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Title: Understanding the Impact of Online Transportation Service (OTS) on the Commuters' Perception of Accessibility: The Case of Jakarta, Indonesia

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Understanding the Impact of Online Transportation Service (OTS) on the Commuters' Perception of Accessibility: The Case of Jakarta, Indonesia

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Summary

Jakarta is one of the world's most congested cities. In response to this issue, Online Transportation Service (OTS) emerged in Jakarta as an alternative transportation service to travel in the city. OTS, as known as ridesharing, is a platform where an individual can ride a car and motorcycle taxi through a mobile application. Brands such as Uber, Grab, Lyft, and Go-Jek are amongst the platform. The number of OTS users in Jakarta has grown rapidly since its arrival in 2014. However, the legalization of OTS is hampered by the different perceptions between the government and OTS companies about the impact of OTS on the accessibility. It is still unclear whether the impact of OTS on the accessibility is positive or negative. Therefore, this study will answer it from the public perception.

Accessibility is a concept regarding the extent to which transportation system and land use can ease the people to reach their destinations. Accessibility can be assessed from transportation, temporal, and individual components. Transportation component is related to the level of service that can be provided by a transportation service. Temporal component is concerning about the degree to which a transportation service can make it more flexible for an individual to perform activities at a limited time. Individual component aims to investigate how the transportation service contributes to fulfil the needs, expand the opportunities, and improve the abilities to travel.

This study aims to explain the extent to which the use of OTS affects the commuters' perception of accessibility in Jakarta. The commuters are chosen as the target group of the research because most of journeys are done for work purposes. Instead of examining all components of accessibility, this study will examine the transport, temporal, and individual components of accessibility. This is due to OTS being new in Jakarta and its impact on land use is not yet significant. To achieve this, a survey of 155 respondents was conducted. Moreover, in-depth interviews with OTS companies and users were also performed to have a deeper understanding behind the survey.

The finding in transport component suggests that OTS provides a fairly good level of service (mean=3.73 out of 5). In temporal component, it is indicated that OTS contributes to increase the flexibility to perform activities (mean=3.54 out of 5). Moreover, the result in individual component reveals that OTS only partially fulfils the need to commute (mean=3.35 out of 5). This is due to its inability to replace public transport, which can be beneficial for the city as OTS may complement the use of public transport. On top of that, commuters perceive that OTS has a positive impact on the level of accessibility (mean=3.67 out of 5).

It is also revealed in this study that the extent to which the commuters perceive the impact of OTS on the accessibility is dependent on their personal characteristics and frequency of OTS use. The frequent OTS users perceive a better accessibility than non-frequent OTS users, 10% higher in fact. Moreover, transport component is the most significant factor affecting the perception of accessibility. Therefore, if the government is aiming to make Jakarta more accessible, OTS companies should be encouraged to provide a better level of service. In addition, the disputes in the legalization of OTS should reach the common ground; one of the ways is by creating a mutual collaboration between OTS companies, public transport operators, and IPT companies to harmonize the city's transportation system.

Keywords: Online Transportation Service, Ridesharing, Accessibility, Perception, Gojek, Grab

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Abbreviations

GPS	: Global Positioning System
ICT	: Information and Communication Technology
IHS	: Institute for Housing and Urban Development
IPT	: Intermediate Public Transport
MANOVA	: Multivariate Analysis of Variance
OTS	: Online Transportation Service
TNC	: Transport Network Company

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Chapter 1: Introduction

1.1 Background

A rapid growth of Internet users has not only occurred in the developed countries, but also in the developing countries. The number of individuals across the developing world who has Internet access over the mobile phone was accounted for 2.5 billion people in 2015. It is estimated to increase by 2.6 billion in 2020, in which 90% of the growth will be contributed by developing regions (Olsen, 2016). The use of Internet in the transportation sector, in particular, is not new for some parts of the world. For example, people in the Netherlands have used public transport information service in mobile application, website, and call center named 9292.nl since 1998. Subsequently, Google Maps appeared in 2005 to give the direction in reaching the desired location. What new is integrating Intermediate Public Transport (IPT) modes with the mobile application. IPT is a type of transportation service that operates with flexible time schedule and sometimes without a fixed route (Ponnuswamy and Victor, 2012). It includes taxi, motorcycle taxi, rickshaw, carpool, and minibuses, such as Jitney in the USA and Jipney in the Philippines.

A platform where an individual can ride a car and motorcycle taxi through a mobile application is called an Online Transportation Service (OTS) (Clewlow and Mishra, 2017; Silalahi, 2017). The mobile application utilizes the algorithm to match the drivers with the passengers for a pre-arranged trip. OTS-based taxi and motorcycle taxi (hereinafter referred as OTS) works similarly as taxi though operated with the help of mobile application for the ordering, payment, and evaluation activities. Uber, Grab, and Lyft are the examples of OTS companies with the largest number of users. According to Statista (2018a), the number of OTS users worldwide has reached 436.8 million people. This fact indicates that OTS has been widely recognized by the modern society.

The increasing popularity of OTS indicates that OTS might affect the urban accessibility. Accessibility is the extent to which the transportation system and land use enable an individual or group to reach the destinations and activities by using transportation means at a various time of the day (Geurs and van Wee, 2004). Based on that definition, there are four components to define accessibility, namely land use component, transport component, temporal component, and individual component. According to van Wee et al. (2013), the implementation of Information and Communication Technology (ICT) in transportation system may affect to change the level of accessibility in all components. First, from the perspective of transport component, ICT provides pre-trip and en-route information that potentially reduce travel resistance. Second, ICT has an impact on the land-use component by distributing the actors over the given locations. As a result, ICT allows remote communications that make related businesses no longer need to have physical offices adjacent to each other. Third, from the perspective of temporal component, ICT enables people to participate in different activities at the same time. For instance, people can use their laptop to work while traveling or carrying business call while driving. Finally, from the perspective of individual component, ICT can change an individual's ability for traveling. For example, ICT can make disable people have a greater ability to travel because they can easily use on-demand taxis. As a way of ICT implementation in transportation sector, OTS has the characteristics that potentially change the components in the accessibility concept as well.

There is a growing debate about the impact of OTS on the accessibility. Azevedo and Maciejewski (2015) argue that OTS potentially gives benefits to passengers and drivers by

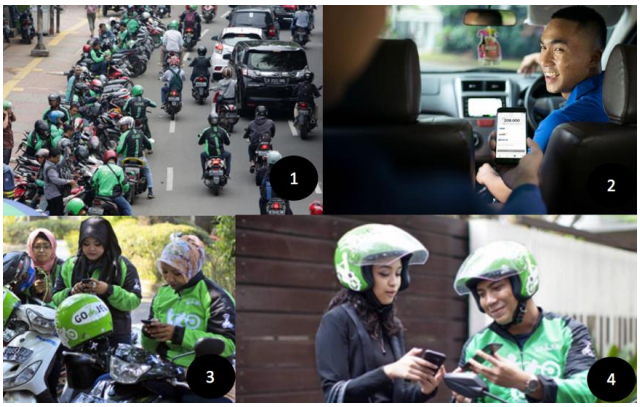
several reasons for efficiency that could be realized.

a. OTS provides travel information that might improves the reliability about the arrival time of the fleet.
b. OTS gives the transparency of price prior to the journey.
c. OTS potentially offers a better quality than a conventional IPT due to the fact that the driver can be assessed directly by the passengers.
d. The mobile application to order OTS probably ease the passengers to find IPT.

However, OTS might also challenge the sustainability of transportation system in the city. The rapid adoption of OTS might decrease the preference of people to use public transportation services. Indeed, it happened in New York City, in which the demand growth of Uber and Lyft has shifted people away from public transport and increased the level of congestion (Schaller, 2017). Not to mention the level of vehicles emission will potentially be escalated as the environmental externality of the increasing number of traffic volume.

As the 4th most populated country in the world with the number of active Internet users of more than 50% of the total population, Indonesia is a big market for OTS business. Thus, there were three leading start-up companies started investing to provide OTS in Indonesia, namely Go-Jek, Grab, and Uber. Nevertheless, Uber eventually pulls out of the Southeast Asia region by selling the operation to Grab due to the loss in competition with local players (Leem and Newcomer, 2018). Since its presence in 2014, the number of OTS users in Indonesia has increased rapidly with the average growth rate of 14% per annum (Statista, 2018b). Furthermore, the use of OTS has become ubiquitous in the daily life of Indonesian people (see Figure 1). Anindhita et al. (2016) argue that the rapid growth in the number of OTS users is due to the lack of quality and quantity of the public transportation service. In particular, OTS-based motorcycle taxi experienced an exponential growth of users due to the severe traffic congestion.

Figure 1 The Illustration of OTS Vehicles in Indonesia



Source: 1. The Jakarta Post/Wendra Ajistyatama, 2018;2. Go-Jek, 2018;3. Bay Ismoyo, 2018;4. Go-Jek, 2018

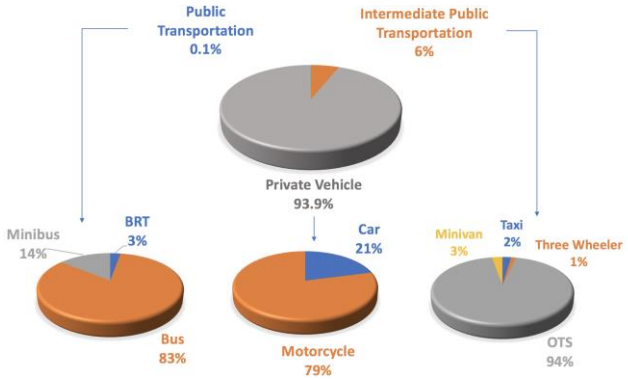
Unlike in the other countries where OTS is mostly used occasionally for the social purpose (Clewlow and Mishra, 2017), OTS in Indonesia is mainly used for daily commuting (Medeiros et al., 2018; Panjaitan, 2016). Nowadays, OTS companies continuously do the innovations by integrating online transportation with other services, such as carpool, food delivery, courier service, grocery shopping delivery, payment service, and daily needs booking. The widespread use of OTS also indicates that perhaps OTS contributes to change the accessibility in the cities in Indonesia, especially Jakarta. However, there is a doubt whether it leads to a better or worse accessibility. Therefore, a study about the impact of OTS on accessibility in Indonesia, especially Jakarta, is required. The major challenge is to find whether the aggregate impact of OTS on the level of accessibility is positive or negative.

1.2 Problem Statement

As the capital city of Indonesia, Jakarta bears the main economic and governmental function in the country. Hence, it becomes a magnet for many people to look for livelihoods. As of 2016, the number of population in Jakarta reached around 10.2 million people (Central Bureau of Statistics of DKI Jakarta, 2017). The number of population increases by 4.3 million people in the daytime because the people who live in the periphery area commute to Jakarta (Central Bureau of Statistics of DKI Jakarta, 2017).

Unfortunately, a great deal of people has not been served by a good quality transportation system. According to Munawar (2006), there are several main problems of public transportation in Jakarta, namely low quality of service, limited variations of public transportation choice, insufficient fund to maintain the vehicles, ineffective management and administration structure of public transportation organization, and security problems, such as pickpockets on the bus. Moreover, the number of public transportation vehicles is considered low to serve the populous city. Currently, the public transportation modes operated in the city are 12 corridors of BRT, bus, minibus, and minivan. As can be seen in Figure 2, the share of public transportation mode in Jakarta is less than 1%. On the contrary, the amount of private vehicles dominates the road of Jakarta. As a result, a great reliance on private vehicles leads to a high traffic volume and eventually a chronic problem of traffic congestion in Jakarta. Cookson (2017) revealed that Jakarta ranked 12th as the most congested city in the world. Given the fact, it is inarguable that the accessibility in Jakarta is low.

Figure 2 The Share of Transportation Mode in Jakarta in 2016



Source: Pemerintah Daerah Khusus Ibukota Jakarta (2017)

Responding to the problems of transportation system in Jakarta, OTS emerged in 2014 as an alternative to fill the gap in the lack of quality in transportation system. Unlike the OTS operation in the other countries, OTS providers in Indonesia do not only offer the service of car taxi, but also motorcycle taxi. The motorcycle taxi is able to provide transportation service in the area where good connectivity of public transport is absent. It also has a lean body that is flexible to maneuver on the congested road (Cervero, 2000). As a result, the number of OTS users in Jakarta has grown rapidly (Katadata, 2016).

Despite the dramatical increase in the number of OTS users, the enactment of the Transportation Ministerial Decree no. 32/2016—which should have legalized the operation of OTS in Indonesia—is still constrained by several factors (Widiartanto, 2017). First, the government wants to set a quota restriction on the number of OTS vehicles in the city. It is due to the negative reaction from conventional IPT drivers towards OTS. The quota restriction is intended to create a healthy competition between OTS and conventional IPT. In addition, the quota restriction also aims to reduce the number of motorized vehicles in Jakarta. Nevertheless, OTS companies do not approve this regulation because it is considered

incompatible with the spirit of the free market economy. Furthermore, it potentially decreases the number of IPT supply to serve transportation demand in the city. As a result, it might reduce the ability of people to travel in the city. Second, the government requires OTS companies to own the vehicles and treat the drivers as legitimate employees. It is intended to ensure regular maintenance of the vehicle as well as ascertain the service quality of the drivers. However, OTS companies express their objection to this request because it is not in accordance with the initial business model of OTS. Moreover, OTS companies argue that they can ensure safety and service quality using their own scheme.

The disputes between the government and OTS companies in the legalization process of OTS reflect that there are different perceptions about the impact of OTS on the accessibility. The government tends to perceive that OTS is a challenge for the sustainability of the transportation system, yet OTS companies perceive that OTS potentially becomes one of the solutions for increasing the level of accessibility. In order to clarify whether the impact of OTS on the accessibility is negative or positive, a study regarding the impact of OTS on the accessibility from the public perception of the commuters is needed. Understanding public perception about the impact of a certain transportation service is important because people are the object in transportation planning and policy. In addition, it is also a way to ensure that the interests of the particular group are not neglected. In particular, this study will examine the commuters' perception of accessibility. The commuters are chosen as the target group of the research because most of the trips made by OTS in Jakarta are for work purposes (Medeiros et al., 2018 and Panjaitan, 2016).

According to Geurs and van Wee (2004), there are four components that define the accessibility, namely transport, land use, temporal, and individual components. The impact of OTS on transport component in Jakarta is quite predictable. Nevertheless, whether the impact is positive or negative is still debatable. Several studies indicate that OTS in Jakarta potentially provides a good level of service (Panjaitan, 2016; Silalahi et al., 2017; Medeiros et al., 2018). On the other hand, some evidences regarding the shortcomings in the service of OTS in Jakarta are also found (Nurhidayah and Alkarim, 2017). For example, sometimes the algorithm does not appropriately pair the passengers with drivers. Thus, it makes the passenger wait too long. Another example is the criminal cases that happened during the journey with OTS. It gives an indication that actually service quality and security of OTS are not always better than the conventional IPT or public transport. Moreover, the impact of OTS on land use, temporal, and individual components are still unclear due to the lack of substantial studies regarding the impact of ICT on the accessibility.

Understanding the level of accessibility is important, as it is the goal of transportation planning and policies (Litman, 2011). The perspective of accessibility does not only consider transportation component, but also comprehensively take all components that affect the people to reach the desired destinations into account (Geurs and van Wee, 2004; Litman, 2011). It is expected that understanding the level of accessibility could help to produce the comprehensive solutions to improve transportation system in the city.

1.3 Research Objectives

This study aims to explain the extent to which the use of OTS affects the commuters' perception of accessibility in Jakarta.

1.4 Research Question

The research question of this study is, "to what extent does the use of OTS affect the

commuters' perception of accessibility in Jakarta?"

Sub Research Questions

1. How do commuters perceive the level of service of OTS?
2. How does the use of OTS make it more flexible for the commuters to perform activities?
3. How does the use of OTS fulfil the needs, expand the opportunities, and improve the abilities of commuters to travel?

1.5 Significance of the Study

For policy development, the result of this study could serve as an input for the revision of the Transportation Ministerial Decree no. 32/2016. As explained earlier, the legalization of OTS in Indonesia is constrained by several factors, such as negative response from conventional IPT, vehicle ownership, driver's status. In order to produce a more inclusive policy, taking account of public perception is substantial because it enhances people's satisfaction with the policy outcome (Traber, 2013). Moreover, understanding the impact of transportation service on accessibility could also contribute to creating a comprehensive solution to improve urban transportation.

For the academic realm, in the past twenty years, many studies about ICT on travel behavior have been undertaken. However, the study of ICT's impact on accessibility is relatively scarce (van Wee et al., 2013). Banister and Stead (2004) also stated that the new perspective on the nature of accessibility is required to understand the relationship between ICT and transportation because the concept of accessibility takes physical and social constraints into account. As OTS is a way of ICT implementation in transportation, this study is expected to enrich the knowledge development of ICT based transportation studies.

Regarding the significance for society, the usage of the Internet is currently evolving, indicating that the current trend for the application of ICT in the transportation sector will be reinforced in the future. This study will be one of the empirical evidences about the effect of ICT use on urban mobility. Therefore, it is expected to contribute to the development of more sustainable ICT implementation on transportation.

1.6 Scope and Limitations

The area scope of this study is Jakarta, Indonesia, and the scope of OTS service is limited to car and motorcycle taxi. It means the services of carpooling, food delivery, instant courier, daily needs booking, and other OTS diversified services are excluded. In addition, the travel intention in this study is bounded to commute.

There are also some limitations of this study. First, the target group of this study is demarcated to the people who use OTS for commuting. Meanwhile, the impact of OTS is not only perceived by the users, but also the non-users. It goes without saying that the real impact of OTS on accessibility in Jakarta could be bigger than the outcome of this study. Second, Grab and Go-Jek are generalized as 'OTS', even though in some aspects these OTS companies provide different levels of service. Third, the study about accessibility usually takes land use component into account. However, the perspective chosen in this study has limitations in investigating land use. Another reason why land use component is not examined is that because OTS is relatively new when this study is made. Fourth, the data collection is conducted in one period. Therefore, the result cannot be generalized with the future circumstance when the changes in transportation regulation and social economic condition might occur.

Chapter 2: Literature Review

2.1 Introduction

The purpose of this chapter is to review the existing literature as the theoretical background of this study. This chapter starts by introducing OTS and its characteristics. It is followed by the overview of accessibility concept, in which the definition and the perception of accessibility will be further elaborated. Furthermore, the components of accessibility, the potential impact of OTS on each component of accessibility, and the role of personal characteristics in affecting the perception of accessibility will be elaborated. Eventually, a conceptual framework will be presented to conclude the relations of all concepts.

2.2 OTS as a Way of ICT Implementation in Transport

ICT refers to a set of technology that allows data collection and processing to provide information through electronic communication (Labelle, 2005). This includes the Internet, e-mail, mobile phones, and other communication mediums. The data from International Telecommunication Union (2017) showed that 48% of total world population is the active users of ICT. In addition, Internet bandwidth worldwide increased by 32% between 2015 and 2016. It indicates that the use of ICT is evolving across the globe.

The adoption of ICT helps to increase the geographical coverage among humans to interact, both physically and virtually (Black and Geenhuizen, 2006). In the transportation sector, ICT has the function of providing information. For example, people in the Netherlands have used 9292.nl, a website and mobile application that provide information of public transportation connection and real-time schedule, for over 20 years (9292.nl, 2015). Another example is Google Maps that is equipped with features that enable people to see real-time traffic condition, travel cost, and route alternatives by car, bicycle, public transport, and foot. The information given by ICT eventually contributes to the reduction of unnecessary trips. It is because using the information, people can choose a shorter route or more effective transport mode option (Pardo, 2010; Barth et al., 2015).

OTS, as known as ride-hailing and ride service of Transport Network Company (TNC), is one way of ICT implementation in the transportation sector. OTS was firstly introduced in the USA under the brand of Uber in early 2009. Following the growth in the number of trips by Uber, several similar companies have entered the market. Nowadays, the OTS operations are spread all over the world, for examples Lyft in the USA, Ola in India, DidiCar in China, Go-Jek in Indonesia, and Grab in several Southeast Asian countries. This transportation service is embedded in an application that allows the passengers to order the fleets from their mobile phone (Clewlow and Mishra, 2017). The application utilizes ICT to do a pre-arranged trip. Then, with the advanced algorithm, the mobile application matches the supply and demand of OTS passengers and drivers.

OTS should not be confused with car-sharing and conventional taxi. Through the car sharing, a number of passengers join in the same car that goes to the same direction at the same schedule. OTS is operated like a taxi, in the sense that single passenger or a group of passengers exclusively uses it without the need to join with the other passengers they do not know. However, unlike conventional taxi, OTS has several characteristics that make the service different and sometimes is perceived as a disruptive innovation for the conventional transportation service. The points below explain the characteristics that distinguish OTS with conventional IPT.

- **Attachment to Global Positioning System (GPS)**

The typical characteristic of OTS is that the service is embedded with GPS (Azevedo and Maciejewski, 2015; Cramer and Krueger, 2016). Therefore, the passengers and drivers can obtain pre-travel and en-route information through OTS mobile application. Prior to the journey, GPS provides the information of travel distance and travel time. When the drivers and passengers have already paired, both of them are given the information about each other's locations. This feature helps the driver to pick up the passengers at the exact location. Moreover, it allows the passengers to monitor the real-time progress of vehicles to reach the pick-up point. The calling and messenger platforms are also provided in the mobile application, so the drivers and passengers can communicate to clarify the unknown information, such as car color and physical features of the passengers. Thus, the passengers do not have to wait in uncertainty for the vehicles to come (Azevedo and Maciejewski, 2015). During the journey, GPS assists the driver to take an effective route to the destination. On the other hand, the passengers can identify where they are during the journey.

- **Fare and Payment**

Unlike conventional taxi, the transparency of travel cost in OTS is provided prior to the journey (Noulas et al., 2017). The travel cost is not only calculated based on travel distance, but also the availability of vehicles, the level of demand, and traffic condition. Therefore, the fare of OTS at the peak hours might increase due to a surged basic fare (Hahn and Metcalfe, 2017).

Regarding the payment, the drivers and passengers do not always need to hand the cash and change money after finishing the trip. The passenger can opt to link their OTS accounts to the credit card accounts or other financial technology platforms. However, this condition varies among OTS companies and countries. For example, Uber in the USA is designed to be completely cashless, yet before its closure in early 2018, Uber in Southeast Asian countries accepted cash.

- **Vehicle Ownership and Employment Status of the Driver**

OTS companies do not claim themselves as transportation companies, but technology companies. Therefore, the OTS vehicles are not owned by OTS companies as their capital assets. Otherwise, the drivers are responsible to provide the vehicles. This business scheme makes the driver treated as the business partners, instead of employees. As the business partners, the drivers have to share their revenue with OTS companies. The amount of the revenue sharing varies between companies and is based on the contract agreement. Having such a business model often makes OTS perceived as a disruptive innovation to the conventional IPT. It is because OTS provides transportation service without being thoroughly responsible for the operational activities of the transport (Cramer and Krueger, 2016; Lee, 2016).

In some countries in Asia, such as Thailand, Indonesia, and Malaysia, the issues about vehicle ownership and employment status of the driver become two of many reasons why OTS-based taxi cannot be legalized as a formal transportation mode (Lee, 2016). The fact that OTS companies do not own OTS vehicles has raised concerns about safety (Feeney, 2015). Without being controlled by the company, the vehicle regular maintenance might be neglected. Furthermore, the security issue is related to the possible criminal acts that might happen during the journey with OTS. In some cases, kidnapping, robbery, and murder were committed by OTS drivers. In response to this concern, OTS companies provide a rating platform in the mobile application. The rating platform allows the passengers to report any unpleasant events during the trip as well as assess the drivers. It is compulsory for every

passenger to rate the driver after the trip ends. If the passengers do not rate the driver, they will not be able to order for the next trip. For the driver, rating is crucial for their existence in the company. If the driver's rating is lower than a certain threshold, the OTS companies can remove the driver from the system (Azevedo and Maciejewski, 2015).

- **Availability and Operation Hours**

Similar to other IPT modes (e.g. conventional taxi and motorcycle taxi, three-wheeler, etc), OTS-based vehicles are not under the obligation to operate in certain operating hours and fixed route either. Shimazaki and Rahman (2000) argue that IPT modes tend to operate in the profitable area or the area that has a high transportation demand (e.g. city center). However, OTS are probably distributed more evenly in all over the city. It is due to GPS in OTS mobile application that gives the ease to the drivers to know where the taxi demand is (Azevedo and Maciejewski, 2015).

2.3 Overview of the Accessibility Concept

2.3.1 Definition of Accessibility

The concept of accessibility has been developed in parallel with the concept of mobility. While the concept of mobility focuses on the performance of transportation as an end, accessibility focuses on the goal to reach destinations or activities by means of transportation modes (Geurs and van Wee, 2004). Therefore, accessibility has taken on board the interplay between transportation system, land use pattern, time-related constraint, and individual characteristics into a further analysis. Accessibility (or access) refers to the ability to reach destinations, participate in certain activities, and obtain goods, services, and information (Litman, 2011; Scheurer and Curtis, 2007; van Wee et al., 2013). Geurs and van Wee (2004:128) use the following definition to describe accessibility:

> *'the extent to which land use and transport systems enable (groups of) individuals to reach activities or destinations by means of a (combination of) transport mode(s)'*

Bhat et al. (2000) in Scheurer and Curtis (2007:5) has a slightly different definition of accessibility as mentioned below:

> '*a measure of the ease of an individual to pursue an activity of a desired type, at a desired location, by a desired mode, and at a desired time.'*

It is noteworthy that the definition provided by Geurs and van Wee (2004) specifically mentions land use and transport system as interrelated enablers that bring through individual or group's ability to reach destinations, whereas this spatial dimension is not prominent in Bhat's et al. (2000) definition (Hoffmann et al., 2016).

Accessibility is the paramount goal of transportation planning and policies (Litman, 2011). From this perspective, transportation users are not classified only as motorists or transit riders, but also people that need to reach destinations, activities, goods, and services. This perspective also states that transportation problems occur not only due to the issues in transportation service, but also all possible barriers that prevent the users to reach the desired location of opportunities. Thus, from the perspective of accessibility, the widest solutions to improve transportation can be considered, including traffic improvement, mobility improvement, more accessible land use, and mobility substitutes such as telecommunications and delivery service (Litman, 2011).

2.3.2 Individual's Perception of Accessibility

Understanding the level of accessibility is not simple as there are several components that must be considered (Geurs and van Wee, 2004; Litman, 2008). Thus, in reality, a perspective should be chosen to comprehend the level of accessibility (Geurs and van Wee, 2004). In conventional studies, spatial perspective is the most prevailing perspective to understand the level of accessibility. This perspective is measurable as it is based on objective measurements, such as travel distance and time. However, this perspective is considered inadequate for understanding the experience of individual to live in complex cities (Kwan and Weber, 2003). In addition, choosing spatial perspective sometimes leads to social exclusion, as a result of excessive emphasis on increasing mobility of the majority group (Lättman et al., 2016).

Choosing individual's perception to comprehend the accessibility can be an alternative for spatial perspective. Lättman et al. (2016) define the individual's perception of accessibility as the degree to which people perceive the ability of transportation system to contribute to making it easier to achieve a satisfactory life. Individual's perception has advantages over spatial perspective in terms of its ability to overcome the complexities in urban form (Kwan and Weber, 2003). The urban form is complex because it is affected by various factors and complicated process. For example, the selection of residential location is not merely affected by the proximity to jobs, but also several individual preferences, such as comfort, environment quality, safety, etc. Understanding accessibility from individual's perception acknowledges various elements that are related to individual's characteristics. As a result, it helps to understand not only the objective measurements (travel distance, travel time, travel cost, etc), but also time constraints and individual preferences in travel patterns.

Nevertheless, it is also critical to notice that each perspective has strengths and weaknesses. The shortcoming of assessing the level of accessibility from an individual's perception is that the competition effects in spatial distribution are not taken into account (Kwan and Weber, 2003). Thus, assessing accessibility from an individual's perception is less suitable to analyze land use change, in which competition effects are involved (Kwan and Weber, 2003; Geurs and van Wee, 2004).

In this study, the individual's perception is particularly chosen to comprehend the accessibility concept. As explained earlier, individual's perception is less suitable for examining land use change. Thus, the land use change will not be examined in this study. Accordingly, it can be considered as one of the limitations of this study.

2.4 Components of Accessibility

Geurs and van Wee (2004) argue that the concept of accessibility consists of four components: land use, transportation, temporal, and individual. These components also define the concept of accessibility.

2.4.1 Transport Component of Accessibility

The transportation component describes the ability of the transportation system to connect the people from their points of origin to the destinations (Geurs and van Wee, 2004). It is concerned about the measures such as travel time (including waiting time and time spent for parking), cost (variable and fixed), and effort (reliability, level of comfort, level of safety, etc), which are related to the level of service. Therefore, the elements to measure the level of service are used to understand transport component of accessibility. Eboli and Mazzulla (2013) and Transport Research Board (2013) summarized that information quality, travel

cost, travel time, travel distance, reliability, comfort, safety and security, as well as costumer care can determine the level of service.

