel time is perceived as dissatisfactory

attribute by the workers due to bus is obstructed by traffic jam almost all the time. Workers who want to arrive in their office in time and get back to their home before late night are less likely to use bus. Easiness in carrying luggage has also perceived as dissatisfactory attribute. This might be caused by the particular situation in which the workers have to carry their working tools or valuable documents that would be inconvenience to be carried by using a bus. In using train, both cost and travel time are the attributes that give the highest satisfaction level. As passenger group perceived travel time as the most satisfactory attribute in using train, the same perception also goes with worker group. While the reasoning for travel time attribute is more or less the same with the passenger group, the workers perceived that the cost in using train is cheap enough for them compared to using a car in which they have to pay for gasoline and toll ticket that is more expensive. The lowest satisfaction level of using train is also given by walking distance, the same with passenger group with more or less the same reason where train stations are generally located far away from residential areas thus walking to the stations is almost impossible for convenience reason. In using the combination of bus and train, the highest satisfaction level is given by cost attribute. This makes sense due to cost attribute is also perceived as satisfactory attribute in both using bus and train separately. Meanwhile, comfort attribute gives the lowest satisfaction level in using the combination of bus and train. Once again, the lowest satisfaction level of worker group is the same as passenger group. In using car, worker group perceived the same satisfaction with passenger group. Ease of carrying luggage, ease of transfer, comfort and walking distance get the high perceived satisfaction from the workers. Travel time is the only one attribute that perceived as dissatisfactory attribute by the workers in using car. It is stressful for being often stuck in traffic jam on daily congested roads of Jakarta especially for the workers who have regular activity and

work. They do not want their time get wasted on the roads after spending one-third of a day in their office. In addition, the travel time in using a car is generally much longer compared to train.

Table 10 Satisfaction Level of Worker Group

Attributes	Bus	Train	Bus and Train	Car
	Mean			
Cost	2.67	5.17	2.33	0.00
Travel Time	-0.50	5.17	1.67	-1.33
Walking Distance	0.00	1.33	1.33	5.17
Ease of Transfer	0.00	2.00	1.33	6.33
Ease of Carrying Luggage	-0.33	2.17	0.83	6.50
Comfort	-0.83	2.50	0.50	5.67

For visitor group, in using bus, cost once again gets the highest satisfaction level due to its cheap fare. This makes cost attribute as the most satisfactory attribute in using a bus for all user groups. Walking distance and comfort are the attributes that give the lowest satisfaction level for visitors. Due to sender and greeter of passenger mainly more than one person then using a bus which is generally crowded is inconvenient. In using train, the highest and the lowest satisfaction level of the visitors are given by the same attributes as the passengers get. Travel time is the attribute with the highest satisfaction level due to its shorter travel time in which no traffic jam involved while walking distance is the lowest satisfaction level due to the nearest train station is actually far away for walking. In using the combination of bus and train, the highest satisfaction level is given by ease of transfer attribute. For visitors, transferring from bus to train or vice versa is considered as a simple task. Meanwhile, the lowest satisfaction level is given by comfort attribute. Due to the combination of bus and train surely including bus, and the lowest satisfaction level in using bus is given by comfort attribute, then comfort attribute becomes an issue for visitor group. Although the transfer between bus and

train is considered easy by visitors, in fact they are uncomfortable in using this chain of modes. In using car, the highest satisfaction level and the lowest satisfaction level of visitor group are also relatively the same with the passenger group. Comfort, ease of transfer and ease of carrying luggage are the most satisfactory attributes while travel time is the less satisfactory attribute. From all modes, car is the most comfortable mode for visitors in which they can use it together with the person who are being sent or picked up personally. The simplicity in using a car also negates the need of transfer. For ease of carrying luggage, even though visitors commonly do not bring luggage, they are willingly help in carrying the luggage of the person they send or greet and car provides straightforward solution for it where the luggage can be immediately placed in the car trunk. Travel time is perceived as the less satisfactory attribute due to it takes longer time in accessing the airport when a car is used.

Table 11 Satisfaction Level of Visitor Group

Attributes	**Bus**	**Train**	**Bus and Train**	**Car**
	Mean			
Cost	4.50	3.50	1.50	1.67
Travel Time	0.83	4.00	1.00	1.17
Walking Distance	0.50	0.50	1.67	3.83
Ease of Transfer	2.00	1.67	1.83	5.17
Ease of Carrying Luggage	0.83	1.67	0.50	5.83
Comfort	0.50	2.33	-0.33	5.17

In overall, for all user groups, cost is the most satisfactory attribute in choosing bus as the transportation mode while ease of carrying luggage is the less satisfactory attribute. Travel time is the most satisfactory attribute in choosing train while walking distance is the less satisfactory attribute. In using the combination of bus and train, cost is the most satisfactory attribute as well as in using bus only while comfort is the less satisfactory attribute. In using car, ease of carrying luggage is the most satisfactory attribute even though ease of transfer and comfort also give

high satisfaction level while travel time is the less satisfactory attribute. So far has been known that travel attributes give different satisfaction level on the mode choice. One travel attribute is more satisfactory while the other is less satisfactory for the users. Of what is already known, the unknown is whether this satisfaction level influences the mode choice of the users and gives significant differences to it. In order to make this unknown known thus the appropriate statistical test will be conducted in search for the answer.

Table 12 Satisfaction Level of All User Groups

Attributes	Bus	Train	Bus and Train	Car
	Mean			
Cost	4.72	5.28	3.22	1.33
Travel Time	1.17	5.61	2.44	0.83
Walking Distance	1.17	0.89	3.06	6.00
Ease of Transfer	1.06	3.00	2.83	6.94
Ease of Carrying Luggage	0.56	2.11	1.67	7.28
Comfort	0.78	3.50	1.17	6.83

Due to the purpose for doing the statistical test is to examine the influence of travel attributes satisfaction level on mode choice of the users then the main point is whether there are any significant differences between satisfaction level of travel attributes so that these attributes can influence the mode choice. Therefore, the appropriate statistical test for this case is ANOVA test. Besides the characteristics of the data match with the requirement for conducting ANOVA and there are more than two groups to be compared, this test is used to determine whether there are any significant differences between the mean value of travel attributes satisfaction level on mode choice. Figure 5 shows the schematic illustration of ANOVA test to find out the influence of travel attributes on mode choice. There is a group of travel attributes that give different satisfaction level, which have been described previously, and then split into smaller groups where each attribute is allocated into

one different group. Furthermore, these smaller groups are associated with each mode choice to find significant differences between the mean values of perceived satisfaction of each attribute on each mode choice.

