Leveraging Industry 4.0: Digitalising On-Demand Services and Promoting Sustainable Transport in Urban Cambodia

Asian Vision Institution

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Chheang Vannarith, PhD
President of Asian Vision Institute

About Asian Vision Institute

Asian Vision Institution (AVI) is an independent think tank based in Phnom Penh, Cambodia, aiming at promoting peaceful, inclusive, adaptive, and sustainable societies in Asia. AVI holds the vision to generate positive changes through knowledge co-creation and multi-stakeholder partnerships, build peaceful, inclusive, adapting, resilient and sustainable communities in Asia, and promote Asian wisdom and perspective and the values of humanity, peace, and cultural diversity in Asia. AVI's missions are 1) to promote inclusive growth and people-centered development; 2) to conduct practical policy and program research; 3) to multi-stakeholder dialogue and strengthen cross-sectoral partnerships and collaboration; 4) to Advance knowledge sharing and build leadership and innovation capacity.

There are six main centers in AVI, namely Mekong Centre for Strategic Studies (MCSS), the Centre for Governance Innovation and Democracy (CGID), the Centre for Sustainable Development Studies (CSDS), the Centre for Culture and Peace Studies (CCPS), and Centre for Inclusive Digital Economy (CIDE), and Centre for Advance Research and Legal Studies (CALS).

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Executive Summary

The shift to green transportation will not only reduce greenhouse gas emissions but also contribute to economic and societal growth and development. Therefore, there is a need to promote road safety, investment opportunities, and job creation. Because it is ten times safer per mile to use sustainable public transportation rather than private mobility, and it would help minimize the probability of getting into a traffic accident by 90% (Marsh, 2020).

This research reported views and insights of 304 Phnom Penh dwellers; they provided their experience of transportation for their daily trips to their destinations for work and other purposes. Private transport was crucial to the residents, especially those who worked full-time, because they required more frequency and urgency for their trips to work. The majority of the respondents owned at least a motorcycle or scooter (98%), followed by a bicycle (22%) and car (20-23%). Although those who use public transportation, the majority of them also own at least a motorcycle or a scooter. Furthermore, most private vehicles also travel by motorcycle or scooter. A small proportion of the respondents were transported by Rormork or rickshaw. It is noted that 1.0 % of the respondents owned neither a bicycle or a vehicle. They either used shared private transportation but did not own any personal vehicle. The study shows that the respondents used motorcycles or scooters always; they sometimes used Rormork.

The respondents rated very often for traveling to work/offices and often to markets and places for visiting. Sometimes, the respondents traveled to pick up their families. Commuters rarely travel either by public or private transportation for bringing children to school, rice transportation, transporting crop production, transporting livestock production, or transporting stuff for business activities. This could demonstrate that apart from traveling to work or the market, other purposes to use either public or private transportation are not majorly needed could be because they walk or their work does not require additional travel purposes, they are single, or they do not have other purposes at all to travel beside work and shop. To a large extent, both public and private transportation users and private transportation-only users were satisfied with services provided such as travel stability, driver attitude, ease of boarding and alighting, internal temperature, walking distance to stations or stops, and travel time and reliability, but not much with seat stability, waiting for time and condition of a station or stops.

However, there are some more improvements as suggested by respondents as follows:

- **Connectivity:** there should be a connection to lines of the same operator, connection to lines of other operators, and line diversity (number of lines of the transit network). During fieldwork, many respondents raised issues about the difficulty in using public transportation due to lack of connectivity and diversification.

- **Accessibility:** It is limited due to a lack of information, the inadequacy of the bus network, and the adequacy of buses, stops, and stations.

- **Information provision:** there is a call for more information, such as an information panel on the next stop, information panels on terminals and bus stops, line information explicitness, availability of timetables and line plans, and information on passes and tariffs. Among all listed, there was a significant number of desires for information on passes and tariffs for both public and private transportation. Many respondents knew nothing about public buses, and they discouraged trying public buses.

- **Safety and security:** commuters felt safe and secure traveling with either public or/and private transportation services and rated it higher than those of timeliness and comfort. Among those components of safety and security, bus/vehicle safety is highly rated so maintaining and enhancing it is crucial and attractive.

- **The kindness of transportation staff (incl. driver):** It is also noted that users of both public and private transportation expect more turn in public transportation service providers/operators higher than in private transportation only.

- **The cost:** Travelers prefer the lower price of transport so that they can travel/go to work/schools/places more frequently and conveniently.

- **Social values:** The respondents strongly agreed that public and private transportations offer a good deal of social value in terms of social safety and security, the highest rate among other assessments throughout the survey. Public transportation contributes to social order, less traffic congestion, and fewer traffic accidents. Moreover, transportation plays a role in maintaining other social values such as fitness and health, livability and amenity, social cohesion, and working conditions in the transport sector.

List of abbreviation

ADB	: Asian Development Bank
AT	: All the time
ASEAN	: Association of South East Asian Nations
EV	: Electric Vehicle
GHG	: Greenhouse Gas
GPS	: Global Positioning System
JICA	: Japan International Cooperation Agency
MPWT	: Ministry of Public Works and Transportation
MSPs	: Mobility Service Providers
NGO	: Non Governmental Organisation
NR	: Not Relevant
O	: Often
OA	: Overall assessment
R	: Rarely
S	: Sometimes
SDG	: Sustainable Development Goals
TNCs	: Transportation Network Companies
UN	: United Nations
UK	: United Kingdom
UNDP	: United Nations Development Programme
VO	: Very Often
WAI	: Weighted Average Index

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I. Introduction

I.1. Background

When a country's economy grows, so does its economic activity, which necessitates that transportation plays a significant role in facilitating the process. In Cambodia, the transport sector is believed to support its ambition to transit from a lower-middle-income country to an upper-middle-income country by 2030 and a high-income nation by 2050. With the rise of industry 4.0, Cambodia is gaining opportunities to develop technological trends and infrastructure, which are crucial determinants of Cambodia's future industrial diversification, productivity growth, and competitiveness. As a result, the government aims to complete the transition into a digital economy by 2023.

In the transportation sector, digitalized on-demand transportation services or so-called online transportation booking such as Passapp, Grab, and city buses where riders can have information beforehand like destination, fee, picture and name of the driver, and type of taxi to choose. The services became available in Cambodia for the first time in 2016. Its popularity is proliferating since it is convenient for riders. Nevertheless, such transportation services come at the expense of environmental exploitation by the increased consumption of nonrenewable energy such as petroleum, diesel, and gas and manufacturing materials like steel, leather, rubber, water, and sand. Moreover, consumption causes air and sound pollution and increases waste which contributes to climate change. This is why this study exists to promote digitized sustainable transportation services in the country.

I.2. Research Objectives

This research aims to strengthen the implementation of the Industrial Development Policy of Cambodia (2015-2025) and Phnom Penh Urban Transport Master Plan 2035 in the rise of Industry 4.0. Specific objectives of the study are:

- To examine characteristics of public and private transport available for commuting within urban neighborhoods;
- To analyze the existing sustainable transport systems which make a positive contribution to economic development, environmental preservation, and social development of the urban neighborhoods they are serving; and
- To draw the perception of domestic commuters within urban neighborhoods concerning on-demand services and sustainable transport.

I.3. Significance of the study

In Cambodia, most digitization and sustainable transport studies have been undertaken by regional and international organizations, such as the Association of Southeast Asian Nations (ASEAN) and the United Nations Development Programme (UNDP). While the findings are broadly reached, they do not always comprehensively fit the Cambodian context. Domestic institutions have conducted some studies, but they have been part of the project cycle, particularly evaluations or assessments.

This research utilizes relevant theories and particular concepts to address the core national, regional, and international issues and focuses on practical application – both actual and presumed – to resolve the development problems in the specific contexts of Cambodia. The research is well linked to the development agenda of Cambodia to improve living styles, affordable transport, road safety, and environmental conservation through digitization and sustainable transport. The research delivers quantitative and qualitative information about digitization and sustainable transport to promote industry 4.0. More importantly, this research will engage with a wide range of stakeholders who have the expertise and direct experiences in the area, such as City Bus operators, private operators, Non-governmental Organizations (NGOs), and commuters in Phnom Penh. In addition, providing a suitable sample size will enable its findings to be better generalized to the context of Cambodia's urban areas. Therefore, it is the firm belief that the results of this research will prove necessary to all the practitioners, planners, and policy-makers of governmental agencies, private companies, and non-governmental agencies for investing in sustainable transportation. Furthermore, the research results and findings will be helpful to promote the implementation of the National Strategic Development Plan (2019−2023) and the implementation of Sustainable Development Goals (SDGs): Goal 7. Affordable and clean energy, Goal 9. Industry, innovation, and infrastructure and Goal 11. Sustainable cities and communities.

II. Literature Review

II.1. On-Demand Services for Transportation in Cambodia

An on-demand economy employs technology to provide an instant supply of goods and services to satisfy consumer demand (Mike Jaconi, 2014). The concept is not nascent. It has been used in the home delivery of items to buyers since the late 1990s, with Webvan and Kozmo companies utilizing it (Spec India, 2020). On-demand services then overgrow, influencing 13 different sectors, including transportation and travel, food delivery, grocery delivery, fuel delivery, cooking gas delivery, healthcare, salon, laundry, car wash, learning, professional services, eCommerce business, and logistics (Shahid Mansuri, 2022). According to Smith (2016), what lies ahead is a transformation in the prevailing business paradigm, “one in which all consumer goods will be available as a service, and all consumer services will be available on demand”. In the transportation industry, the emergence of transportation network companies

(TNCs), who are private-sector mobility service providers (MSPs), such as Uber and Lyft, plays a crucial role in carrying passengers in metropolitan and suburban areas (Hyland & Mahmassani, 2020; Mahmassani, 2016; Shaheen et al., 2016). The services can also be called "ride-sourcing", in which a passenger uses a smartphone application to transmit GPS location to request a ride from a private passenger car (Rayle et al., 2014). Because of the conveniences they offer consumers compared to alternative means of transportation, their market share has increased significantly in cities across the United States (Hyland & Mahmassani, 2020). Cambodia is no exception, as on-demand services have been spotted in the country recently. In 2016, Passapp was launched and founded by a Cambodian (Soh, 2016). It was the first digitized mobile application platform where people could request rides from tuk tuk drivers. Later, more competitors emerged, including Grab, WeGO, TADA, Eagle, SmartRide, and Zelo. However, these mobility service providers come with the impact of increasing automobile traffic and causing congestion in the city.