- **Information Quality**

There are two types of information that can be obtained from transportation service and infrastructure; pre-travel and en-route information (van Wee et al., 2013). Departure and arrival schedule, travel time, travel cost, travel distance, and route are the information that can be known prior to the journey. Therefore, they are called pre-travel information. Meanwhile, the en-route information covers travel progress and remaining time until reach the desired location. Obtaining travel information helps individual to reduce travel resistance (Barth et al., 2015; Pardo, 2010; Transport Research Board, 2013; van Wee et al., 2013). Nevertheless, the goal of providing information only can be achieved if the information has a good quality. The information quality can be assessed from the content usefulness, content adequacy, and the ease of use (Silalahi et al., 2017). Content usefulness is the accuracy of the information, content adequacy refers to the completeness of information, and ease of use is the degree to which the people can interpret the information effortlessly (Silalahi et al., 2017).

- **Travel Cost**

Travel cost is the amount of money spent to use a certain service of transportation. Personal travel cost can be measured in daily, weekly, or monthly terms, depending on the unit of measurement taken. In the case of IPT, travel cost is sometimes different during rush hour and non-rush hour, in which a surged price is usually applied during the rush hour (Cervero, 2000). This especially occurs in IPT modes that do not have fixed rate. The drivers can set a high price in order to get a high profit. Whether the passenger perceive that travel cost is expensive or not is relative and highly dependent on the extent to which the passengers afford to pay (Litman, 2008).

- **Travel Time**

Travel time is the amount of time needed to reach the destination. Transport Research Board (2013) refers total travel time as the sum of waiting time for vehicles, in vehicle travel time, and searching time for parking. Travel time is a mediating variable for the temporal component; a reduction in travel time implies to more activities that can be done by an individual in a day (Geurs and van Wee, 2004). Therefore, it is important to understand whether a certain transportation service can have an ability to reduce total travel time of the users.

- **Travel Distance**

Travel distance refers to the length of journey people take to reach a destination. Travel distance is sometimes affected by a decision of taking a selected route. When a shorter route is less congested, it is most likely selected. Otherwise, the driver might take a longer route. A shorter route selection equals in principle to shorter travel distance. In relation to travel time, travel distance can sometimes affect travel time. With an assumption that there is no congestion along the way, a farther distance might lead to longer the travel time (Litman, 2008).

- **Reliability**

Beirão and Sarsfield Cabral (2007) described reliability as the ability of a transportation service to adhere punctual schedule. Punctuality is highly affected by the adequacy of available vehicles for a certain transportation service. More number of vehicles leads to a higher level of punctuality. Reliability often becomes a severe problem in developing countries that have not implemented electronic timetable in the public transportation system. The problem is not having a long waiting time, but rather the uncertainty about the arrival time of the fleet (Eboli and Mazzulla, 2013). Lättman et al. (2016) found that reliability

appeared to be one of the most important factors to make people perceive that the level of accessibility is good. In addition, a good level of reliability tends to lead the passengers to use the transportation service more often (Eboli and Mazzulla, 2013).

- **Comfort**

Comfort is the degree to which the transportation service can provide good physical quality on board, including soft and clean seats, smoothness of the ride, right temperature, pleasant odors, and low level of vibration and noise (Beirão and Sarsfield Cabral, 2007; Eboli and Mazzulla, 2013). The additional facilities provided by the transportation service can also be the element of comfort, as long as it contributes to the improvement of physical quality on board. Comfort is one of the key elements of passenger's satisfaction (Redman et al., 2013; Tandir, 2016). Also, according to Lättman et al. (2016), comfort is an important factor that determines people's perception of accessibility.

- **Safety and Security**

The element of safety does not only related to the sense of safety against possible accidents, but also the feeling of being secure to not to be a victim in a crime during the journey (Joewono and Kubota, 2006). The improvements in safety and security have a positive effect on people's perception of accessibility of a transportation service (Lättman et al., 2016).

- **Costumer Care**

Customer care includes the provision of communication before and after the trip that make the journey more enjoyable and easier (Eboli and Mazzulla, 2013). A transportation service is perceived to care about their customers when it provides the staffs and drivers who can communicate politely, be helpful, and give knowledgeable information. The responsiveness to the complaints is also included as the element of customer care. Various means of evaluation are usually employed by transportation provider to improve their service quality. Along with the development of ICT, currently many evaluations about customer care are conducted through online survey and rating platform. In addition, nowadays complaints can also be submitted through social media.

2.4.2 Land Use Component of Accessibility

The land-use component reflects the spatial distribution of opportunities or activities at the destinations (Geurs and van Wee, 2004). This concept contains the assessments about a) the amount and quality of spatial distribution of opportunities at a geographical area, i.e. the distributions of jobs, shops, schools, health facilities, etc b) the demand for activities or opportunities at an area, and c) the competitive nature of demand for opportunities at the destination.

2.4.3 Temporal Component of Accessibility

The temporal component examines the time-related constraints and opportunities that the people experience for their activity patterns, including the availability of activities or opportunities at a time of the day or the availability of time for participating in certain activities (e.g. working hours, opening time for shops, malls, recreation, operating hours of public transportation, etc) (Geurs and van Wee, 2004). The constraints can be understood by assessing the number of opportunities available at a time and the amount of time available to participate in activities.

- **Opportunities Available at a Time**

Opportunities available at a time are the amount of possible activities to be performed at a given time (Geurs and van Wee, 2004). More activities that are possible to be done at given time implies to a higher accessibility of people. For example, the implementation of ICT in daily life gives people a greater flexibility to perform several activities once at a time (i.e.

online shopping, e-banking, food delivery, etc) (Kwan and Weber, 2003; Mokhtarian, 1990; van Wee et al., 2013). As a result, people might become available for more opportunities of activity.

- **Time available to Participate in Activities**

Time available in a day to participate in activities is the amount of time people can utilize to conduct some activities (Geurs and van Wee, 2004). Access to activities sometimes is restricted to certain times or hours in a day, e.g. operating hours, working hours, and opening hours. Therefore, any actions that can eliminate the time constraints may contribute to increasing the perception of accessibility.

2.4.4 Individual Component of Accessibility

The individual component investigates the needs, opportunities, and abilities of an individual to access social and economic opportunities (Geurs and van Wee, 2004). A transportation service can bring a better accessibility when it provides a service that can fulfil the needs, expand the opportunities of the users to travel, and improve the abilities.

- **Needs**

Needs that people have for traveling are affected by several personal characteristics, such as age, gender, household situation, phase of life, and educational level (Geurs and Ritsema van Eck, 2001). For example, people with higher educational level will have greater access to white-collar jobs. Thus, they earn more money and feel greater needs to use private car.

- **Opportunities**

Opportunities for traveling are related to the income and travel budget (Geurs and Ritsema van Eck, 2001). For example, people with low income and travel budget will less likely have an opportunity to own private vehicles. Thus, they do not have vast opportunities to use different types of transportation mode. As a result, they are highly dependent on public transport and non-motorized transport.

- **Abilities**

Abilities for traveling are related to capacity and skills owned by an individual to access particular transportation service (Geurs and Ritsema van Eck, 2001). For example, people who cannot drive or do not have private vehicles will have less have ability to reach job opportunities located in the area that cannot be reached by public transportation, IPT, or non-motorized transport, and people with disability need special service to use public transportation.

2.5 Potential Impacts of OTS on the Commuters' Perception of Accessibility

Van Wee et al. (2013) argue that ICT potentially has impacts on four components of accessibility; transport, land use, temporal, and individual. As a way of ICT implementation in the transportation sector, OTS has some potential impacts on the four components of accessibility as well. In this section, the potential impacts of OTS on those four components will be discussed.

2.5.1 Transport Component of Accessibility

Transport component is related to level of service that a certain transportation mode can provide (Geurs and van Wee, 2004). Eboli and Mazzulla (2013) and Transport Research Board (2013) gives several indicators to perceive the level of service, namely information quality, travel cost, travel time, travel distance, reliability, comfort, safety and security.

- **Information Quality**

As way of ICT implementation in transportation sector, OTS is attached with GPS.

Therefore, OTS can provide the pre-travel and en-route information. Information provided by OTS prior to the journey are travel cost, travel distance, route, and estimated time arrival. Meanwhile, the information given during the journey is vehicle features, driver's information (name, rating, and telephone number), and journey progress on the route. In some countries, pre-travel information about OTS has been connected to Google Maps, which eases the commuters to compare prices, travel time, and travel distance of different transport services and modes. Accordingly, the commuters can decide which transportation mode or service that has the best value for money. Whether or not the information can contribute to reducing travel resistance depends on the information's content usefulness, content adequacy, and the ease of use (Silalahi et al., 2017). Therefore, it is important to examine if the information given by OTS is useful, adequate, and easy to interpret.

- **Travel Cost**

OTS fare is relatively more expensive than public transport. However, OTS might provide transportation service at relatively low price compared to private vehicles and conventional IPT (Azevedo and Maciejewski, 2015). As a result, OTS might have an impact on providing affordable transportation service at the similar quality as conventional IPT. However, cost affordability is relative to willingness to pay. Moreover, it is important to notice that travel cost of OTS could be different for the same distance during rush hour and non-rush hour. During rush hours, the price is surged and might exceed people's willingness to pay. Another important factor in travel cost is the promotion discount. As OTS is relatively new, it gives a lot of promotion discounts that possibly affect the commuters' perception of cost affordability.

- **Travel Time**

Travel time when using OTS consists of waiting time and in-vehicle travel time. As OTS gives the information about estimated time arrival, the commuters are helped to leave their position of origin just in time and it potentially reduces waiting time (Azevedo and Maciejewski, 2015; Rayle et al., 2014). Nevertheless, there is a possibility that the travel information provided by OTS is inaccurate. Therefore, a further investigation regarding the ability of OTS to reduce total travel time needs to be conducted.

In addition, the existence of GPS in OTS might help the drivers to reduce in vehicle travel time by taking less congested road. However, whether the GPS tends to prioritize shorter time or shorter distance needs to be investigated. Shorter time sometimes take a longer route, resulting in a more expensive travel cost. Meanwhile, a shorter distance might result in longer travel time due to congestion occurs along the road.

- **Travel Distance**

Travel distance is the length of the journey, which can be affected by the selection of route. OTS potentially reduces the length of the journey as it employs GPS as a real-time map. With the help of GPS, OTS drivers can choose the most effective route (Azevedo and Maciejewski, 2015). However, the accuracy of effective route as informed by the GPS is also related with the information quality. If the GPS on the OTS does not inform accurate information about effective route, then the shorter travel distance is less likely to be realized.

- **Reliability**

Reliability can be indicated from the punctuality of vehicle arrival as well as the adequacy of available vehicles (Beirão and Sarsfield Cabral, 2007; Sumaedi, 2014). OTS has a potential to be punctual when picking up the commuters as it is embedded with GPS. Commuters can get information about estimated time arrival, so they do not have to wait in uncertainty. Nevertheless, sometimes GPS in the mobile application does not work properly, resulting in

the failure to pair the commuters with drivers nearby. As a result, the commuters should wait longer or cancel the order until being paired with the right drivers. In addition, along with the growth in the number of OTS vehicles, the number of available OTS vehicles on the road is supposed to be adequate. However, it needs to be further investigated due to the exponential increase in the number of OTS users. If commuters perceive that being paired with OTS drivers is easy, then we can say that the number of OTS vehicles is adequate.

- **Comfort**

Comfort includes the elements related to quality of the vehicles (comfort on board), such as soft and clean seats, smoothness of the ride, right temperature, pleasant odors, and low level of vibration and noise (Beirão and Sarsfield Cabral, 2007; Eboli and Mazzulla, 2013). A research by Panjaitan (2016) revealed that comfort on board of OTS is the indicator that needs to be improved. Moreover, the indicator of comfort also includes the additional facilities that support comfort on board, such as cashless payment facility and ease to order through mobile. Some commuters might perceive that the implementation of technology on payment and booking methods makes the service becomes very practical. However, those who are clueless about the use of technology might not perceive the same benefits. Not to mention if the technology does not work properly. Moreover, OTS-based motorcycle taxi also provides helmets and masks to the commuters. It is interesting to investigate whether people perceive that the helmets and masks provided by OTS are proper, in a sense that they are clean and fit.

- **Safety and Security**

OTS has a potential impact on the level of safety and security (Feeney, 2015). According to Joewono and Kubota (2006), safety and security can be related to the accident and crime. The emergence of OTS has raised the issue of safety due to the fact that the ownership of the vehicles is not on the OTS companies. As a result, the OTS companies do not have any obligation to undergo periodic maintenance (Feeney, 2015). It is possible that the vehicle engines are poorly maintained and become prone to accident. In order to ensure the safety of passengers, OTS-based motorcycle taxi provides helmets. Nevertheless, the facilities given to ensure the safety of OTS-based taxi are still unclear. On top of that, it is important to ensure whether OTS companies cover the journey with insurance. In regards to security, the concerns raised from the fact that the drivers are not registered as legitimate employees. Thus, there is always the risk that the commuters become the victims of criminal acts committed during the journey with OTS. Nevertheless, the way that OTS provides the en-route information about the real-time location and journey progress somehow has a potential to make the commuters feel secure during the journey.

- **Costumer Care**

Customer care is related to politeness, helpfulness, and knowledgeability of the transport provider in communicating with the passengers as well as the responsiveness of the staffs on handling complaints (Eboli and Mazzulla, 2013). The evaluation of costumer care in OTS is conducted using a rating platform. The rating platform about costumer care quality is designed very simple; the commuters only need to give stars to the drivers with the scale of 1 to 5 with 5 being the most positive. It is compulsory for every passenger to give the rating to the driver. Otherwise, they cannot order the next trip. By embedding the rating platform in the mobile application, it is expected that OTS can provide polite, helpful, and knowledgeable drivers, so that the positive effect on the perception of accessibility can be realized. However, the accuracy of driver rating is dependent on the quality of passenger assessment. Sometimes the passengers just give perfunctory rate to the drivers. Thus, the rating does not reflect the reality.

In addition to rating platform, there is also a box embedded in the rating platform where commuters can deliver their complaints if they have. The complaints can also be delivered through social media. Nevertheless, a further investigation about the responsiveness of complaints should be conducted in order to know the extent to which online platform on OTS can be effective to actualize customer care.

2.5.2 Land Use Component of Accessibility

In general, ICT has the impacts on land use component on three levels (van Wee et al., 2013). First, ICT might have an effect on land use change. For example, the distribution of office location is not necessarily adjacent to each other since remote communications could be conducted. Second, it has a role in the distribution of actors. For example, the distribution of professionals in certain expertise may change due to the impact of ICT that enables the dispersion of industry types in wider locations. Third, ICT has an impact on the role of actors. For example, the possibility of parents to work from home leads to the decision of parents to pick up the children by themselves.

However, in the case of OTS, the impact on land use is probably not significant in the short term. It is because OTS is relatively new. There is no clear evidence whether or not OTS can affect land use changes as well as distribution of actors and their roles. It might need a longer time to see the clear effect of OTS on this component. Moreover, patterns of land use and individual accessibility seem to be determined by many more complicated processes in contemporary cities (Kwan and Weber, 2003), thus the relationship between land use and accessibility becomes unclear and difficult to examine. Up to this point, the foundation of a behavioral framework to examine the relation of long-term land use change with household activity has not been complete enough (Waddell, 2001). Based on the reasons above, this study will not examine the impact of OTS on the land use component.

2.5.3 Temporal Component of Accessibility

Temporal component is related to the time-related constraints people experience in the activity patterns (Geurs and van Wee, 2004). ICT have the impacts on "the availability of opportunities at different times of day" and "the time available for activities" by reducing the time-related constraints to do the activity (van Wee et al., 2013) and so OTS.

- **Opportunities Available after Working Hours and while Traveling**

Opportunities available at a time of commuters can be assessed by the number of activities they can perform after working hours as well as while riding with OTS. If OTS can contribute to saving daily travel time, people may be able to do more activities after working hours. In addition, people can do two or more activities once at a time while riding with OTS because they do not have to drive. OTS-based taxi users might be able to pick business calls or work with laptop conveniently. The more opportunities people can take at a given time, the higher their accessibility level (Geurs and van Wee, 2004). However, temporal component is highly dependent to transport component. If OTS does not significantly change the travel time, the number of activities that can be performed in a day might remain low. Moreover, if OTS fails to provide comfort on board, people are less likely able to perform activities while traveling.

- **Flexibility to Work Longer**

For commuters, time available to participate in activity is indicated by the length of working hours and availability to work longer due to the presence of OTS. The fact that operating hours bound the operation of public transport becomes a time-related constraint for commuters to work overtime. Sometimes they are reluctant to work until late because there is no available vehicle to go home. OTS has potential to eliminate that time constraints as it has

the flexibility in operating hours. The premise is lesser time-related constraints will result in a higher accessibility (Geurs and van Wee, 2004).

2.5.4 Individual Component of Accessibility

In regards of individual component, ICT has an impact on shaping the needs, opportunities, and abilities for traveling (van Wee et al., 2013). It should be noticed that the needs, opportunities, and abilities are constructed from personal characteristics, such as gender, age, income, occupation, level of educational, car ownership, and ability to drive (Geurs and van Wee, 2004). Therefore, personal characteristics function as a mediator variable. As the object of this study is commuter who use OTS, the discussion about the needs, opportunities, and abilities for traveling in this section will be tailored with the personal characteristics of commuters.

- **Needs to Use Certain Transportation Modes to Commute**

The presence of OTS may contribute to alter the needs of commuters to use certain transportation modes to commute. There are two possible impacts of OTS on the needs to use certain transportation mode, namely substitution and complementary. While substitution refers to the reduction in the use of transport mode, complementary is the increase in the use of transport mode as a result of enhanced service (Salomon, 1986). The impact of OTS can be considered positive if it can substitute the use of private vehicles and complement the use of public transport. Conversely, the impact of OTS is negative if OTS reduce the need to use public transport.

Empirical studies on the impact of OTS on the use of public transportation and private vehicles produce different results. Thus, the impact of OTS on changing the needs to use private vehicles and public transportation is still unclear. A study by Martin and Shaheen (2011) figured out that one OTS vehicle potentially replaces 9 to 13 vehicles on the road in a day. Murphy and Feigon (2016) and Smith (2016) supported that finding by arguing that frequent OTS users are less likely to purchase cars or motorcycles (Murphy and Feigon, 2016; Smith, 2016). Nevertheless, a study by Clewlow and Mishra (2017) revealed a countervailing result, in which the majority of OTS users in USA still retain their vehicle ownership.

In relation to the need to use public transport, Murphy and Feigon (2016) argue that there is a positive correlation between the use of OTS and public transport. On the contrary, a study by Clewlow and Mishra (2017) found that in total the use of OTS has reduced public transport usage by 6%. However, the effect can be different for various types of public transport. Clewlow and Mishra (2017) found that the use of Light Rail Transit (LRT) and bus services reduced by 3% and 6% respectively after the presence of OTS in USA, while the use of heavy rail transit increased by 3%.

The results of various studies have shown that OTS has different impacts in different places. Clewlow and Mishra (2017) suggest that the difference in effect of OTS on the needs to use certain transportation mode is considerably based on the quality of transportation system in the city. The better the quality of public transport, the less likely people need to use private vehicles. The emergence of OTS will create a positive impact if it makes people shift away from the use of private vehicles and serves as a complement for public transportation.

- **Opportunities to Commute by OTS or in Combination with other Transportation Modes**

People with low affordability have less opportunities to use private vehicles (Geurs and Ritsema van Eck, 2001). They are most likely dependent on public transport and non-

motorized transport. The presence of OTS might give people a wider opportunity to use different selections of transportation mode to commute. It can be proven by investigating the types of transportation modes commuter use before and after the OTS operates. OTS might give commuters a wider opportunity to use different selections of transportation mode if OTS really can provide affordable transportation service. The degree to which OTS is able to provide affordable transportation will be examined in transportation component section.

- **Abilities to Reach Job Locations**

OTS might be able to change the ability of commuter to reach job locations. Sometimes the ability to reach the job locations is constrained by the absence of adequate transportation service. As OTS is not bounded by any fixed route and time schedule, it can access the area that is not served by public transport at any time. Thus, it might help people who do not own private vehicles nor skill to drive to commute to (or from) the places that is not served by public transport.

2.6 Personal Characteristics of the Commuters

Personal characteristics consist of gender, age, income, occupation, level of education, car ownership, and ability to drive. Geurs and van Wee (2004) argue that personal characteristics influence the level of accessibility. For instance, the commuters that earn higher incomes probably perceive that the cost of OTS-based taxi at the rush hours is affordable, female workers might feel using OTS is less secure, and more educated people potentially perceive that using OTS mobile application is easier compared to what less educated people perceive. Based on the examples, the personal characteristics are the bridge between the use of OTS and perception of accessibility. They do not belong to any component of accessibility and their existence is not affected by the use of OTS. Therefore, personal characteristics have a function as a moderator between the use of OTS and perception of accessibility.

2.7 Conclusion

As a new innovation in the transportation service, OTS is often seen as a disruption to conventional transportation service (Cramer and Krueger, 2016). It has incorporated vehicles and taxi management with finance technology and ICT. Even though OTS provides an advanced way to use IPT, it leaves a question whether or not this innovation can give the people an improvement in the level of accessibility.

Accessibility is the goal of transportation planning and policy (Litman, 2011). Understanding accessibility would help to produce a comprehensive solution, including improvement of transportation service and effective utilization of technology for transportation system. Nevertheless, accessibility is a complex concept that incorporates several factors (Litman, 2011). According to Geurs and van Wee (2004), there are four components that should be considered in order to understand accessibility, namely transport, land use, temporal, and individual. However, in this study, the land use component is excluded from the analysis for two reasons. First, the foundation of a framework to explains the link between long-term land use change with travel patterns has not complete enough (Waddell, 2001). Second, OTS is relatively new and its impact on the land use change is probably insignificant.

Assessing accessibility is complex. Thus, a particular perspective should be selected. This study will examine the level of accessibility from the perception of individual. Assessing people's perception of accessibility is considered to be more responsive to the complexities in urban form because it takes account of not only objective measures (travel distance, travel time, etc) but also the individual characteristics that set temporal and spatial constraints (Kwan and Weber, 2003; Lättman et al., 2016). However, it is also important to notice that

this perspective has some weaknesses. One of which is its insufficiency to analyze competition effects in spatial distribution. This is again the reason why land use component is not discussed in this study.

Several studies regarding the relationship between ICT and travel behavior have given some clues about the impact of OTS on the transport, temporal, and individual components of accessibility. Nevertheless, whether OTS can improve commuters' perception of accessibility is yet unknown. It seems that OTS has different impacts in different places, depending on personal characteristics of the population in a place or city (Clewlow and Mishra, 2017). Therefore, personal characteristics are also considered in this study. As the commuters become the object of this study, the indicators of personal characteristics will be tailored with the characteristics of commuters.

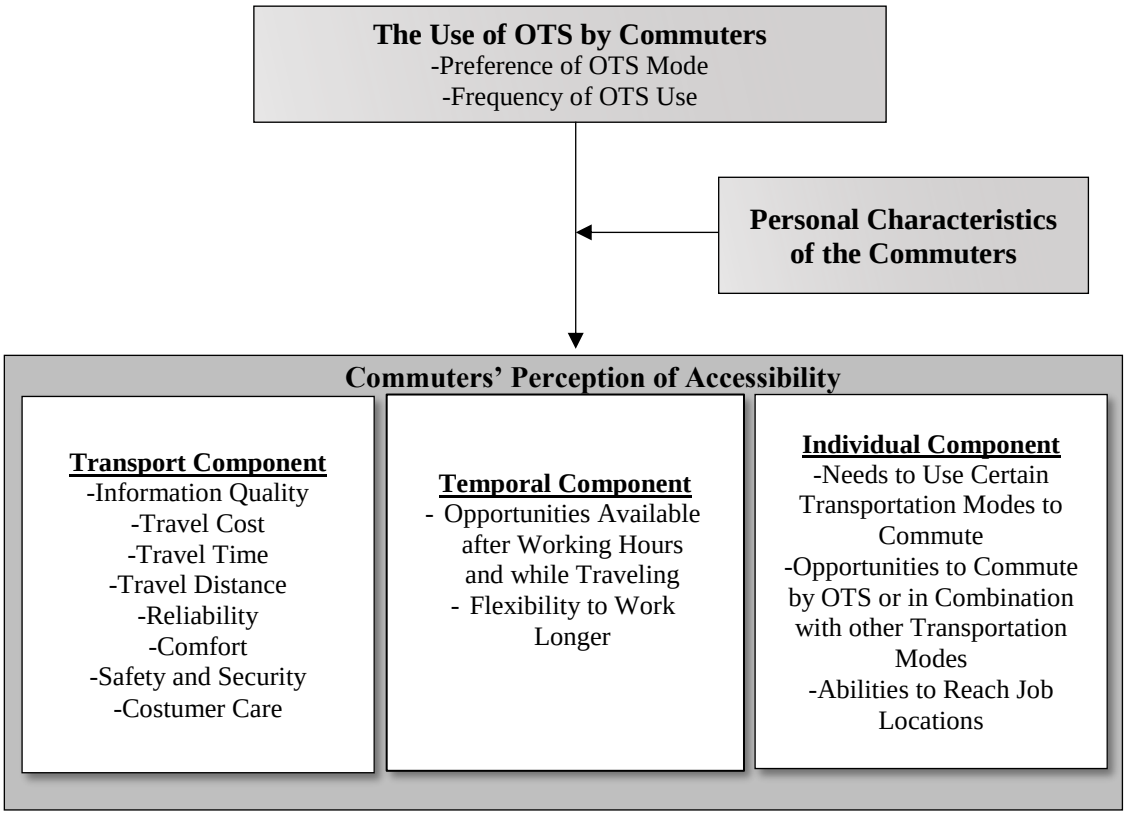
2.8 Conceptual Framework

As defined by Miles and Huberman (1994) in Maxwell (2004), 'the conceptual framework is a visual or written product, one that explains, either graphically or in narrative form, the main things to be studied—the key factors, concepts, or variables—and the presumed relationships among them'. Thus, the conceptual framework aims to explain what is happening on the phenomena and the factors that affect the phenomena. Furthermore, it helps to assess the goal of the study, refine the research questions, and choose appropriate methods.

In this study, the definition of accessibility provided by Geurs and van Wee (2004) becomes the backbone because it comprehensively incorporates various components. Van Wee et al. (2013) subsequently conducted a study about how the implementation of ICT in transportation might lead to the changes in one or more components of accessibility. OTS is a way of ICT implementation in transportation sector. Thus, the use of OTS has potential impacts on changing those components as well. Nevertheless, among all four components in the accessibility concept, only three of them will be examined in this study. Those three components are transport, temporal, and individual components.

It is also acknowledged that the impact on the components of accessibility is affected by personal characteristics (Geurs and van Wee, 2004). However, personal characteristics are not influenced by the use of OTS. Therefore, the role of personal characteristics is as a mediator. Based on the theoretical background used in this study, the figure below depicts the conceptual framework that visually explains the impact of OTS on the perception of accessibility.

Figure 3 Conceptual Framework



Chapter 3: Research Design and Methods

3.1 Introduction

This chapter aims to present the strategy and methods employed in this study. It begins with the operationalization of variables and indicators and is followed by the explanation of research strategy, sampling techniques, and procedure in data collection. This chapter further describes the reliability, validity, as well as techniques used for data analysis.

3.2 Operationalization of Variables and Indicators

According to van Thiel (2013), operationalization is the transition from theory to research strategy. In the operationalization, the theoretical concepts are translated into variables and indicators that are feasible to measure. The operationalization part gives the direction and delineation about the factors that will be studied in the empirical part.

This study aims to explain the extent to which the use of OTS affects the commuters' perception of accessibility in Jakarta. The aim of the study indicates that there are two main concepts used, namely OTS and accessibility. The independent variable is the use of OTS and the dependent variable is the commuters' perception of accessibility. Moreover, since the perception of accessibility is influenced by personal characteristics, then personal characteristics of the commuters have a function as a moderating variable. The use of OTS can be defined from the preference of OTS mode as well as the frequency of OTS use. Meanwhile, the perception of accessibility can be defined through the elaboration of three components, namely transport, temporal, and individual components (Geurs and van Wee, 2004). In this study, the individual's perception is selected as a perspective to understand the level of accessibility. This perspective focuses on how people perceive the service performance of their modal choices and their impacts on time-related constraints to fulfil the needs, improve the ability, and expand the opportunities to travel (Lättman et al., 2016; Geurs and van Wee, 2004).