Figure 5 Schematic Illustration of Travel Attribute Influence on Mode Choice

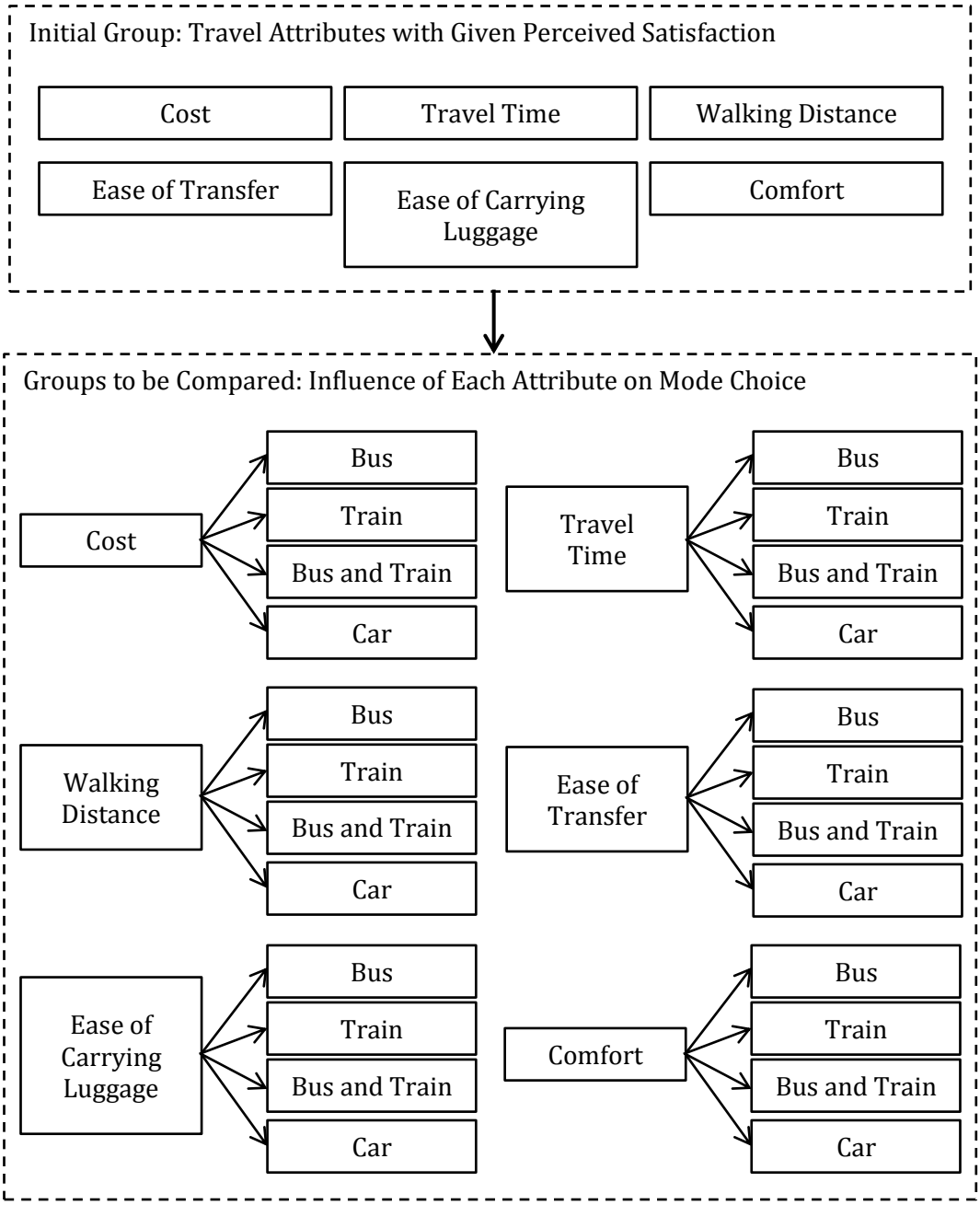


Table 13 gives the results of ANOVA test while Table 14 shows the value of satisfaction level. Furthermore, the results of ANOVA test are significant for all

attributes, namely cost, travel time, walking distance, ease of transfer, ease of carrying luggage and comfort. These attributes have *P-Value* below 0.05, and even below 0.01 or in the confidence level of 99%, and it means that there are significant differences between the mean values of perceived satisfaction in using each modes for each attributes. The attributes significance indicates that these results in line with the existing literature that also use and indicate the same significance (Harvey 1986, Mandalapu and Sproule 1995, Tsamboulas et al. 2011 and Bud et al. 2011). Since ANOVA test gives significant results then at least two means are significantly different from each other. At this point, it is realized that ANOVA test is a comprehensive statistic test that does not tell which specific mode choice that is significantly different for one given travel attribute. For example, whether perceived satisfaction of cost attribute gives significant difference for the users in determining the mode choice between bus and train or the significant difference only occurs in determining the mode choice between bus and car because bus cost is much more cheaper than car. Thus, post hoc test is needed to determine the specific mode choice pairs that are significantly different for each attribute. Post hoc test Bonferroni is used in this follow-up due to its flexibility and simplicity.

Table 13 ANOVA Test of Travel Attributes towards Mode Choice

Travel Attributes	***F***	***P-Value***	**Significance**
Cost	10.68	1.55×10^{-6}	Yes
Travel Time	12.37	1.91×10^{-7}	Yes
Walking Distance	20.48	1.38×10^{-11}	Yes
Ease of Transfer	27.96	4.30×10^{-15}	Yes
Ease of Carrying Luggage	33.56	1.51×10^{-17}	Yes
Comfort	27.26	8.84×10^{-15}	Yes

Table 14 Value of Satisfaction Level

Value	Cost	Travel Time	Walking Distance	Ease of Transfer	Ease of Carrying Luggage	Comfort
1	Very satisfied					
2	Satisfied					
3	More or less satisfied					
4	More or less dissatisfied					
5	Dissatisfied					
6	Very dissatisfied					

After getting the results from ANOVA test which all attributes are significant, the following post hoc test is conducted to find out the significant difference of specific mode choice pairs for each attribute. Post hoc test is conducted six times for six significant attributes. Thus, six post hoc tests will be presented separately in order to discuss any significant difference results from these tests.

The post hoc test that is done for cost attribute indicates that the significant differences are obtained from three pairs of mode choice; bus and car, train and combination of bus and train, train and car. This result means that cost is statistically significant in influencing the mode choice of those three pairs. Table 15 shows the post hoc test result of cost attribute. The mean value of each mode choice indicates the satisfaction level of the users towards cost attribute of each mode. A mean value that is closer to 1 indicates the highest satisfaction level while a mean value that is closer to 6 indicates the lowest satisfaction level. For cost attribute, higher satisfaction level is given by lower cost in using particular mode. The perceived satisfaction of the users towards cost attribute gives significant differences in how they choose between bus and car, between train and combination of bus and train, and between train and car. There is significant difference in choosing transportation mode between bus and car, and by looking at the mean value of satisfaction level in using each mode, this significant is in a way that cost in

using bus is lower than using car. The different choice between train and combination of bus and train is also significant in a way that cost in using train is lower than using combination of bus and train. The last significant difference is the choice between train and car in which the cost in using train is lower than using car. The cost attribute influencing the users in choosing transportation modes which are in the three pairs of mode choice; between bus and car, between train and combination of bus and train, and between train and car, due to there are cost differences in using those modes. Considering the results for these three pairs are significant, the users will be influenced to use the mode which has lower cost in its pair; bus for the pair of bus and car, train for the pair of train and combination of bus and train, and train for the pair of train and car.

Moreover, there are no statistically significant difference for the other three pairs of mode choice, namely bus and train, bus and combination of bus and train, car and combination of bus and train. When exposed to cost attribute, the users do not make any differences on mode choice between bus and train, between bus and combination of bus and train, and between car and combination of bus and train. In relation to the literature, Harvey (1986) and Tsamboulas et al. (2011) pointed cost as the significant attribute in building the mode choice where competitive fares from public transportation could attract more mode share from private car.

Table 15 Post Hoc Test Bonferroni for Cost Attribute

Mode Choice	Mean	STD	N	Mean Difference (Significance)		
				Train	Bus & Train	Car
Bus	2.20	0.99	50	0.16 (No)	0.44 (No)	0.94 (Yes)*
Train	2.04	0.86	50	-	0.60 (Yes)*	1.10 (Yes)*
Bus & Train	2.64	1.10	50	-	-	0.50 (No)
Car	3.14	1.28	50	-	-	-

* mean difference is significant at $\alpha = 0.05$

The post hoc test that is done for travel time attribute indicates that the significant differences are obtained from three pairs of mode choice; bus and train, train and combination of bus and train, train and car. This result means that travel time is significant in influencing the mode choice of those three pairs. Table 16 shows the post hoc test result of travel time attribute. The mean value of each mode choice indicates the satisfaction level of the users towards travel time attribute of each mode. A mean value that is closer to 1 indicates the highest satisfaction level while a mean value that is closer to 6 indicates the lowest satisfaction level. For travel time attribute, higher satisfaction level is given by shorter travel time in using particular mode. The perceived satisfaction of the users towards travel time attribute gives significant differences in how they choose between bus and train, between train and combination of bus and train, and between train and car. By looking at the mean value of satisfaction level in using each mode, the different choice between bus and train is significant in a way that travel time in using bus is longer than using train. The different choice between train and combination of bus and train is also significant in a way that travel time in using train is shorter than using combination of bus and train. The last significant difference is the choice between train and car in which the travel time in using train is shorter than using car. The travel time attribute influencing the users in choosing transportation modes which are in the three pairs of mode choice; between bus and train, between train and combination of bus and train, and between train and car, due to there are travel time differences in using those modes. Considering the results for these three pairs are significant, the users will be influenced to use the mode which has shorter travel time in its pair; train for the pair of bus and train, train for the pair of train and combination of bus and train, and train for the pair of train and car.