II.1.1. Government platforms

To keep up with the trend, the Cambodian government has also digitized public bus services and made them available for public usage. The application is called "City Bus", which can be accessed and downloaded for free in the Apple Store (for iOS users) and Google Play (for Android users). The software allows tracking the real-time movement of all public buses in Phnom Penh. It is created by ITSUMO Tec company with support from the Phnom Penh municipal hall and the Japan International Cooperation Agency (JICA). The software makes it easier for individuals to plan excursions depending on bus availability. Based on the governor of Phnom Penh city, this mobile application would also assist drivers in improving coordination with one another and avoiding scheduling conflicts, for instance, when two or more buses arrive simultaneously at the same bus stop (David, 2019).

However, it still contains loopholes because the app is not an interactive platform and only enables users to check the location of the bus, but they cannot make any demands on it.

II.2. Existing Public and Private Transportation in Cambodia

II.2.1. Public transportation

A. Public Bus

Cambodia's public buses started their operation in September 2014 with only three lines. It has expanded to 17 lines with a total of 622 stations and 235 public buses to provide more services for the public. The operation starts at 5:30 in the morning and stops at 8:30 PM. The average

frequency of each stop lies in the range of 10 to 30 minutes according to actual traffic conditions.

Before the outbreak of the COVID-19 pandemic, the approximate number of passengers taking the public bus accounted for 30,000 per day. Due to the pandemic, the rate decreased to only 7,000 per day (Phnom Penh Post, 2020). The price of tickets is 1,500 riel per trip and is free for monks, disabled people, students, civil servants, garment workers, and children under 1 meter height. These public buses provide transportation to all people, especially those with financial difficulties or who do not own a private vehicle. The buses are also popular among students after leaving school in the evening, ensuring safety.

Traffic congestion and long waiting duration for passengers remains the primary issue that must be tackled for Cambodia's public bus operation. As the number of private vehicles in the country increases due to economic development, roads become more congested, and public buses are forced to export on narrow streets. In addition, the depots or stations are often too small (JICA, 2020).

B. Taxi Boat

Another public transportation type established in 2018 is the public water taxi boat. The boat travels from the Northern Russey Keo district to Takmao in Kandal province. Four boats are in operation daily, from 5:30 AM to 5:30 PM. The average speed for the boat is 40 km per hour, and the duration of each trip is about 45 minutes. It is equipped with air conditioners and can take up to 60 passengers per ride. It has a total of 6 stations: 4 current stops (Russei Keo, Old Market, Chatomouk, and Chbar Ampov) with two stops in construction (Preak Pnov and Takmao station). The initiation of the service is to provide another form of transportation aiming to reduce traffic jams in the city (Ministry of Public Works and Transportation, n.d-b).

It is free of charge for monks, students, the elderly, workers (with ID cards), and civil servants. The regular ticket price is 0.5 USD or 2,000 riel. Despite the relatively low cost, only 200 passengers use the service daily. Some days, passenger rates may fall to below 10 (Hin Pisei, 2020).

Issues regarding this transportation service are that the passenger needs to use a motorcycle to get to the jetties waiting, which can be insufficient and require a direct route to the ferry jetties. Moreover, other services, such as bus services, appear to be more convenient for the people with the excellent road condition from Phnom Penh to Takmao. Thus, most passengers travel to enjoy the sights during the weekends, holidays, or leisure (Sen David, 2019).

C. Railway

The Cambodian Railway has two lines the Northern Line, with a total length of 386 km from Phnom Penh to Poipet, and the Southern Line, with a total distance of 264 km from Phnom Penh to Preah Sihanouk Province. There are two types of services for each railway line: passenger and vehicle shipping.

For the Southern Railway, there are six directions for passenger services: (1). Phnom Penh to Sihanoukville, (2). Phnom Penh to Kampot, (3). Phnom Penh to Takeo, (4). Sihanoukville to Kampot, (5). Sihanoukville to Takeo, (6). Takeo to Kampot, and vice versa. The fee ranges lowest to 4 dollars and the highest to 7 dollars. The departure schedules are on Fridays, Saturdays, and Sundays from 7:00, 15:00, and 16:00, according to each direction heading. The Northern Railway offers a broader range of directions with a total of 16 directions (32 including vice versa) in which passengers can travel from Phnom Penh to Poipet, Battdoeng, Pursat, Battambang, Sisophon, and vice versa. Poipet to Sisophon, Battambang, Pursat, and Battdoeng; from Sisophon to Battambang, Pursat, Battdoeng; and Battdoeng to Sisophone and Pursat; Pursat to Battambang and Battdoeng (Ministry of Public Works and Transportation, n.d-a). The Vehicle shipping service includes cars, motorbikes, bicycles, and goods with the price ranging from 5 dollars to 14 dollars.

II.2.2. Private Transportation

A. Car

The private car is one of the most favored modes of transportation for those who can afford it. The number of registered vehicles has increased rapidly. For instance, as of 2021, 920,000 cars are registered, rising from only 65,000 vehicles in 1998 (Chan, 2020). In 2021 alone, the car industry witnessed a surge in sales of 24%; the increase can be explained by the economy's growth, increasing people's income and ability to afford it (Sithika, 2021).

A private car appears very suitable for many people as they can travel short and long distances. They can easily transport short distances to school, work, or anywhere across the city, and long distances across the country. Traveling to provinces during holidays with a private car brings more comfort and convenience.

B. Motorcycle

Private motorcycles remain the most popular mode of transportation in Cambodia, with 5.2 million motorcycles registered with an annual growth rate of 300,000 to 400,000. There is no driving license for small-engine motorcycles below 125cc, but it is required for engines above 125cc. People of most ages use motorcycles for daily use, transporting around the city to school, work, or leisure. Riding motorcycles is more accessible considering the congested roads of the city. Moreover, tourists can rent a bike for short trips in the town to enjoy the beautiful scenery.

For instance, motorcycle rental is popular among tourists in Siem Reap, seeing Kulen Mountain and Kampot enjoying Bokor Mountain, with a price range from 5 to 25 dollars per day.

Apart from owning motorcycles, the population can transport using a motorcycle taxi called Motor Dob. It is the fastest and most common form of transportation found in almost every city corner; typically, the drivers would approach, and the price could be negotiated. However, this transportation is limited to only one driver and one passenger. Thus, most people use motor dob for short rides; a group of tourists would need a few motor taxis, which is inconvenient and lacks space for bags or luggage.

C. Bus/ Van

Populations who do not own or want to use a private vehicle for traveling can depend on various private bus companies in the kingdom. There are currently over ten bus companies, with a few attracting the population the most, including Giant Ibis, Mekong Express, Capitol, Laryta, and Cambodia Post VIP Van. These companies provide buses with not only typical 45 seats but also minivans with 12-15 seats, which are faster and more comfortable. Extra services such as wifi and water are also found in all the leading companies mentioned.

However, most of these companies only offer rides to leading tourist destinations, for instance, Phnom Penh, Siem Reap, Sihanoukville, Battambang, Kep, Kompot, and neighboring borders such as Thailand, Vietnam, and Laos. Thus, for people who wish to travel to other provinces, another option is by vans, typically with 12-15 seats found at the big bus stations; drivers would raise their hands and lobby passengers to take the ride. Issues for these types of van services is that it is not comfortable, the 15 seats sometimes exceed more as the drivers would pick up passengers on the street frequently.

D. Taxi

Riding a taxi is also a popular option, especially among expats who need to be picked up from the airport to their hotels. Most company taxis, such as Global Taxi, Taxi association, and Tranchoic Taxi, can be found in -populated tourist destinations, especially the airport, but the most common are the unmarked and unmetered taxis that agencies or hotels can arrange. The price from the airport to the city center would cost around 12 to 18 dollars.

Private taxis can also be booked to various destinations in Cambodia apart from the city. Tourists can use booking websites or applications such as BookMeBus to book taxis for their trips with a fixed price and comfortable service.

E. Plane

Despite having ten airports in the country, only three international airports are in operation: the Phnom Penh International Airport, Siem Reap International Airport, and the Sihanoukville International Airport. Phnom Penh and Siem Reap can host up to 5 million passengers a year, with the Phnom Penh Airport can handle ten aircraft at once while Siem Reap Airport can hold 8. The Sihanouk Airport can take relatively more minor passengers, only 0.5 million per year, and handle four aircraft simultaneously (Asian Development Bank, 2019).

Due to the increase in tourists, in 2019, the Phnom Penh Airport accounted for 6 million, 3.9 million for Siem Reap, and 1.6 million for Sihanoukville Airport. All three airports are in service for 55 destinations and welcomed more than 700 flights per week before the pandemic. Most passengers take domestic flights to save time as it only takes 45 minutes from Phnom Penh to Siem Reap and Sihanoukville, but the price ranges from 50 to 100 US dollars (Eurocham Cambodia, 2020).

F. Cyclo

Cyclo is a three-wheeled bicycle taxi, one of the oldest transportation in the kingdom for the past 80 years. Transportation was widely popular among Cambodians, accounting for 1,500 cyclos in Phnom Penh in 1999, but the number dramatically dropped to only 300 in 2021(Touch, 2020). The low rate of cyclo poses a threat to the extinction of this service due to the emergence of faster and more modern forms of transportation. Frequently, people use cyclo for short rides, such as from home to the market, or for leisure, exploring the view of the city. It offers a more romantic and relaxed ride when time is not a concern(Phnom Penh Capital Hall, n.d).

G. Tuk Tuk/ Rickshaws

Tuk Tuk or Remork used to be the most favoured transportation in the kingdom, especially in the capital city and main tourist destinations such as the city view or temples because it could easily hold many people like a group of family or tourists. In recent years, Remork has been replaced by electric rickshaws because most find the price negotiation with Remork drivers a headache. In contrast, the rickshaws calculate the price according to the length of the ride. Despite the decline in popularity, Remork is still in demand for sightseeing because rickshaws are small and inconvenient for viewing the scenery (Raksmey, 2022).