The table below shows how the OTS and accessibility concepts are operationalized with the variables and measurable indicators. The variables and indicators are chosen based on various literature sources. The information of each indicator will be obtained through survey. There are several advantages and disadvantages of using survey for this study. It is claimed that survey is the best way for obtaining the information of multi indicators in a limited time (Gable, 1994; Glasow, 2005; van Thiel, 2007). Moreover, the applications of rating scales and multiple choices make the respondents easier to respond the question in the survey. Nevertheless, the information obtained cannot be in depth and is demarcated by the questions in the survey questionnaire. Therefore, the questions should be formulated properly in order to get the information that is needed.

The survey questionnaire is divided into four sections. The first section contains the screening questions, in which further questions will not be asked if the prospective respondents do not pass the screening questions. The second section is related to the use of OTS. In this section, the preference of OTS mode and frequency of OTS use will be asked. The third section aims to gather information about commuters' perception of accessibility by assessing the impact of OTS on three components of accessibility, namely transport, temporal, and individual. The last section contains the questions about personal characteristics of the commuters.

Table 1 Operationalization of Concepts and Variables

Concept	Variable	Sub Variable		Indicator	Value	Source
OTS	The Use of OTS	Preference of OTS Mode		Preference to use OTS-based taxi or motorcycle taxi	Nominal	(Clewlow and Mishra, 2017)
		Frequency		Frequency of OTS use in a week	Ratio	
Accessibility	Commuters' Perception of Accessibility	Transport Component	Information Quality	Content usefulness of pre-travel information	Ordinal (Scale of 1-5)	(Silalahi et al., 2017; van Wee et al., 2013)
				Content adequacy of pre-travel information	Ordinal (Scale of 1-5)	
				Ease of use/interpret pre-travel information	Ordinal (Scale of 1-5)	
				Content usefulness of en-route information	Ordinal (Scale of 1-5)	
				Content adequacy of en-route information	Ordinal (Scale of 1-5)	
				Ease of use/interpret en-route information	Ordinal (Scale of 1-5)	
				Ability of information to reduce travel resistance	Ordinal (Scale of 1-5)	
			Travel Cost	Actual fare at non-rush hour	Ratio	(Azevedo and Maciejewski, 2015; Cervero, 2000; Litman, 2008)
				Affordability at non-rush hours without a promotion discount	Ordinal (Scale of 1-5)	
				Affordability at non-rush hours with a promotion discount	Ordinal (Scale of 1-5)	
				Actual fare at rush hour	Ratio	
				Affordability at rush hour without a promotion discount	Ordinal (Scale of 1-5)	
				Affordability at rush hour with a promotion discount	Ordinal (Scale of 1-5)	
			Travel Time	Waiting time	Ratio	(Azevedo and Maciejewski, 2015; Transport Research Board, 2013; Rayle et al., 2014).
				In vehicle travel time	Ratio	
				Ability to reduce total travel time	Ordinal (Scale of 1-5)	
			Travel Distance	Distance of the journey	Ratio	(Azevedo and Maciejewski, 2015; Litman, 2008)
				Effectiveness of route selection	Ordinal (Scale of 1-5)	
			Reliability	Punctuality	Ordinal (Scale of 1-5)	(Beirão and Sarsfield Cabral, 2007; Sumaedi, 2014)
				Adequacy of OTS vehicle	Ordinal (Scale of 1-5)	
			Comfort	Comfort of seat	Ordinal (Scale of 1-5)	(Beirão and Sarsfield Cabral, 2007; Eboli and Mazzulla, 2013)
				Level of vibration	Ordinal (Scale of 1-5)	
				Temperature on board (OTS taxi only)	Ordinal (Scale of 1-5)	
				Usefulness of cashless payment	Ordinal (Scale of 1-5)	
				Ease to use the mobile application	Ordinal (Scale of 1-5)	
				Provision of proper helmet and mask (OTS motorcycle taxi only)	Ordinal (Scale of 1-5)	
			Safety and Security	Safety from traffic accident	Nominal and Ordinal (Scale of 1-5)	(Feeney, 2015; Joewono and Kubota, 2006)
				Security from crime while riding		

Concept	Variable	Sub Variable		Indicator	Value	Source
			Customer Care	Politeness of the driver	Ordinal (Scale of 1-5)	(Eboli and Mazzulla, 2013
				Helpfulness of the driver	Ordinal (Scale of 1-5)	
				Knowledgeability of the driver	Ordinal (Scale of 1-5)	
				Reliability of rating platform	Ordinal (Scale of 1-5)	
				Responsiveness to customer's complaint	Ordinal (Scale of 1-5)	
		Temporal Component	Opportunities available after working hours and while traveling	Type of activities performed after working hours	Nominal	(Geurs and van Wee, 2004; van Wee et al., 2013)
				Opportunities to perform more activities after working hours	Nominal and Ordinal (Scale of 1-5)	
				Activities while traveling	Nominal	
				Opportunities to perform more activities while traveling	Ordinal (Scale of 1-5)	
			Flexibility to work longer	Length of working hours	Ratio	
				Availability to work longer due to OTS	Ordinal (Scale of 1-5)	
		Individual Component	Needs to use certain transportation modes to commute	Needs to own private vehicles	Ordinal (Scale of 1-5)	(Geurs and Ritsema van Eck, 2001; Geurs and van Wee, 2004)
				Needs to use private vehicles	Ordinal (Scale of 1-5)	
				Needs to use public transport	Ordinal (Scale of 1-5)	
			Opportunities to commute by OTS or in combination with other modes	Opportunities to use different types of transportation modes before using OTS for commuting	Nominal	
				Opportunities to use different types of transportation modes after using OTS for commuting	Nominal	
			Abilities to reach job locations	Adequacy of public transportation in job locations	Ordinal (Scale of 1-5)	
				Adequacy of public transportation in residential area	Ordinal (Scale of 1-5)	
				Abilities to commute to/from locations that are not served by public transport	Ordinal (Scale of 1-5)	
	Personal Characteristics of the Commuters			Gender	Nominal	(Geurs and van Wee, 2004)
				Age	Ratio	
				Income	Ratio	
				Occupation	Nominal	
				Level of education	Ordinal (Scale of 1-5)	
				Car ownership	Nominal	
				Ability to drive	Nominal	

3.3 Research Strategy

The research strategy of survey will be applied to this study. Pinsonneault and Kraemer (1993:77) define survey as 'the means for gathering information about the characteristics, actions, or opinions of a large group of people'. Survey is virtually identical with the questionnaire, although it essentially goes beyond that (van Thiel, 2007). In this study, the main data type is quantitative and will be collected using structured questionnaire. The quantitative data will then be processed through the aid of statistical analysis. For the purpose of gaining additional data, semi-structured interview will be conducted to select respondents and the Head of Research at Go-Jek, one of OTS companies in Indonesia. There are four respondents that will be selected. The selection will be based on their answers and willingness to conduct further interview. These respondents should represent the different characteristics of OTS use, which is explained by frequency and preference of mode. Therefore, these respondents will consist of non-frequent user of OTS-based taxi, frequent user of OTS-based taxi, non-frequent user of OTS-based motorcycle taxi, and frequent user of OTS-based motorcycle taxi. Frequent users are the people who use OTS for more than 5 times and non-frequent users are the people who use OTS for less than 5 times. The semi-structured interview will gain in-depth information, which can be useful to give insight on the numerical data, especially for analyzing why the commuters' perception on the level of accessibility differentiates between the characteristics of OTS use.

Specifically, the population of this study is the commuters who use OTS in Jakarta. It implies to the fact that a great deal of population is involved in the study. Thus, as stated by Gable (1994), Glasow (2005) and van Theil (2014), survey is the most appropriate strategy for such circumstance, especially when time and budget are limited. The questionnaire employed in this survey consists of close-ended questions, meaning that the questions can be answered by a simple selection of options, numerical scale, and short answer. Thus, cross-sectional data collection can be employed with the combination of different approaches, such as physical questionnaire and online survey (Babbie, 1990). Survey is also adequate for gathering demographic data (Glasow, 2005). In regards of validity, survey enables the data to be easily generalized with other studies that show similar evidences. Thus, through the research strategy of survey, a high external validity can be achieved.

A research that is operationalized with survey may be confronted with some drawbacks. For instance, it is difficult to ensure that the respondents answer the questions truthfully, especially if the questionnaire contains a large number of questions. Sometimes the respondents even do not want to participate or respond the questionnaires at all (van Thiel, 2007). For this challenge, the researcher will give an incentive to attract people for participating in the survey. Moreover, questionnaire is one-way data retrieval. Once the survey is conducted, the questions cannot be modified or eliminated. The mistakes in questioning particular indicators can create the risks of reliability and validity. Therefore, it is important to design a structured survey instrument with clear and unambiguous words. To achieve this aim, pilot survey will be administered prior to the fieldwork. The pilot survey will be conducted by face to face survey and online survey, in which each approach will be undertaken to five pilot survey respondents. Therefore, a total of 10 people will be approached to participate in the pilot survey.

3.4 Data Collection Method and Instrument

3.4.1 Sampling Techniques and Sample Size Selection

According to the information derived from Go-Jek and Grab, the number of OTS vehicles in Jakarta is around 1,000,000 units. If assumed that one vehicle can serve 10 trips a day and in average one person conduct 1.5 trips a day (Medeiros et al., 2018), then it is estimated that there

are 6.6 million OTS users in Jakarta. Therefore, based on Slovin formula with the error of 8% and confidence level of 95%, the number of samples should be at least 151 commuters. It is realized that among 100% of future respondents approached to fill the questionnaires, only a part of them will reply. Therefore, with the assumption of 20% response rate, the number of questionnaires that will be distributed is 755 units.

This study employs non-probability data sampling with the sampling population derived from OTS users in Jakarta. Although the population size is known, non-probability data sampling is more feasible than probability technique which is time consuming and expensive as it requires a list of population element (Cooper and Schindler, 2014). Respondents are randomly selected by firstly asking some screening questions. These are the criteria for selecting the respondents:

- They use OTS for daily commuting
- They are in productive age group (15-65 years old)
- They could live in or at the outskirts of Jakarta, but must work in Jakarta
- They are not OTS drivers

The further questions about OTS use characteristics and perception of accessibility will be then asked to those who pass the screening questions.

3.4.2 Data Collection Method and Instruments

This research uses survey as the main data collection method. The data will be acquired by face to face survey and online survey. According to Leeuw (2005), combining several approach to collect data is useful to compensate the weakness of each approach. Face to face survey is time consuming, thus online survey can help to reach more respondents within shorter time. On the other hand, using online survey alone might result in the unrepresentativeness of a certain group, especially those who are not exposed to the use of Internet. Therefore, face to face survey can assist to ensure that all target groups are covered. This study targets to obtain 101 respondents from online survey and 50 respondents from face to face survey. The respondents from face to face survey will be selected using simple random sampling to avoid biased result. Meanwhile, the online survey will be distributed to several social media groups that have members from different ages, occupations, education levels, and genders (e.g. carpooling community Facebook group, church community WhatsApp group, school alumni Facebook group, etc).

The survey instrument that will be administered in this research is structured questionnaire with several close-ended questions. The questionnaire will be divided into three sections. The first section is the screening part. The second section will attempt to collect data for the independent variable, in which the preference of OTS mode and frequency of OTS use will be asked. The third section will further obtain the information about their perception of accessibility by using OTS for daily commuting. In the questionnaire, the respondents are given some choices of answer and scales, so that the information can be quantified.

Moreover, in order to collect in-depth information for the analysis, four selected OTS users, Manager at Grab Indonesia, and the Head of Research at Go-Jek will also be interviewed with a semi-structured interview guide that contains several open-ended questions. Both questionnaire and interview guide will be written in vernacular (Bahasa Indonesia) that is easily understood by the respondents. For the triangulation process, the primary information used in this study will also be equipped with the secondary data derived from statistical data from Jakarta Central Bureau of Statistic. Several relevant articles from media will also be used if needed.

3.5 Reliability and Validity

According to Yin (2003), reliability is about consistency and stability. It means that the operations of the research can produce the consistent result even though it is conducted under

different circumstance and to different group of respondents. Meanwhile, validity is related to accuracy and truthfulness. Validity refers to the extent to which the result corresponds to actual reality (Neuman, 2003). Validity is distinguished into three types that are also related to reliability; internal validity, external validity, and construct validity. Internal validity refers to the accuracy in the internal process, meaning that the researchers do not make any error throughout the research process in order to produce credible result (Neuman, 2003). External validity is the degree to which the result can be generalized to other situation and population (Neuman, 2003). Moreover, construct validity is the extent to which the legitimate conclusion can be made from the operationalization, so that the conclusion can contribute to the theoretical construct on which the operationalization was based (Brown, 2000).

Reliability in survey research is affected by many factors, but according to Brown (1997), from the point of view of researchers, there are three important factors that can affect reliability; the quality of the questions, the length of the questions, and the fitness to the group that are involved in the measurement process. To ensure reliability in this study, multiple indicators will be administered to measure a variable. Moreover, reliability of the study can also be ensured through appropriate statistical method, such as the Cronbach's Alpha Test of Reliability.

The research will assure internal validity by doing proper procedure of data collection and analysis. Prior to data collection, the pilot survey will be conducted in order to reduce ambiguity in the questions. During the data collection, the researcher will monitor the process. To ensure that the questions are asked to the right respondents, the selection of respondents will be controlled through the screening questions. The data input will be conducted in parallel with data collection to recognize whether non-representativeness of certain group occurs. In the analysis procedure, data preparation and aggregation will be undertaken carefully to ensure the quality and completeness of the data. Finally, the validity will also assured using Pearson's Correlation Analysis. Using Pearson's Correlation Analysis, it will be revealed whether each question in the questionnaire has a high correlation with the result of the study. In order to ensure external validity, survey strategy with adequate number of samples will be applied to allow generalization. Moreover, the quantitative data from survey will be justified with the information gathered from in-depth interview and secondary statistical data. Furthermore, in order to establish construct validity, a thorough understanding of the theories and designing operationalization based on theories have been conducted.

3.6 Data Analysis Technique

The data will be analyzed using descriptive and inferential analysis. The descriptive analysis aims to describe the basic feature of the data in the study. The methods used for descriptive analysis are cross tabulation and frequency analysis. Cross tabulation allows to see the difference answers between OTS-based taxi and OTS-based motorcycle taxi users. It will also show which categories of answer that appear most frequent. Moreover, frequency analysis is used to find out the mean of several indicators. The inferential analysis aims to investigate the significant difference between variables. The inferential analysis will use several methods, such as MANOVA, linear regression, and multiple regression. Prior to do inferential analysis, reliability and validity of the data will be tested using Cronbach's Alpha Test of Reliability and Pearson's Correlation Analysis. Data coding, editing, and analysis will be conducted in Statistical Package for Social Science (SPSS). Meanwhile, charts, graphs, and tables will be produced using Microsoft Excel spread sheet.

Chapter 4: Research Findings

4.1 Introduction

This chapter presents the major findings from data collection in the field. It begins with the overview of the traffic condition in Jakarta and is followed by personal characteristics of the respondents. The next part gives the descriptive analysis about the perception of each component in accessibility concept. The last part is the inferential analysis which aims to investigate whether or not there are significant differences in the perception of accessibility between the commuters. This last part eventually will disclose which component in accessibility concept is the most statistically significant.

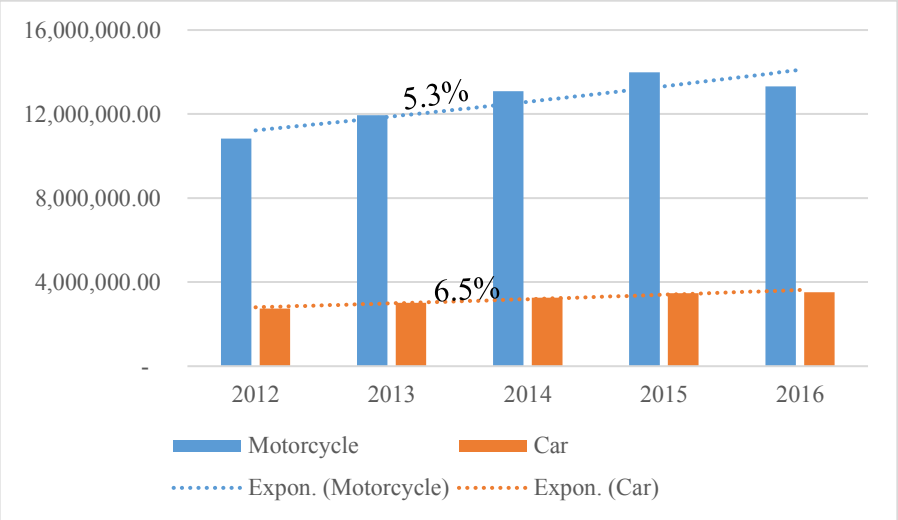
4.2 Overview of Transportation Condition in Jakarta

Jakarta is not only the capital city of Indonesia, but also a city where ajor business and commerce activities in Indonesia take place. In 2016, GDRP of DKI Jakarta Province reached approximately Rp 2,177 trillion (~ € 131 billion) with annual growth of 7.3%. Among other provinces in Java Island, DKI Jakarta Province has the highest GDRP. As of 2016, 29.3% of GDRP in Java Island came from Jakarta (Central Bureau of Statistics of DKI Jakarta, 2017).

Given the fact, Jakarta is the city that offers a great deal of job opportunities. The number of job vacancies in Jakarta increased over time with growth rate of 8.9% per annum (Central Bureau of Statistics of DKI Jakarta, 2017). As a result, Jakarta receives a positive influx of migrant from other provinces in Indonesia. The annual growth rate of migrants in Jakarta for the last 10 years was 24.3% (Central Bureau of Statistics of DKI Jakarta, 2017). Thus, Jakarta becomes the most populous city in Indonesia with total population of 10.2 million and density of 15,663 people per km^2 (Central Bureau of Statistics of DKI Jakarta, 2017). In the day-time, the number of population in Jakarta is higher. It is due to the fact that many people from the peripheral area commute to Jakarta. Bureau of Communications and Public Information DKI Jakarta (2016) stated that in 2015, 50% of commuting trips in Jakarta were resulted by roundtrip journey from the peripheral area.

Unfortunately, the large population in Jakarta is not served by a good public transportation system. As a result, people prefer to use private vehicles and hence, 93.9% of vehicles on the roads in Jakarta are categorized as private vehicles. Motorcycle is the transportation mode with the highest number in Jakarta, followed by private car. The number of motorcycles in 2016 reached around 13.3 million units (79% of total number of private vehicles). Meanwhile, the number of private cars in 2016 was accounted for approximately 3.5 million units (21% of total number of private vehicles). Both motorcycles and private cars have annual growth rate of 5.3% and 6.5% respectively (See Figure 4). The growth rate of both vehicles is greater than the growth rate of road development, which is only 4.0% per year (Central Bureau of Statistics of DKI Jakarta, 2016). Without any policy taken, obviously Jakarta will continue to experience severe transportation problems.

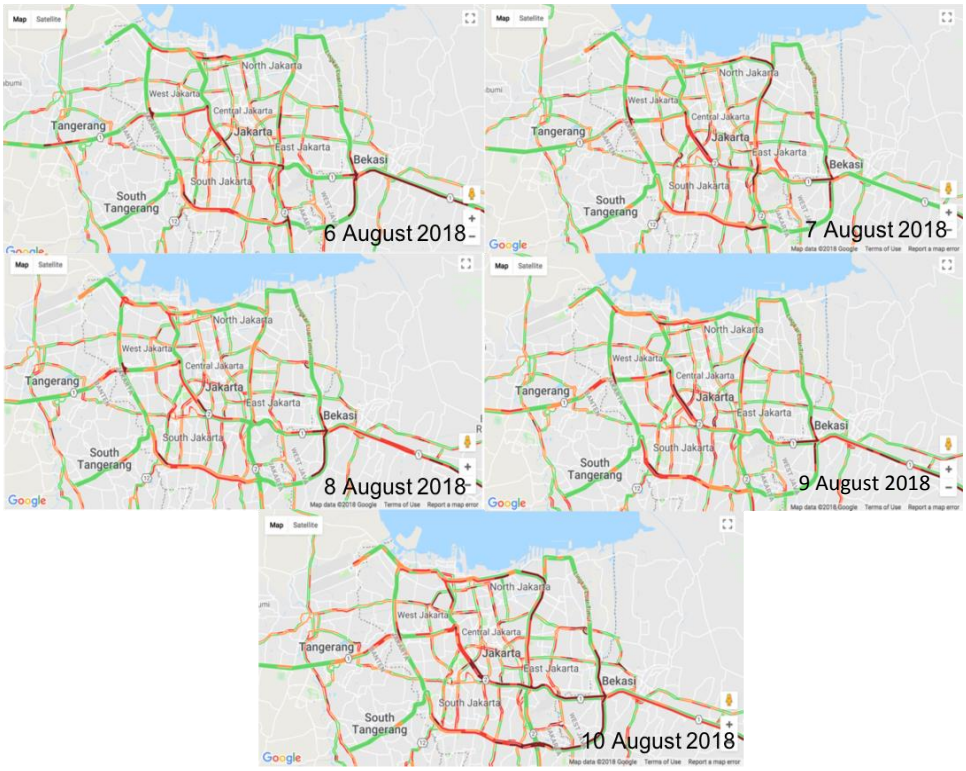
Figure 4 Number of Registered Vehicles in Jakarta 2012-2016



Source: Central Bureau of Statistics of DKI Jakarta, 2016

The pictures below illustrate Jakarta's traffic condition in the weekdays. The maps were taken using Google Maps during 6 August-10 August 2018 at 6 p.m. local time, when people commute from work to home. The pictures below indicate that traffic congestion in Jakarta always occurs every single weekday, especially in the major arterial roads where central business districts are located.

Figure 5 Congestion Map in Jakarta



The transportation condition in Jakarta undoubtedly makes the people perceive that the city's accessibility is low. In response to this issue, OTS emerged in 2014 with several characteristics of transportation service that possibly make the people easier to commute and eventually change the commuters' perception of accessibility in Jakarta. Accordingly, OTS has become a ubiquitous transportation service in the big cities of Indonesia. As of 2018, Go-Jek, one of OTS

mobile application in Indonesia, has been downloaded for more than 70 million times. At the same time, Grab, the competitor of Go-Jek, has been downloaded for approximately 68 million times (Paskalis, 2018).

4.3 Personal Characteristics of the Commuters/Respondents

This study aims to have the minimum sample size of 151 units. Initially, 207 responses were collected. However, 20 responses did not pass the screening questions and the other 32 responses were incomplete. In the end of the survey period, 155 valid responses were collected and treated as the samples of this study. Fifty-one responses were obtained from face to face survey and 100 responses were collected from online survey. Prior to the survey, pilot survey was conducted to 10 people; 5 people were approached to conduct face to face survey and 5 other people were approached to fill the online questionnaire. The feedbacks and comments were subsequently gathered to improve the quality of the questionnaire.

The respondents were selected using simple random sampling method in order to avoid biased result. Respondents of face to face survey were obtained by approaching OTS users in public area. Meanwhile, link of online questionnaire was distributed to several social media groups which members come from different backgrounds. Nevertheless, a striking result is still found in the personal characteristics of respondents, in which the composition of respondents is dominated by white-collar female workers with the age range of 18-30 years old. Moreover, 93.6% of the respondents have higher education degrees (combination of 55.5% Bachelor and 38.1% Master). The author could argue that this sample is representative and depicting the real condition because the respondents of previous studies about OTS in Indonesia, e.g. those conducted by Panjaitan (2016), Silalahi et al. (2017), and Medeiros et al. (2018), are also dominated by young educated female respondents.

Table 2 Gender of the Respondents

	Count		Percentage			
	OTS-based taxi	OTS-Based Motorcycle taxi	OTS-based taxi	OTS-Based Motorcycle taxi	Total	Total Percentage
Male	17	46	56.7%	36.8%	63	40.6%
Female	13	79	43.3%	63.2%	92	59.4%
Total	30	125	100.0%	100.0%	155	100.0%

From all respondents asked in the survey, the proportion of female respondents dominates the sample (59.4%). A cross tabulation analysis between gender, ability to drive, and vehicle ownership shows that more male respondents have the ability to drive and own private vehicles. The result indicates that male does not need to use OTS as much as female and thus, could be a rational justification why OTS users is dominated by female.

Table 3 Cross Tab Analysis between Gender, Ability to Drive, and Ownership of Private Vehicles

Gender	Ability to Drive				Ownership of Private Vehicles			
	Yes	No	Yes	No	Yes	No	Yes	No
Male	59	4	93.7%	6.3%	58	5	92.1%	7.9%
Female	66	25	72.5%	27.5%	71	19	78.9%	21.1%

A further analysis regarding age reveals that OTS is used by commuters within the age range of 18 to 29 years old (60.6%), followed by commuters aged between 30 to 39 years old (26.5%). This finding indicates that OTS is used mostly by millennial workers. Millennials are those who was born between 1981 and 1996 (Smith, 2016).

Table 4 Age of the Respondents

	Count		Percentage		Total	Total Percentage
	OTS-based taxi	OTS-Based Motorcycle taxi	OTS-based taxi	OTS-Based Motorcycle taxi		
under 18 years old	0	1	0.0%	0.8%	1	0.6%
18 to 29 years old	22	72	73.3%	57.6%	94	60.6%
30 to 39 years old	5	36	16.7%	28.8%	41	26.5%
40 to 49 years old	1	10	3.3%	8.0%	11	7.1%
50 to 64 years old	1	4	3.3%	3.2%	5	3.2%
65 years old and above	1	2	3.3%	1.6%	3	1.9%
	30	125	100.0%	100.0%	155	100.0%

A possible explanation for this result is that millennials have more exposure to internet usage and smart phone (Smith, 2016). In addition, commuters older than 40 years old are usually more financially established and hence, tend to use private vehicles for commuting.

Table 5 Occupation of the Respondents

	Count		Percentage		Total	Total Percentage
	OTS-based taxi	OTS-based Motorcycle Taxi	OTS-based taxi	OTS-based Motorcycle Taxi		
Civil servant	4	37	13.3%	29.6%	41	26.5%
Private sector employee	20	72	66.7%	57.6%	92	59.4%
Entrepreneur	5	2	16.7%	1.6%	7	4.5%
Others	1	14	3.3%	11.2%	15	9.7%
Total	30	125	100.0%	100.0%	155	

In regards of occupation, the majority of the respondents work as private sector employees (59.4%) and civil servants (26.5%). A different preference of mode is found between 'Entrepreneur' and 'Others'. Entrepreneurs tend to use OTS-based taxi (16.7%) rather than OTS-based motorcycle taxi. Meanwhile, 'Others', including blue-collar workers, are likely to use OTS-based motorcycle taxi (11.2%). It is because the price for using OTS-based taxi is beyond the blue-collar workers' affordability to pay.

Table 6 Monthly Income of the Respondents

	Count		Percentage		Total	Total Percentage
	OTS-based taxi	OTS-based Motorcycle Taxi	OTS-based taxi	OTS-based Motorcycle Taxi		
< Rp 5million	1	19	3.3%	15.2%	20	12.9%
Rp 5-10 million	7	51	23.3%	40.8%	58	37.4%
Rp 10-15 million	5	26	16.7%	20.8%	31	20.0%
Rp 15-20 million	6	14	20.0%	11.2%	20	12.9%
> Rp 20 million	10	12	33.3%	9.6%	22	14.2%
No response	1	3	3.3%	2.4%	4	2.6%
Total	30	125	100.0%	100.0%	155	

An analysis regarding monthly income shows that OTS users are evenly distributed in all monthly income categories. A slight concentration (37.4%) is found in the monthly income range of Rp 5-10 million (~€ 297-595). As travel cost with OTS-based taxi is more expensive than OTS-based motorcycle taxi, OTS-based taxi is likely to be used by people with a higher monthly income. The data shows that OTS-based taxi users is dominated by commuters with the monthly income of >Rp 15 million (~> € 906), 53.3% in fact. Meanwhile, OTS-based motorcycle taxi users (55.2%) are concentrated in a lesser monthly income of less than Rp 10 million (~€ 595).

Table 7 Education Level of the Respondents

	Count		Percentage			
	OTS-based taxi	OTS-based Motorcycle Taxi	OTS-based taxi	OTS-based Motorcycle Taxi	Total	Total Percentage
Junior High School	0	1	0.0%	0.6%	1	0.6%
Senior High School	1	4	0.6%	2.6%	5	3.2%
Bachelor	17	69	11.0%	44.5%	86	55.5%
Master	12	47	7.7%	30.3%	59	38.1%
PhD	0	3	0.0%	1.9%	3	1.9%
No response	0	1	0.0%	0.6%	1	0.6%
Total	30	125			155	

In line with the fact that OTS is mainly used by the white-collar workers, the last education degrees that are achieved by most users are Bachelor (55.5%) and Master (38.1%).