Moreover, there are no statistically significant difference for the other three pairs of mode choice, namely bus and combination of bus and train, bus and car, car and combination of bus and train. When exposed to travel time attribute, the users do not make any differences on mode choice between bus and combination of bus and train, between bus and car, and between car and combination of bus and train. In relation to the literature, Tsamboulas et al. (2011) in their research also indicated travel time as the significant attribute in determining the mode choice where shorter travel time from public transportation could attract more mode share from private car. Furthermore, Budd et al. (2011) specified travel time as the significant attribute for the worker group that they prefer due to the high traffic of morning and evening flight almost coincide with their work shift thus they tend to use transportation mode with shorter travel time.

Table 16 Post Hoc Test Bonferroni for Travel Time Attribute

Mode Choice	Mean	STD	N	Mean Difference (Significance)		
				Train	Bus & Train	Car
Bus	3.18	1.29	50	1.20 (Yes)*	0.32 (No)	0.06 (No)
Train	1.98	0.74	50	-	0.88 (Yes)*	1.26 (Yes)*
Bus & Train	2.86	1.07	50	-	-	0.38 (No)
Car	3.24	1.45	50	-	-	-

* mean difference is significant at $\alpha = 0.05$

The post hoc test that is done for walking distance attribute indicates that the significant differences also obtained from three pairs of mode choice; bus and car, train and car, car and combination of bus and train. This result means that walking distance is significant in influencing the mode choice of those three pairs. Table 17 shows the post hoc test result of walking distance attribute. The mean value of each mode choice indicates the satisfaction level of the users towards walking distance attribute of each mode. A mean value that is closer to 1 indicates the highest satisfaction level while a mean value that is closer to 6 indicates the lowest

satisfaction level. For walking distance attribute, higher satisfaction level is given by shorter walking distance in using particular mode. The perceived satisfaction of the users towards walking distance attribute gives significant differences in how they choose between bus and car, between train and car, and between car and combination of bus and train. There is significant difference in choosing transportation mode between bus and car, and by looking at the mean value of satisfaction level in using each mode, this significant is in a way that walking distance in using bus is farther than using car. The different choice between train and car is also significant in a way that walking distance in using train is farther than using car. The last significant difference is the choice between car and combination of bus and train in which the walking distance in using car is closer than using combination of bus and train. The walking distance attribute influencing the users in choosing transportation modes which are in the three pairs of mode choice; between bus and car, between train and car, and between car and combination of bus and train, due to there are walking distance differences in using those modes. Considering the results for these three pairs are significant, the users will be influenced to use the mode which has closer walking distance in its pair; car for the pair of bus and car, car for the pair of train and car, and car for the pair of car and combination of bus and train.

Moreover, there are no statistically significant difference for the other three pairs of mode choice, namely bus and train, bus and combination of bus and train, train and combination of bus and train. When exposed to walking distance attribute, the users do not make any differences on mode choice between bus and train, between bus and combination of bus and train, and between train and combination of bus and train. In relation to the literature, Mandalapu and Sproule (1995) discussed the attribute of walking distance as the significant one due to the

accessibility and reliability of transportation mode are more likely to attract additional share.

Table 17 Post Hoc Test Bonferroni for Walking Distance Attribute

Mode Choice	Mean	STD	N	Mean Difference (Significance)		
				Train	Bus & Train	Car
Bus	3.20	1.25	50	0.10 (No)	0.44 (No)	1.46 (Yes)*
Train	3.30	1.27	50	-	0.54 (No)	1.56 (Yes)*
Bus & Train	2.76	0.87	50	-	-	1.02 (Yes)*
Car	1.74	1.03	50	-	-	-

* mean difference is significant at $\alpha = 0.05$

The post hoc test that is done for ease of transfer attribute indicates that the significant differences are obtained from four pairs of mode choice; bus and train, bus and car, train and car, car and combination of bus and train. This result means that ease of transfer is significant in influencing the mode choice of those four pairs. Table 18 shows the post hoc test result of ease of transfer attribute. The mean value of each mode choice indicates the satisfaction level of the users towards ease of transfer attribute of each mode. A mean value that is closer to 1 indicates the highest satisfaction level while a mean value that is closer to 6 indicates the lowest satisfaction level. For ease of transfer attribute, higher satisfaction level is given by transfer easiness or simplicity in using particular mode. The perceived satisfaction of the users towards ease of transfer attribute gives significant differences in how they choose between bus and train, between bus and car, between train and car, and between car and combination of bus and train. There is significant difference in choosing transportation mode between bus and train, and by looking at the mean value of satisfaction level in using each mode, this significant is in a way that transfer when using bus is more difficult than using train. The different choice between bus and car is also significant in a way that transfer when using bus is more difficult than using car. The different choice between train and car is significant in a

way that transfer when using train is more difficult than using car. The last significant difference is the choice between car and combination of bus and train in which transfer when using car is simpler than using combination of bus and train. The ease of transfer attribute influencing the users in choosing transportation modes which are in the four pairs of mode choice; between bus and train, between bus and car, between train and car, and between car and combination of bus and train, due to there are differences in the easiness of transfer when using those modes. Considering the results for these four pairs are significant, the users will be influenced to use the mode which provides the easiness of transfer in its pair; train for the pair of bus and train, car for the pair of bus and car, car for the pair of train and car, and car for the pair of car and combination of bus and train.

Moreover, there are no statistically significant difference for the other two pairs of mode choice, namely bus and combination of bus and train, train and combination of bus and train. When exposed to ease of transfer attribute, the users do not make any differences on mode choice between bus and combination of bus and train, and between train and combination of bus and train. In relation to the literature, Mandalapu and Sproule (1995) discussed the attribute of ease of transfer, along with walking distance that previously described, as the significant one due to the accessibility and reliability of transportation mode are more likely to attract additional share.

Table 18 Post Hoc Test Bonferroni for Ease of Transfer Attribute

Mode Choice	Mean	STD	N	Mean Difference (Significance)		
				Train	Bus & Train	Car
Bus	3.28	1.28	50	0.58 (Yes)*	0.48 (No)	1.82 (Yes)*
Train	2.70	0.91	50	-	0.10 (No)	1.24 (Yes)*
Bus & Train	2.80	1.05	50	-	-	1.34 (Yes)*
Car	1.46	0.86	50	-	-	-

* mean difference is significant at $\alpha = 0.05$

The post hoc test that is done for ease of carrying luggage attribute indicates that the significant differences are obtained from three pairs of mode choice; bus and car, train and car, car and combination of bus and train. This result means that ease of carrying luggage is significant in influencing the mode choice of those three pairs. Table 19 shows the post hoc test result of ease of carrying luggage attribute. The mean value of each mode choice indicates the satisfaction level of the users towards ease of carrying luggage attribute of each mode. A mean value that is closer to 1 indicates the highest satisfaction level while a mean value that is closer to 6 indicates the lowest satisfaction level. For ease of carrying luggage attribute, higher satisfaction level is given by the easiness in carrying luggage and the availability of luggage storage in particular mode. The perceived satisfaction of the users towards ease of carrying luggage attribute gives significant differences in how they choose between bus and car, between train and car, and between car and combination of bus and train. There is significant difference in choosing transportation mode between bus and car, and by looking at the mean value of satisfaction level in using each mode, this significant is in a way that carrying luggage when using bus is more difficult than using car. The different choice between train and car is also significant in a way that carrying luggage when using train is more difficult than using car. The last significant difference is the choice between car and combination of bus and train in which carrying luggage when using car is easier than using combination of bus and train. The ease of carrying luggage attribute influencing the users in choosing transportation modes which are in the three pairs of mode choice; between bus and car, between train and car, and between car and combination of bus and train, due to there are differences in the easiness of carrying luggage when using those modes. Considering the results for these three pairs are significant, the users will be influenced to use the mode which provides the easiness of carrying luggage in its

pair; car for the pair of bus and car, car for the pair of train and car, and car for the pair of car and combination of bus and train.