Electric Rickshaws such as Passapp and Grab are newly emerging transportation in Cambodia, which gained vast support from Cambodian citizens, as it is modern, quick, and safe at a reasonable price. In 2019, Grab and Passapp in the kingdom were evident, with the drivers having accumulated more than 10,000 drivers with Grab coming into the competition with technological advantage and further expansion such as Grab Car, Grab Rewards and even Grab Pay(Shaun Turton & Bopha Phorn, 2019).

H. Bike

Daily bicycle transportation in Cambodia is vastly for Cambodian students who have financial difficulties, especially in rural areas. Families with poor economic backgrounds with kids live a few kilometers away from school by bike. Thus, foreign stakeholders regularly donate bikes to rural places for students who cannot afford a bike to have one for traveling to school. Moreover, bikes are popular among tourists who want to enjoy forestry or temple views, especially in Siem Reap. Bicycle rental can be found in the center of the town with prices ranging from 3 to 5 dollars per day.

I. Boat & Ferries

Water transportation, such as boats and ferries, is also available in Cambodia. The speed ferry allows passengers to travel from Phnom Penh to Siem Reap and Siem Reap to Battambang along the Mekong River. The ride from Phnom Penh to Siem Reap would take approximately 5 hours and cost 35 dollars, while the ride from Siem Reap to Battambang would take 5 to 8 hours and cost 16 dollars. Moreover, in Sihanoukville, boat and ferry services are in demand due to the need for people to travel from one island to another. Tickets can be purchased from several companies or agencies.

The issue regarding these water transportation is that they can be operated when adequate water is in the Mekong River. Thus, during the low water season, specifically from March to July. Moreover, the price and duration of the ride are higher and longer than other modes of transportation.

II.3. Existing Sustainable Transportation in Phnom Penh

Cambodia has committed to transforming its transportation industry to be sustainable by reducing fuel use in vehicles and replacing them with green cars that run on electricity to cut operating costs and eliminate greenhouse gas emissions (Vanyuth, 2021). Sustainable transportation refers to any green transportation with a low environmental impact, including walking, cycling, public bus, carpooling, car sharing, and green vehicles (Marwah, 2022). In Cambodian traffic, many electric vehicle (EV) four-wheelers have been noticed (Chanthol & Chaker, 2022). For example, various companies have exhibited more than ten models of EV automobiles in Phnom Penh showrooms. In addition, the two-wheeler market has approximately nine suppliers, whereas the three-wheeler market has one supplier. Aside from Evs, there is also an innovative ride-sharing service called Go2, which provides a smartphone platform for consumers to rent electric motorbikes for only 4.5 cents per minute (Energy Lab, n.d).

II. 4. Roles and Benefits of Sustainable Transportation for Cambodia

II.4.1. Roles of Sustainable Transportation in Environmental Protection in Cambodia

According to Environmental Protection UK, transportation is the leading source of air and noise pollution, accounting for 27% of total greenhouse gas (GHG) emissions, with 122 million metric tons of carbon dioxide produced in 2019 (Paul Collins, 2021). While in the US, transport is also a major emitter of GHG, accounting for nearly 30 percent of total greenhouse gas emissions in 2020 (United States Environmental Protection Agency, 2022). However, personal automobiles account for 82% of these emissions, with buses and railways accounting for only 6% (Jane Marsh, 2020). Based on Qureshi and Lu (2007) & Whitelegg (1993), greenhouse gas emissions and transportation energy use are expected to double by 2025. This highlights the critical importance of increasing sustainable transportation consumption. Furthermore, Black (1996) stated that "the current petroleum-based motor vehicle highway system is not sustainable due to the finite nature of petroleum reserves, air quality problems, global atmospheric problems, excessive fatalities, congestion, and urban sprawl". Thus, shifting the transportation mode to green transportation contributes to environmental protection in many ways.

II.4.2. Roles of Sustainable Transportation System in Economic and Social Development in Cambodia

The shift to green transportation will reduce greenhouse gas emissions and contribute to economic and societal growth and development. It promotes road safety, investment opportunities, and job creation. In terms of people's safety, it is ten times safer per mile to use sustainable public transportation rather than private mobility, and it would help minimize the probability of getting into a traffic accident by 90% (Marsh, 2020). In Cambodia, road accidents are one of the leading causes of mortality. As reported by UNDP (2021), traffic accidents alone caused 13,700 injuries and over 2,000 deaths in 2019, with 5.4 people dying on average every day. The death rate would fall dramatically with the emergence of sustainable transportation consumption. On the other hand, sustainable transportation, such as buses, trains, bikes, and light rail, employs roughly 450,000 people (The Campaign for Better Transport, 2010). Overall, according to the Low Emission Development Strategies Global Partnership's series of reports, sustainable transportation "creates jobs, improves commuter safety through investments in bicycle lanes, pedestrian pathways, and non-pedestrian pathways, and makes access to employment and social opportunities more affordable and efficient" (Marwah, 2022).

III. Research Design and Methodology

This project was conducted as an experimental design by employing descriptive and explanatory approaches to explore the critical perception of domestic commuters' service

satisfaction provided by public and private transport regarding digitalization, on-demand services, and sustainable transport in the rise of Industry 4.0. Today, only Phnom Penh has public and private transportation service providers (i.e., Grab or PassApp). Therefore, the data collection was conducted in Phnom Penh using a structured questionnaire and social tools for quantitative and qualitative data.

Household surveys among commuters were conducted using standardized questionnaire items among domestic commuters in Phnom Penh. Known population is adopted to determine the sample sizes based on Yamane (1967) with 6% precision. In 2019, the public bus service transported 8.3 passengers; an average of between 28,000 and 30,000 passengers were using the public bus (Phnom Penh municipal administration). Out of the population, 304 domestic commuters were contacted and agreed to participate in interviews. Two groups of commuters were interviewed. An experimental group is a group of Phnom Penh residents who experienced public and private transportation, with a sample size of 155 residents. Another group is the control group, who are Phnom Penh residents who experienced using private transport only; the sample size was 149 residents.

The observation was done by investigating the behaviors of passengers and drivers for qualitative research. Also, the observations were conducted to identify the quality of services and conformability of bus stops.

Key informants were made with relevant organizations, including government agencies, private companies, and NGOs. The interview is necessary to collect data regarding policy, legal framework, and services operated by public and private transport services.

Key Stakeholder Consultations were conducted to collect their comments, feedbacks and inputs from key stakeholders, including government, private companies, commuters and groups, and NGOs, after getting preliminary findings for validation, feedback, and further inputs before writing the manuscripts and reports. A consultation was organized among domestic commuters of public and private transportation services. Another consultation was conducted to share the preliminary findings and to collect feedback, comments and additional inputs, including suggestions for policy applications and future planning.

Excel and Statistical Package for the Social Sciences (SPSS) were used to process, manage and analyze the data. The Excel program was used for data entry, while SPSS was applied for data analysis. Descriptive statistical analysis tools were performed in this report.

- Mean and Standard Deviation were used to measure the respondents' perception and insights, for example services of private and public transportation services.
- Weighted Average Index (WAI) was used to rate the degree of satisfaction of the respondents regarding services of public and private transportation. The five scales were: (1) considerably less; (2) less; (3) moderate; (4) high; (5) very high.

- T-test was applied to compare the mean scores of two groups on a given variable (both public and private transportation users and private transportation users only).

IV. Data Analysis from the field

IV.1. Characteristics of Respondents

Target groups of respondents are residents, and commuters who have experience using transportation services, including private and public transportation in neighborhoods of Phnom Penh. During the survey, 304 respondents were contacted for the interviews to share their insights and perception regarding their services . In this research, private transportation refers to personal or owned vehicles or private transportation services such as Rormork, Rickshaw and Aassapps, Tuk Tuk, and taxis. In recent years, various technology companies which provide users with transportation services in Phnom Penh; they include PassApp, Grab, WeGo, and TADA. Public transportation is a municipal public transport system only served in Phnom Penh by the Phnom Penh Municipal Government. Since 2014, the Phnom Penh Municipal Government has operated a city bus starting from three lines and has 17 lines across the city. The current public bus system works in Ta Khmao (South), Prek Pnov (North), Chbar Ampov (East), and Special Economic Zone (West). The fare per voyage, irrespective of distance, was 1500 Khmer Riels or US$ 0.37. Travelers who are senior citizens over 70 years, young children under 1 meter, disabled, monks, students, and teachers are eligible for free travel, but must show their identities. In addition, the Phnom Penh Municipal Government also granted free travel among factory workers, valid between 1 September 2017 and 1 September 2021.

Snowball sampling design was applied to recruit the participants for the interview. Male and female respondents were similarly recruited: 57 % of females and 43% are males (Table 1).

Table 1 to 5 briefly describes demographic information and data to provide some background of the respondents before making analyses of their perception regarding their transport experience in Phnom Penh of Cambodia.

Table1. Percentage of gender and type of transportation they were using

	Both Private and Public	Private Transportation Only	Overall
Male	41.3	44.3	42.8
Female	58.7	55.7	57.2
Overall	**100.0**	**100.0**	**100.0**

More than half (57.6%) of the respondents completed their bachelor's, followed by a Master's (1.3%) and Ph.D. (0.7%). Around fifth of the respondents (9.2%); 12.1 of them experienced using private transportation only, and 6.5%used both private and public transport (Table 2).

Table2. Educational attainment of the respondents

Attributes	Both Private and Public Transportation	Private Transportation Only	Overall
Lower than secondary school	6.5	12.1	9.2
Associate/technical school	11.0	8.7	9.9
Bachelor	55.5	59.7	57.6
Master	1.9	0.7	1.3
PhD	1.3	0.0	0.7
Overall	**100.0**	**100.0**	**100.0**

Approximately 56.0% were born in Phnom Penh, and the other 44.0 % were originally from different provinces across the country (Table 3). The research only interviewed the respondents who experienced using private transportation only and both public and private transportation. The analysis was beneficial in improving the implication of transport in Phnom Penh and Cambodia as a whole. In general, newcomers to Phnom Penh from other parts of Cambodia may face some issues regarding traffic congestion and the selection of vehicle types for their daily commute.