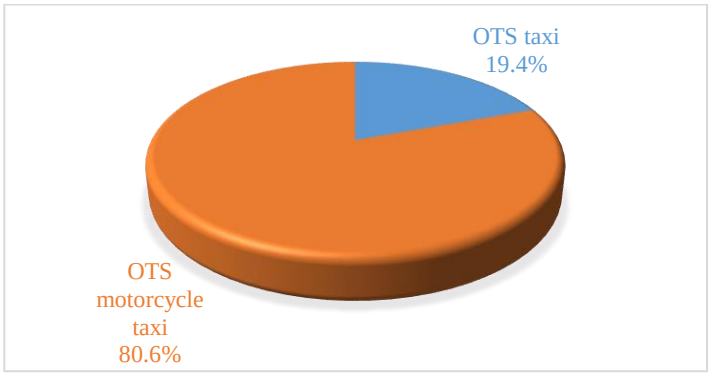
Based on the conceptual framework, the personal characteristics of the respondents have a role as a moderating variable for the perception of accessibility. It means the commuters' perception of accessibility is affected by their personal characteristics. More explanation about the extent to which personal characteristics of the commuters affect their perception of accessibility will be discussed in 'Inferential Analysis' section.

4.4 Characteristics of OTS Use

4.4.1 Preference of Modes

There are two transportation modes used for operating OTS in Indonesia, namely car taxi and motorcycle taxi. In this study, the number of respondents who prefer to use OTS-based motorcycle taxi is accounted for 125 people (80.6%). Meanwhile, the number of respondents who make OTS-based taxi as their preferred mode for commuting is accounted for 30 people (19.4%). This composition also implies that more people in Jakarta prefer to use OTS-based motorcycle taxi than OTS-based taxi for commuting.

Figure 6 Preference of Modes Composition



A higher preference for OTS-based motorcycle is because motorcycles have a small body and require less space to move. Thus, it has a high flexibility to break through the gridlocked roads and able to reach the destination within shorter travel time. Furthermore, motorcycles use less fuel than a car, resulting in a cheaper fare.

"I use OTS-based motorcycle taxi because Jakarta is congested. Using OTS-based motorcycle taxi, I can slip between vehicles stuck in congestion. Moreover, it is very affordable." (Frequent OTS-based motorcycle taxi user, 62, female, civil servant)

"I use OTS-based motorcycle taxi non-frequently, only if I am almost late to go to work. By using OTS-based motorcycle taxi, I can get to my destination quickly and I don't need to worry about the traffic jams." (Non-frequent OTS-based motorcycle taxi user, 28, male, employee)

4.4.2 Frequency of OTS Use

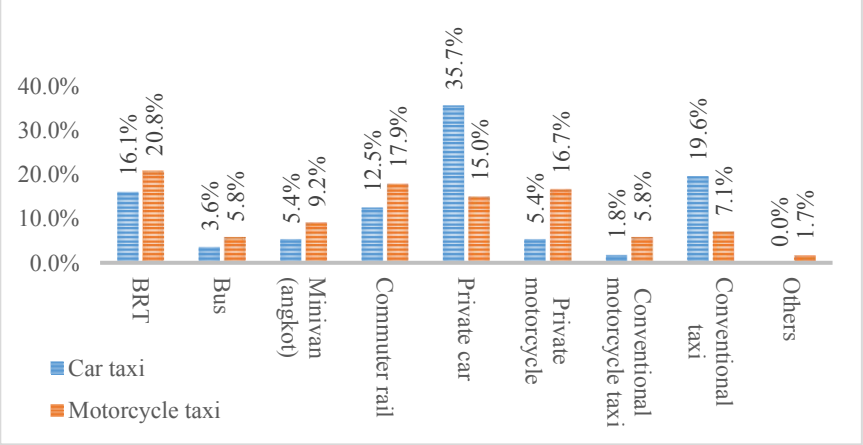
Based on the frequency, people in Jakarta generally use OTS as a daily transportation service. As can be seen in the table below, 64.6% respondents use OTS for at least 5 times a week, indicating that OTS is used for daily commuting. It also confirms the argument that OTS in Jakarta has been ubiquitous and utilized mainly for work purposes (Medeiros et al., 2018; Panjaitan, 2016). Furthermore, the commuters who use OTS for more than 5 times a week are called as frequent users and the commuters who use OTS for less than 5 times a week are called as non-frequent users.

Table 8 Frequency of OTS Use

	OTS taxi		OTS Motorcycle taxi		Total	
More than 10 times a week	8	26.7%	33	26.4%	41	26.5%
8-10 times a week	3	10.0%	25	20.0%	28	18.1%
5-7 times a week	7	23.3%	24	19.2%	31	20.0%
2-4 times a week	5	16.7%	29	23.2%	34	21.9%
Once a week	0	0.0%	5	4.0%	5	3.2%
Once in two weeks	0	0.0%	3	2.4%	3	1.9%
Once a month	7	23.3%	6	4.8%	13	8.4%
Total	30	100.0%	125		155	

There is a slight difference in the frequency of use between OTS-based motorcycle taxi and OTS-based taxi. The data show that OTS-based motorcycle taxis users are concentrated within the frequency of use of 2 to more than 10 times a week. Meanwhile, OTS-based taxis are either used for more than 10 times a week (26.7%), 5 to 7 times a week (23.3%), or once a month (23.3%). These findings suggest that OTS-based taxis are more likely to be used for non-frequent commuting compared to OTS-based motorcycle taxis.

Figure 7 Transportation Modes Substitutions when OTS is not Used



When OTS is not used for full-time commuting, 35.7% of OTS-based taxi respondents use private car and the other 19,6% use conventional taxi. On the other hand, OTS-based motorcycle taxi respondents seem to use more diverse transportation modes, in which BRT (20.0%), commuter rail (17.9%), and private motorcycle (16.7%) are commonly used when commuters do not use OTS-based motorcycle taxi. It is also possible that when the commuters do not use OTS for commuting, they use combinations of various modes of transport.

4.5 Descriptive Analysis

The descriptive analysis aims to explain the commuters' perception of each component in accessibility concept. The methods used in this analysis were cross tabulation and frequency analysis. Cross tabulation was used to compare the answers of two or more different groups of samples; in this study the groups are OTS-based taxi and OTS-based car taxi users. In addition, frequency analysis was conducted to some indicators that require the overall means.

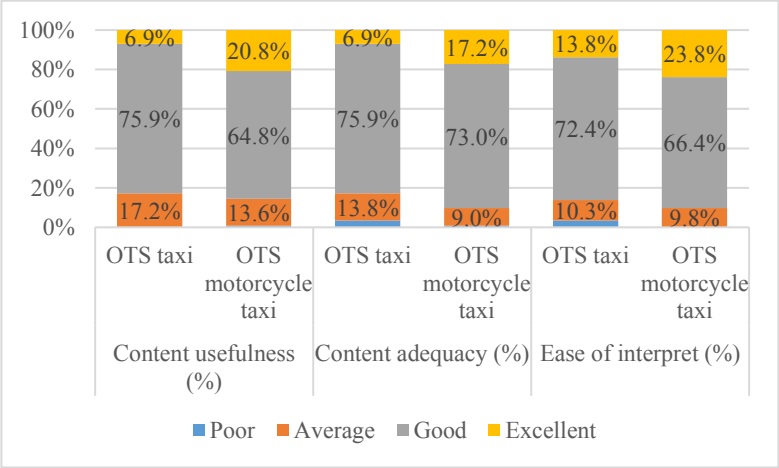
4.5.1 Perception of Transport Component of Accessibility

The investigation of the transport component aims to comprehend the degree to which OTS can provide the level of service for commuters. As explained in the Chapter 2, the examined level of service consists of information quality, travel cost, travel time, travel distance, reliability, comfort, safety and security, as well as customer care quality. The discussion in this section will particularly answer the first research sub-question; *'how do commuters perceive the level of service of OTS?'*

- **Perception of Information Quality**

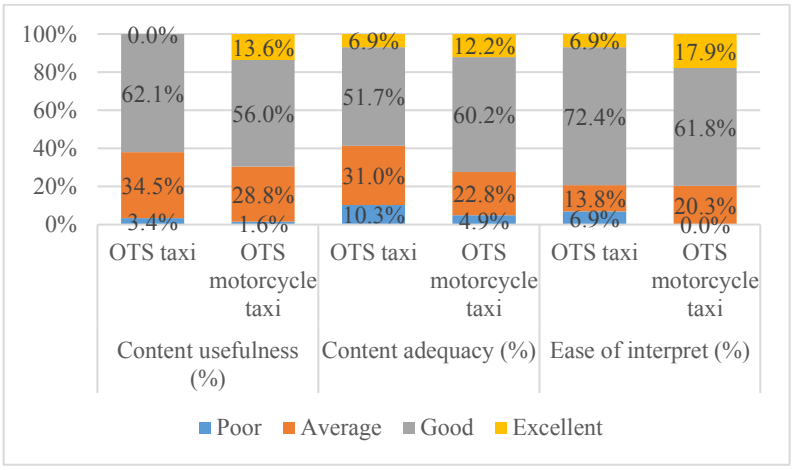
The information quality is assessed based on the content usefulness or accuracy of the information, the content adequacy or completeness of the information, and the ease to interpret the information. The information quality can be distinguished into two categories, namely pre-travel and en-route information.

Figure 8 Pre-travel Information Quality



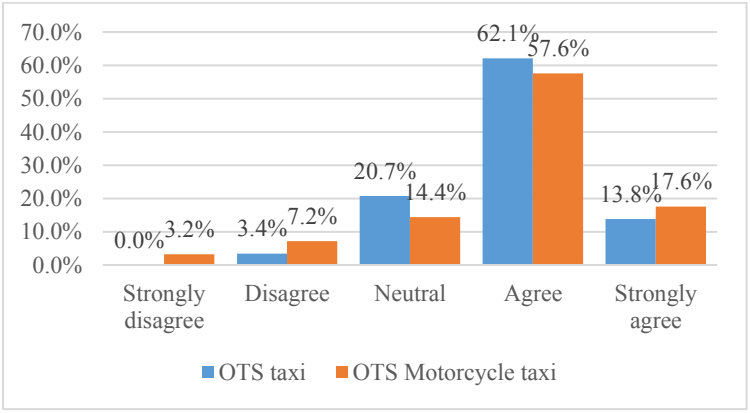
Regarding pre-travel information, the commuters generally perceive that every element of pre-travel information quality is good (see Figure 8). It indicates that there are no major issues regarding the usefulness, adequacy, and ease of interpreting information about travel cost, travel distance, route, and estimated time arrival. Using OTS, commuters can obtain complete and accurate information prior to the journey. Moreover, the information can be interpreted easily. This result is valid for OTS-based motorcycle taxi and OTS-based taxi.

Figure 9 En-route Travel Information Quality



In addition, the commuters also perceive that every element of the en-route travel information quality of OTS in Jakarta is good (see Figure 9). It means that the information regarding vehicle features, driver's information (name, rating, and telephone number), and journey progress on the route provided by OTS are complete, accurate, and easy to interpret. This result is also valid for OTS-based motorcycle taxi and OTS-based taxi.

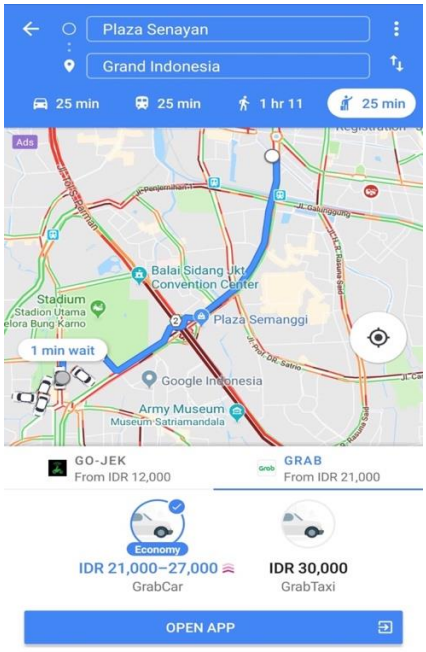
Figure 10 Ability of Travel Information to Reduce Travel Resistance



As a result, 75.9% of OTS-based taxi respondents (combination of 62.1% of respondents who say agree and 13.8% of respondents who say strongly agree) and 75.2% of OTS-based motorcycle taxi respondents (combination of 57.6% of respondents who say agree and 17.6% of respondents who say strongly agree) have a positive perception that OTS in Jakarta could help to reduce their hesitation to travel. This finding is in line with the theory which argue that ICT could reduce travel resistance because traveller could access travel information before and during the journey (Barth et al., 2015; Pardo, 2010; Transport Research Board, 2013; van Wee et al., 2013).

To optimize the advantage of travel information, the information of OTS in Jakarta has been interlinked with Google Maps (see Figure 11). Using the travel information, commuters can compare the travel cost, time, and distance of different transportation services prior to the journey. It helps them to determine which transportation service is the most efficient and effective to be used.

Figure 11 Information of OTS in Google Maps



Source: Google Maps, 2018

- **Experience and Perception of Travel Cost**

The perception of travel cost for OTS should be assessed based on the time when the commuters use OTS. It is because the surged price is implemented at the peak hours and may shift the perception of cost affordability. In addition, the promotion discount provided by OTS companies are also considered in the assessment as it also supposedly has an impact on the perception of cost affordability.

Figure 12 Actual Fare of OTS at the Non-rush Hours

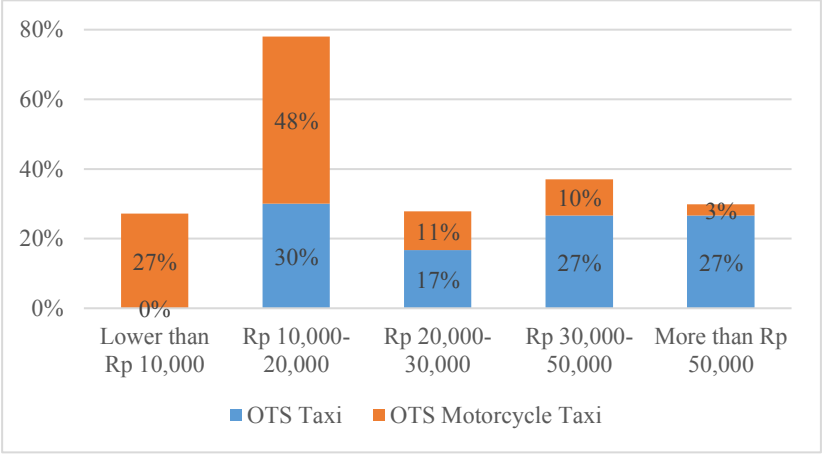


Figure 12 shows the actual fare of using OTS at the non-rush hours. Actual fare is the OTS fare without promotion discount. This study only examines actual fare and does not include the analysis of promotion fare because the amount and type of promotion discount fluctuate over time.

As illustrated in the figure above, the commuters in Jakarta typically spend Rp 10,000 to 20,000 (~ € 0.59 to 1.19) for one-way commuting with OTS at the non-rush hours. It is also found that travel cost for OTS-based motorcycle users is concentrated within the range of Rp 10,000 to 20,000 (~ € 0.59 to 1.19) with the average of Rp 19,284 (~ € 1.16). Meanwhile, the travel costs of OTS-based taxi users are more evenly distributed within the range of Rp 10,000 to more than 50,000 (~ € 0.59 to more than 2.98) with the average of Rp 39,300 (~ € 2.37). It is due to the

difference in vehicle rate (price per km) of OTS-based taxi and OTS-based motorcycle taxi. The actual fare for OTS-based taxi is definitely higher than OTS-based motorcycle taxi, resulting in a more expensive cost of OTS-based taxi. The following table shows the vehicle rate for OTS in Jakarta at the non-rush hours.

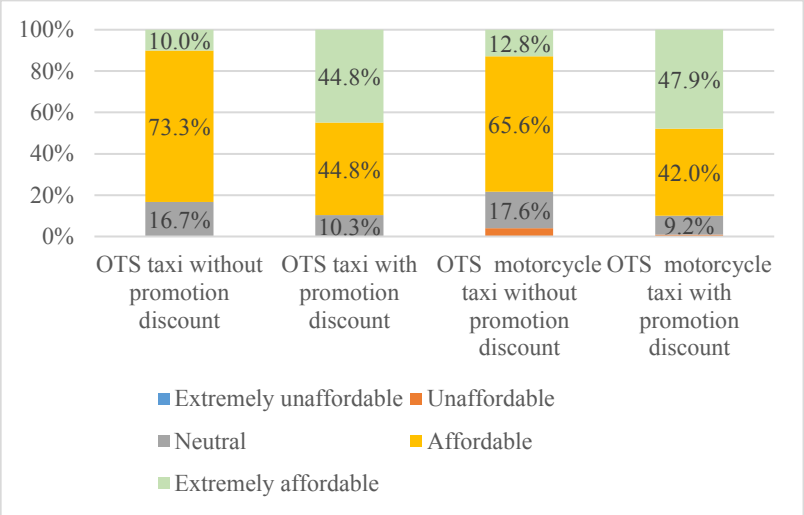
Table 9 Vehicle Rate of OTS at the Non-rush Hours

	Grab	Go-Jek
OTS-based motorcycle taxi	• Rp 1,500 (~ € 0.09) per km (for the first 12 km) • After 12 km, the fare increases to Rp 3,000 (~ € 0.18) per km • Minimum fare: Rp 5,000 (~ € 0.30)	• Rp 1,500 (~ € 0.09) per km (for travel distance of 0 to 10 km) • Rp 3,000 (~ € 0.18) per km (for travel distance of above 10 km) • Minimum fare: Rp 6,000 (~ € 0.36)
OTS-based taxi	• Rp 3,500 (~ € 0.21) per km • Minimum fare: Rp 10,000 (~ € 0.59)	• Rp 10,000 (~ € 0.59) per km for the first 2.85 km • After 2.85 km, the fare changes to Rp 3,500 (~ € 0.21) per km • Minimum fare: Rp 10,000 (~ € 0.59)

Source: Kumparan, 2017 *(https://kumparan.com/@kumparantech/go-jek-naikkan-tarif-go-ride-dan-go-car-mulai-juli-2017)*; Grab, 2016 *(https://www.grab.com/id/blog/naik-grabbike-kini-makin-hemat/)*

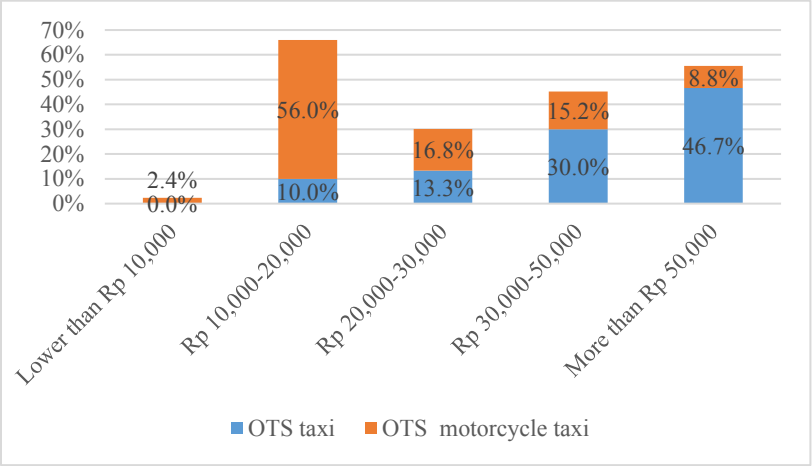
Furthermore, the perception of affordability to travel with OTS at the non-rush hours was also asked to the respondents. In this respect, the perception of affordability is differentiated between perceptions of affordability with and without a promotion discount.

Figure 13 Affordability to Travel with OTS at the Non-rush Hours



According to the figure above, there is similar perception between OTS-based taxi and OTS-based motorcycle taxi users. For 73.3% OTS-based taxi respondents and 65.6% OTS-motorcycle taxi respondents, using OTS during non-rush hours without the promotion discount is affordable. The level of affordability increases when the promotion discount is implemented. With the promotion discount, the OTS-based taxi users who perceive that the travel cost is extremely affordable rise to 44.8% from 10.0% and OTS-based motorcycle taxi users who perceive that the travel cost is extremely affordable rise to 47.9% from 12.8%. It indicates that the role of a promotion discount is considerably important in shifting the perception of affordability to travel with OTS.

Figure 14 Actual Fare of OTS at the Rush Hours



At the rush hours, the actual fares between OTS-based motorcycle taxi and OTS-based taxi are significantly different. The majority of OTS-based motorcycle taxi users spend Rp 10,000 to 20,000 (~ € 0.59 to 1.19) with the average spending of Rp 25,842 (~ € 1.56) for one-way commuting at the rush hours, which is the same amount of money as they spend at the non-rush hours. Meanwhile, 46.7% of the commuters who use OTS-based taxi need to pay travel cost of more than Rp 50,000 (~ € 2.98) with the average spending of Rp 63,733 (~ € 3.84) for one-way commuting at the rush hours. The result indicates that the travel cost of using OTS-based motorcycle taxi is less susceptible to the surged price. The possible explanation is that the average travel distance for OTS-based motorcycle taxi is short. Therefore, the effect of the surged price is weak.

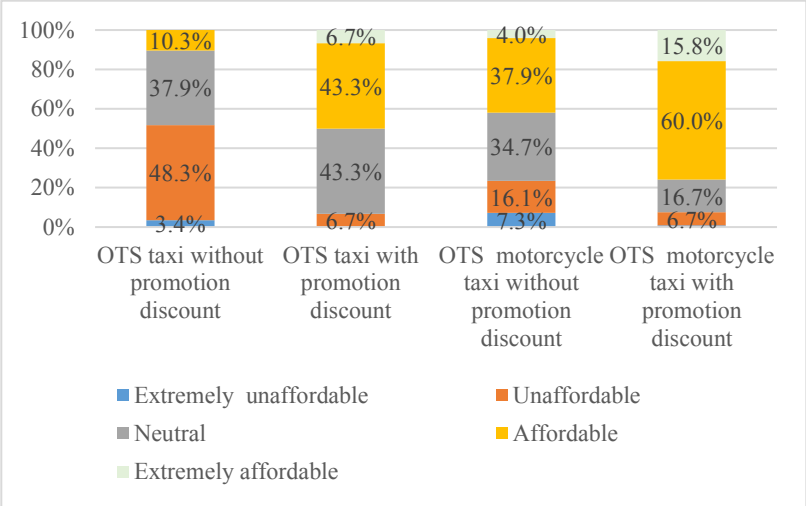
Table 10 Vehicle Rate of OTS at the Rush Hours

	Grab	Go-Jek
OTS-based motorcycle taxi	• Rp 1,500 (~ € 0.09) per km (for the first 12 km) • After 12 km, the fare increases to Rp 3,000 (~ € 0.18) per km Minimum fare: Rp 5,000 (~ € 0.30) • Additional fare of Rp 2,500 (~ € 0.15) at the rush hours • Minimum fare: Rp 5,000 (~ € 0.30)	• Rp 2,500 (~ € 0.15) per km (for travel distance of 0 to 10 km) • Rp 3,000 (~ € 0.18) per km (for travel distance of above 10 km) • Minimum fare: Rp 10,000 (~ € 0.59)
OTS-based taxi	• Rp 4,000 (~ € 0.24) per km • Minimum fare: Rp 10,000 (~ € 0.59)	• Rp 10,000 (~ € 0.59) per km for the first 2.35 km • After 2.35 km, the fare changes to Rp 4,250 (~ € 0.25) per km • Minimum fare: Rp 10,000 (~ € 0.59)

Source: Kumparan, 2017 *(https://kumparan.com/@kumparantech/go-jek-naikkan-tarif-go-ride-dan-go-car-mulai-juli-2017)*; Grab, 2016 *(https://www.grab.com/id/blog/naik-grabbike-kini-makin-hemat/)*

For example, based on the table above, the additional fare for using OTS-based motorcycle taxi with Grab is Rp 2,500 (~ € 0.15), flat rate for all distance. Meanwhile, the additional cost for using OTS-based motorcycle taxi with Go-Jek is Rp 1,000 (~ € 0.06) for the first 10 km. Therefore, for short travel distance, say 5 km, the additional cost for using OTS-based motorcycle taxi will not exceed Rp 5,000 (~ € 0.30).

Figure 15 Affordability to Travel with OTS at the Rush Hours



By spending around Rp 63,733 (~ € 3.84) for one-way commuting at the rush hours, 51.7% of OTS-based taxi respondents (combination of 48.3% who say unaffordable and 3.4% who say extremely unaffordable) have negative perception on the cost affordability (see Figure 15). OTS-based taxi users' perception of affordability could slightly change when the promotion discount is applied at the rush hours, in which only 6.7% of OTS-based taxi users have negative perception on the cost affordability and the other 50.0% of OTS-based taxi users (combination of 43.3% who say affordable and 6.7% who say extremely affordable) have negative perception on the cost affordability. On the other hand, 60.0% of OTS-based motorcycle taxi users still perceive that the service is affordable even though it is used at the rush hours and without promotion discount.

The result in the perception of travel cost suggests that the promotion discount is considerably significant to shift the perception of affordability. Nevertheless, the nature of promotion discount is temporary. In other words, not every single day in a month the promotion discount is applicable. Go-Jek has not even given promotions to passengers for a long time.

"We actually don't do much promo right now. Promotion exists only if passengers use Go-Pay for payment and it is only Rp 1,000 (~€ 0.059)." (Ramda Yanurzha, Head of Research at Go-Jek)

In the first place, promotional discounts are intended to attract people to use OTS. Along with the exponential growth of the users, the number of discounts is gradually decreasing. However, this does not make the commuters stop using OTS. It is because the commuters perceive that using OTS is relatively cheaper than using private car or conventional IPT.

"OTS is definitely cheaper than the private car. Using private car, I have to not only pay for the gas, but also parking fee and toll charge. Not to mention the tiredness of driving in a gridlocked Jakarta. Actually, the price of taking Blue Bird (conventional taxi) is the same as taking Grab or Go-car (OTS-based taxi), but when it first appeared, OTS offered a lot of promotions. Even there was a time when I did not have to pay at all for using OTS. The promotions gradually made me shift to OTS." (Frequent OTS-based taxi user, 23, male, entrepreneur)

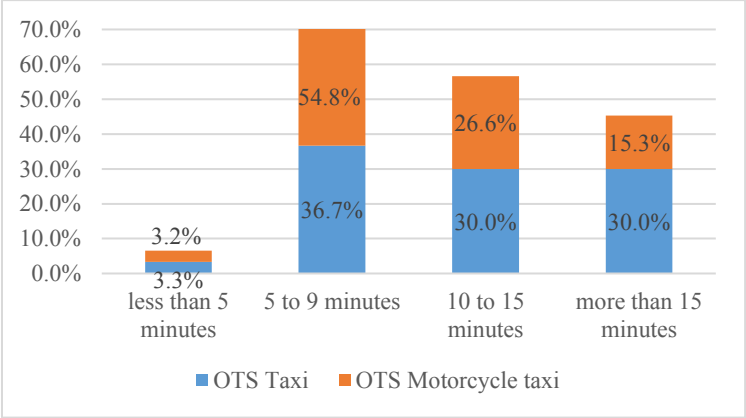
"Before OTS was booming, I used to take ojek (conventional motorcycle taxi) from BRT stop in Pulo Gadung terminal to my house and vice versa. I have no issues with the cost, it was only Rp 10,000 for 5 km ride. Nowadays, I use OTS from BRT stop in Gambir to my house. It is about 10

km, but I only spend Rp 15,000-20,000 for a ride. If I used ojek (conventional motorcycle taxi), the drivers would not want to be paid just that much. They must ask the minimum fare of Rp 35,000. The fare can even go higher if it is raining or congested." (Frequent OTS-based motorcycle taxi user, 62, female, civil servant)

- **Experience and Perception of Travel Time**

Travel time is examined based on two indicators, namely waiting time and in-vehicle travel time. In this section, the quantitative data about how people experience waiting time and in-vehicle travel time will be described. Furthermore, the analysis will be followed by the commuters' perception about the ability of OTS to reduce the overall travel time.

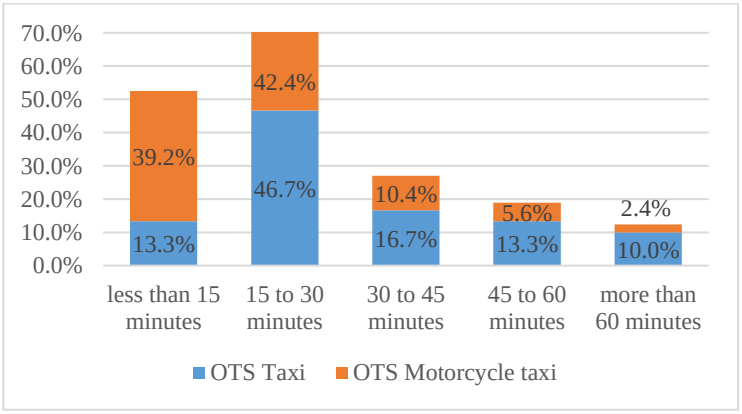
Figure 16 Waiting Time



The average waiting time for OTS-based taxi and OTS-based motorcycle taxi are 10.7 minutes and 8.7 minutes consecutively. According to Dhingra (2011), ideal waiting time for transportation service should be at maximum of 10 minutes. Therefore, the waiting time of OTS is actually quite ideal. Moreover, pre-travel information could somehow give certainty to the commuters and make them perceive that the long waiting time is acceptable.