Moreover, there are no statistically significant difference for the other three pairs of mode choice, namely bus and train, bus and combination of bus and train, train and combination of bus and train. When exposed to ease of carrying luggage attribute, the users do not make any differences on mode choice between bus and train, between bus and combination of bus and train, and between train and combination of bus and train. In relation to the literature, Harvey (1986) expressed the significance of the attribute of easiness in carrying luggage and concluded that passenger who carrying more than one luggage is less likely to use public transit. Furthermore, the post hoc test results in this research show the significant differences in the pair of each public transport to the car, and then it is true that the easiness in carrying luggage affect the mode choice. The users more likely to use car when they bring many luggage, or at least more than one luggage as Harvey (1986) stated.

Table 19 Post Hoc Test Bonferroni for Ease of Carrying Luggage Attribute

Mode Choice	Mean	STD	N	Mean Difference (Significance)		
				Train	Bus & Train	Car
Bus	3.40	1.36	50	0.44 (No)	0.34 (No)	2.02 (Yes)*
Train	2.96	1.05	50	-	0.10 (No)	1.58 (Yes)*
Bus & Train	3.06	1.20	50	-	-	1.68 (Yes)*
Car	1.38	0.67	50	-	-	-

* mean difference is significant at $\alpha = 0.05$

The post hoc test that is done for comfort attribute indicates that the significant differences are obtained from four pairs of mode choice; bus and train, bus and car, train and car, car and combination of bus and train. This result means that comfort is significant in influencing the mode choice of those four pairs. Table 20 shows the post hoc test result of comfort attribute. The mean value of each mode

choice indicates the satisfaction level of the users towards comfort attribute of each mode. A mean value that is closer to 1 indicates the highest satisfaction level while a mean value that is closer to 6 indicates the lowest satisfaction level. For comfort attribute, higher satisfaction level is given by the more comfortable mode. The perceived satisfaction of the users towards comfort attribute gives significant differences in how they choose between bus and train, between bus and car, between train and car, and between car and combination of bus and train. There is significant difference in choosing transportation mode between bus and train, and by looking at the mean value of satisfaction level in using each mode, this significant is in a way that using bus is less comfortable than using train. The different choice between bus and car is also significant in a way that using bus is less comfortable than using car. The different choice between train and car is significant in a way that using train is less comfortable than using car. The last significant difference is the choice between car and combination of bus and train in which using car is more comfortable than using combination of bus and train. The comfort attribute influencing the users in choosing transportation modes which are in the four pairs of mode choice; between bus and train, between bus and car, between train and car, and between car and combination of bus and train, due to there are comfort differences in using those modes. Considering the results for these four pairs are significant, the users will be influenced to use the mode which gives more comfort in its pair; train for the pair of bus and train, car for the pair of bus and car, car for the pair of train and car, and car for the pair of car and combination of bus and train.

Moreover, there are no statistically significant difference for the other two pairs of mode choice, namely bus and combination of bus and train, train and combination of bus and train. When exposed to comfort attribute, the users do not make any differences on mode choice between bus and combination of bus and

train, and between train and combination of bus and train. In relation to the literature, both of Mandalapu and Sproule (1995) and Budd et al. (2011) works agreed that comfort attribute is significant and argued that the mode choice is a product of public perception of comfort and convenience.

Table 20 Post Hoc Test Bonferroni for Comfort Attribute

Mode Choice	Mean	STD	N	Mean Difference (Significance)		
				Train	Bus & Train	Car
Bus	3.30	1.42	50	0.66 (Yes)*	0.12 (No)	1.76 (Yes)*
Train	2.64	0.90	50	-	0.54 (No)	1.10 (Yes)*
Bus & Train	3.18	1.19	50	-	-	1.64 (Yes)*
Car	1.54	0.71	50	-	-	-

* mean difference is significant at $\alpha = 0.05$

In determining the influence of travel attributes on mode choice of the users, it is found that the six travel attributes are significant. Further post hoc test shows that each attribute gives significant differences in several pairs of mode choice as shown in Table 21. It means that each attribute makes people consider choosing desired mode, whether it has lower cost, shorter travel time, shorter walking distance, easy to transfer, sufficient luggage storage, or sufficient comfort. If one of these mode, for example train, can offer the attribute with the most desirable value then it is more likely that train will be chosen. From the post hoc results, car is the dominant mode with four attributes, namely walking distance, ease of transfer, ease of carrying luggage and comfort, being valued more satisfactory than others while train is considered more satisfactory in two remaining attributes, namely cost and travel time. In linkages with mode choice of the users in Table 7, the results are in accordance where 42% of the respondents using car.

Table 21 Travel Attributes Significance Overview

Attribute*	CS			TT			WD			ET			EL			CM		
Mode**	T	BT	C	T	BT	C	T	BT	C	T	BT	C	T	BT	C	T	BT	C
B	×	×	√	√	×	×	×	×	√	√	×	√	×	×	√	√	×	√
T	-	√	√	-	√	√	-	×	√	-	×	√	-	×	√	-	x	√
BT	-	-	×	-	-	×	-	-	√	-	-	√	-	-	√	-	-	√
C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

* CS = Cost, TT = Travel Time, WD = Walking Distance, ET = Ease of Transfer, EL = Ease of Carrying Luggage, CM = Comfort

** B = Bus, T = Train, BT = Bus and Train, C = Car

*** (√) = Significant, (×) = Not Significant

As to conclude this subchapter, travel attributes do influence the mode choice of the respondents as the ground access users of Soekarno-Hatta International Airport. Each determined transportation mode, namely bus, train, combination of bus and train, and car, has six travel attributes, namely cost, travel time, walking distance, ease of transfer, ease of carrying luggage, and comfort, which is perceived differently by the users. One of the attributes might satisfy the users when using a bus, but it is not the case with the other attributes that might be perceived dissatisfactory. The statistical test of ANOVA is conducted and the results indicate that all six attributes are significant which means the differences on mode choice indeed influenced by the satisfaction with these attributes. Further, post hoc test for the significant results of ANOVA test also conducted to underline the specific significant differences on mode choice for each attribute. The results show that cost gives significant differences in determining the mode choice of the users between bus and car, train and combination of bus and train, and train and car. Travel time gives significant differences in determining the mode choice between bus and train, train and combination of bus and train, and train and car. Walking distance gives significant differences in determining the mode choice between bus and car, train and car, and car and combination of bus and train. Ease of transfer gives significant differences in determining the mode choice between bus and train, bus and car,

train and car, and car and combination of bus and train. Ease of carrying luggage gives significant differences in determining the mode choice between bus and car, train and car, and car and combination of bus and train. And the last attribute, comfort, gives significant differences in determining the mode choice between bus and train, bus and car, train and car, and car and combination of bus and train. Thus, related to the result of chi square test where the users do not choose their transportation mode in accessing the airport randomly, these results answer the first research question that all the six travel attributes and their level of satisfaction influence the ground access users of Soekarno-Hatta International Airport in determining their mode choice. With regard to the aim of this research, the mode choice of people who go to and from the airport is expected to be shifted by applying the statistically significant attributes that provide higher satisfaction level on bus, train, and combination of bus and train to the actual public transportation system in Jakarta particularly for the public transport that serve the connection to and from Soekarno-Hatta International Airport. Further explanation will be discussed in the subchapter of recommendation.