Table3. Percentage of place of birth

		Both Private and Public	Private Transportation Only	Overall
Born in Phnom Penh	Yes	60.0	51.7	55.9
	No	40.0	48.3	44.1
	Overall	100.0	100.0	100.0

Most of the respondents (76.3%) were single and 23.3% were married (Table 4).The respondents provided their experience of transportation for their daily trips to their destinations for work and other purposes. Table 5 reveals that 71.4% of the respondents were working, and 28.6% of others did not have jobs yet. The number of commutes is also influenced by their positions because working people may require more trips, especially to their working destination. In Phon Penh, motorists tended to own most households; however, they also held cars. Some people use both motors and vehicles. At the same time, the number of household members is also associated with the number of vichical owned.

Table4. Percentage of marital status

	Both Private and Public	Private Transportation Only	Overall
Single	80.0	72.5	76.3
Married	20.0	27.5	23.7
Overall	100.0	100.0	100.0

Table5. Percentage of respondents having job and type of transportation they were using

		Both Private and Public	Private Transportation Only	Overall
Are you working now?	Yes	67.7	75.2	71.4
	No	32.3	24.8	28.6
	Overall	100.0	100.0	100.0

o IV.2. Operating/Active public and private transports in Phnom Penh

The results from fieldwork show that more than half of the respondents were working as full-time staff. A higher proportion of the respondent (68.5%) working full-time used private transportation only. It is also the case for part-time workers; the number of private transportation travelers is less than part-time workers who consume both public and private transportation services, which is about 7% and 11%, respectively (Table 6). Private transportation was crucial to the residents, especially those who worked full-time, because they required more frequency and urgency for their trips to work. The selection of vehicle types was likely dependent upon affordability and preference. However, most people liked cars but could not afford them, especially gasoline.

Table6. Percentage of respondents having part-time or full-time job and type of transportation they were using

N=304	Both Private and Public	Private Transportation Only	Overall
Full-Time	56.8	68.5	62.5
Part-Time	11.0	6.7	8.9
Overall	67.7	75.2	71.4

The participants in the interviews came from a variety of positions and careers, ranging from professionals, managers, technicians, associate professionals, clerical support workers, services and sales workers, skilled agricultural, forestry and fishery worker, craft and related trades worker, plant and machine operators, assembler, elementary occupation, armed force, and students. The majority of the commuters were in the services and sales (27%) and clerical (13%). There are a number of professionals, managers, technicians, associate professionals, skilled agricultural, forestry, and fishery worker, craft and related trades worker, Plant and machine operators, assemblers, elementary occupation, armed forces, and students, and there are about 28.6% do not have any employment or any study (Table 7).

Table7. Percentage of their type of primary job and type of transportation they were using

N=304	Both Private and Public	Private Transportation Only	Overall
Manager	3.2	6.7	4.9
Professional	6.5	8.1	7.2
Technicians and associate professional	6.5	2.0	4.3
Clerical support worker	9.7	16.1	12.8
Services and sales worker	29.0	24.8	27.0
Skilled agricultural, forestry and fishery worker	0.6	0.7	0.7
Craft and related trades worker	1.3	0.0	0.7
Plant and machine operators, and assembler	0.6	6.0	3.3
Elementary occupation	3.2	8.1	5.6
Armed force	1.3	0.0	0.7
Study only	3.9	2.0	3.0
Other	1.9	0.7	1.3
Jobless	32.3	24.8	28.6
Overall	100.0	100.0	100.0

The morning travelers used as many transportation services, either public or private, and more morning commuters than the afternoon (Figure 1). Among working people only, the respondents traveled in the morning, between 63.4% (private transportation only) and 67.6% (mixed public and private transportation). At the same time, most afternoon travelers use private vehicles only, which was 36.6%, compared to mixed public and private transport, which is about 32% (Figure 2). The respondents traveling with private transport tended to be faster because they could use App to order while public transport needed to wait at the station.

Figure1. Percentage of their working day and type of transportation they were using

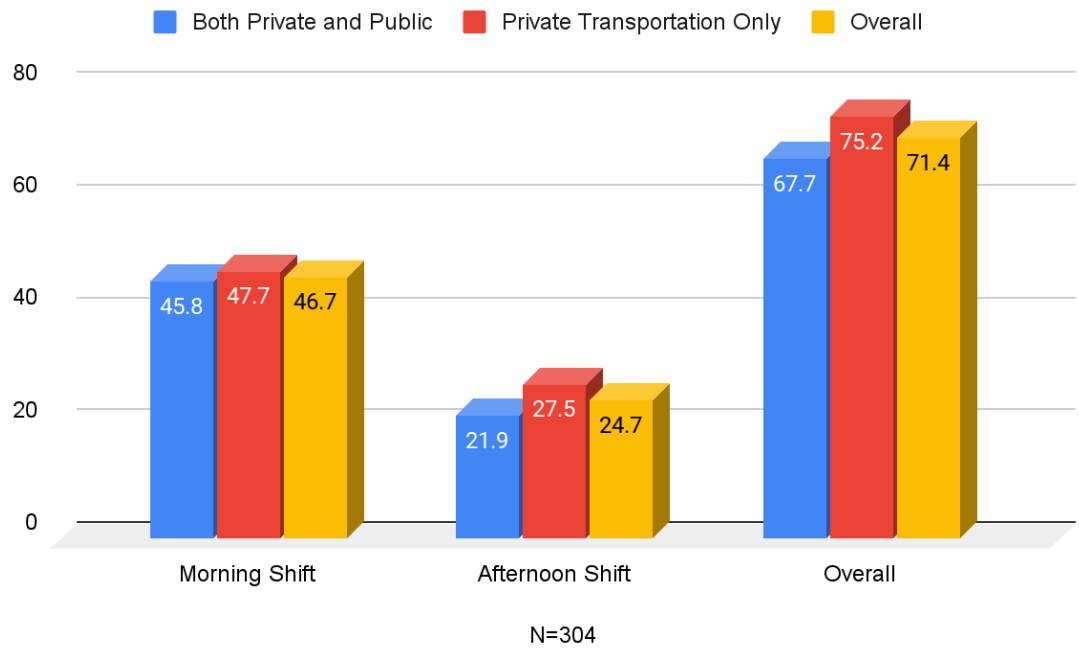
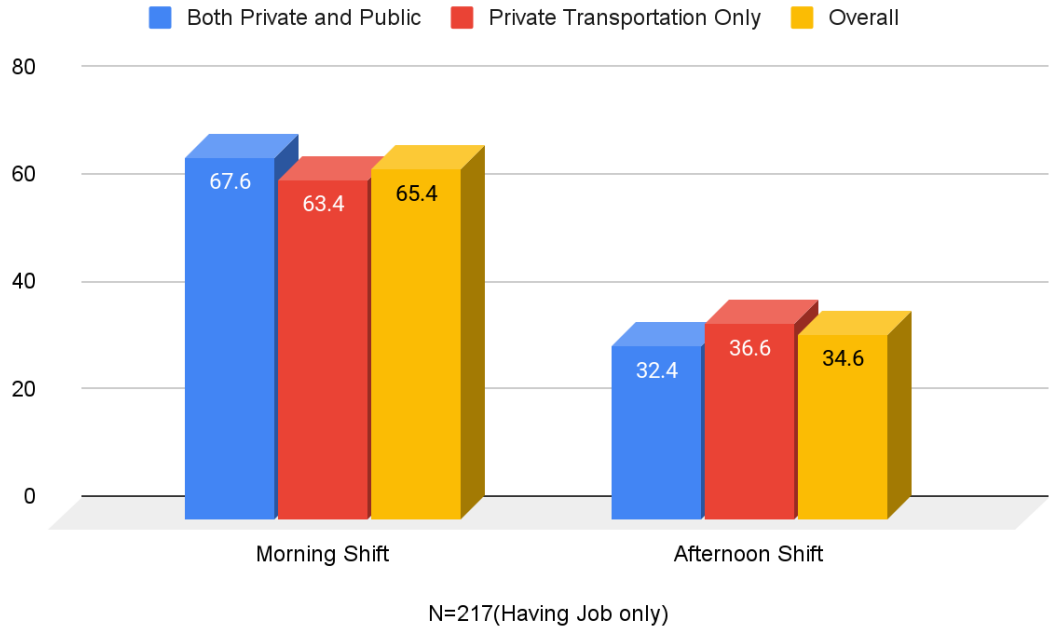
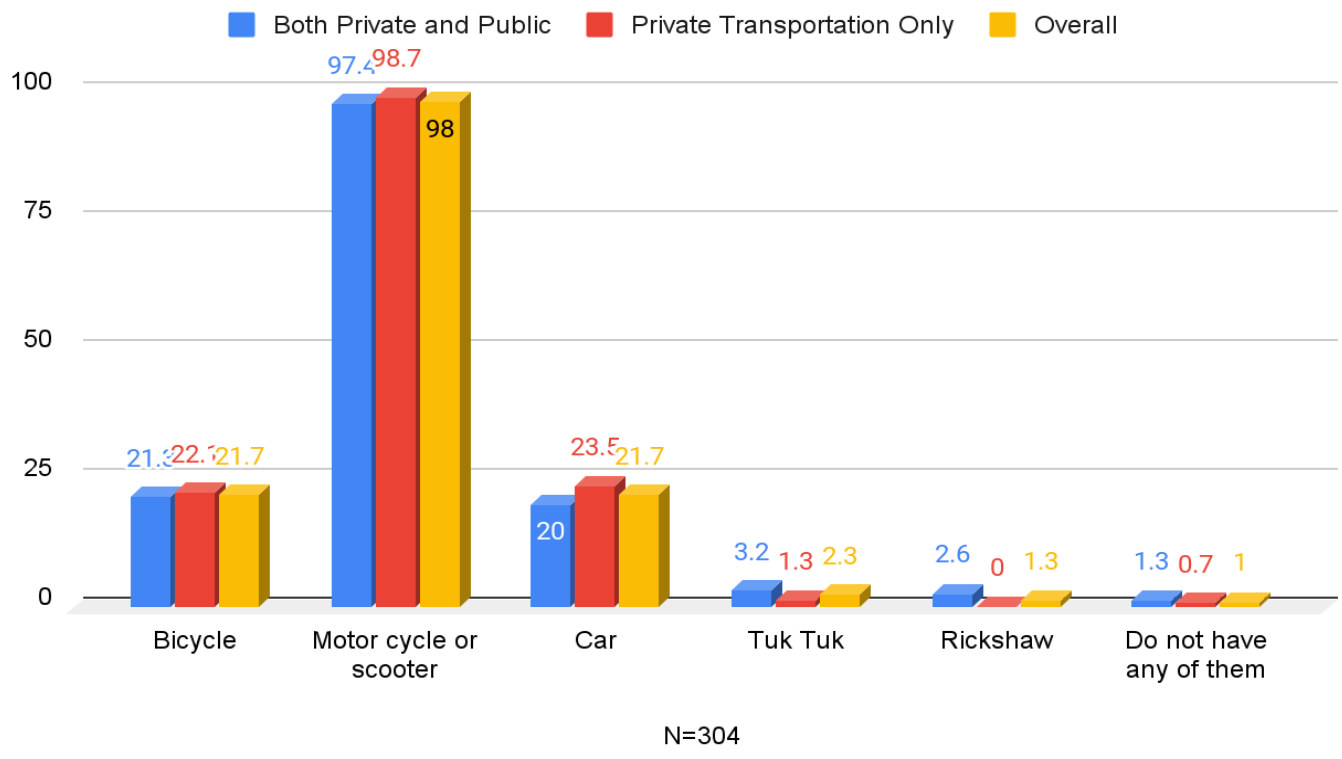