"After being paired with an OTS driver, I usually call him to ask his position. Sometimes I also monitor his real-time position. If he is still far away, I will wait in my office. I don't consider it as waiting because I can do my work until the driver arrives. The driver usually calls me when he arrives and then I will be out of my office building." (Non-frequent OTS-based taxi user, 26, female, employee)

Figure 17 In-vehicle Travel Time



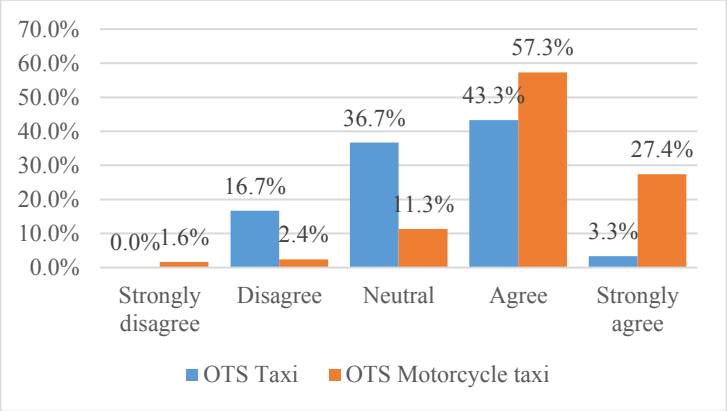
Most of OTS-based motorcycle taxi and OTS-based taxi users spend 15 to 30 minutes to travel with OTS (see Figure 17). The average in-vehicle travel time of using OTS is 27.6 minutes. The commuters perceive that in-vehicle travel time of using OTS is relatively shorter than the public transport. It is because OTS can deliver people directly to the destination; unlike the public

transport that is operated in a radial route and sometimes requires multiple transit, which causes longer travel time.

"It takes 30 minutes for one-way commuting if I use BRT, but only 15 minutes if I use OTS. It is because BRT takes a longer route and I have to transit." (Non-frequent OTS-based taxi user, 26, female, employee)

"It is faster to use OTS because the route is efficient, I don't have to do multiple transit." (Non-frequent OTS-based motorcycle taxi user, 28, male, employee)

Figure 18 Ability to Reduce Travel Time



As a result of reduced waiting time and in-vehicle travel time, 46.6% of OTS-based taxi users (combination of 43.3% of respondents who say agree and 3.3% of respondents who say strongly agree) and 84.7% of OTS-based motorcycle taxi users (combination of 57.3% of respondents who say agree and 27.4% of respondents who say strongly agree) perceive that OTS is able to reduce the overall travel time.

It is also interesting to investigate whether the route recommended by the GPS in OTS tends to prioritize shorter time or shorter distance. Shorter time sometimes take a longer route, resulting in a more expensive travel cost. Meanwhile, a shorter distance might result in longer travel time due to congestion occurs along the road.

As informed by Go-Jek, there is no fixed formula to determine the route. The OTS companies always recommend a fair route for customers and drivers. In the end, the route taken depends on the passengers and drivers.

"It really depends on the people's preference. Some people prefer congested short route, yet some other prefer less congested long route. Of course, the shorter route is cheaper and more profitable for the customers. However, we also have to provide a fair way for the drivers. We realize that no matter what we choose, people will disagree. When the long route is recommended, people will perceive that the travel cost is expensive and eventually cancel the booking. If we recommend short route, there will be a friction between customer and drivers. So, we choose the median." (Ramda Yanurzha, Head of Research at Go-Jek)

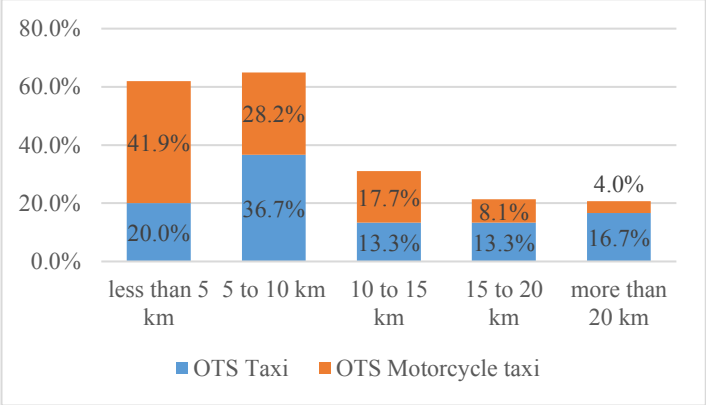
In addition, the competitor of Go-Jek, Grab, has no longer showed the recommended route as the pre-travel information. The selection of route is completely based on the decision of the drivers and users. However, the price calculation is based on the travel distance instead of travel time

- **Experience and Perception of Travel Distance**

The distance of the journey can be impacted by the selection of route. If the GPS embedded on OTS leads the drivers to take effective route selection, then the travel distance while using OTS can be reduced. Otherwise, there might be no significant impact on travel distance.

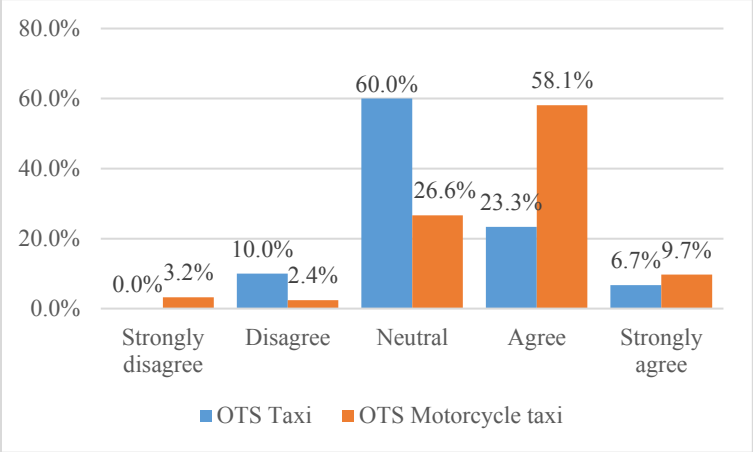
This section will firstly explain the quantitative data about travel distance that the commuters experience while using OTS. Furthermore, the analysis will be followed by the commuters' perception about the effectiveness of route selection.

Figure 19 Travel Distance with OTS



The figure above shows that OTS-based motorcycle taxi in Jakarta is mainly used for short distance journey, in which 41.9% respondents use OTS-based motorcycle taxi for travel distance of less than 5 km and the other 28.2% use it for travel distance of 5 to 10 km. It also confirms that a short travel distance is the reason why travel costs of OTS-based motorcycle taxi are not highly susceptible to the surged price at rush hours. In addition, it gives an indication that OTS-based motorcycle taxi is used only as a connecting vehicle from point of origin to main transportation hubs, such as BRT stop or commuter rail station. The detail of transportation modes combination for commuting will be further elaborated in the individual component section. On the other hand, OTS-based taxi in Jakarta is used for slightly farther journey that has distance of 5 to 10 km.

Figure 20 Effectiveness of Route Selection



There is a different result about the perception of respondents regarding the effectiveness of route selection. Most of OTS-based motorcycle taxi users perceive that the route selected by the driver is generally effective (58.1% of respondents say agree and 9.7% of respondents say strongly agree that OTS-based motorcycle taxi usually takes effective route). Nevertheless, OTS-based taxi users tend to be neutral to assess the effectiveness of the route selection (60.0%).

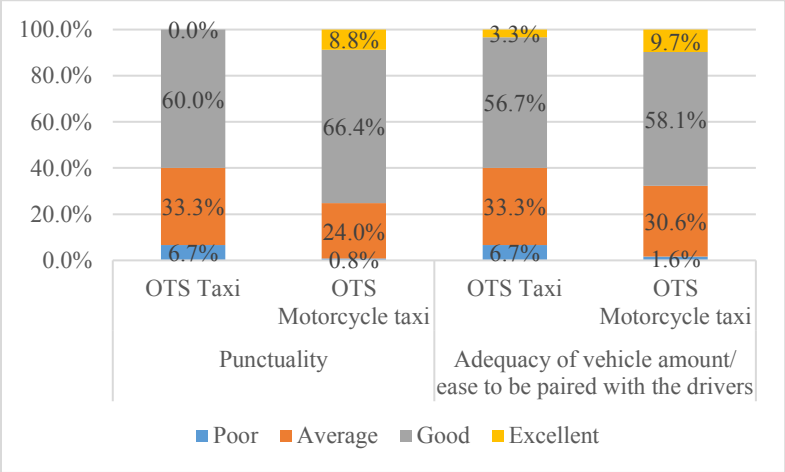
It is related to the flexibility of the vehicles in taking alternative route. As motorcycle taxi has a lean body, it is able to easily maneuver in a narrow back-way that is shorter and less congested than the arterial roads.

In addition, Jakarta also enacts the 'odd-even traffic policy' as a part of the Traffic Demand Management strategies. The 'odd-even traffic policy' aims to limit the number of cars entering Jakarta. This policy stipulates that the cars with odd license plate number are allowed to pass certain arterial road at certain hours only on odd-numbered dates and vice versa. Several types of transportation modes are excepted from this policy, including public transportation, logistic truck, and motorcycle. It certainly limits the flexibility of cars, including OTS-based taxi. Therefore, at certain hours OTS-based taxi that needs to pass the arterial road where the 'odd-even traffic policy' is imposed should take a detour, resulting in ineffectiveness in route selection.

- **Perception of Reliability**

The information quality is assessed based on punctuality and adequacy of the vehicles. Punctuality is the adherence of the fleets to arrive at estimated time as informed in the mobile application. Adequacy of vehicles measures the degree to which the amount of vehicles meets the number of OTS demand. The concern in this aspect is that OTS might be often belated and inadequate in term of the amount of vehicles, resulting in the difficulty on the passenger side to ride OTS.

Figure 21 Punctuality and Adequacy of Vehicle Amount



The figure above depicts that both OTS-based motorcycle taxi and OTS-based taxi users in Jakarta perceive that the punctuality and adequacy in the number of OTS vehicles is good, meaning that there are no major issues in reliability of OTS. In general, the commuters are satisfied with the punctuality and the adequacy of OTS amount in Jakarta.

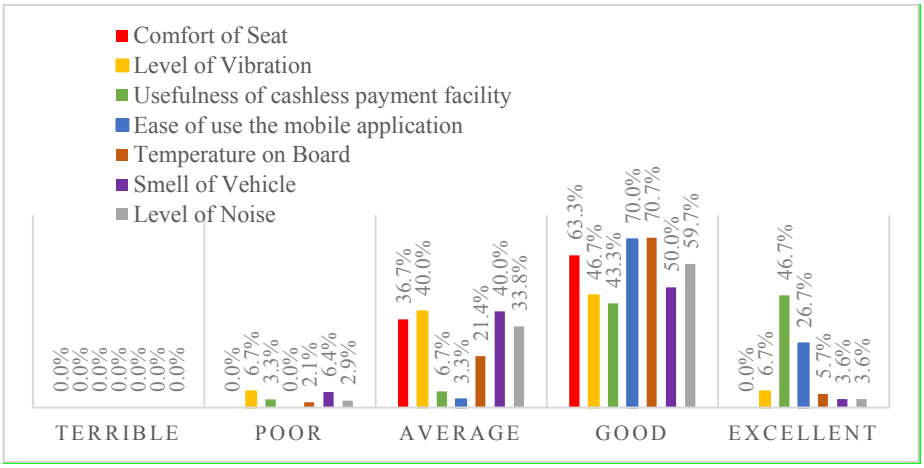
The adequacy in the number of OTS vehicles in Jakarta is inseparable with the rapid growth in the number of OTS drivers between 2015 and 2016. During that period, the number of OTS drivers in Indonesia increased by 500,000 people and about 30-40% of which was in Jakarta (Katadata, 2016). A research by Lembaga Demografi Universitas Indonesia (2017) revealed that the income of being an OTS driver was 17.8% larger than the regional minimum wage in Indonesia. Income raise subsequently became the reason for the increase in the number of OTS drivers.

- **Perception of Comfort**

OTS-based motorcycle taxi and OTS-based taxi have different indicators of comfort. Comfort of seat, level of vibration, usefulness of cashless payment facility, and ease of use the mobile

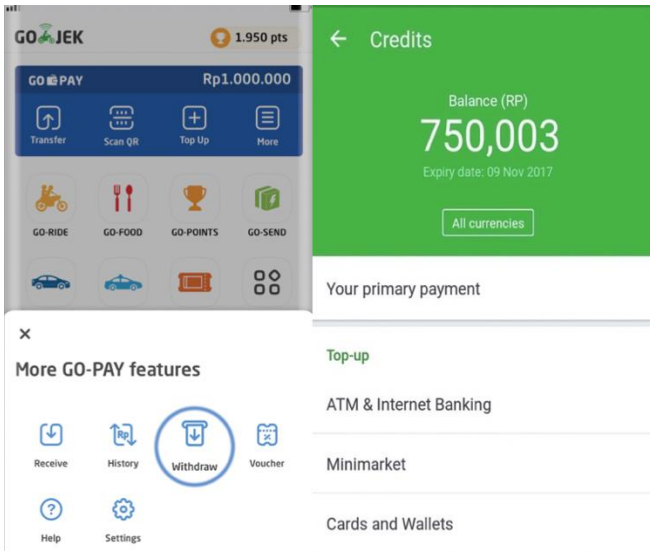
application are the mutual indicators that are applicable for both OTS-based taxi and motorcycle taxi. In addition, each type of service has specific indicators of comfort. Temperature on board, level of noise, and smell of vehicles are only applicable for OTS-based taxi. Meanwhile, the specific indicator of comfort for OTS-based motorcycle taxi is the cleanliness of the helmet and mask.

Figure 22 Comfort of OTS-based taxi



For OTS-based taxi, every indicator of comfort is generally perceived as 'good' by the respondents. No indicator of OTS-based taxi comfort is perceived as 'terrible'. However, several indicators, such as smell of vehicle, level of vibration, and comfort of seat might need an improvement. It appears that there is a high percentage of respondents who perceive those indicators as 'average'. In addition, among all indicators of comfort in OTS-based taxi, usefulness of cashless payment facility is perceived as the most positive indicator, in which 46.7% of OTS-based taxi respondents say that usefulness of cashless payment facility is 'excellent' and 43.3% of OTS-based taxi respondents find it as 'good'.

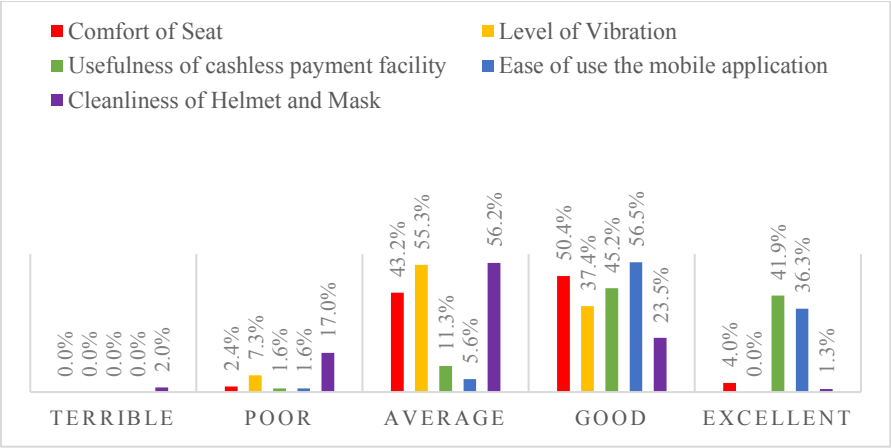
Figure 23 User Interface of Cashless Payment Facility in OTS



The cashless payment facility of OTS in Indonesia is not only available in the form of credit card payment, but also digital payment platform, e.g.: Go-Pay for Go-Jek and GrabPay for Grab (see Figure 23). Using the digital payment platform, the users can store the money on the mobile application. The credit can be used not only for transportation service, but also items and service purchase on the mobile application. When users pay for the items or service using the digital

payment platform, the credit points are deducted from the balance. In addition, the credit points can be transferred to fellow OTS users at no cost.

Figure 24 Comfort of OTS-based Motorcycle Taxi



A positive perception towards cashless payment facility is also found in OTS-based motorcycle taxi, in which 41.9% and 45.2% of OTS-based motorcycle taxi users perceive it as 'excellent' and 'good' respectively. However, there is a room for improvement for cleanliness of helmet and mask, comfort on seat, and level of vibration of OTS-based motorcycle taxi. In response to this, the OTS company stated that the inconvenience can be reported using a complaint box platform. One of the functions of the complaint box and rating platform is to bridge communications between the company and customers so that the company can provide maximum service. Moreover, the existence of complaint box and rating platform is also intended to make the users aware of their own comfort while riding.

"If you ride an angkot (minivan) and find an unpleasant thing, it is difficult for you to report it, no? By having the complaint box and rating platform, we are actually making people care about themselves. Self-care is not only expressing on social media, but actually do it by reporting to us." (Ramda Yanurzha, Head of Research at Go-Jek)

Interestingly, although several aspects need to be improved, some users of OTS-based motorcycle taxi opine that OTS-based motorcycle taxi is more convenient than public transport. When using OTS-based motorcycle taxi, they do not need to jostle in the vehicle. Moreover, OTS-based motorcycle taxi is also better than public transport in term of smoothness of riding.

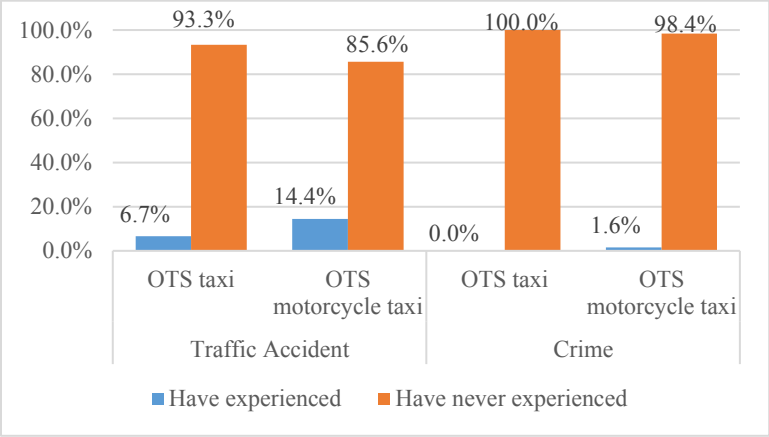
"Overall, OTS is more convenient than public transport. Public transport in Jakarta is very crowded at the rush hours, so we can't sit during the journey." (Frequent OTS-based motorcycle taxi user, 62, female, civil servant)

"Except for BRT and commuter rail, public transport in Jakarta uses 'sistem kejar setoran' (sales target system). Sometimes the driver is speeding in order to reach the amount of target." (Non-frequent OTS-based motorcycle taxi user, 28, male, employee)

- **Perception of Safety and Security**

Concerns about safety and security raised due to the fact that OTS vehicles are not owned by the company and the drivers are not employees. Therefore, vehicle engines might be not regularly maintained, and the drivers' standard level of service is probably uncontrolled.

Figure 25 Traffic Accident and Crime

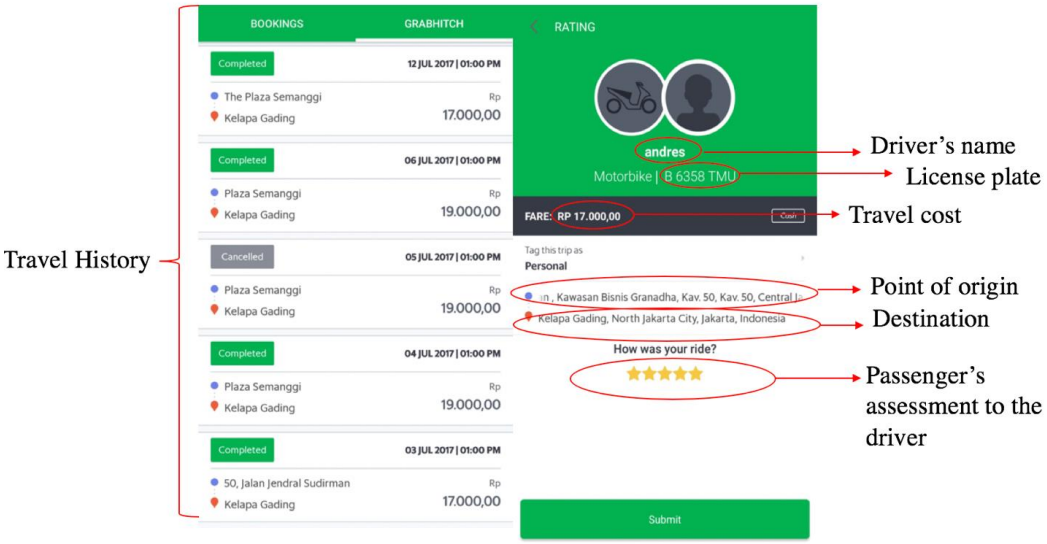


According to the figure above, 18 OTS-based motorcycle taxi respondents (14.4%) have experienced traffic accident while riding and 2 respondents (1.6%) have been a victim in a crime while commuting with OTS-based motorcycle taxi. The types of crime that have ever occurred to them were robbery and intimidation by the driver. OTS-based taxi is relatively safer and more secure than OTS-based motorcycle taxi, as only 2 OTS-based taxi respondents (6.7%) have experienced traffic accident while riding and none of them has been a victim in a crime while commuting.

OTS companies are actually very concerned about safety and security of their customers. In order to ensure the identity of the drivers, OTS companies require the drivers to provide resident identity card (KTP), the vehicle registration certificate (STNK), the driver's license (SIM), and the police certificate of good conduct (SKCK). Some of the data is interlinked to travel information in mobile application. The mobile application also keeps a travel history that records the information of OTS journey (see Figure 26). This somehow could contribute to a higher sense of security when using OTS.

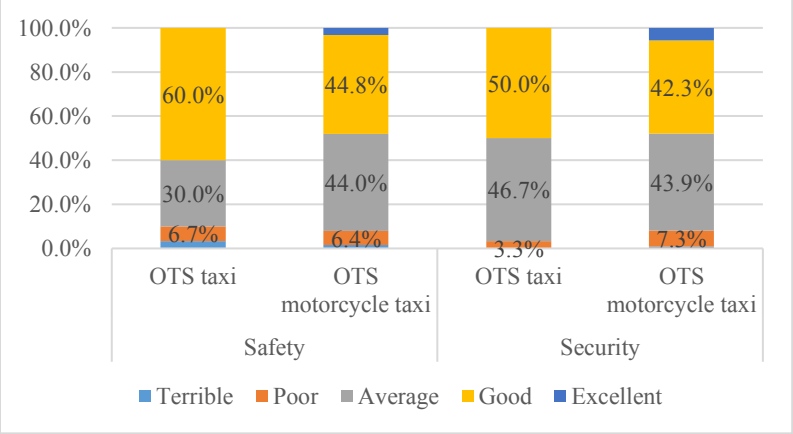
"I'd rather use OTS because all transactions are recorded, so if you have problem, you can target who the driver is. For example, if you get robbed or something, you know that the driver is this guy." (Frequent OTS-based taxi user, 23, male, entrepreneur)

Figure 26 User Interface of Travel History Provided by Grab Taxi Indonesia



In order to minimize the safety problems due to the use of old engines, OTS companies oblige the drivers to use the vehicles produced after the year of 2011. Moreover, the accident insurance is also provided to the users. The insurance covers the benefits for death and defects as well as reimbursement of medical expense. However, the insurance claim cannot be processed if the accidents are caused due to traffic violations.

Figure 27 Perception of Safety from Traffic Accident and Security from Crime

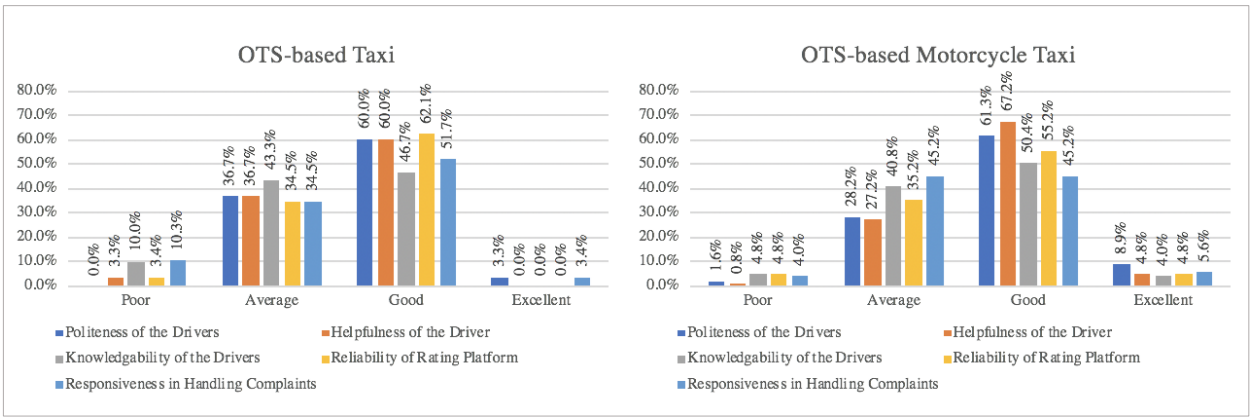


Despite the fact that OTS companies have made a lot of efforts to ensure safety and security, both OTS-based motorcycle taxi and OTS-based taxi users perceive that the level of safety and security while commuting with OTS is in between 'good' and 'average'. From a scale of 1 to 5, the mean for the level of safety from traffic accident and security from crime is 3.06 and 3.07 consecutively. Thus, safety and security of OTS actually still need to be improved.

- **Perception of Customer Care**

The assessment of customer care involves the indicators of politeness of the driver, helpfulness of the driver, knowledgeability of the drivers about traffic map and condition, reliability of rating platform regarding customer care quality, and responsiveness in handling complaints.

Figure 28 Perception of Customer Care



According to the Figure 28, OTS-based taxi and OTS-based motorcycle taxi respondents perceive that all indicators of customer care are in between 'average' and 'good'. Improvements are needed for several indicators, such as knowledgeability of the drivers for OTS-based taxi as well as responsiveness in handling complaints for OTS-motorcycle taxi as more than 40% of users perceive these indicators as 'average'. However, the OTS drivers in general could provide politeness and helpfulness. In addition, rating platform regarding customer care quality is commonly perceived as reliable.

Having the rating platform regarding customer care quality and the complaint box in the mobile application is indeed the strategy of OTS companies to retain the customer care quality. OTS companies will not hesitate to terminate the partnerships with the drivers who have a rating below the threshold or are reported doing improper things. Moreover, OTS companies also provide various ways for the users to deliver their complaints, e.g. call center, e-mail, and the comments on the app-store.

"As a technology product, we do as the best we can do to ensure the customer care quality. If customers report unpleasant incidents happened to them, we will definitely take a firm action. We do not even hesitate to terminate the partnerships with the drivers. We want to provide good service by having multiple ways to give feedback for us. Besides the platform on the mobile app, the feedback can be delivered through call center, e-mail, and even the comments on the app-store. Of course, we will respond all comments coming to us because they are related to our performance." (Ramda Yanurzha, Head of Research at Go-Jek)

Particularly in Grab, score in the rating platform becomes a tool to determine which driver to allocate for transportation demand in the area. The driver with a higher score in the rating platform will enjoy the priority in the allocation process.

"Our engines search the best drivers for the passengers. For example, there are two drivers and one passenger in the same radius. The first driver has a score of 4.5 and the second one has a score of 2.2, then the first driver will be prioritized to be paired with the passenger." (R, Manager at Grab Taxi Indonesia)

On top of that, quality enhancements in term of driver capabilities are also maintained by providing training and rewards.