5.2. The Differences between Airport Ground Access User Groups on Their Mode Choice

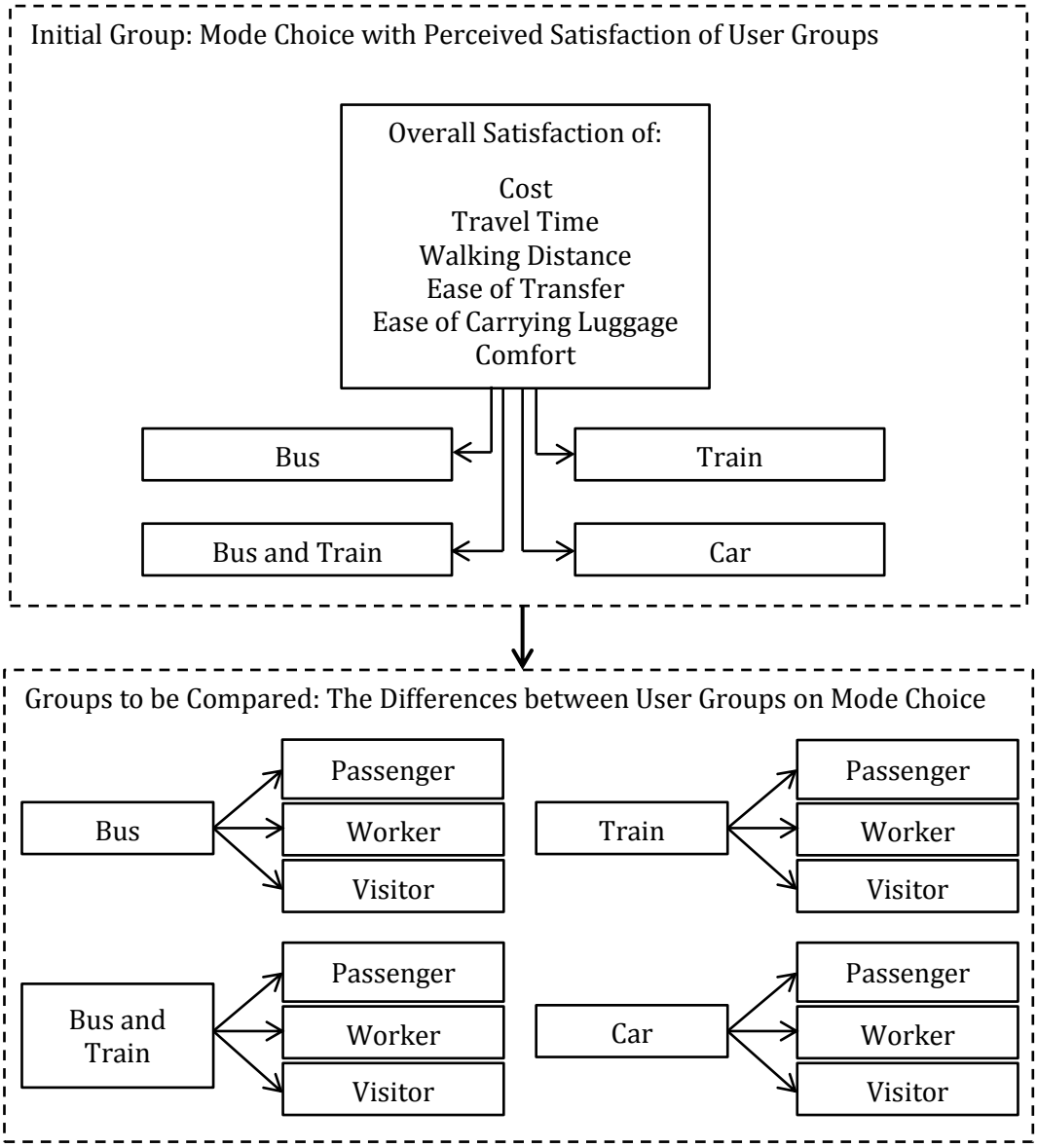
While the previous subchapter discusses the influence of travel attributes on mode choice of the whole users, this second subchapter will discuss the differences between the groups of the users in choosing their transportation mode. Going back to the theoretical framework and the categorization of the users based on their travel purpose as shown in Figure 2 and Table 6, there are three different groups that distinguish the ground access users of Soekarno-Hatta International Airport, namely passenger group, worker group and visitor group. And recalling Table 9,

Table 10 and Table 11, satisfaction level of these groups on their mode choice differ from each other. In using bus, all of these groups perceived cost as the attribute with highest satisfaction level due to its low fares. However, ease of transfer and ease of carrying luggage give low satisfaction level for passenger group while comfort and travel time give low satisfaction level for worker group. Visitor group perceived walking distance and comfort as the attributes with lowest satisfaction level when using a bus. As for the train, the most satisfactory attribute for all groups is also the same, namely travel time due to its shorter travel time compared to the other transportation modes. This also applies to the most dissatisfactory attribute in using train which is also the same for all groups, namely walking distance due to the relatively far distance to get to the train stations from the residential areas in Jakarta. In using the combination of bus and train, passenger group gives highest satisfaction level for its walking distance attribute, worker group gives highest satisfaction level for cost attribute and visitor group gives highest satisfaction level for ease of transfer attribute. Meanwhile, all groups give the same lowest satisfaction level for comfort attribute when using combination of bus and train. In using car, comfort is the attribute with highest satisfaction level for passenger group while cost is the attribute with lowest satisfaction level. As for worker group and visitor group, the attribute with highest and lowest satisfaction level is the same. Ease of carrying luggage is the attribute that has highest satisfaction level while travel time is the one that has lowest satisfaction level for both groups.

However, in answering the second research question, it is still unknown whether the differences in the satisfaction level of each mode choice from each user group can make a difference between user groups on their mode choice. Thus, a statistical test will be conducted to determine whether this difference is statistically significant or not, and which pairs of user groups that have differences in choosing

particular mode, namely bus, train, combination of bus and train, and car. Figure 6 shows the schematic illustration in how the differences between user groups in determining mode choice. As in the initial group, all of mode choice has its perceived satisfaction from the users based on the travel attributes that have been discussed in previous subchapter. Furthermore, each mode choice is presented in relation with the user groups. The user groups are paired to each mode choice in order to determine which pairs that gives significant difference in choosing particular mode.

Figure 6 Schematic Illustration of the Differences between User Groups on Mode Choice



In conducting the analysis for this subchapter, the same tests from the previous subchapter are used in determining the significant differences between user groups on their mode choice. Originated from the satisfaction level that is in the form of interval data, ANOVA test and post hoc test for the significant results are selected as the appropriate statistical tests. The difference step in these tests is the inclusion of user groups in choosing their mode based on the overall satisfaction of travel attributes it offers. Table 22 shows the results of ANOVA test and it indicates that the differences between user groups in choosing particular mode are significant except for train. Train is the only mode that does not give significant result from ANOVA test. With *P-Value* exceeding 0.05, it can be stated that the group of passenger, worker and visitor have no significant differences in choosing train as their transportation mode. As for other three significant results, post hoc test Bonferroni is also used in order to determine which pairs of user groups that have statistically significant differences in choosing particular mode; bus, combination of bus and train, and car.