Figure2. Percentage of their working day and type of transportation they were using (Working People Only)



In terms of the type of personally owned transporter, the majority of the respondents owned at least a motorcycle or scooter (98%), followed by a bicycle (22%) and car (20-23%). For over three decades, motorcycles remained the primary type of vehicle used by Cambodian people. Motorcycles have been popularly used for daily commutes, especially to work; they were brand new second-hand made in Japan, South Korea, and China. Although those who use public transportation, the majority of them also own at least a motorcycle or a scooter. Furthermore, most private transportation also travels by motorcycle or scooter. A small proportion of the respondents were transported by Rormork or rickshaw. It is noted that 1.0 % of the respondents owned neither a vehicle nor a bicycle. They either used shared private transportation but did not own any personal vehicle (Figure 3).

Figure3. Percentage of all type of vehicles they owned and type of transportation they were using



Of all vehicles that the respondents owned, since most of them owned only a motorcycle or scooter, they did not really own many vehicles, so the type of primary vehicle that they used was the motorcycle or scooter (92.4%), followed by car (4.6%) (Table 8). Very few use bicycles, Rormork, or rickshaws. Apart from using public transportation for those who use mixed transportation (both public and private transportation), their primary private vehicle that you

would use is a motorcycle or scooter (93%), and a car (2.6%). Similarly, in private transportation, only commuters travel with their scooter or motorcycle (about 92%) and car (6.7%) (Figure 4).

Table8. Percentage of type of primary vehicle they owned and they were using

N=304	Both Private and Public	Private Transportation Only	Overall
Bicycle	0.6	0.7	0.7
Motorcycle or scooter	92.9	91.9	92.4
Car	2.6	6.7	4.6
Rormork	1.3	0.0	0.7
Rickshaw	1.3	0.0	0.7
Do not have any of them	1.3	0.7	1.0
Overall	100.0	100.0	100.0

Figure4. Percentage of type of primary vehicle they owned and type of transportation they were using

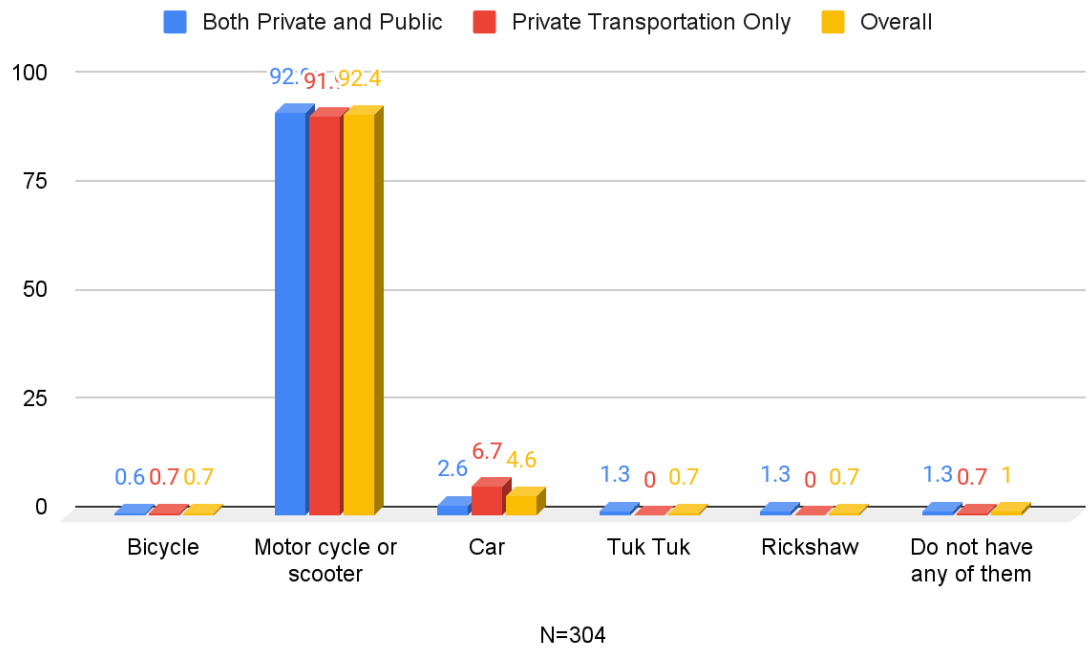


Table 9 describes perception towards the frequency of the respondents in using the following types of vehicles for their transportation to the destination. Weight Average Index (WAI) shows that the respondents used motorcycles or scooters all the time; they sometimes used Rormork. Other types of vehicles such as cycles, public bus, passenger in a car, van, rickshaw, and taxi were rated as rare frequencies. T-test also confirms that the respondents who used both private

and public transportation rated more frequency to commute on foot, public bus, van and rickshaw than those who traveled by private transport only. Some people prefer different types of transport used for different purposes. For example, they may travel by car when they travel far distances but they may use public buses or their own motor bike for work. People also liked to use Rormork or Richaw for going to parties because they are affordable and safe.

Table9. Frequency of using the following types of vehicles for their transportation

Attribute	Both Private and Public (n=155)		Private Transportation Only (n=149)		Overall (n=304)		P-value
	WAI[1]	OA	WAI	OA	WAI	OA	
On foot	0.19	R	0.15	R	0.17	R	0.04*
Bicycle	0.14	R	0.10	R	0.12	R	0.10
Public bus	0.33	S	0.04	R	0.19	R	0.00**
Motor cycle or scooter	0.80	VO	0.81	AT	0.81	AT	0.71
Drive a car	0.20	S	0.20	R	0.20	R	0.84
Passenger in a car	0.19	R	0.17	R	0.18	R	0.28
Lorry or van	0.16	R	0.12	R	0.14	R	0.00**
Rormork	0.28	S	0.24	S	0.26	S	0.09
Rickshaw	0.08	R	0.04	R	0.06	R	0.01**
Car/Taxi	0.08	R	0.06	R	0.07	R	0.22

IV. 3. Transportation experience and satisfaction

Based upon the result of surveys and in-depth interviews and focus group discussions, it is understood that a motorbike was the most convenient and frequently used vehicle. Motorbike is affordable to all classes in Phnom Penh and Cambodia as a whole. Almost everyone can afford to process a motorbike. In addition, it is convenient and does not have as much traffic as a car. The respondents reveal that a car is the best option for a far distance, for example the travel is between 100 and 200 kilometers. Car has an air conditioner and can maintain temperature to make the traveler comfortable. Motorbike is good for working staff and business. Moreover, cars require a high cost for gasoline and some of the cost for car parking. PassApp is good for 20- and 30-kilometers distances. PassApp is easy and convenient. The service can be ordered from an App available on the phone. Public transport is good for monks, teachers, students and

[1]Notes: WAI = weight average index measured on a five-point scale [Rarely(R) = 0.00–0.20, Sometimes(S) = 0.21–0.40, Often (O) = 0.41–0.60, Very Often (VO) = 0.61–0.80, Very All the time (AT) = 0.81–1.00]. Not Relevant= NR, OA = Overall assessment.

workers who wish to travel long distances with an affordable fee. It is cheap or free for students, monks, and disable and garment workers with card proof. However, they may need more time to travel.

More particularly, private transportation services like PassApp are preferable because services are available every time and everywhere, place and seat are comfortable, waiting is less than ten seconds. Moreover, PassApp can carry out heavy cargo, and transport passengers when they are drunk. Drunken passengers would feel safer to go by PassApp than they drove themself. On the other hand, PassApp can save more money if passengers share costs during their transportation; it can carry as many as four people per commute. App applications can help to track location and identity of drivers which are important for safety reasons.

Public or bus transportation is favorable when it offers affordable and fixed prices. Moreover, it is free for students, people with disabilities, elderly and garment workers. It is the safest means of transportation with aircon, comfort, less pollution, less traffic time. But the waiting time and the availability in different corners of the city is a concern. Some passengers also complained about many stops and noises made by other passengers during the commutes.

Perception regarding own transportation (self-vehicle) was only it provides faster and convenient, and no need to wait to commute. People prefer using owned vehicles because they are convenient and on-demand. However, it can be less preferred as it produces high pollution and high cost of maintenance. In general, Cambodian people do not like to walk to seek for transportation as well as wait a long time.