"We have regular community program, such as training and English course. We also give rewards to the drivers at the drivers engagement event with the hope that the other drivers will be inspired to achieve the highest quality as they can." (R, Manager at Grab Taxi Indonesia)

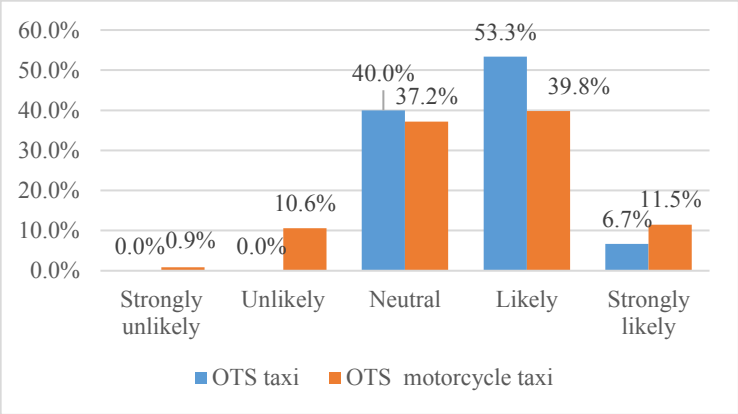
4.5.2 Perception of Temporal Component of Accessibility

The temporal component aims to investigates the extent to which OTS can eliminate time-related constraints and eventually make people more flexible in performing activities. In this study, as commuters become the object of the research, temporal component will be explained through commuters' perceptions of opportunities available after working hours, opportunities available while traveling, as well as flexibility to work longer. The findings in this section will answer the second research sub-question; *'how does the use of OTS make it more flexible for the commuters to perform activities?'*

- **Perception of Opportunities Available after Working Hours and while Traveling**

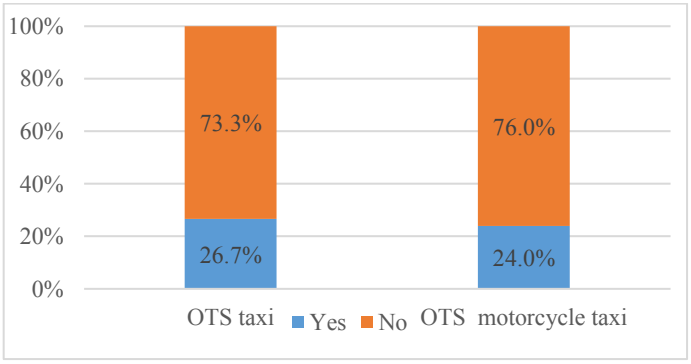
Greater opportunities available after working hours will be achieved if OTS can contribute to reducing travel time. In addition, commuters may be able to do more activities while traveling when OTS can provide comfort. It has been revealed in this study that OTS has a relatively positive impact on reducing travel time and providing comfort. As a result, OTS makes it more flexible for the users to have more activities after working hours.

Figure 29 Opportunities to Do Activities after Working Hours



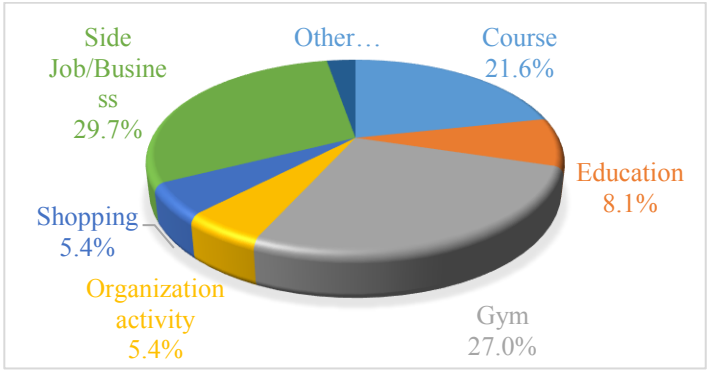
According to the figure above, 60.0% of OTS-based taxi users (combination of respondents who say likely (53.3%) and strongly likely (6.7%)) and 51.3% of OTS-based motorcycle taxi users (combination of respondents who say likely (39.8%) and strongly likely (11.5%)) perceive that using OTS gives them more opportunities to do activities after working hours. The percentage of respondents who are neutral on this indicator is quite high (40.0% for OTS-based motorcycle taxi and 37.2% for OTS-based taxi). However, the overall mean is at 3.56 out of 5, meaning that commuters who use OTS are likely to have more opportunities to do activities after working hours. As asserted by Litman (2008), the goal of transportation is not merely the journey, but the ability to reach activities. Therefore, the increase in the opportunities to do more activities make people have a better accessibility.

Figure 30 Percentage of People who Have Main Activities other than Working



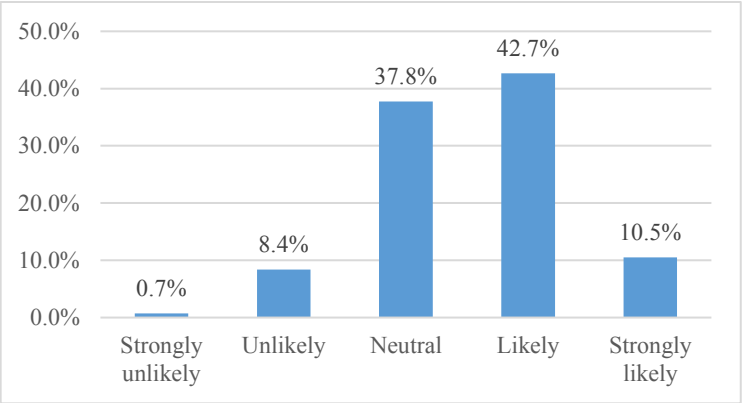
Nevertheless, the majority of OTS-based motorcycle taxi users (76.0%) and OTS-based taxi users (73.3%) say that they do not have any main activities performed after working hours. Among all OTS-based taxi and motorcycle taxi users who have main activities performed after working hours, 29.7% of them have side job/business, 27.0% go to the gym, and 21.6% take courses (see Figure 31).

Figure 31 Type of Activities Performed after Working Hours



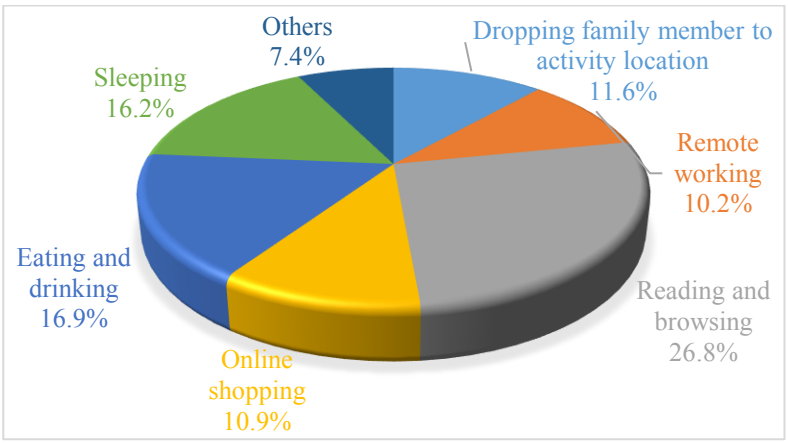
Regarding the opportunities to perform more activities while traveling, Kwan and Weber (2003), Mokhtarian (1990), and van Wee et al. (2013) argue that the use of ICT in transportation might enable people to conduct activities once at a time while traveling. Analysis regarding the opportunities to perform more activities while traveling is conducted only for OTS-based taxi users. It is because the passengers in OTS-based motorcycle taxi are not able to do activities while traveling. The data suggest that 53.2% of respondents who use OTS-based taxi (combination of respondents who say likely (42.7%) and strongly likely (10.5%)) have the opportunities to perform other activities while commuting (see Figure 32).

Figure 32 Opportunities to Perform More Activities while Traveling with OTS-based Taxi



Moreover, the figure below also shows that reading or browsing on the Internet is the most common activity to be conducted while traveling with OTS-based taxi (26.8%). It is followed by eating and drinking (16.9%), sleeping (16.2%), dropping family member to activity location (11.6%), online shopping (10.9%), and remote working (10.2%).

Figure 33 Activities while Traveling with OTS-based taxi?

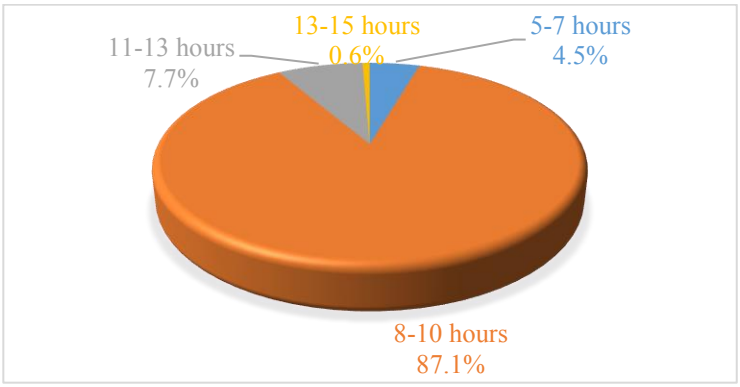


Based on the data analysis in this section, we can say that OTS has a positive contribution to make the commuters perceive that they have more opportunities to do activities after working hours. However, only 26.7% of OTS based taxi users and 24% of OTS based motorcycle taxi users have main activities other than working (see Figure 30). In addition, by using OTS-based taxi, the commuters also have opportunities to do activities while traveling. This finding confirms the theory which argue that the implementation of ICT on transport allows a greater travel time flexibility. Moreover, it opens up possibilities for some activities to be carried out remotely (Banister, 2008; van Wee et al., 2013).

- **Perception of Flexibility to Work Longer**

Access to activities is sometimes restricted to time-related constraints, e.g. operating hours and opening hours (Geurs and van Wee, 2004). For commuters, their abilities to work longer are often constrained by limited operating hours of public transportation. In Jakarta, public transport modes commonly do not operate after 11 p.m. That being so, public transport users do not have a wide range of transportation mode selections if they have to work overtime.

Figure 34 Length of Working Hours



As can be seen in the figure above, the average length of working hours in Jakarta is 8.7 hours with the majority of people work within 8 to 10 hours. However, at certain conditions, workers are required to work overtime. Before OTS existed in Jakarta, conventional taxi used to become a choice of transportation mode for late night commuting. There are numerous conventional taxi service firms in Jakarta. Nevertheless, only a few taxi brands that have good reputation.

"I only trust Blue Bird (a conventional taxi brand in Jakarta). The drivers of other taxi companies sometimes refuse to turn on the taximeter, so I have to pay more than the real cost. Moreover, I don't feel safe while taking conventional taxi other than Blue Bird." (Frequent OTS-based taxi user, 23, male, entrepreneur)

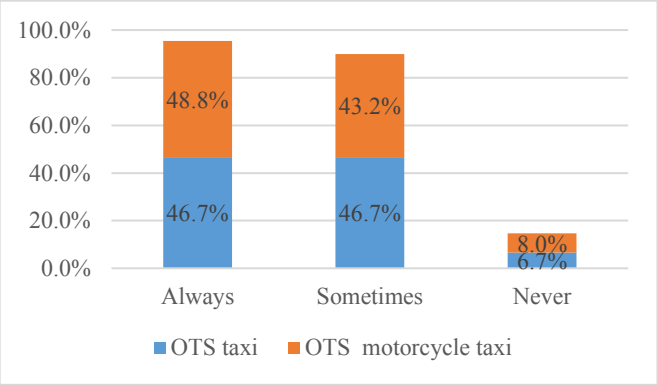
In Indonesia, the conventional taxi service industry is dominated by two players; Blue Bird Group and Express Transindo Utama. Blue Bird is the clear market leader with fleets of about 32,500 units and market share of 43%. Meanwhile, Express comes in a second place with a number of fleets of 30,000 units and 30% market share (Indonesia Investment, 2015).

The arrival of OTS in Jakarta has challenged the conventional taxi service. Not only is it easier to order, OTS also provides a transparency in price. Accordingly, commuters have started to substitute the use of conventional taxi for late night commuting.

"I used to take a conventional taxi when I had to work overtime, but now I prefer OTS because it can be ordered from the mobile application. It is more practical and safer compared to hailing a conventional taxi on the road." (Non-frequent OTS-based taxi user, 26, female, employee)

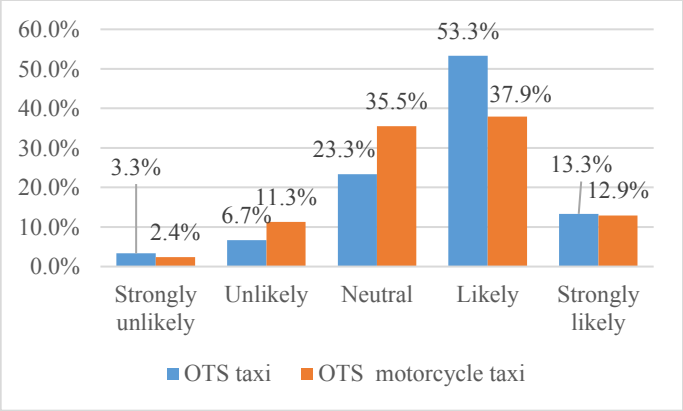
"Compared to conventional taxi, OTS gives me a more transparent information about how much I have to pay before I ride though it does not necessarily cheaper." (Frequent OTS-based taxi user, 23, male, entrepreneur)

Figure 35 Percentage of Commuters who Use OTS as a Transportation Service for Overtime Working



As can be seen in the figure above, 48.8% of OTS-based motorcycle users and 46.7% of OTS-based taxi users claim that they always use OTS as the transportation service when they have to work overtime; 43.2% of OTS-based motorcycle users and 46.7% of OTS-based taxi users claim that they sometimes use OTS as the transportation service when they have to work overtime. On the other hand, the percentage of commuters who has never used OTS for late night commuting is considerably small.

Figure 36 Flexibility to Work Longer



As a result, 66.6% of OTS-based taxi respondents (combination of 53.3% who say likely and 13.3% who say strongly likely) and 50.8% of OTS-based motorcycle taxi respondents (combination of 37.9 % who say likely and 12.9% who say strongly likely) consider that they are more flexible to work overtime because of the presence of OTS.

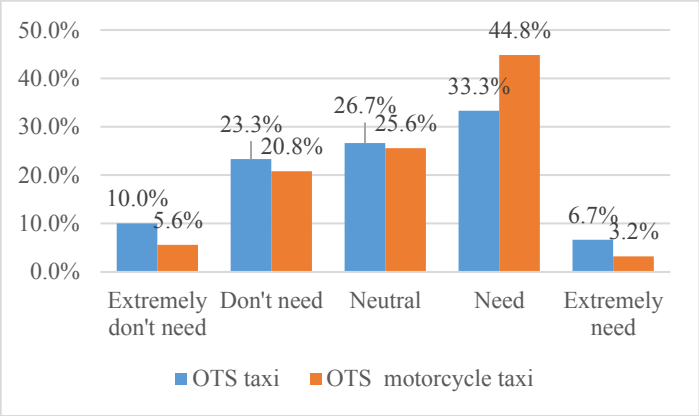
4.5.3 Perception of Individual Component of Accessibility

Individual component aims to investigate the change in needs, opportunities, and ability to travel. The result in this section will eventually answer the third research sub-question; *'how does the use of OTS fulfil the needs, expand the opportunities, and improve the abilities of commuters to travel?'*

- **Perception of the Needs to Use Certain Transportation Modes to Commute**

Perception of the needs to use certain transportation modes to commute is assessed from the needs to own private vehicles as well as the needs to use private vehicles and public transport. OTS will be considered to have positive impact on the accessibility if the service can fulfil the needs, expand the opportunities, and improve the abilities of commuters to travel.

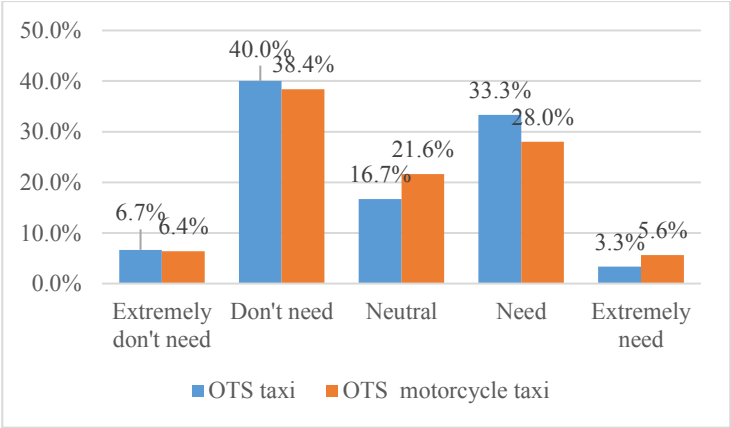
Figure 37 Need to Own Private Vehicles



In the previous section, it is revealed that OTS has been used as a daily transportation service to commute in Jakarta. It means the commuters are getting more attached to OTS. Nevertheless, the need to own private vehicles is still high. As can be seen in the figure above, 33.3% of OTS-based taxi users perceive that they still need to own private vehicles and the other 6.7% perceive that they extremely need to own private vehicles. A similar perception also appears on OTS-based taxi users, in which the percentage of respondents who say need and extremely need to own private vehicles is 44.7% and 3.2% respectively. This finding suggests that in the long term, the use of OTS might have a little impact to decrease the overall amount of private vehicles in Jakarta.

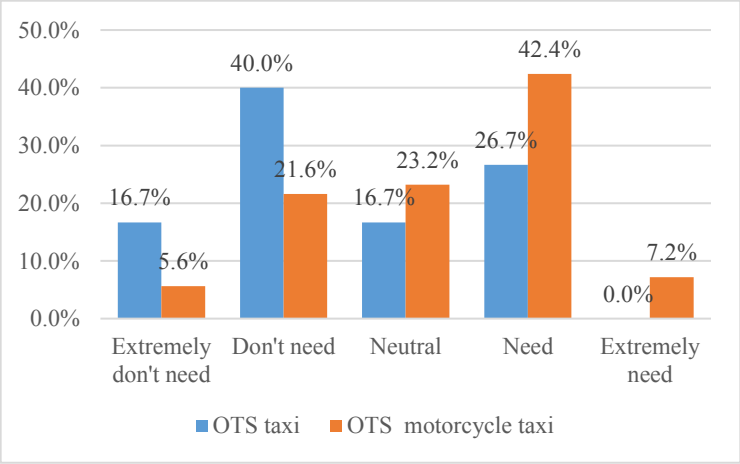
"I think I still need to have a private car. Someday I will have a family and I think every family needs to have a private vehicle. It has nothing to do with the convenience of OTS. It is mainly because having a private car gives more agility, especially if one day I have children. I can leave my stuff in the car; the pillow and blanket for the children, cosmetics, comb, and tissue to get prepared. Then, using private car sometimes is more practical." (Non-frequent OTS-based taxi user, 26, female, employee)

Figure 38 Need to Use Private Vehicle



In regards of the need to use private vehicle, 40% of OTS-based taxi users and 38.4% of OTS-based motorcycle taxi users perceive that they do not need to use private vehicles to commute. Meanwhile, 33.3% of OTS-based taxi users and 28% of OTS-based motorcycle taxi users perceive that they still need to use private vehicles. The percentage of OTS users who still need to use private vehicles is remarkably high even though not the highest. The overall mean for this indicator is 2.88. Therefore, we can argue that OTS could substitute the use of private vehicles although the effect is small.

Figure 39 Need to Use Public Transportation



In regards of the need to use public transportation, 49.6% of the commuters who use OTS-based motorcycle taxi perceive that they still need (42.4%) and extremely need (7.2%) to use public transport. Meanwhile, 23.2% of the commuters who use OTS-based motorcycle taxi say neutral and the other 21.6% perceive that they do not need to use public transportation. It indicates that OTS partially substitute the use of public transportation. OTS can also be used in combination with public transport. For example, some commuters use OTS-based motorcycle taxi to reach public transportation hubs, such as BRT stop and commuter rail station.

"The distance of my house to the nearest BRT stop is about 5 km. It is beyond my walking distance. I have to take a minivan, OTS, or conventional motorcycle taxi to go to BRT stop. However, I prefer to use OTS because the minivan or conventional motorcycle taxi cannot pick me up right at the door of my house as OTS does." (Frequent OTS-based motorcycle taxi user, 62, female, civil servant)

On the other hand, 56.7% of the commuters who use OTS-based taxi are negative about the need to use public transport (combination of respondents who say do not need (40.0%) and extremely do not need (5.6%)). In fact, most of them did not use public transportation before OTS existed, but private car and conventional taxi (see Figure 43). As indicated in the discussion of personal characteristics of the respondents (see Table 6), OTS-based taxi users mostly earn a higher income. Thus, they afford to use more comfortable transportation modes and rarely use public transportation to commute.

"I almost never use public transportation. The public transportation in Jakarta is crowded and full of suspicious people. I used to drive my own car for commuting, but now I use OTS more often." (Frequent OTS-based taxi user, 23, male, entrepreneur)

"*I usually drive my own car for commuting, but I order OTS to go to work when I'm tired or lazy to drive. I rarely use public transport because it is not convenient for me."* (Non-frequent OTS-based motorcycle taxi user, 26, female, employee)

- **Perception of Opportunities to Commute by OTS or in Combination with Other Transportation Modes**

Analysis of the need to use public transport has revealed a relatively high percentage of OTS users still need to use public transport. However, the types of public transport are yet unknown. The analysis in this section will specifically explain which public transportation modes are used in combination with OTS.

Figure 40 Opportunity to Commute by OTS in Combination with Other Transportation Modes

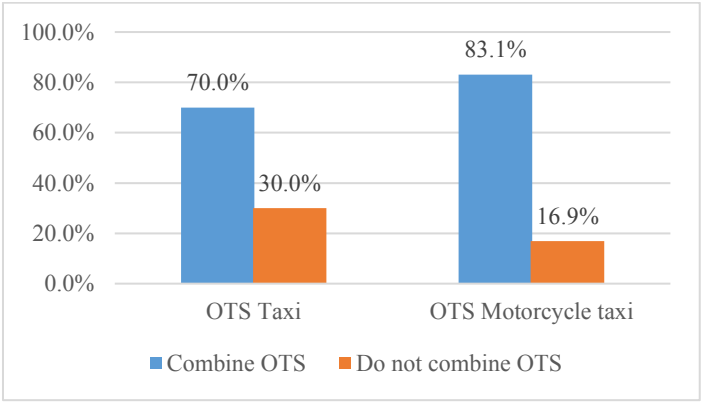
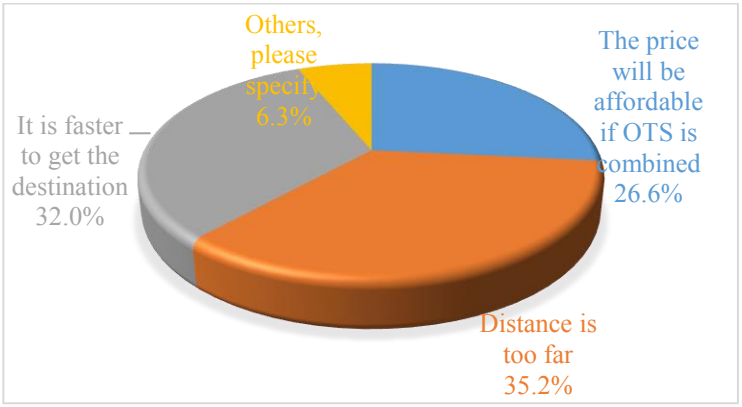


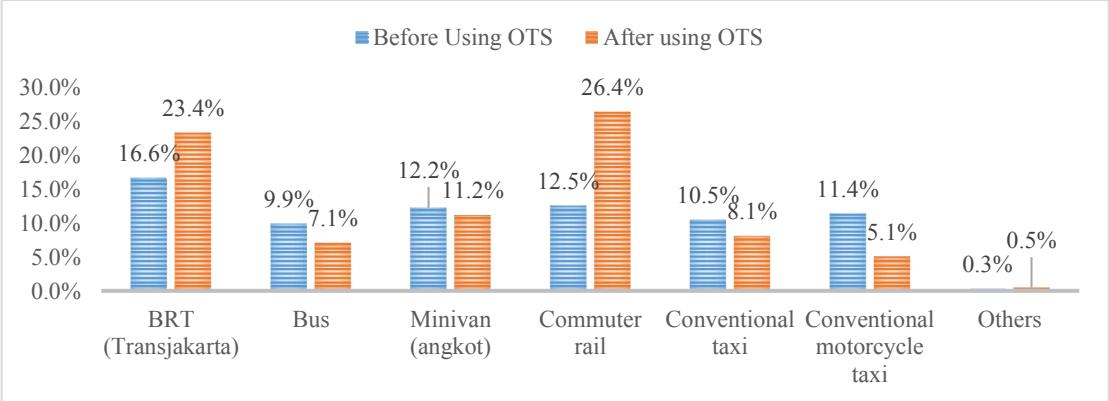
Figure 40 illustrates the answer to the question of whether OTS is used in combination with other modes. As can be seen in the chart above, 70.0% of OTS-based taxi users and 83.1% of OTS-based motorcycle users use OTS in combination with other transportation modes. The reason why commuters use OTS in combination with other transportation modes can be seen in the figure below.

Figure 41 The Reason to Use OTS in Combination with Other Transportation Modes



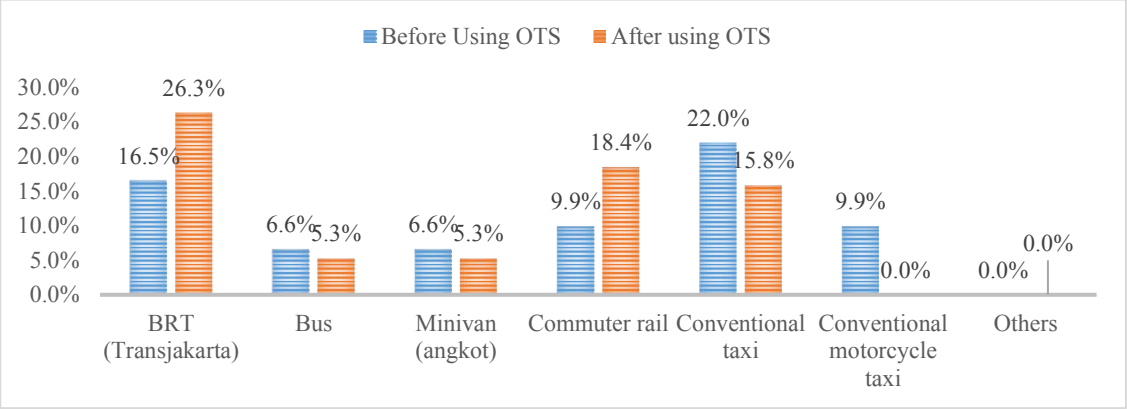
Among all the respondents who use OTS in combination with the different transportation modes to commute, 35.2% of which say that the distance is too far if OTS is not used in combination with other modes. Meanwhile, another 32.0% perceive that combining the transportation modes will make them faster to get the destination. The result in this section asserts the assumption that OTS is generally used as a connecting vehicle that delivers people from the point of origin to transportation hub. Thus, the questions about the combination of transportation modes before and after using OTS were asked.

Figure 42 Opportunities to Use Different Transportation Modes before and after Using OTS for Commuting (OTS-based motorcycle taxi users)



It turns out that before the presence of OTS in Jakarta, OTS-based motorcycle taxi greatly relied on almost all types of public transportation modes. After the presence of OTS, the levels of use for bus, minivan, conventional taxi, and conventional motorcycle taxi decrease. On the contrary, the levels of use for BRT and commuter rail increase since commuters started to use OTS. This result indicates that OTS has a substitution effect on the use of bus, minivan, conventional taxi, and conventional motorcycle taxi. However, it also complements the use of BRT and commuter rail. Based on the data above, we can argue that the use of OTS-based motorcycle taxi might contribute to promoting the use of BRT and commuter rail.

Figure 43 Opportunities to Use Different Transportation Modes before and after Using OTS for Commuting (OTS-based taxi users)



The similar result is also found on the OTS-based taxi. Before using OTS-based taxi, the commuters were highly dependent on the use of conventional taxi. Today, the percentage of OTS-based taxi users who also use conventional taxi is reduced. The reduction in the level of use is also found in bus and conventional taxi. Meanwhile, the use of BRT and commuter rail increases sharply after OTS-based taxi is used. This data suggests that OTS-based taxi substitutes the use of bus, minivan, conventional taxi, and conventional motorcycle taxi. However, OTS-based taxi is complementary to BRT and commuter rail.

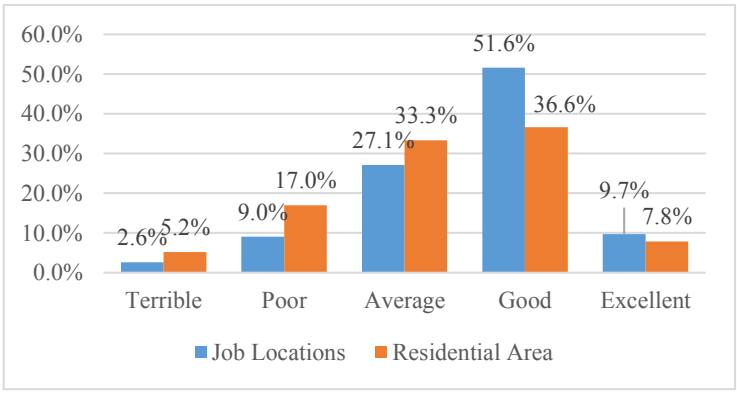
Analysis in this section concludes that OTS enables the commuters to have various selections of transportation modes. The main factor for using OTS in combination with other transportation modes are travel distance (35.2%) and travel time (32.0%). Moreover, another insight that can be obtained in this section is that OTS complements the use of BRT and commuter rail, which are the public transportation modes that are usually used for long distance commuting. Nevertheless, OTS substitutes the use of bus and minivan, which are the public transportation modes that are usually used for short distance commuting. It also substitutes the use of IPT, such as conventional taxi and conventional motorcycle taxi. Eventually, the result of analysis in this section confirms that OTS is used as a connecting vehicle from the point of origin to public transportation hubs.