Table 22 ANOVA Test of Mode Choice towards Satisfaction of User Groups

User Groups	***F***	***P-Value***	**Significance**
Bus	6.90	1.19×10^{-3}	Yes
Train	1.51	0.22	No
Bus and Train	15.11	5.84×10^{-7}	Yes
Car	3.99	0.02	Yes

The post hoc test that is done for mode choice of bus indicates that the significant differences are obtained from two pairs of user groups; between passenger and worker, between worker and visitor. Table 23 shows the post hoc test result for mode choice of bus. The overall satisfaction of the user groups on bus gives statistically significant differences for those two pairs. The pair of passenger group and worker group is significantly different in choosing bus as their

transportation mode. The difference is that the bus will be chosen by the passenger group when bus is given to both of passenger group and worker group as the only mode choice because passenger group is more satisfied in using a bus compared to worker group. This satisfaction level is indicated by the mean value of passenger group which is lower than worker group's and the mean difference between them gives the significant result. The mean value as low as 1 indicates higher satisfaction level. Another pair of user groups that is significantly different when only has bus as the only mode choice is the pair of worker and visitor. The difference between worker group and visitor group is in the way that bus will be chosen by the visitor group due to visitor group is more satisfied in using a bus compared to worker group. The mean value of visitor group is lower than worker group's and the mean difference gives the significant result. Moreover, this post hoc test also gives non significant result for the pair of passenger and visitor. It means that there is no statistically significant difference between passenger group and visitor group in choosing bus as their transportation mode. Both passenger group and visitor group will choose bus despite the satisfaction level difference in using it.

Table 23 Post Hoc Test Bonferroni for Mode Choice of Bus

User Groups	**Mean**	**STD**	**N**	**Mean Difference (Significance)**	
				Worker	Visitor
Passenger	2.88	1.33	22	0.62 (Yes)*	0.11 (No)
Worker	3.50	1.48	15	-	0.51 (Yes)*
Visitor	2.99	1.00	13	-	-

* mean difference is significant at $\alpha = 0.05$

The post hoc test that is done for mode choice of combination of bus and train indicates that the significant differences are obtained from two pairs of user groups; between passenger and worker, between passenger and visitor. Table 24 shows the post hoc test result for mode choice of combination of bus and train. The overall

satisfaction of the user groups on combination of bus and train gives statistically significant differences for those two pairs. The pair of passenger group and worker group is significantly different in choosing combination of bus and train as their transportation mode. The difference is that the combination of bus and train will be chosen by the passenger group when combination of bus and train is given to both of passenger group and worker group as the only mode choice due to passenger group is more satisfied in using bus and train combination compared to worker group. This satisfaction level is indicated by the mean value of passenger group which is lower than worker group's and the mean difference between them gives the significant result. The mean value as low as 1 indicates higher satisfaction level. Another pair of user groups that is significantly different when only has combination of bus and train as the only mode choice is the pair of passenger and visitor. The difference between passenger group and visitor group is in the way that bus and train combination will be chosen by the passenger group due to passenger group is more satisfied in using bus and train combination compared to visitor group. The mean value of passenger group is lower than visitor group's and the mean difference gives the significant result. Moreover, this post hoc test also gives non significant result for the pair of worker and visitor. It means that there is no statistically significant difference between worker group and visitor group in choosing combination of bus and train as their transportation mode. Both worker group and visitor group will choose bus and train combination despite the satisfaction level difference in using it.

Table 24 Post Hoc Test Bonferroni for Mode Choice of Bus and Train

User Groups	Mean	STD	N	Mean Difference (Significance)	
				Worker	Visitor
Passenger	2.51	0.99	22	0.65 (Yes)*	0.70 (Yes)*
Worker	3.16	1.09	15	-	0.05 (No)
Visitor	3.21	1.09	13	-	-

* mean difference is significant at $\alpha = 0.05$

The post hoc test that is done for mode choice of car indicates that the significant difference is only obtained from one pair of user groups; between passenger and worker. Table 25 shows the post hoc test result for mode choice of car. The overall satisfaction of the user groups on car gives statistically significant difference for the pair of passenger group and worker group. The pair of passenger group and worker group is significantly different in choosing car as their transportation mode. The difference is that the car will be chosen by the passenger group when car is given to both of passenger group and worker group as the only mode choice due to passenger group is more satisfied in using a car compared to worker group. This satisfaction level is indicated by the mean value of passenger group which is lower than worker group's and the mean difference between them gives the significant result. The mean value as low as 1 indicates higher satisfaction level. Moreover, this post hoc test also gives non significant results for two pairs of user groups; between passenger and visitor, between worker and visitor. The mean value differences from these two pairs do not give significant results. It means that there is no statistically significant difference between passenger group and visitor group and between worker group and visitor group in choosing car as their transportation mode. Both pairs of user groups will choose car despite the satisfaction level difference in using it.

Table 25 Post Hoc Test Bonferroni for Mode Choice of Car

User Groups	Mean	STD	N	Mean Difference (Significance)	
				Worker	Visitor
Passenger	1.92	1.18	22	0.40 (Yes)*	0.15 (No)
Worker	2.32	1.44	15	-	0.25 (No)
Visitor	2.08	1.31	13	-	-

* mean difference is significant at $\alpha = 0.05$

The test results, in overall, indicate that there are statistically significant differences between user groups in determining their mode choice. Table 26 shows the overview in significant differences between three different user groups on mode choice. The differences between passenger group and worker group occur in all of mode choices, except for train which has no significant result. The mode choice of car, in particular, only gives the difference between passenger and worker group, and this is in line with Budd et al. (2011) in which visitors have the tendency to use the same car with passengers. It is also that characteristics of visitors more or less are the same with passengers'. In linkages with the mode choice of the user groups as shown in Table 7, the significant differences are reflected on that result where combination of bus and train is chosen more by passenger than worker and visitor, and car is chosen more by passenger than worker.

Table 26 Significance Overview of User Groups Differences on Mode Choice

Mode Choice*	B		BT		C	
User Groups**	W	V	W	V	W	V
P	√	×	√	√	√	×
W	-	√	-	×	-	×
V	-	-	-	-	-	-

* B = Bus, BT = Bus and Train, C = Car
** P = Passenger, W = Worker, V = Visitor
*** (√) = Significant, (×) = Not Significant

In summarizing this subchapter, the ground access users of Soekarno-Hatta International Airport are categorized into three different groups based on their

travel purpose, namely passenger group, worker group and visitor group. From their perceived satisfaction towards determined mode choice, these user groups give different satisfaction level for bus, train, combination of bus and train, and car. Therefore, statistical test is conducted to determine whether this different satisfaction level brings differences between the user groups in choosing particular transportation mode. ANOVA test gives significant results for the user groups' satisfaction level on three mode choice, namely bus, combination of bus and train, and car, while the result for train is not significant. Following the ANOVA test, post hoc test is done for each mode with significant result. The results indicate that there are significant differences between user groups in choosing each significant mode. For mode choice of bus, there is difference between passenger group and worker group in which passenger group is more satisfied and gives higher satisfaction level compared to worker group. There is also difference between worker group and visitor group in which visitor group is more satisfied and gives higher satisfaction level compared to worker group. For mode choice of bus and train combination, there are differences from two pairs; between passenger group and worker group, and between passenger group and visitor group. From these two pairs, the differences are that passenger group gives higher satisfaction level compared to worker group and visitor group. For mode choice of car, the only difference is between passenger group and worker group in which passenger group gives higher satisfaction level compared to worker group. In answering the second research question, the results suggest that perceived satisfaction from each user group gives significant difference when it comes to choose one particular transportation mode. Furthermore, passenger group gives higher satisfaction level for each significant mode; bus, bus and train combination, and car, compared to worker group and visitor group. Thus, it can be concluded that passenger group is generally satisfied

with the travel attributes of their mode choice. As in the line with the aim of this research, the differences between user groups in choosing their transportation mode can be used as the reference in order to improve public transportation in accessing Soekarno-Hatta International Airport. These differences are statistically significant in how bus and combination of bus and train satisfying each user group. Worker group and visitor group, specifically, are the groups that consider bus and combination of bus and train not too satisfactory to be chosen and used. Therefore, the improvement to travel attributes of public transport, such as make it more comfortable to be used or make the transfer between public transports easier to be done, is needed so that it can satisfy and attract more mode share from these groups.