Table 10 indicates that three top purposes of transportation among 304 commuters are traveling to work, traveling to market and visiting other places. T-test analysis confirms that the perception of the respondents with both private and public transportation and private transportation only were not significantly different. The respondents rated very often for travelling to work/offices and often to markets and places for visit. Sometimes, the respondents travelled to pick up their families. Commuters rarely travel either by public or private transportations for bringing children to school, rice transportation, transporting crop production, transporting livestock production, or transporting stuff for business activities. This could demonstrate that apart from traveling to work or market, other purposes to use either public or private transportation is not majorly needed could be because they walk or their work does not require additional travel purposes, they are single, or they do not have other purposes at all to travel beside work and shop. In these recent years, travel congestion has become bad in Phnom Penh. Some people did not prefer to travel if they are not necessary. Some people require to get up early in the morning to travel to work to avoid traffic jams.

Table10. How often they used their vehicle according to the following purposes and type of transportation they were using

Attribute	Both Private and Public (n=155)		Private Transportation Only (n=149)		Overall (n=304)		P-value
	WAI	OA	WAI	OA	WAI	OA	
Working place	0.58	O	0.64	VO	0.61	VO	0.21

Traveling to market	0.45	O	0.50	O	0.48	O	0.12
Bringing children to school	0.11	R	0.10	R	0.11	R	0.72
Bringing family member to hospital	0.26	S	0.28	S	0.27	S	0.33
Visiting other place for pleasure	0.45	O	0.43	O	0.44	O	0.50
Going to religious places like pagoda	0.28	S	0.29	S	0.28	S	0.89
Transporting rice production	0.03	R	0.05	R	0.04	R	0.35
Transporting crop production	0.03	R	0.05	R	0.04	R	0.17
Transporting livestock production	0.03	R	0.02	R	0.03	R	0.30
Transporting stuff for business activities	0.09	R	0.06	R	0.08	R	0.13
Other purposes	0.03	R	0.04	R	0.04	R	0.94

Table 11 describes the travel behavior of Phnom Penh residents. The study shows that people in Phnom Penh are more likely to commute with their relatives and friends using both public and private transportation than those who use private transportation only, 0.44/0.46 versus 0.42/0.44 respectively. However, the respondents similarly commute with colleagues sometimes. Moreover, they rarely travel with spouses or children or clients. This may be because they are single, or their work does not require any transportation or meeting clients. Travelling together also helps to reduce cost or reduce pollution. People have started to realize this issue.

Table11. How often they used their vehicle with the following people and type of transportation they were using

Attribute	Both Private and Public (n=155)		Private Transportation Only (n=149)		Overall (n=304)		P-value
	WAI	OA	WAI	OA	WAI	OA	
Spouse	0.09	R	0.15	R	0.12	R	0.05*
Children	0.09	R	0.12	R	0.11	R	0.28
Relatives	0.44	O	0.39	S	0.42	O	0.07
Colleagues / co-workers	0.33	S	0.33	S	0.33	S	0.93
Friends	0.46	O	0.43	O	0.44	O	0.17
Clients	0.15	R	0.12	R	0.13	R	0.24
Others	0.02	R	0.02	R	0.02	R	0.68

Table 12 illustrates that to a large extent both public and private transportation users and private transportation only users were satisfied with services provided such as travel stability, driver attitude, ease of boarding and alighting, internal temperature, walking distance to stations or stops, and travel time and reliability. However, to some extent transport services were found moderately satisfied and preferred from private to public or vice versa. For example, seat stability travelers were more satisfied for private transportation only users than those who were both private and public transport users. Wait for the service for those who use both public and private transportation is a little bit more satisfying than those who use private transportation only. It is also interesting to note that the condition of a station or stops for public and private transportation services are received better than those who use private transportation only.

Table12. Respondent'' satisfaction toward private company transports service for their trip and type of transportation they were using (argument of non-using public transports)

Attributes	Both Private and Public (n=155)		Private Transportation Only (n=149)		Overall (n=304)		P-value
	WAI	OA	WAI	OA	WAI	OA	
Seat stability	0.59	M	0.64	S	0.61	S	0.07
Travel stability	0.63	S	0.65	S	0.64	S	0.26
Wait for service	0.60	S	0.59	M	0.60	M	0.57
Driver attitude	0.62	S	0.61	S	0.61	S	0.55
Ease of boarding and alighting	0.65	S	0.63	S	0.64	S	0.17
Internal temperature	0.63	S	0.61	S	0.62	S	0.32
Walking distance to stations or stops	0.62	S	0.60	S	0.61	S	0.40
Travel time and reliability	0.65	S	0.62	S	0.63	S	0.06
The condition of station or stop	0.63	S	0.60	M	0.61	S	0.14

IV.3.1. Connectivity

Table 13 suggests that commuters would like to have some improvements in terms of connectivity in both public and private transportation services such as connection to lines of the

same operator, connection to lines of other operators, and line diversity (number of lines of the transit network). During field work, many respondents raised the issues about difficulty in using public transportation due to lack of connectivity and diversification. Sometimes the traveller wished to travel to the suburbs by public bus but they felt it was difficult to find connectivity therefore they opted to use private vehicles. Besides the cheaper cost, the people did not see much advantage of public buses. Some people have positive thinking of bus for good environment.

Table13. Level of agreement towards transport systems in term of Connectivity that respondents wish to be and type of transportation they were using

Connectivity	Both Private and Public (n=155)		Private Transportation Only (n=149)		Overall (n=304)		P-value
	WAI	OA	WAI	OA	WAI	OA	
Connection to lines of the same operator	0.79	A	0.72	A	0.76	A	0.02**
Connection to lines of other operators	0.76	A	0.72	A	0.74	A	0.10
Line diversity (number of lines of the transit network)	0.68	A	0.65	A	0.66	A	0.30

IV.3.2. Accessibility

Table 14 suggests that the respondents wished to have some improvements in terms of accessibility in public and private transportation services, such as accessibility of the bus network, reduced mobility users' accessibility, and adequacy of the most used bus stop location. There were few stops, and passengers needed to walk to find the station. Monks, students, teachers and workers felt that public buses were the best choice for them because they did not need to pay. Public buses also provide opportunities for parents to go to work because they do not need to bring their children to school. After being instructed and accompanied by parents a few times, many students could travel by bus to school and back home by themselves.

Table14. Level of agreement towards transport systems in terms of Accessibility that respondents wish to be any type of transportation they were using

Accessibility	Both Private and Public (n=155)		Private Transportation Only (n=149)		Overall (n=304)		P-value
	WAI	OA	WAI	OA	WAI	OA	
Accessibility of the bus network	0.74	A	0.72	A	0.73	A	0.37

(number of bus stops)							
Reduced mobility users' accessibility	0.78	A	0.77	A	0.77	A	0.63
Adequacy of the most used bus stop location	0.76	A	0.72	A	0.74	A	0.04

IV.3.3. Information

Table 15 suggests that the respondents would like to have some improvements in terms of information provided in both public and private transportation services, such as information panels on the next stop, information panels on terminals and bus stops, line information explicitness, availability of timetables and line plans, and information on passes and tariffs. Among all listed, there was a significant number of desires for information on passes and tariffs, which was for both public and private transportation. There was not yet no enough information about the station. The public transport was not yet good service so not many people were interested. The bus application should have information on bus schedules and updates. Many respondents knew nothing about public buses and they discouraged trying public buses.

Table15. Level of agreement towards transport systems in term of Information that respondents wish to be and type of transportation they were using

Information	Both Private and Public (n=155)		Private Transportation Only (n=149)		Overall (n=304)		P-value
	WAI	OA	WAI	OA	WAI	OA	
Service information availability	0.76	A	0.73	A	0.75	A	0.23
Availability of timetables and line plans	0.75	A	0.74	A	0.75	A	0.77
Line information explicitness	0.76	A	0.76	A	0.76	A	0.84
Information panels on terminals and bus stops	0.76	A	0.76	A	0.76	A	0.73
Information panel on next stop	0.77	A	0.76	A	0.77	A	0.42
Information on passes and tariffs	0.81	SA	0.80	SA	0.81	SA	0.64

IV.3.4. Time

Table 16 presents the level of satisfaction with transportation services in terms of time. Commuters of public and private transportations accept the time consumed by the transportation service. However, both "private and public" transportation users rated higher than those who are private transportation only, which is 0.68-0.73 WAI and 0.67-0.71 WAI, respectively. But overall, the time scale for punctuality, service frequency, trip duration, line reliability, and service time window is acceptable by both "private" and "public" transportations commuters. The respondents expressed that they accepted the travel time that the transportation services had offered so far. Some travelers care more about time constraints than the cost of travel; they wish to pay for the price. Therefore, public bus is not their option.

Table16. Level of agreement towards transport systems in term of Time satisfaction that respondents wish to be and type of transportation they were using

Time satisfaction	Both Private and Public (n=155)		Private Transportation Only (n=149)		Overall (n=304)		P-value
	WAI	OA	WAI	OA	WAI	OA	
Bus punctuality	0.68	A	0.71	A	0.70	A	0.28
Service frequency	0.68	A	0.69	A	0.69	A	0.65
Trip duration	0.70	A	0.70	A	0.70	A	0.83
Line reliability	0.73	A	0.71	A	0.72	A	0.29
Service time window	0.70	A	0.67	A	0.68	A	0.19

IV.3.5. Comfort

The respondents, according to their responses, overall found comfort with the transport systems of public and private transportation services (Table 17). They are comfortable with the physical state of vehicles, vehicle cleanliness, illumination, temperature, volume, professionality of transportation staff, bus stops, and visibility. Both "private and public" and private transportation only have relatively similar rates of comfort for both private and public transportation commuters, for private transportation only.