In order to encourage the use of OTS in combination with public transport. Go-Jek has just signed the MoU with Jakarta Mass Rapid Transit (MRT) regarding the development of non-farebox business and mobile payment in the area around the MRT station. It includes the integrated payment system between MRT and Go-Jek. Therefore, Go-Jek users who already use mobile payment in their transactions do not need to prepare Jakarta MRT ticket card separately. On the other hand, Grab is currently developing an application feature to enhance the seamless connectivity between Grab and public transport. Using this feature, Grab users can order OTS and public transport at once. Travel information and payment for both transportation services will be also integrated into this feature.

- **Perception of Abilities to Reach Job Locations**

The ultimate goal of accessibility is the ease to reach the destinations (Litman, 2011). For commuters, the destinations are the job locations. This section will discuss whether OTS is able to change the ability of commuter to reach job locations.

Figure 44 Adequacy of Public Transportation in Job Locations and Residential Area



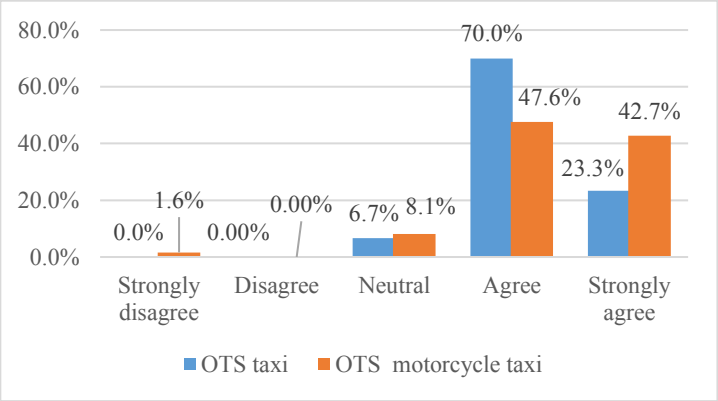
According to the figure above, most of respondents (51.6% say good and 9.7% say excellent) are positive about the adequacy of public transport in their job locations. This finding is not surprising as the job locations are usually located in the city center and served by various public transport options. Meanwhile, the commuters' perception toward adequacy of public transport in residential area is not as good as job locations. Only 44.4% of the respondents (combination of 36.6% who say good and 7.6% who say excellent) perceive that the public transport in their residential area is adequate.

Figure 45 Illustrations of Neighborhood Area in Jakarta

Source: 1. Merdeka.com, 2017 2. Jakarta100brs.com,2018

The houses in the most of Jakarta's residential area are highly packed (see Figure 45); the streets are narrow, only one or two vehicles can pass on the neighbourhood streets, and no public transport service in the neighbourhood area. Moreover, the distance between the neighbourhood area and public transportation hub is relatively far. Therefore, people have to use IPT for the first miles of commuting distance.

Figure 46 Abilities to Commute to or from the Locations that are Not Served by Public Transportation



The respondents were also asked whether the presence of OTS makes them able to reach locations that are not served by public transportation. The data shows that 93.3% of OTS-based taxi users (combination of 70.0% who say agree and 23.3% who say strongly agree) and 90.3% of OTS-based motorcycle taxi users (combination of 47.6% who say agree and 42.7% who say strongly agree) perceive that OTS can increase their abilitoes to commute to/from the locations that are not served by public transportation.

4.5.4 Summary of the Commuters' Perception of Accessibility

According to the commuters surveyed in this study, their perception of accessibility in Jakarta can be summarized as follows.

a. Transport component: OTS can provide a fairly good level of service (mean=3.73 out of 5; hereinafter 'mean' of a Likert scale of 1 to 5 will be referred as M). Nevertheless, there are several indicators that still have a room for improvement, e.g. OTS-based taxi's waiting time, affordability of OTS-based taxi in the rush hours, level of vibration and cleanliness of helmet and mask of OTS-based motorcycle taxi, as well as safety and security for OTS in general.
b. Temporal component: Thanks to its fairly good level of service, OTS could contribute to increasing the flexibility to perform activities (M=3.54).
c. Individual component: Despite the fact that the commuters still want to own private vehicles, OTS can slightly reduce the need to use private vehicles. However, its effect on changing the need to use public transportation is varied depending on the types of public transportation mode. In addition, OTS gives more ability to commuters to travel from/to the area where public transport service is poor.

4.6 Inferential Analysis

Reflecting on the descriptive analysis shown above, we can argue that OTS could make Jakarta more accessible, as perceived from the viewpoint of commuters who use OTS. Nevertheless, the descriptive analysis could not answer whether there are differences in the perception of accessibility between different groups of respondents. Thus, inferential analysis needs to be conducted.

Before doing inferential analysis, it is critical to ensure the reliability and validity of the data. Therefore, this section begins with reliability and validity analysis. Next, MANOVA was conducted to know the relationship between personal characteristics of respondents and the perception of accessibility. MANOVA was also used to know the relationship between the frequency of OTS use and the perception of accessibility (each component and overall perception). It is followed by regression analysis which aims to see the extent to which the frequency of OTS use affects the perception of accessibility. This section is ended by revealing

which accessibility component that has the most significant effect on the commuters' perception of accessibility.

4.6.1 Reliability and Validity Analysis

- **Reliability Analysis**

The reliability analysis was carried out using Cronbach's alpha test. The alpha coefficient (α) ranges from 0 to 1, with 1 implies a perfect consistency in concept measurement and 0 reflects no consistency in concept measurement. A commonly accepted rule for describing reliability using Cronbach's alpha is that the α value should be greater than 0.7. However, in another literature, the α value of at least 0.6 is still acceptable (Leech et al., 2005).

Firstly, the reliability analysis was carried out for the ordinal indicators in each component of accessibility; transport component, temporal component, and individual. Later on, all ordinal indicators were tested together to see whether all indicators are reliable to measure perception of accessibility. The reliability analysis produced a result as follows.

Table 11 Reliability Analysis

	Alpha Coefficient	No. of indicators
Transport Component	0.85	28
Temporal Component	0.68	3
Individual Component	0.64	4
Perception of Accessibility	0.81	35

The alpha coefficients (α) of all indicators in the transport, temporal, and individual components as well as perception of accessibility are more than 0.6. Therefore, the indicators are reliable and highly correlated. In other words, the average correlations of all indicators are accurate to estimate the overall perception of accessibility.

As all indicators in each component are reliable, it is allowed to compute the indicators into a latent variable. In this study, there are 4 latent variables produced using compute procedure; 'transport component' (M=3.73), 'temporal component' (M=3.54), 'individual component' (M=3.35), and 'perception of accessibility' (M=3.67). Accordingly, these indicators would be utilized for the further analysis.

Figure 47 Compute Procedure

- **Validity Analysis**

Validity analysis aims to test whether the research instrument measures what it is intended to measure (Neuman, 2003). One of the methods to conduct validity analysis is to find out the correlation degree between the measuring instrument and the result (Buley, 2000). Therefore, Pearson Correlation Test was used to test the validity of research instrument. Using this method, the correlations between each question in the research instrument and the latent variable of 'Perception of Accessibility' were tested. The question in the research instrument is valid if the tested variables show the correlation coefficient of at least 5%. Based on this test, it is revealed

that every question in the research instrument has a high correlation coefficient (see table in Annex). Thus, a good validity in the research instrument is confirmed.

4.6.2 MANOVA Analysis

MANOVA is used for the analysis that involves more than one dependent variable and one independent variable at a time. In this section, there are two things that are carried out with MANOVA. First, the analysis about the relationship between personal characteristics of the commuters and indicators in the perception of accessibility; this analysis indicates the effects of different personal characteristics of the commuters on the perception of accessibility. Second, the analysis about the relationship between frequency of OTS use and the perception of accessibility; this analysis indicates the effect of frequency of OTS use on each accessibility component and overall perception of accessibility.

- **Relationship between Personal Characteristics of the Commuters and Indicators in the Perception of Accessibility**

This analysis aims to see whether OTS users, who consist of various personal characteristics, have the different perception of accessibility. In this section and after, OTS refers to OTS-based taxi and OTS-based motorcycle taxi.

Table 12 Effects of Personal Characteristics of the Commuters on Indicators in the Perception of Accessibility

Source	Dependent Variable (Perception of Accessibility)	Type III Sum of Squares	df	Mean Square	F	Sig.
Between gender	Security from crime	2.368	1	2.368	4.821	0.030
	Safety from traffic accident	1.781	1	1.781	3.369	0.068
	Needs to own private vehicles	0.768	1	0.768	0.780	0.378
	Needs to use private vehicles	7.630	1	7.630	7.147	0.008
	Needs to use public transport	0.427	1	0.427	0.351	0.554
	Politeness of the drivers	2.996	1	2.996	9.135	0.003
	Helpfulness of the drivers	1.601	1	1.601	5.527	0.020
	Opportunities to perform more activities after working hours	3.536	1	3.536	6.013	0.015
Between monthly income	Affordability	3.513	4	0.878	2.808	0.028
	Travel Cost	27.194	4	6.799	5.619	0.000
	Comfort	0.819	4	0.205	1.440	0.225
	Needs to own private vehicles	5.914	4	1.478	1.501	0.206
	Needs to use private vehicles	1.365	4	0.341	0.309	0.871
	Need to use public transport	4.030	4	1.007	0.812	0.520
Between Education Level	Information Quality	2.890	3	0.963	3.086	0.029
	Ease to use the mobile application	5.509	3	1.836	5.174	0.002
	Usefulness of cashless payment facility	4.214	3	1.405	2.683	0.049
Between Occupation	Working hours	13.886	3	4.629	2.357	0.074
	Opportunities to perform more activities after working hours	0.956	3	0.319	0.524	0.667
	Availability to work longer due to OTS	0.555	3	0.185	0.209	0.890
	Need to use public transport	4.920	3	1.640	1.384	0.250
	Needs to use private vehicles	10.174	3	3.391	3.140	0.027
	Needs to own private vehicles	7.303	3	2.434	2.480	0.063
Between Age	Comfort	0.401	5	0.08	0.530	0.753
	Needs to own private vehicles	8.108	5	1.622	1.631	0.156
	Working hours	9.273	5	1.855	0.885	0.493
	Availability to work longer due to OTS	8.670	5	1.734	2.051	0.076
	Affordability	1.121	5	0.224	0.677	0.642
	Travel Cost	4.303	5	0.861	0.627	0.679

From the output of MANOVA, it can be concluded that:
Between gender

1. There is a difference in the perception of security from crime between men and women ($p<0.05$, $F=4.82$). Interestingly, women feel more secure in OTS compared to men ($M=3.56$). It could be because OTS drivers are more polite and helpful to women.
2. There is a significant difference in the need to use private vehicle between men and women ($p<0.05$, $F=7.14$). In particular, men perceive a higher need to use the private vehicles ($M=3.18$).
3. There is a significant difference in the perception of politeness of the drivers between men and women ($p<0.05$, $F=9.13$), in which women perceive a better politeness of the drivers ($M=3.84$).
4. There is a significant difference in the perception of helpfulness of the drivers between men and women ($p<0.05$, $F=5.52$). Compared to men, women perceive a better helpfulness of the drivers ($M=3.80$).
5. There is a significant difference in the perception of opportunities to perform more activities after working hours ($p<0.05$, $F=6.01$). Compared to men, women perceive that they have more opportunities to perform more activities after working hours ($M=3.68$). It also means that OTS makes the women to have more flexibility to do the domestic works, such as taking care of the children, preparing food, etc.
6. There is no significant difference in the perception of safety as well as the need to own private vehicle and need use public transportation.

Between monthly income

1. A significant difference is found in the perception of cost affordability between the commuters that have different levels of monthly income ($p>0.05$, $F=2.80$). The commuters with income range of Rp >20million ($M=3.72$) are scoring higher than commuters with income range of Rp <5 million ($M=3.58$), meaning the higher income commuters perceive that OTS cost is more affordable than the lower income commuters.
2. There is a significant difference in travel cost of commuters within different level of monthly income ($p<0.05$, $F=5.61$). The commuters with income range of Rp >20million ($M=3.66$) are scoring higher than commuters with income range of Rp <5 million ($M=2.46$), meaning the higher income commuters pay more travel cost than the lower income commuters. It could be because the higher income commuters tend to use OTS taxi as can be seen in Table 6.
3. Monthly income has no influence on the perception of comfort, needs to own private vehicles, need to use private vehicles, and need to use public transportation.

Between education level

1. There is a significant difference in the perception of information quality between commuters within different level of education ($p<0.05$, $F=3.08$). The commuters with the last education level of Master's degree perceive a better information quality than non-degree, Bachelor graduates, and PhD graduates ($M=4.67$).
2. A significant difference is found in the perception of ease to use the mobile application between commuters within different level of education ($p<0.05$, $F=5.17$). Master's degree graduates perceive a higher level of ease to use the mobile application compared to non-degree, Bachelor graduates, and PhD graduates ($M=4.37$).
3. There is a difference in the perception of usefulness of cashless payment facility between commuters within different level of education ($p<0.05$, $F=2.68$). Master's degree graduates perceive a better usefulness of cashless payment facility than non-degree, Bachelor graduates, and PhD graduates ($M=4.34$).

Between occupation

1. A significant difference is found in the need to use private vehicles between private sector employee, civil servant, entrepreneur, and others ($p<0.05$, $F=3.14$). Among all types of occupation, entrepreneur perceives a higher need to use private vehicles ($M=4.00$).
2. There is no significant difference in the working hours, opportunities to perform more activities after working hours, availability to work longer due to the presence of OTS, need to use public transport, and need to own public vehicles among commuters with different types of occupation.

Between age

1. There is no significant difference in the perception of comfort, need to own private vehicles, working hours, availability to work longer due to OTS, perception of affordability, and travel cost between the commuters in different age groups. It means that commuters have similar perceptions on those things regardless their ages.

Based on MANOVA analysis, the different perceptions of accessibility are found in the different personal characteristics of the commuters. Accordingly, it justifies the assertion which argues that personal characteristics affect the level of accessibility (Geurs and van Wee, 2004).

- **Relationship between Frequency of OTS Use and the Perception of Accessibility**

This analysis aims to see whether frequent and non-frequent OTS users have different perception of accessibility. In this section and after, the frequent OTS users refer to the commuters who use OTS more than 5 times a week and the non-frequent OTS users refer to the commuters who use OTS less than 5 times a week.

Table 13 Effects of Frequency of OTS Use on the Components in Perception of Accessibility

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Frequency of OTS Use	Transport Component	0.904	1	0.904	8.954	0.003
	Temporal Component	3.204	1	3.204	7.491	0.007
	Individual Component	6.686	1	6.686	19.034	0.000
	Perception of Accessibility	0.396	1	0.396	5.018	0.027

According to the table above, it can be concluded that there are significant differences in the perceptions of all accessibility components between frequent and non-frequent OTS users. Specifically, the explanation is as follows:

1. A significant difference is found in the perception of transport component between frequent and non-frequent OTS users ($p<0.05$, $F=8.95$). The frequent OTS users perceive a higher perception of transport component ($M=3.78$). It means they experience a better level of service than non-frequent user.
2. There is a significant difference in the perception of temporal component between frequent and non-frequent OTS users ($p<0.05$, $F=7.49$). The frequent OTS users perceive a higher perception of temporal component ($M=3.64$). It means the frequent OTS users perceive that they are more flexible to perform activities compared to the non-frequent OTS users.
3. There difference in the perception of individual component between frequent and non-frequent OTS users is highly significant ($p<0.05$, $F=19.03$). The non-frequent users are scoring higher in the perception of individual component ($M=3.63$). It is particularly because the non-frequent OTS users have higher needs to use private vehicles and public transports.
4. All in all, there is a significant difference in the overall perception of accessibility between frequent and non-frequent OTS users ($p<0.05$, $F=5.01$). The frequent OTS users

perceive a better perception of accessibility (M=3.71). Thus, it can be concluded that the more often commuters use OTS, the better accessibility they perceive.

- **Regression Analysis**

Based on MANOVA analysis, it is indicated that the frequency of OTS use has an effect on changing the perception of accessibility. However, the degree to which the frequency of OTS use affects the perception of accessibility is yet unknown. Therefore, linear regression analysis was conducted. Linear regression was particularly selected because it reveals the correlation coefficient (B coefficient) between the frequency of OTS use and the overall perception of accessibility. The result of this analysis eventually answers the main research question; *"to what extent does the use of OTS affect the commuters' perception of accessibility in Jakarta?"*

Table 14 Regression Analysis about the Relationship of Frequency of OTS Use and the Perception of Accessibility

Model	Unstandardized Coefficients		Standardized Coefficients Beta	t	Sig.
	B	Std. Error			
(Constant)	3.495	0.081		43.193	0.000
Frequency of OTS Use	0.109	0.047	0.184	2.312	0.022

The B coefficient tells how many units perception of accessibility changes for a single unit increase in the frequency of OTS use. Like so, 1 point increase in the frequency of OTS use corresponds to 0.10 point increase on the perception of accessibility. Based on this result, it can be concluded that the frequent OTS users perceive a higher accessibility than the non-frequent OTS users. It is showed that the frequent OTS users' perception of accessibility is 0.1 point (or 10%) higher than the non-frequent OTS users' perception of accessibility. Accordingly, this finding supports the argument of van Wee et al. (2013) that say the implementation of ICT in transportation sector can contribute to the increase in accessibility.

It is also useful to know which component has the most influence on shaping the perception of accessibility of OTS users in Jakarta. Therefore, multiple regression analysis was conducted to know the correlation coefficient between each component and the latent variable of perception of accessibility. Multiple regression analysis was used because this analysis involves more than one independent variable and one dependent variable at a time.

Table 15 Multiple Regression Analysis about the Relationship of Each Component of Accessibility and the Perception of Accessibility

Model	Unstandardized Coefficients		Standardized Coefficients Beta	t	Sig.
	B	Std. Error			
(Constant)	0.015	0.006		2.412	0.017
Transport Component	0.806	0.002	0.923	529.215	0.000
Temporal Component	0.080	0.001	0.187	104.336	0.000
Individual Component	0.110	0.001	0.242	139.997	0.000

Based on the analysis, it can be seen that every component has a significant effect on the perception of accessibility. However, transport component is the most significant factor that determines the degree of perception of accessibility ($p<0.05$, $t=529.21$). The B coefficient of 0.806 indicates that 1 point increase in transport component equals to 0.806 increase in the perception of accessibility. Therefore, an improvement in the level of service will significantly contribute to a better perception of accessibility.

Chapter 5: Conclusions and Recommendations

5.1 Introduction

This chapter aims to outline the main findings and conclusions derived from data collection along with the research objective. Accordingly, the chapter ends with the recommendations for policy formulation and further academic research.

5.2 Conclusion

5.2.1 Restatement of Study Purpose and Background Information

Being one of the most congested cities in the world, the accessibility level of Jakarta is undoubtedly low. The provision of public transport service is considered inadequate in fulfilling transportation demand, both in quality and quantity. Thus, people prefer to use private vehicles, resulting in a domination of private vehicle on the roads of Jakarta. The arrival of OTS in 2014 has brought a new choice for traveling in the city. Accordingly, the number of OTS users has grown rapidly (Katadata, 2016).

Despite the fact that the number of OTS users is growing, the operation of OTS has not been legalized due to the disputes between the government and OTS companies (Widiartanto, 2017). The disputes reflect that there are different perceptions about the impact of OTS on the accessibility. In order to clarify whether the impact of OTS on the accessibility is negative or positive, a study regarding the impact of OTS on the accessibility from the perception of the commuters is needed. The commuters were specifically selected as the target group of the research because most of the trips made by OTS in Jakarta are for work purposes (Medeiros et al., 2018 and Panjaitan, 2016).

According to Geurs and van Wee (2004), the accessibility concept consists of four components, namely level of service (transport component), relationship of transport system and land use (land use component), flexibility to perform activities at different times of the day (temporal component), as well as need, opportunity, and abilities of individual to travel (individual component). In regards of transport component, there are some indications that OTS in Jakarta potentially provides a good level of service (Panjaitan, 2016; Silalahi et al., 2017; Medeiros et al., 2018). However, the shortcomings of OTS' service quality are also found, especially in terms of comfort, safety, and security (Nurhidayah and Alkarim, 2017). In addition, there is a lack of evidence regarding the impacts of OTS on the land use, temporal, and individual components.

Hence, this study aims to explain the extent to which OTS affects the commuters' perception of accessibility in Jakarta. In order to achieve the study purpose, this study has three sub-questions that basically explain the impacts of OTS on each components of accessibility:

1. How do commuters perceive the level of service of OTS?
2. How does the use of OTS make it more flexible for the commuters to perform activities?
3. How does the use of OTS fulfil the needs, expand the opportunities, and improve the abilities of commuters to travel?

This study does not examine the impact of OTS on the perception of land use component. It is because OTS operation in Jakarta is relatively new. Thus, the impact of OTS on the perception of land use component is allegedly insignificant.

5.2.2 Research Outcome

This study begins with the doubts whether OTS has negative or positive impacts on the commuters' perception of accessibility. According to the data derived from 155 respondents, it is indicated that the commuters perceive that OTS provides a fairly good accessibility (M=3.67). This conclusion was drawn based on the findings in three components of accessibility; transport, temporal, and individual components. Regarding transport component, the commuters commonly perceive that OTS' level of service of is good (M=3.73). Nevertheless, there are rooms for improvement in several indicators. For OTS-based taxi, the indicators that need to be improved are affordability in the non-rush hours without a promotion discount, smell of the vehicle, level of vibration/smoothness of riding, and comfort of seat. For OTS-motorcycle taxi, the indicators that need to be improved are cleanliness of helmet and mask, level of vibration/smoothness of riding, safety and security, knowledgeability of the drivers, as well as responsiveness in handling complaint. The finding in transport component eventually has answered the first sub-research question; '*how do commuters perceive the level of service of OTS?'.*

The second sub-research question is *'how does the use of OTS make it more flexible for the commuters to perform activities?'*. It is found in this study that OTS can contribute to increasing the flexibility of commuters to perform activities (M=3.54). It is because OTS is in principle able to reduce travel time. The commuters who use OTS perceive that they have higher opportunities to perform activities outside working hours. The study also reveals that the commuters who use OTS-based taxi are able to do activities while traveling. In addition, the commuters also perceive that OTS gives them more flexibility to work longer as OTS are available for late night commuting after overtime working.

The investigation in individual component suggests that OTS can partially fulfil the needs of commuters to travel. This conclusion was drawn based on the finding that private vehicles ownership and public transport use are still needed although commuters use OTS. OTS can replace the use of private vehicle, but not public transportation. OTS does substitute to the use of bus, minivan, conventional taxi, and conventional motorcycle taxi, but not BRT and commuter rail. In fact, OTS motorcycle taxi can play a complementary role to the BRT and commuter rail. It is used as a connecting vehicle that delivers the commuters to BRT stops and commuter rail stations. Thus, it might contribute to increasing the use of BRT and commuter rail. Furthermore, this study also reveals that the commuters perceive that their abilities to reach job locations are improved due to the existence of OTS. The finding in individual component eventually has answered the third sub-research question; *'how does the use of OTS fulfil the needs, expand the opportunities, and improve the abilities of commuters to travel?*

According to MANOVA analysis, the independent variables—personal characteristics of the commuters and frequency of OTS use—have effects on the perception of accessibility. Personal characteristics affect the degree to which accessibility is perceived by the commuters. For example, women feel more secure in OTS compared to men. It could be because the drivers are more polite and helpful towards women than men. Furthermore, frequency of OTS use also has an impact on the extent to which commuters perceive the accessibility. Frequent OTS users tend to perceive a better accessibility than non-frequent users. It is indicated by the result of linear regression, in which the frequent OTS users' perception of accessibility is 10% higher than the non-frequent OTS users' perception of accessibility. This finding eventually has answered the main research question; *'to what extent does OTS affect the commuters' perception of accessibility in Jakarta'.* In addition, the result of multiple regression indicated that transport

component has the most significant impact on the perception of accessibility. Therefore, an improvement in OTS' level of service is significant to increase the accessibility in Jakarta.

In conclusion, OTS can be considered as a positive contributor to increasing the perception of accessibility. However, there is a plenty of room for improvement in the transport component of OTS. Improving the lacking indicators in transport component is critical as the transport component is the most influential factor in the perception of accessibility. In addition, by improving the transportation component, the performance of other components might also increase. For instance, if people perceive that the comfort and security of OTS increase, they might be more flexible in doing activities while traveling. Nevertheless, it is important to notice that the improvement in transportation component of OTS should not make people shift from public transport to OTS. Otherwise, the existence of OTS in Jakarta might bring new problems, such as traffic congestion and pollution as a result of the increasing volume of motorized vehicles.

5.2.3 Linking Back to the Literature

As a way of ICT implementation in transportation sector, the result of this study can be linked with the literature about ICT in transportation sector. Specifically, the study finding is in accordance with the argument of van Wee et al. (2013), which says that ICT potentially has an impact on the components of the accessibility concept. From the commuters' perception, the impact of OTS is fairly positive. The more frequent OTS is used, the better the accessibility that commuters perceive. This conclusion is based on the investigation of three components in the accessibility concept extracted from Geurs and van Wee (2004).

Regardless of the fact that there are several aspects to be improved in transportation component, OTS in Jakarta has proven that it could provide a good level of service. This finding is in line with the literature about the potential impact of OTS on urban mobility (Rayle et al., 2014; Azevedo and Maciejewski, 2015; Murphy and Feigon, 2016; Smith, 2016; Panjaitan, 2016; Silalahi et al., 2017; Medeiros et al., 2018). In particular, travel information quality (M=4.57) and ability to reduce travel time (M=3.92) are the indicators that have high scores. This study found that the travel information quality eventually contributes to reducing travel resistance, which confirms the arguments of Barth et al. (2015), Pardo (2010), and van Wee et al. (2013). Information quality also contributes to reducing waiting time; as Rayle et al (2014) and Azevedo and Maciejewski (2015) argue, the travel information in OTS potentially helps the passengers to leave the position just in time. Thus, people perceive that their travel time is reduced.

Accessibility is also related to time-related constraints, such as operating hours and working hours (Geurs and van Wee, 2004). The existence of time-related constraints makes people not flexible to perform activities. However, using OTS makes the commuters perceive that they have more flexibility to perform more activities in a day, including overtime working. It corresponds to the statement of Banister (2009), which says that the new technology in transportation allows a greater time flexibility and hence, provides tremendous opportunities for people to perform a wide range of desired activities. In addition, the study also reveals that the commuters who use OTS-based taxi are able to do activities while traveling. This finding confirms the assertion that ICT implementation in transportation service potentially eliminate the time-related constraints because several activities can be performed once at a time (Kwan and Weber, 2003; Mokhtarian, 1990; van Wee et al., 2013).

The finding on the impact of OTS on the needs to own private vehicles is contrary to the empirical studies conducted by Murphy and Feigon (2016) and Smith (2016). In those studies, the OTS users are less likely to purchase private vehicles. However, this study reveals that the

commuters still need to own motorcycles or cars although they can use OTS. The difference in the result finding may be caused by the difference in the demographic profile in the area of study. Furthermore, the finding on the impact of OTS on the needs to use private vehicle is similar with the study conducted Martin and Shaheen (2011), in which the use of OTS can lead to the less use of private vehicles. In regards to the needs to use public transport, the result of this study corresponds to the study finding of Clewlow and Mishra (2017). Whether OTS has substitutions or complementary effect on the use of public transport are dependent on the type of public transport (Clewlow and Mishra, 2017). In this study, OTS substitutes the use of minivan, bus, and conventional IPT, but play a complementary role to BRT and commuter rail.

5.3 Recommendations

5.3.1 Policy Recommendations

The aim of this research is to examine the extent to which the use of OTS can affect the commuters' perception of accessibility. Based on the research findings, we can draw a conclusion that OTS contributes to providing a fairly good perception of accessibility to the users (M=3.67). Transport component or the level of service is the most significant factor affecting the perception of accessibility. However, there are a plenty of rooms for improvement in the level of service. Therefore, if the government is aiming to make the commuters perceive a better accessibility, it is critical to encourage OTS companies to provide a better level of service.