6. CONCLUSION

Air transportation has become the desirable option for travelling since it offers several advantages such as fastest travel time and with the rising of low cost carrier flight, or LCC, makes the cost of air transportation as cheap as road and rail transportation. This, of course, brings its own impact. People go more often to the airport to take a flight. Business and commerce make their expansion to the airport area, expand and build more office building where it possible and attract numbers of worker. While the growth of infrastructure that connecting the airport to the city is slower than the growth of air transportation itself, the congestion on the road gradually increasing due to the high dependency on private car. This traffic condition might lead to undesirable effects like longer time in reaching airport due to traffic jam and environmental degradation due to excess emissions. This research is conducted in order to contribute to this problem resolution by the way of determining the travel attributes influence on mode choice of certain type of people who accessing the airport for certain purpose, who is known as the users of airport ground access, and the differences tendency of these users in choosing their mode. And since air transportation is global matter, the research case is narrowed to one airport in Jakarta, Indonesia; Soekarno-Hatta International Airport. Using statistic approach, survey was performed in order to obtain the required data.

The analysis results indicate that all of travel attributes; cost, travel time, walking distance, ease of transfer, ease of carrying luggage and comfort, significantly influence mode choice of the users. Furthermore, the significances of these attributes are based on the significant differences between the overall mode choice; bus, train, combination of bus and train and car towards particular attribute. It means that satisfaction towards each attributes will leads the users to choose one of the modes. For cost attribute, there is significant difference, among others, between

bus and car that the cost of using bus is perceived more satisfactory by the users than using car. In overall, the significant difference between bus and car occurs on three attributes; travel time, ease of transfer and comfort, the significant difference between bus and combination of bus and train is none, the significant difference between bus and car occurs on five attributes; cost, walking distance, ease of transfer, ease of carrying luggage and comfort, the significant difference between train and combination of bus and train occurs on two attributes; cost and travel time, the significant difference between train and car occurs on all of attributes and the significant difference between car and combination of bus and train occurs on four attribute; walking distance, ease of transfer, ease of carrying luggage and comfort. From the six significant attributes, car is the most dominant mode which is considered in providing the highest level of satisfaction of four attributes; walking distance, ease of transfer, ease of carrying luggage and comfort. The perceived satisfactions of car make it as the mode with the highest mode share of the users by 42%.

As for the differences between user groups, namely passenger group, worker group and visitor group, in choosing their transportation mode, there are also significant differences results between these user groups. However, train does not give significant result. These differences between user groups are based on the satisfaction level towards the mode choice. For mode choice of bus, there is significant difference, among others, between passenger and worker that bus is perceived more satisfactory by passenger compared to worker. In overall, the significant difference between passenger and worker occurs on all of significant mode choice, the significant difference between passenger and visitor occurs on combination of bus and train mode choice and the significant difference between worker and visitor occurs on bus mode choice. The significant differences between

user groups place the passenger group as the most satisfied group on their mode choice compared to other two groups. Despite the results are satisfactory and answer the questions, there is shortcoming in this research. The collected data are too limited to conduct the test and analysis. Nevertheless, the most appropriate statistical methods are chosen to cope with small sample size so that the sufficient results can be obtained.

In reflecting the results of this research on the specific case study in Soekarno-Hatta International Airport, it can be concluded that people, who go to and from this airport with the purpose of flight, work, and send or greet someone, have their mode choice influenced by six different travel attributes in which four of them; walking distance, ease of transfer, ease of carrying luggage, and comfort, give high satisfaction level for car. Thus, it makes car as the dominant mode that people use in accessing the airport even though cost and travel time attributes give high satisfaction level for train. The need to reduce the high level of private car usage can be done by upgrading the public transport based on the four attributes that have high satisfaction level for car so that it can make public transport as the competitive mode in the market share. Based on their purpose, people who are categorized as passenger in Soekarno-Hatta International Airport have higher satisfaction level in using bus, bus and train, and car. Thus, it gives a clue for public transportation authority to attract the other people who are categorized as worker and visitor to use public transport and make it as the satisfactory mode.

6.1. Recommendation

The results of this research show that car is the dominant mode with four influencing attributes. It reflects the actual reality where the use of private car is high and people are highly dependent on it for travelling to the airport. The

recommendation that can be achieved through this research in order to improving public transportation is by exposing the advantages of both private car and public transport. Since public transport, bus and train, has the advantages in term of cost and travel time over private car then it is known that the effort to reduce the fares of bus and train is not really needed. Moreover, the advantage of travel time also indicates that the infrastructure is sufficient enough to accommodate the traffic of public transport. However, it does not mean that infrastructure development is not needed considering the growth of air transportation is projected to gradually increase by 4.7% per year worldwide until 2031 which means that traffic from and to airport will also increase. In the other side, car has advantages in term of comfort and convenience. Car is often considered as the most comfort and convenience mode due to it can be parked as close as possible to the origin or destination point, no need to transfer, has considerable ratio of the number of passengers to the luggage storage and clean. These advantages, thus, become the key points in improving the public transportation system by making it reach the same state of comfort and convenience although it seems to be difficult. In order to make the walking distance to public transport as short as possible then it is needed to extend the network by building more bus stop or train station within the reach of densely populated area. It is also important to build bus stop or train station that is located within the airport area (Harvey, 1986). Besides using car does not require transfer, some of public transport lanes also provide direct access to the airport. However, the addition of these direct lanes and simplifying the transfer of public transport are needed due to car is still considered satisfied in the term of easiness in transfer (Dell'Olio and Ibeas, 2011). The easiness in carrying luggage is a tricky part in public transport because several type or model of vehicle does not offer sufficient luggage storage. Substitution of old model to the new one might answer this problem but will cause

high cost replacement in turn (Harvey, 1986, Humphreys and Ison, 2002). The last attribute, comfort in term of cleanliness, can be approached by regulating regular cleaning and promoting clean campaign to the users (Gakenheimer, 2001, Humphreys and Ison, 2005).

As for the future work, the research can be conducted using Stated Preference (SP) method that gives the hypothetical options in which the preferences of the users will be reflected on wider options. In addition, the mode choice set can be specified prior to the survey and the range of attributes of can be extended when using SP method. The combination of Revealed Preference (RP) and SP method can also give benefit in conducting the research when travel demand models are to be made based on actual market choices from observable situations. Another important recommendation is that the research related to travel behaviour is classified as the work with wide scope, thus more time should be spent in designing the research and collecting the data. With the sufficient time, it is expected to get the sufficient data and satisfactory result. Furthermore, there are other travel attributes that can be considered in determining the satisfaction level of the users that can be included to expand the future work.

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APPENDIX 1

Survey Questionnaire
Mode Choice of Airport Ground Access Users

Questionnaire for Individual Characteristics

1. What is your gender?
   a. Male
   b. Female

2. What is your age?
   a. Less than 20 years
   b. 20 – 29 years
   c. 30 – 39 years
   d. 40 – 49 years
   e. 50 – 59 years
   f. More than 59

3. How many of your households are in total?
   a. Household members _____
   b. Working members _____

4. Where do you live?
   a. Jakarta Greater Area
   b. West Java
   c. Indonesia
   d. Abroad

5. How many vehicles do your household own?
   a. None
   b. Car _____

6. What is your approximate household monthly income?
   a. Less than IDR 2,000,000 (US$ 200)
   b. IDR 2,000,000 (US$ 200) – IDR 3,999,999 (US$ 399)
   c. IDR 4,000,000 (US$ 400) – IDR 5,999,999 (US$ 599)
   d. IDR 6,000,000 (US$ 600) – IDR 7,999,999 (US$ 799)
   e. IDR 8,000,000 (US$ 800) – IDR 9,999,999 (US$ 999)
   f. More than IDR 9,999,999 (US$ 999)
   g. Do not want to answer

Questionnaire for Travel Characteristics

1. What is your purpose of trip?
   - Flight trip (passenger)
   - Work trip (worker)
   - Visiting trip (greeter/sender)

2. What is your destination?
   a. Terminal building
   b. Other than terminal building

3. How do you travel to and/or from the airport?
   a. Bus
   b. Train
   c. Bus and train (combination)
   d. Car
   e. Others _____