Table17. Level of agreement towards transport systems in term of Comfort that respondents wish to be and type of transportation they were using

Comfort	Both Private and Public (n=155)		Private Transportation Only (n=149)		Overall (n=304)		P-value
	WAI	OA	WAI	OA	WAI	OA	

Physical state of vehicles (quality, conservation, new/old)	0.79	A	0.80	A	0.80	A	0.77
Bus cleanliness	0.75	A	0.79	A	0.77	A	0.06
Bus comfort	0.77	A	0.78	A	0.77	A	0.58
Bus illumination	0.77	A	0.77	A	0.77	A	1.00
Bus temperature adequacy	0.79	A	0.76	A	0.78	A	0.10
Average user volume (occupancy)	0.76	A	0.74	A	0.75	A	0.36
Professionality/caution/ driver skillfulness	0.76	A	0.76	A	0.76	A	0.80
Bus stop coziness (weather conditions)	0.73	A	0.70	A	0.72	A	0.34
Bus stop conservation and cleanliness	0.72	A	0.73	A	0.72	A	0.87
Bus stop illumination	0.73	A	0.71	A	0.72	A	0.49
Adequate visual arrival of buses at bus stops	0.74	A	0.73	A	0.73	A	0.66

IV.3.6. Security/Safety

The study shows that commuters felt safe and secure traveling with either public or/and private transportation services and rated it higher than timeliness and comfort (Table 18). The safety and security included components such as vehicle safety, security on the vehicle, and vehicle stop/station safety. Among those components of safety and security, bus/vehicle safety is highly rated, 0.81 by commuters with both private and public transportation commuters, 0.83 by commuters with private transportation only, and 0.82 overall. The traveler raised two main issues of security: faster drivers and sexual harassers. If the bus is full; girls are probably violated with sexual harassment.

Table18. Level of agreement towards transport systems in term of Security/Safety that respondents wish to be and type of transportation they were using

Security/Safety	Both Private and Public (n=155)		Private Transportation Only (n=149)		Overall (n=304)		P-value
	WAI	OA	WAI	OA	WAI	OA	
Bus safety (vehicles)	0.81	SA	0.83	SA	0.82	SA	0.28
Security on buses	0.74	A	0.74	A	0.74	A	0.80
Bus stop safety	0.73	A	0.74	A	0.73	A	0.55

IV.3.7. Environmental Impacts

The responses show their rates in terms of impact on the environment. The commuters strongly agreed that the bus plays a key role in contributing to traffic fluidity, which is 0.83 WAI for both private and public transportation users, 0.82 WAI for private transportation only users, and 0.83 WAI in overall, which is the second highest rate so far among other assessments of satisfaction throughout the survey (Table 19). Since 2014, the government of Cambodia has put its vigorous efforts to promote environmentally friendly vehicles to reduce air pollution through bus operations. The action has to reduce individual car ownership and increase the number of users of public transportation for example, city buses.

Table19. Level of agreement towards transport systems in term of environmental impact that respondents wish to be and type of transportation they were using

environmental impact	Both Private and Public (n=155)		Private Transportation Only (n=149)		Overall (n=304)		P-value
	WAI	OA	WAI	OA	WAI	OA	
Noise	0.68	A	0.67	A	0.68	A	0.69
Bus contribution to traffic fluidity	0.83	SA	0.82	SA	0.83	SA	0.58

IV.3.8. User Attendance

Table 20 presents commuters' level of agreement regarding transportation personnel kindness. Users of transportation services, regardless of public or private, expect the kindness of transportation staff (incl. driver). It is also to note that users of both public and private transportation expect more kindness in public transportation service providers/operators higher than from private transportation only.

Table20. Level of agreement towards transport systems in term of that Transportation Personnel Performance respondents wish to be and type of transportation they were using

Transportation Personnel Kindness	Both Private and Public (n=155)		Private Transportation Only (n=149)		Overall (n=304)		P-value
	WAI	OA	WAI	OA	WAI	OA	
Driver kindness	0.75	A	0.71	A	0.73	A	0.06
Staff kindness	0.74	A	0.71	A	0.73	A	0.11

IV.4. Interests on Existing sustainable transport systems in Phnom Penh

IV.4.1. Economic Interest

In terms of economic value, the commuters reported that they agreed that the cost and benefits were acceptable and of value to respect. The economic value included ease of access, affordability, productivity/efficiency, and benefit to the economy. In many cases, a convenient transportation system helped increase economic activities because it helped mobility, job creation, and more business opportunities/initiatives. Drivers could earn more from the services. While travelers prefer lower cost of transport so that they can travel/go to work/schools/places more frequently and conveniently. However, it is to note that the combined transportation of public and private transportation services are more favored than private transportation only users (Table 21).

Table21. Level of agreement towards transport systems in term of Economic value that respondents wish to be and type of transportation they were using

Economic Outcome	Both Private and Public (n=155)		Private Transportation Only (n=149)		Overall (n=304)		P-value
	WAI	OA	WAI	OA	WAI	OA	
Easy to access by residents	0.76	A	0.75	A	0.76	A	0.70
Affordable transportation operation cost	0.77	A	0.76	A	0.77	A	0.78
High productivity/efficiency	0.75	A	0.73	A	0.74	A	0.26
High benefit to national economy	0.75	A	0.72	A	0.74	A	0.07

IV.4.2. Environmental Benefits

In addition to impact on the environment, transportation plays an essential role in keeping and increasing environmental value. The survey found that commuters agree that their way of transportation does contribute to a lot of environmental outcomes such as low ecological intrusion, low emission to air, low emission to water and soil, low noise, and low waste. Among ratings, public and private transportation commuters score higher than private transportation only (Table 22). Public transportation produces less pollution per trip than private transportation, especially when it can carry many passengers and things per trip/vehicle.

Table22. Level of agreement towards transport systems in term of Environmental value that respondents wish to be and type of transportation they were using

Environmental Outcome	Both Private and Public (n=155)		Private Transportation Only (n=149)		Overall (n=304)		P-value
	WAI	OA	WAI	OA	WAI	OA	
Low direct ecological intrusion	0.70	A	0.68	A	0.69	A	0.43
Low Emission to airs	0.74	A	0.72	A	0.73	A	0.28
Low emission to soil and water	0.74	A	0.72	A	0.73	A	0.30
Low noise	0.75	A	0.74	A	0.74	A	0.63
Low waste	0.75	A	0.74	A	0.75	A	0.78

IV.4.3. Social Benefits

In the lens of social value, the respondents strongly agreed that both public and private transportations offer a good deal of social value in terms of social safety and security, the highest rate among other assessments throughout the survey (Table 23). Public transportation contributes to social order, less traffic congestion, and less traffic accidents. Moreover, transportation plays a role in maintaining other social values such as fitness and health, livability and amenity, social cohesion, and working conditions in the transport sector. Like other assessments, it is found that public and private transportation commuters score higher than private transportation only.

Table23. Level of agreement towards transport systems in term of Social value that respondents wish to be and type of transportation they were using

Social Outcome	Both Private and Public (n=155)		Private Transportation Only (n=149)		Overall (n=304)		P-value
	WAI	OA	WAI	OA	WAI	OA	
Safety and security	0.84	SA	0.82	SA	0.83	SA	0.18
Fitness and health	0.78	A	0.75	A	0.76	A	0.14
Livability and amenity	0.77	A	0.74	A	0.76	A	0.11
Social cohesion	0.75	A	0.73	A	0.74	A	0.39

Working conditions in transport sector	0.75	A	0.73	A	0.74	A	0.15

IV.5. Perspective on future transportation system in Cambodia

According to in depth interviews, it shows a list of expectations that commuters wish to see some improvements and elements added onto the existing transportation services include:

- An App that provides GPS to track where the bus is.
- Bus is overcrowded. The number of passengers should be limited, for example to the number of seats.
- There are a lot of passengers when the students leave school.
- Encourage more people using public transportation.
- Creation of more lines and more destinations and diversify the destination.
- Be more punctual.
- Sky train and underground can help to make transport in the city better.
- The people do not prefer the bus because of the delay.
- Individual cars should park properly.
- Individual car drivers should be more careful.
- More knowledge of driving and traffic law.
- The urban planner should have some design for the sidewalk.
- There should be a road designed for public buses.

According to table 24, the respondents perceive the future of the transport system in Cambodia that improved/integrated transport and new technologies are the most important features, followed by a need for sustainable vehicles. The proposed system would help people to turn in using public transportation because it will also provide them with timely and faster ways of transportation.

Table24. Perception of level of important of features respondents would like to see in Cambodian transport system in the future and type of transportation they were using

Attributes	Both Private and Public (n=155)		Private Transportation Only (n=149)		Overall (n=304)		P-value
	WAI	OA	WAI	OA	WAI	OA	
Improved/integrated public transport	0.82	HI	0.83	HI	0.82	HI	0.77
Improved cycle facilities	0.70	I	0.71	I	0.70	I	0.64

Reduced demand/growth	0.77	I	0.75	I	0.76	I	0.44
New technologies	0.82	HI	0.83	HI	0.83	HI	0.71
Model shift	0.70	I	0.70	I	0.70	I	1.00
Attitude/cultural change	0.74	I	0.73	I	0.73	I	0.81
Car pooling	0.75	I	0.74	I	0.74	I	0.52
Sustainable car travel	0.80	HI	0.79	I	0.80	I	0.70
Flexible working	0.74	I	0.70	I	0.72	I	0.17
Bus tracking	0.78	I	0.74	I	0.76	I	0.05*
No need for much change in current transport service	0.70	I	0.66	I	0.68	I	0.09
Zero-emission, accessible, cheaper	0.78	I	0.74	I	0.76	I	0.06
Cable car system	0.75	I	0.71	I	0.73	I	0.06

IV.5.1. Perception on sustainable transportation

The interviews suggest some tips and advice for sustainable transportation. These include:

- Do not travel alone if going by car. If we are alone we should use a motorbike.
- Attitude and behaviors of drivers should be changed.
- Reform and improve the transportation system.
- Increase trains, trams and buses use in the city.
- Some parts of the city have no good road condition.
- Sky trains should be added. The skype train should be as low as PassApp.
- Respect each other when commuting

V. Conclusion and Recommendations

V.1. Conclusion

The shift to green transportation will reduce greenhouse gas emissions and contribute to economic and societal growth and development. It promotes road safety, investment opportunities, and job creation. It is ten times safer per mile to use sustainable public transportation rather than private mobility, and it would help minimize the probability of getting into a traffic accident by 90% (Marsh, 2020).