Most of indicators that need to be improved—smell of the vehicle, level of vibration/smoothness of riding, and comfort of seat for OTS-based taxi and cleanliness of helmet and mask, level of vibration/smoothness of riding, safety and security, knowledgeability of the drivers for OTS-motorcycle taxi—are related to the service of the drivers and the comfort of their vehicles. Therefore, in order to achieve service excellence, it is important for OTS companies to recruit the drivers carefully and train them. In addition, it would be better if OTS companies could increase the speed of response in handling complaints, as responsiveness in handling complaint is an indicator that has a relatively low score among others. The improvement in the level of service might have an impact on the temporal component as well. For example, if people perceive that riding with OTS is comfortable and secure, they might be able to do more activities while traveling. Furthermore, there might be more people opt to use OTS for late night commuting. This actually is beneficial for OTS companies as well.

Another indicator that has a low score in transportation component is the affordability of OTS-based taxi at the rush hours without promotion code. Actually, OTS price has been a controversial topic in Indonesia. A lower price is indeed able to encourage people to use OTS, it also increases their sense of affordability. However, at the same point, it potentially decreases the revenue of the drivers. OTS drivers, who most of them come from middle-low class society (Lembaga Demografi Universitas Indonesia, 2017), will suffer if OTS companies decrease the fare of OTS. Not to mention that the reduction in price might encourage people to use OTS for full distance commuting. In other words, it makes people shift away from the use of public transport. Therefore, it might be better to leave this indicator's performance as it is. In this regard, the economic law of supply and demand will work.

It is also found in this study that OTS-based motorcycle taxis complement the use of public transport and reduce the need to use private vehicles. Hence, the existence of OTS-based motorcycle taxi potentially promotes mobility in a more sustainable manner. Thus, the collaboration between the public transport operators and OTS companies is inarguably needed for a greater benefit. Promoting OTS does not mean that OTS should replace the use of public transportation. Instead, the connectivity between OTS and public transportation is important to

be enhanced. There are several points to be discussed between the government and OTS companies that may be able to strengthen the relations between OTS and public transport.

- Cashless integrated payment method: The result of this study has revealed that cashless payment method is essential to provide comfort to the users. Thus, having cashless integrated payment method for OTS and public transport may contribute to make intermodal use between both transportation services seamless and efficient. This attempt should be feasible as cashless payment has been implemented for the use of public transport in Jakarta. Furthermore, it is also beneficial for the government due to its contribution to the reduction in money printing cost and money distribution cost.
- OTS waiting area: OTS waiting area has been available in several public places, such as shopping malls and offices, but not in the commuter rail stations and BRT stops. Whereas having OTS waiting area can ease the passengers and drivers to identify each other's' location. In addition, it can also help to maintain order in the area around transportation hub.
- Promotion price: It has been revealed in this study that promotion discount has a notable role not only in making commuters perceive that the price of OTS is affordable, but also increase the adoption rate of OTS. In order to enhance the use of OTS in combination with public transport, a promotion price can be implemented when people use OTS in combination with public transport.

On top of that, the dispute in the legalization process of OTS should reach the common ground. The vehicle ownership and the employment status in OTS companies does not need to be forced as long as OTS companies could guarantee its safety and service quality. Furthermore, protests from conventional IPT should not be suppressed by limiting the number of OTS quota in an area. Restrictions on the number of OTS will actually reduce the adequacy of OTS vehicles to serve the existing demand. Instead, integrating conventional IPT into OTS mobile application might be an option. In fact, this attempt has been done by Blue Bird and Go-Jek.

5.3.2 Recommendations for Further Research

This study is bound to several limitations, one of which is the target population selection. The respondents are limited to people who use OTS for commuting. Then, the study may produce different results if it is conducted for people who do not use OTS for commuting. Therefore, the future research recommendation that could be performed by the future scholar is related to the impact of OTS from the perspective of non-OTS users. Furthermore, a comparative research between OTS users and non-OTS users could be useful as well.

Second, it is found at some points that Go-Jek and Grab have different strategies in providing service to the users. The difference in the strategies sometimes leads to the different level of service. Therefore, the study regarding OTS in Indonesia in the future could distinguish the level of service provided by Go-Jek and Grab.

The third limitation of this study is that the land use component is not examined. In the long run, OTS might affect the distribution of actors. For instance, people are more willing to live in the farther locations as they perceive that job locations are quite accessible if they use OTS to commute. Subsequently, it probably has an impact on land use change. For the time being, the impact of OTS is not yet visible. However, in the future, it could be a study to be conducted.

Finally, the next step for the further research is to explore the feasibility of OTS and public transport integration. However, it is important to ensure that the further studies about OTS in Indonesia always keep up with the updates of OTS regulation and company policy implemented by the OTS providers.

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Annex 1: Research Instruments

Questionnaire

Start of Block: Screening Question

UNDERSTANDING THE IMPACT OF ONLINE TRANSPORTATION SERVICE (OTS) ON THE COMMUTERS' PERCEPTION OF ACCESSIBILITY

My name is Anastasia Ratna Wahyuwijayanti, a master student of Urban Management and Development in Institute for Housing and Urban Development Studies, Erasmus University Rotterdam, the Netherlands. I would like to observe the impact of Online Transportation Service (OTS) on the commuters' perception of accessibility in Jakarta. OTS is motorcycle taxi or car taxi that can be ordered through mobile application. OTS, for instance, are **Go-Jek and Grab.**

It would be appreciated if you could participate in the survey. It should take only 15 minutes of your time. Please be assured that your responses will be treated confidentially and analyzed as a group. Participation in this survey will give you a chance to win a Rp 100.000 voucher that will be topped up in your OTS account, so don't miss your chance! Thank you for your participation.

SECTION I

Q2 Have you ever used Online Transportation Service (OTS) for commuting from home to work and from work to home?

- ○ Yes
- ○ No

Q3 Do you work in Jakarta?

- ○ Yes
- ○ No

Q4 Do you live in Jabodetabek area?

- ○ Yes
- ○ No

Q5 Are you an OTS driver by profession or side job?

- ○ No. I am NOT an OTS driver
- ○ Yes. I am an OTS driver

End of Block: Screening Question

Start of Block: Characteristics of OTS Use

SECTION II

Q6

What is the type of OTS mode that you use more often for commuting?

- ○ Car taxi
- ○ Motorcycle taxi

Please notice that your answers in the next questions of this survey are related to the type of OTS mode that you use more often.

Q7 How often do you use OTS for commuting?

- ○ More than 10 times a week
- ○ 8-10 times a week
- ○ 5-7 times a week
- ○ 2-4 times a week
- ○ Once a week
- ○ Once in two weeks
- ○ Once a month

Q8 If you don't use OTS for full-time commuting, what is the transportation mode you use to substitute OTS vehicles? (you can choose more than 1 answer)

- ☐ BRT (Transjakarta)
- ☐ Bus
- ☐ Minivan (angkot)
- ☐ Commuter rail
- ☐ Private car
- ☐ Private motorcycle
- ☐ Conventional motorcycle taxi
- ☐ Conventional taxi
- ☐ Others

End of Block: Characteristics of OTS Use

Start of Block: Travel Information

SECTION III

Q9 How would you rate your experience with **pre-travel** information quality provided by OTS?

*pre-travel information: information obtained prior to the journey
i.e. travel cost, estimated time arrival, travel distance

	Terrible	Poor	Average	Good	Excellent
Usefulness/accuracy of information	○	○	○	○	○
Adequacy/completeness of information	○	○	○	○	○
Ease of interpreting the information	○	○	○	○	○

Q10 How would you rate your experience with **en-route** information quality provided by OTS?

*en-route information: information obtained during the journey
i.e. journey progress, traffic condition, vehicles feature, drivers' information

	Terrible	Poor	Average	Good	Excellent
Usefulness/accuracy of information	○	○	○	○	○
Adequacy/completeness of information	○	○	○	○	○
Ease of interpreting the information	○	○	○	○	○

Q11 To what extent do you agree with this statement?

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Travel information provided by OTS can reduce my hesitation to travel.	○	○	○	○	○

End of Block: Travel Information

Start of Block: Travel Cost

Q12 How much do you spend for commuting with OTS (one-way) **during non-rush hours** without promotion discount?
(please answer with Rupiah as the currency)

_____

Q13 How much do you spend for commuting with OTS (one-way) **during rush hours** without promotion discount?
(please answer with Rupiah as the currency)

_____

Q14 How would you rate the **affordability** of commuting with OTS?

	Extremely unaffordable	Unaffordable	Neutral	Affordable	Extremely affordable
During **non-rush** hours **without** a promotion discount	○	○	○	○	○
During **rush** hours **without** a promotion discount	○	○	○	○	○
During **non-rush** hours **with** a promotion discount	○	○	○	○	○
During **rush** hours **with** a promotion discount	○	○	○	○	○

End of Block: Travel Cost

Start of Block: Travel Time

Q15 How long do you usually **wait** for OTS to come while commuting?
(please answer with minutes as a unit)

_____

Q16 Regardless of waiting time, how long do you usually **commute with OTS (one-way)**?
(please answer with minutes as a unit)

_____

Q17 To what extent do you agree with this statement?

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Commuting with OTS can reduce my travel time.	○	○	○	○	○

End of Block: Travel Time

Start of Block: Travel Distance

Q18 How far do you commute (one-way) with OTS?
(please fill with kilometer as a unit)

_____

Q19 To what extent do you agree with this statement?

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Route taken by OTS drivers is effective that it can shorten my distance to commute.	○	○	○	○	○

End of Block: Travel Distance

Start of Block: Reliability

Q20 How would you rate your experience with **reliability** while commuting with OTS?

	Terrible	Poor	Average	Good	Excellent
Punctuality	○	○	○	○	○
Adequacy of vehicle amount/ ease to be paired with the drivers	○	○	○	○	○

End of Block: Reliability

Start of Block: Comfort

Q21 How would you rate your experience with **comfort** while commuting with OTS vehicles in general?

	Terrible	Poor	Average	Good	Excellent
Comfort of seat	○	○	○	○	○
Level of vibration while riding	○	○	○	○	○
Usefulness of cashless payment facility	○	○	○	○	○
Ease of use the mobile application	○	○	○	○	○

Q22 How would you rate your experience with **comfort** while commuting with **OTS taxi**?
(please leave it blank if you have never used OTS taxi for commuting)

	Terrible	Poor	Average	Good	Excellent
Temperature on board	○	○	○	○	○
Smell of vehicles	○	○	○	○	○
Level of Noise	○	○	○	○	○

Q23 How would you rate your experience with **comfort** while commuting with **OTS motorcycle taxi**?
(please leave it blank if you have never used OTS motorcycle taxi for commuting)

	Terrible	Poor	Average	Good	Excellent
Cleanliness of helmet and mask	○	○	○	○	○

End of Block: Comfort

Start of Block: Safety and Security

Q24 How would you rate your experience with **safety and security** while commuting with OTS?

	Terrible	Poor	Average	Good	Excellent
Level of safety from traffic accident	○	○	○	○	○
Level of security from crime	○	○	○	○	○

Q25 Have you ever involved in traffic accident while commuting with OTS?

- ○ Yes
- ○ No

Q26 Have you ever been a victim in crime while commuting with OTS?

- ○ Yes
- ○ No

Q27 If you have ever been a victim in crime while commuting with OTS, what kind of crime have you experienced?

_____

End of Block: Safety and Security

Start of Block: Costumer Care

Q28 How would you rate the quality of **costumer care** while commuting with OTS?

	Terrible	Poor	Average	Good	Excellent
Politeness of the drivers	○	○	○	○	○
Helpfulness of the drivers	○	○	○	○	○
Knowledgeability of the drivers about Jakarta's map and traffic condition	○	○	○	○	○
Reliability of rating platform	○	○	○	○	○
Responsiveness in handling complaints	○	○	○	○	○

End of Block: Costumer Care

Start of Block: Opportunities available after working hours and while traveling

Q29 Do you have any main activities other than work that you do after working hours (i.e. side job, course, education, etc)?

○ Yes

○ No

Q30 If yes, what is it?

_____

Q31 How likely does OTS give you the opportunity to perform more activities after working hours?

	Strongly unlikely	Unlikely	Neutral	Likely	Strongly likely
More activities performed after working hours due to OTS	○	○	○	○	○

Q32 What are the other activities that you usually perform while using OTS taxi?
(Please leave it blank if you have never used OTS taxi for commuting. You can choose more than one answer)

- ☐ Dropping family member to activity location
- ☐ Remote working
- ☐ Reading and browsing
- ☐ Online shopping
- ☐ Eating and drinking
- ☐ Sleeping
- ☐ Others
- ☐ None of the above

Q33 How likely does OTS taxi give you the opportunity to perform more activities while commuting with OTS?
(Please leave it blank if you have never used OTS taxi for commuting)

	Strongly unlikely	Unlikely	Neutral	Likely	Strongly likely
More activities performed while commuting	○	○	○	○	○

End of Block: Opportunities available after working hours and while traveling

Start of Block: Flexibility to work longer

Q34 How many hours do you work in a day?

_____

Q35 How often do you use OTS as your transportation service when you have to work overtime?

- ○ Always
- ○ Sometimes
- ○ Never

Q36 How likely does OTS give you flexibility to work longer?

	Strongly unlikely	Unlikely	Neutral	Likely	Strongly likely
Flexibility to work longer due to OTS	○	○	○	○	○

End of Block: Flexibility to work longer

Start of Block: Needs to Use Certain Transportation Mode to Commute

Q37 To what extent do you agree with these statements?

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
As I can use OTS for commuting, I DO NOT need to own private vehicles.	○	○	○	○	○
OTS shift me away from private vehicles usage.	○	○	○	○	○
OTS shift me away from public transportation usage.	○	○	○	○	○

End of Block: Needs to Use Certain Transportation Mode to Commute

Start of Block: Opportunities to commute by OTS or in combination with other modes

Q38 Before OTS was introduced, what transportation mode did you use for commuting? (you can choose more than 1 if you combine modes)

- [ ] BRT (Transjakarta)
- [ ] Bus
- [ ] Minivan (angkot)
- [ ] Commuter rail
- [ ] Private car
- [ ] Private motorcycle
- [ ] Conventional taxi
- [ ] Conventional motorcycle taxi
- [ ] Others

Q39 Do you combine OTS vehicles with other transportation modes?

- ○ Yes
- ○ No

Q40 If yes, which combination of modes do you use?
(you can choose more than 1 answer)

- [ ] BRT (Transjakarta)
- [ ] Bus
- [ ] Minivan (angkot)
- [ ] Commuter rail
- [ ] Private car
- [ ] Private motorcycle
- [ ] Conventional taxi
- [ ] Conventional motorcycle taxi
- [ ] Others

Q41 Why do you combine modes while commuting?

- ○ The price will be affordable if OTS is combined
- ○ Distance is too long
- ○ It is faster to get the destination
- ○ Others, please specify _____

End of Block: Opportunities to commute by OTS or in combination with other modes

---

Start of Block: Abilities to reach job locations

Q42 How would you rate the **adequacy of public transportation service** in the locations below?

	Terrible	Poor	Average	Good	Excellent
Job locations (i.e. office, meeting places, etc)	○	○	○	○	○
My neighbourhood	○	○	○	○	○

Q43 To what extent do you agree with this statement?

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
OTS gives me more ability to commute to (or from) locations that are not served by adequate public transportation service	○	○	○	○	○

End of Block: Abilities to reach job locations

Start of Block: Personal Characteristics

SECTION IV

Q44 What is your gender?

○ Male

○ Female

Q45 How old are you?

_____

Q46 What is your occupation?

- ○ Civil servant
- ○ Employee
- ○ Entrepreneur
- ○ Others

Q47 How much is your monthly income?

- ○ < Rp 5million
- ○ Rp 5-10 million
- ○ Rp 10-15 million
- ○ Rp 15-20 million
- ○ Rp 20-25 million
- ○ Rp 25-30 million
- ○ Rp 30-35 million
- ○ Rp 35-40 million
- ○ >40 million

Q48 What is the last education you have completed?

- ○ Did not attend school
- ○ Elementary school
- ○ Junior High School
- ○ Senior High School
- ○ Bachelor
- ○ Master
- ○ PhD

Q49 Do you have any cars or motorcycles in your household?

- ○ Yes
- ○ No

Q50 Are you able to drive car or motorcycle?

- ○ Yes
- ○ No

End of Block: Personal Characteristics

Start of Block: Contact

Q51 Are you willing to be contacted for further data retrieval?

- ○ Yes
- ○ No

Q52 If yes, please indicate your name, contact number, e-mail, or social media account

_____

End of Block: Contact

Semi-structured Interview to OTS Users

The interview to OTS users aims to obtain in-depth information about the impact of OTS on their perception of accessibility. The result of this interview can help to analyse the meaning behind the numbers produced by quantitative survey. This semi-structured interview will last approximately 15 minutes, depending on the length and quality of answer.

1. Why do you use OTS for commuting?
2. What makes the perception of accessibility regarding OTS-taxi / OTS-motorcycle taxi better or worse than public transport?
3. What makes the perception of accessibility regarding OTS-taxi / OTS-motorcycle taxi better or worse than private vehicle?
4. What makes the perception of accessibility regarding OTS-taxi / OTS-motorcycle taxi better or worse than conventional taxi?
5. What are the elements of OTS that need to be improved in order to increase your level of accessibility?

Semi-structured Interview to OTS Company (Go-Jek/Grab)

The interview to OTS company (Go-Jek/Grab) aims to obtain in-depth information about the extent to which the service of OTS company can change the commuter's perception of accessibility. This semi-structured interview will last approximately 30 minutes, depending on the length and quality of answer.

1. To what extent does Go-Jek/Grab strive to give a better level of accessibility through the improvement of aspects below:
    a. Information quality (pre-travel and en-route)
    b. Fare (rush hour and non-rush hour basic fare, promotion, etc)
    c. Travel distance and time
    (does the GPS of Go-Jek/Grab tend to choose shorter route or less congested route? Why?)
    d. Reliability (punctuality and adequacy of vehicles)
    e. Comfort (comfort on board, payment facility, ease to use the mobile application/user experience design, quality of riding equipments, such as helmet and mask)
    f. Safety (insurance, identity screening for drivers, vehicle periodic maintenance, etc)
    g. Customer care (politeness, helpfulness, and knowledgeability of the drivers and response to complaint)

2. What are the most frequent complaints about service quality of Go-Jek/Grab? Why does it happen? What has Go-Jek done to solve the problem?

3. Does Go-Jek/Grab have a platform that integrates OTS with public transport? How about the response of users to this extent?

4. What is the biggest challenge to realize the improvement of service quality?

Annex 2: SPSS Result

Reliability Analysis

Transport

Reliability Statistics

Cronbach's Alpha	N of Items
.847	28

Temporal

Reliability Statistics

Cronbach's Alpha	N of Items
.680	3

Individual

Reliability Statistics

Cronbach's Alpha	N of Items
.647	4

Perception of Accessibility

Reliability Statistics

Cronbach's Alpha	N of Items
.815	35

Validity Analysis

Correlations	Perception of Accessibility
Usefulness/accuracy of pre-travel information	.544**
Adequacy/completeness of pre-travel information	.542**
Ease of interpreting the pre-travel information	.555**
Usefulness/accuracy of en-route information	.581**
Adequacy/completeness of en-route information	.488**
Ease of interpreting the en-route information	.578**
Ability to Reduce Travel Resistance	.295**
The affordability of commuting with OTS during non-rush hours without a promotion code	.302**
The affordability of commuting with OTS during rush hours without a promotion code	.291**
The affordability of commuting with OTS during non-rush hours with a promotion code	.429**
The affordability of commuting with OTS during rush hours with a promotion code	.425**
Effectiveness of route selection	.288**
Punctuality	.567**
Adequacy of vehicle amount/ ease to be paired with the drivers	.603**
Comfort of seat	.439**
Level of vibration while riding	.369**
Usefulness of cashless payment facility	.416**
Ease of use the mobile application	.582**
Temperature on board (Car taxi)	.611**
Smell of vehicles (Car taxi)	.552**
Level of Noise (Car taxi)	.492**
Cleanliness of helmet and mask (motorcycle taxi)	.363**
Safety from traffic accident	.469**
Security from crime	.380**
Politeness of the drivers	.561**
Helpfulness of the drivers	.534**
Knowledgeability of the drivers about Jakarta's map and traffic condition	.436**
Reliability of rating platform	.569**
Responsiveness in handling complaints	.531**
Opportunities to perform more activities after working hours	.333**
Opportunities to perform more activities while traveling	.270**
Availability to work longer due to OTS	.268**
Needs to use private vehicles	.106**
Needs to own private vehicles	.128**
Need to Use Public Transport	.187*
Abilities to commute to/from locations that are not served by public transport	.275**

MANOVA Analysis

- **Relationship between Personal Characteristics of the Commuters and Indicators in the Perception of Accessibility**

Gender

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	Security from crime	2.368[a]	1	2.368	4.821	.030
	Safety from traffic accident	1.781[b]	1	1.781	3.369	.068
	Needs to own private vehicles	.768[c]	1	.768	.780	.378
	Needs to use private vehicles	7.630[d]	1	7.630	7.147	.008
	Need to Use Public Transport	.427[e]	1	.427	.351	.554
	Politeness of the drivers	2.996[f]	1	2.996	9.135	.003
	Helpfulness of the drivers	1.601[g]	1	1.601	5.527	.020
	Opportunities to perform more activities after working hours	3.536[h]	1	3.536	6.013	.015
Intercept	Security from crime	1720.037	1	1720.037	3502.030	.000
	Safety from traffic accident	1670.655	1	1670.655	3160.492	.000
	Needs to own private vehicles	1494.808	1	1494.808	1518.634	.000
	Needs to use private vehicles	1266.703	1	1266.703	1186.499	.000
	Need to Use Public Transport	1406.387	1	1406.387	1157.214	.000
	Politeness of the drivers	1991.923	1	1991.923	6073.011	.000
	Helpfulness of the drivers	1985.654	1	1985.654	6855.952	.000
	Opportunities to perform more activities after working hours	1815.244	1	1815.244	3086.982	.000
Q44	Security from crime	2.368	1	2.368	4.821	.030
	Safety from traffic accident	1.781	1	1.781	3.369	.068
	Needs to own private vehicles	.768	1	.768	.780	.378
	Needs to use private vehicles	7.630	1	7.630	7.147	.008
	Need to Use Public Transport	.427	1	.427	.351	.554
	Politeness of the drivers	2.996	1	2.996	9.135	.003
	Helpfulness of the drivers	1.601	1	1.601	5.527	.020
	Opportunities to perform more activities after working hours	3.536	1	3.536	6.013	.015

Monthly Income

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	Affordability	3.513[a]	4	.878	2.808	.028
	TravelCostComputed	27.194[b]	4	6.799	5.619	.000
	Comfort	.819[c]	4	.205	1.440	.225
	Needs to own private vehicles	5.914[d]	4	1.478	1.501	.206
	Needs to use private vehicles	1.365[e]	4	.341	.309	.871
	Need to Use Public Transport	4.030[f]	4	1.007	.812	.520
Intercept	Affordability	1495.327	1	1495.327	4781.932	.000
	TravelCostComputed	870.673	1	870.673	719.590	.000
	Comfort	1437.644	1	1437.644	10109.019	.000
	Needs to own private vehicles	1147.703	1	1147.703	1165.259	.000
	Needs to use private vehicles	957.269	1	957.269	867.634	.000
	Need to Use Public Transport	1028.840	1	1028.840	829.115	.000
Q47rc2	Affordability	3.513	4	.878	2.808	.028
	TravelCostComputed	27.194	4	6.799	5.619	.000
	Comfort	.819	4	.205	1.440	.225
	Needs to own private vehicles	5.914	4	1.478	1.501	.206
	Needs to use private vehicles	1.365	4	.341	.309	.871
	Need to Use Public Transport	4.030	4	1.007	.812	.520

Education

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	Information Quality	2.890[a]	3	.963	3.086	.029
	Ease of use the mobile application	5.509[b]	3	1.836	5.174	.002
	Usefulness of cashless payment facility	4.214[c]	3	1.405	2.683	.049
Intercept	Information Quality	570.591	1	570.591	1827.929	.000
	Ease of use the mobile application	462.405	1	462.405	1302.705	.000
	Usefulness of cashless payment facility	473.130	1	473.130	903.452	.000
Q48rc	Information Quality	2.890	3	.963	3.086	.029
	Ease of use the mobile application	5.509	3	1.836	5.174	.002
	Usefulness of cashless payment facility	4.214	3	1.405	2.683	.049

Occupation

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	Working hours	13.886[a]	3	4.629	2.357	.074
	Opportunities to perform more activities after working hours	.956[b]	3	.319	.524	.667
	Availability to work longer due to OTS	.555[c]	3	.185	.209	.890
	Needs to use private vehicles	10.174[d]	3	3.391	3.140	.027
	Need to Use Public Transport	4.920[e]	3	1.640	1.384	.250
	Needs to own private vehicles	7.303[f]	3	2.434	2.480	.063
Intercept	Working hours	4804.609	1	4804.609	2446.414	.000
	Opportunities to perform more activities after working hours	822.168	1	822.168	1350.580	.000
	Availability to work longer due to OTS	773.060	1	773.060	874.655	.000
	Needs to use private vehicles	630.006	1	630.006	583.276	.000
	Need to Use Public Transport	567.906	1	567.906	479.124	.000
	Needs to own private vehicles	690.075	1	690.075	702.912	.000
Q46	Working hours	13.886	3	4.629	2.357	.074
	Opportunities to perform more activities after working hours	.956	3	.319	.524	.667
	Availability to work longer due to OTS	.555	3	.185	.209	.890
	Needs to use private vehicles	10.174	3	3.391	3.140	.027
	Need to Use Public Transport	4.920	3	1.640	1.384	.250
	Needs to own private vehicles	7.303	3	2.434	2.480	.063

Age

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	Comfort	.401[a]	5	.080	.530	.753
	Needs to own private vehicles	8.108[b]	5	1.622	1.631	.156
	Working hours	9.273[c]	5	1.855	.885	.493
	Availability to work longer due to OTS	8.670[d]	5	1.734	2.051	.076
	ComputedAffordability	1.121[e]	5	.224	.677	.642
	TravelCostComputed	4.303[f]	5	.861	.627	.679
Intercept	Comfort	198.527	1	198.527	1309.514	.000
	Needs to own private vehicles	178.949	1	178.949	179.979	.000
	Working hours	1014.268	1	1014.268	484.200	.000
	Availability to work longer due to OTS	155.177	1	155.177	183.543	.000
	ComputedAffordability	194.646	1	194.646	587.403	.000
	TravelCostComputed	145.613	1	145.613	106.144	.000
Q45rc2	Comfort	.401	5	.080	.530	.753
	Needs to own private vehicles	8.108	5	1.622	1.631	.156
	Working hours	9.273	5	1.855	.885	.493
	Availability to work longer due to OTS	8.670	5	1.734	2.051	.076
	ComputedAffordability	1.121	5	.224	.677	.642
	TravelCostComputed	4.303	5	.861	.627	.679

- **Relationship between Frequency of OTS Use and the Perception of Accessibility**

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	TransportComponent	.904[a]	1	.904	8.954	.003
	TemporalComponent	3.204[b]	1	3.204	7.491	.007
	IndividualComponent	6.686[c]	1	6.686	19.034	.000
	PerceptionOfAccessibility	.396[d]	1	.396	5.018	.027
Intercept	TransportComponent	1942.197	1	1942.197	19226.478	.000
	TemporalComponent	1728.502	1	1728.502	4041.597	.000
	IndividualComponent	1648.786	1	1648.786	4693.974	.000
	PerceptionOfAccessibility	1891.316	1	1891.316	23964.242	.000
FrequencyofOTSUse	TransportComponent	.904	1	.904	8.954	.003
	TemporalComponent	3.204	1	3.204	7.491	.007
	IndividualComponent	6.686	1	6.686	19.034	.000
	PerceptionOfAccessibility	.396	1	.396	5.018	.027

Regression Analysis

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.184[a]	.034	.027	.28131

a. Predictors: (Constant), FrequencyofOTSUse

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.423	1	.423	5.347	.022[b]
	Residual	12.108	153	.079		
	Total	12.531	154			

a. Dependent Variable: PerceptionOfAccessibility

b. Predictors: (Constant), FrequencyofOTSUse

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.495	.081		43.193	.000
	FrequencyofOTSUse	.109	.047	.184	2.312	.022

a. Dependent Variable: PerceptionOfAccessibility

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	1.000[a]	1.000	1.000	.00592

a. Predictors: (Constant), IndividualComponent, TransportComponent, TemporalComponent

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	12.387	3	4.129	117821.994	.000[b]
	Residual	.005	150	.000		
	Total	12.392	153			

a. Dependent Variable: PerceptionOfAccessibility

b. Predictors: (Constant), IndividualComponent, TransportComponent, TemporalComponent

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.015	.006		2.412	.017
	TransportComponent	.806	.002	.923	529.215	.000
	TemporalComponent	.080	.001	.187	104.336	.000
	IndividualComponent	.110	.001	.242	139.997	.000

a. Dependent Variable: PerceptionOfAccessibility

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