4. In relation with question no. 4 (above), what is the amount of people in the group while you travel to the airport?
   a. One (just yourself)
   b. Two
   c. Three
   d. More than three

5. How many luggage you carry in your trip?
   a. None
   b. One luggage
   c. Two luggage
   d. More than two luggage

Questionnaire for Travel Attributes

1. In choosing your travel route and mode, which attributes do you take into account most? (you can check multiple options, or check the most appropriate option if you just pick one)
   a. Cost
   b. Travel time
   c. Travel distance
   d. Waiting time
   e. Walking time
   f. Walking distance
   g. Ease of transfer
   h. Number of transfer
   i. Ease of carrying luggage
   j. Comfort
   k. Others _____

2. Would you consider travelling by bus or train, when, if you have options?
   a. A better integration of bus and train
   b. A combination ticket for bus and train with cheaper price
   c. The travel time using bus and train is faster than using a car
   d. Airport train station is located in the terminal building
   e. Bus service is available in connecting the terminal building with the other buildings outside the terminal area
   f. Bus service is available in connecting my home with nearby train station
   g. High service frequency of bus and train
   h. Availability of sufficient public transport infrastructure
   i. Bus and train reach the suburbs area
   j. Others _____
   k. I already do

Questionnaire for Satisfaction over **Bus**

1. **If you often use bus**, please give the reasons for using it. (you can check multiple options, or check the most appropriate option if you just pick one)
   a. Short travel time
   b. Fare is low
   c. The operational time of bus suit my travel time
   d. The buses usually arrive on schedule
   e. The bus stop is close from my home
   f. The bus stop is close from my destination
   g. The buses are not too crowded
   h. No need to transfer to another vehicle
   i. Easy to carrying luggage
   j. The buses are clean
   k. Others _____

2. **If you rarely use bus**, please give the reasons for not using it. (you can check multiple options, or check the most appropriate option if you just pick one)
   a. Too much time wasted
   b. Too much money spent
   c. The operational time of bus does not suit my travel time
   d. The buses rarely arrive on schedule
   e. The bus stop is far away from my home
   f. The bus stop is far away from my destination
   g. The buses are very crowded
   h. Many transfers needed
   i. Inconvenient for carrying luggage
   j. The buses are dirty
   k. Others _____

3. Please give your **satisfaction** level of the trip with **bus** with respect to the following attributes. (you can check the boxes under the row of satisfaction level)

	Very Satisfied					Very Dissatisfied
	1	2	3	4	5	6
Cost	☐	☐	☐	☐	☐	☐
Total travel time	☐	☐	☐	☐	☐	☐
Walking distance	☐	☐	☐	☐	☐	☐
Ease of transfer	☐	☐	☐	☐	☐	☐
Ease of carrying luggage	☐	☐	☐	☐	☐	☐
Comfort	☐	☐	☐	☐	☐	☐

satisfaction explanation:

1 = very satisfied	4 = more or less dissatisfied
2 = satisfied	5 = dissatisfied
3 = more or less satisfied	6 = very dissatisfied

Questionnaire for Satisfaction over **Train**

1. **If you often use train**, please give the reasons for using it. (you can check multiple options, or check the most appropriate option if you just pick one)
   a. Short travel time
   b. Fare is low
   c. The operational time of train suit my travel time
   d. The trains usually arrive on schedule
   e. The train station is close from my home
   f. The train station is close from my destination
   g. The trains are not too crowded
   h. No need to transfer to another vehicle
   i. Easy to carrying luggage
   j. The trains are clean
   k. Others _____

2. **If you rarely use train**, please give the reasons for not using it. (you can check multiple options, or check the most appropriate option if you just pick one)
   a. Too much time wasted
   b. Too much money spent
   c. The operational time of train does not suit my travel time
   d. The trains rarely arrive on schedule
   e. The train station is far away from my home
   f. The train station is far away from my destination
   g. The trains are very crowded
   h. Many transfers needed
   i. Inconvenient for carrying luggage
   j. The trains are dirty
   k. Others _____

3. Please give your **satisfaction** level of the trip with **train** with respect to the following attributes. (you can check the boxes under the row of satisfaction level)

	Very Satisfied					Very Dissatisfied
	1	2	3	4	5	6
Cost	☐	☐	☐	☐	☐	☐
Total travel time	☐	☐	☐	☐	☐	☐
Walking distance	☐	☐	☐	☐	☐	☐
Ease of transfer	☐	☐	☐	☐	☐	☐
Ease of carrying luggage	☐	☐	☐	☐	☐	☐
Comfort	☐	☐	☐	☐	☐	☐

satisfaction explanation:

1 = very satisfied	4 = more or less dissatisfied
2 = satisfied	5 = dissatisfied
3 = more or less satisfied	6 = very dissatisfied

Questionnaire for Satisfaction over **Bus and Train (in Combination)**

1. **If you often use bus and train**, please give the reasons for using it. (you can check multiple options, or check the most appropriate option if you just pick one)
   a. Short travel time
   b. Fares are low
   c. The operational time of bus and train suit my travel time
   d. The bus and train usually arrive on schedule
   e. The bus and train station are close from my home
   f. The bus and train station are close from my destination
   g. The bus and train are not too crowded
   h. The transfer between bus and train are simple
   i. Easy to carrying luggage
   j. The bus and train are clean
   k. Others _____

2. **If you rarely use bus and train**, please give the reasons for not using it. (you can check multiple options, or check the most appropriate option if you just pick one)
   a. Too much time wasted
   b. Too much money spent
   c. The operational time of bus and train does not suit my travel time
   d. The bus and train rarely arrive on schedule
   e. The bus and train station are far away from my home
   f. The bus and train station are far away from my destination
   g. The bus and train are very crowded
   h. The transfer between bus and train are complicated
   i. Inconvenient for carrying luggage
   j. The bus and train are dirty
   k. Others _____

3. Please give your **satisfaction** level of the trip with **bus and train** with respect to the following attributes. (you can check the boxes under the row of satisfaction level)

	Very Satisfied					Very Dissatisfied
	1	2	3	4	5	6
Cost	☐	☐	☐	☐	☐	☐
Total travel time	☐	☐	☐	☐	☐	☐
Walking distance	☐	☐	☐	☐	☐	☐
Ease of transfer	☐	☐	☐	☐	☐	☐
Ease of carrying luggage	☐	☐	☐	☐	☐	☐
Comfort	☐	☐	☐	☐	☐	☐

satisfaction explanation:

1 = very satisfied	4 = more or less dissatisfied
2 = satisfied	5 = dissatisfied
3 = more or less satisfied	6 = very dissatisfied

Questionnaire for Satisfaction over **Car**

1. **If you often use car**, please give the reasons for using it. (you can check multiple options, or check the most appropriate option if you just pick one)
   a. Short travel time
   b. Cost for using car is low
   c. Car can be used anytime I want for travelling
   d. I can take shorter route
   e. Easy to carrying luggage
   f. Others _____

2. **If you rarely use car**, please give the reasons for not using it. (you can check multiple options, or check the most appropriate option if you just pick one)
   a. Too much time wasted
   b. Too much money spent
   c. I do not have car
   d. Often stuck in traffic jam
   e. Inconvenient for carrying luggage
   f. Others _____

3. Please give your **satisfaction** level of the trip with **car** with respect to the following attributes. (you can check the boxes under the row of satisfaction level)

	Very Satisfied					Very Dissatisfied
	1	2	3	4	5	6
Cost	☐	☐	☐	☐	☐	☐
Total travel time	☐	☐	☐	☐	☐	☐
Walking distance	☐	☐	☐	☐	☐	☐
Ease of transfer	☐	☐	☐	☐	☐	☐
Ease of carrying luggage	☐	☐	☐	☐	☐	☐
Comfort	☐	☐	☐	☐	☐	☐

satisfaction explanation:

1 = very satisfied	4 = more or less dissatisfied
2 = satisfied	5 = dissatisfied
3 = more or less satisfied	6 = very dissatisfied