According to 304 respondents who provided their experience of transportation for their daily trips to their destinations for work and other purposes, private transportation was crucial to the residents, especially those who worked full-time, because they require more frequency and urgency for their trips to work. The majority of the respondents owned at least a motorcycle or scooter (98%), followed by bicycle (22%) and car (20-23%). Although those who use public transportation, the majority of them also own at least a motorcycle or a scooter. Furthermore, most private transportation also travels by motorcycle or scooter. A small proportion of the

respondents were transported by Rormork or rickshaw. It is a note that 1.0 % of the respondents owned neither a bicycle nor a vehicle. They either used a shared private transportation but did not own any personal vehicle. The study shows that the respondents used motorcycles or scooters all the time; they sometimes used Rormork.

The respondents rated very often for traveling to work/offices and often to markets and places for visit. Sometimes, the respondents traveled to pick up their families. Commuters rarely travel either by public or private transportations for bringing children to school, rice transportation, transporting crop production, transporting livestock production, or transporting stuff for business activities. This could demonstrate that apart from traveling to work or market, other purposes to use either public or private transportation is not majorly needed could be because they walk or their work does not require additional travel purposes, they are single, or they do not have other purposes at all to travel beside work and shop. To a large extent both public and private transportation users and private transportation only users were satisfied with services provided such as travel stability, driver attitude, ease of boarding and alighting, internal temperature, walking distance to stations or stops, and travel time and reliability, but not much with seat stability, waiting time and condition of a station or stops.

However, there are some more improvements as suggested by respondents as follows:

- **Connectivity:** there should be a connection to lines of the same operator, connection to lines of other operators, and line diversity (number of lines of the transit network). During fieldwork, many respondents raised the issues about the difficulty in using public transportation due to lack of connectivity and diversification.
- **Accessibility:** It is limited due to lack of information, inadequacy of the bus network,and adequacy of buses, stops and stations.
- **Information provision:** there is a call for more information such as information panel on next stop, information panels on terminals and bus stops, line information explicitness, availability of timetables and line plans, and information on passes and tariffs. Among all listed, there was a significant number of requests for information on passes and tariffs for both public and private transportations. Many respondents knew nothing about public buses and they discouraged trying public buses.
- **Safety and security:** commuters felt safe and secure traveling with either public or/and private transportation services, and rated it higher than those of timeliness and comfort. Among those components of safety and security, bus/vehicle safety is highly rated so maintaining and enhancing it is crucial and attractive.
- **The kindness of transportation staff (incl. driver):** It is also to note that users of both public and private transportation expect more kindness in public transportation service providers/operators higher than private transportation only.
- **The cost:** Travelers prefer lower cost of transport so that they can travel/go to work/schools/places more frequently and conveniently.
- **Social values:** The respondents strongly agreed that both public and private transportations offer a good deal of social value in terms of social safety and security, the highest rate among other assessments throughout the survey. Public transportation contributes to social order, less traffic congestion, and less traffic accidents. Moreover, transportation plays a role in maintaining other social values such as fitness and health, livability and amenity, social cohesion, and working conditions in the transport sector.

V.2. Policy Recommendations

Based on findings in the survey, in-depth interviews, group discussion and key informants during fieldwork in Cambodia. The following are some highly suggested policy recommendations for the policymakers and stakeholders:

- **Improving services' quality by increasing the access to information, accessibility and connectivity for the commuters:** During the research, many passengers complained about insufficiency of bus stops, lack of information about direction and diversified connectivity. The number of commuters is increasing so the Phnom Penh Municipal Government should also increase the accessibility to enable the passengers to be satisfied with the services. Moreover, the improved connection of commuting locations is required to promote public transportation usage. In particular, the availability and connectivity of public transportation should increase the availability, accessibility and connectivity in the suburbs of Phnom Penh. The attraction of travel should start from the expansion from the suburbs of Phnom Penh.
- **Promoting positive perception towards city buses among Phnom Penh residents:** The Phnom Penh Municipal Government should raise the awareness of public perception regarding the benefits of using public transportation. The Phnom Penh Municipal Government may produce short videos about public buses and also promote its help among school students, teachers and garment workers at their working place. Moreover, the Phnom Penh Municipal Government also should increase the accessibility and connectivity to comfort the commuters. During the research, many passengers complained about short bus stops, lack of information about direction and diversified connectivity.
- **Ensuring security and safety for passengers** by educating drivers to respect and be compliant to traffic laws safety measures and client satisfaction. Both public and private service providers should have driving licenses including bus, Rormork and Rickshaw, Taxi. The Phnom Penh Municipal Government and private companies should not allow any driver without driving licenses to provide services for the passengers. In addition, regular training and meetings should be organized to provide updated information and knowledge regarding the security and safety of the passengers.
- **Increasing public and private investment on city buses and other forms of public transportation in Phnom Penh:** Various experiences from developed countries, public transportation help to improve the environment and reduce traffic congestion. Therefore, the Phnom Penh Municipal Government should work with private companies to promote various forms of public transportation, especially city buses.

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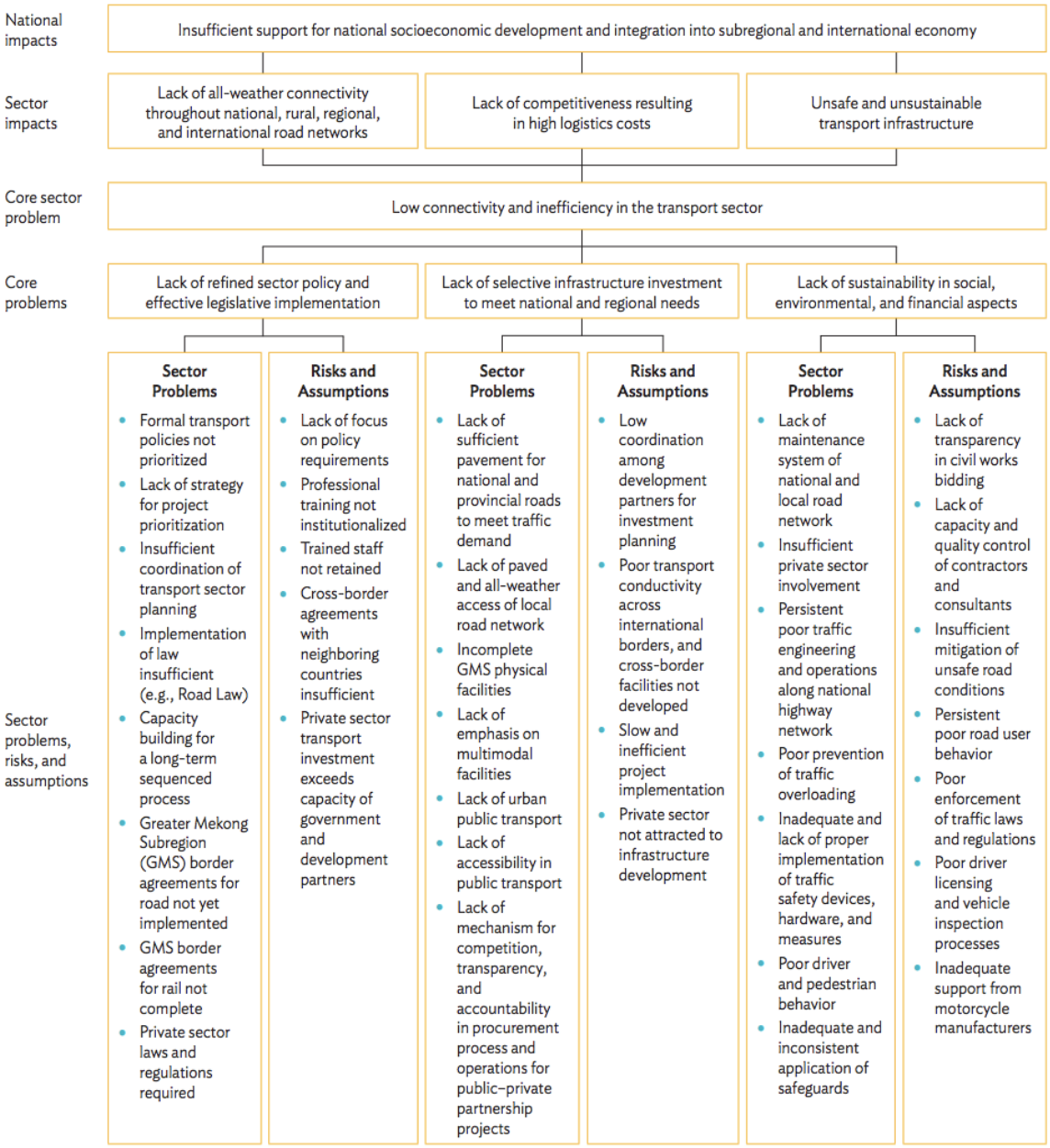
- **Appendix:**

1. Problem Tree For Transport Sector

APPENDIX

PROBLEM TREE FOR TRANSPORT SECTOR



Source: ADB 2019

2. Face to Face Questionnaire

Leveraging Industry 4.0 – digitalising on-demand services and promoting sustainable transport in urban Cambodia

We are a group of researchers from the Asian Vision Institute, granted by the Australian Alumni Cambodia, to conduct a study on Leveraging Industry 4.0 – digitalising on-demand services and promoting sustainable transport in urban Cambodia. This study specifically aims to provide a comprehensive understanding of opportunities to develop technological trends and infrastructure, which are crucial determinants of Cambodia's future industrial diversification, productivity growth, and competitiveness. It also attempts to understand areas for improvement for the government to support Phnom Penh Urban Transport Master Plan 2035 in the rise of Industry 4.0.

Consent Clause:

Your participation in this study is voluntary. It is up to you to decide whether or not to take part in this study. After you sign the consent form, you are still free to withdraw at any time and without giving a reason. Withdrawing from this study will not affect the relationship you have, if any, with the researcher. If you withdraw from the study before data collection is completed, your data will be returned to you or destroyed.

As part of the Australian Government's aid program, we request permission to film and/or photograph you.

The information below should help you to understand why we would like to take an image of you, where this image might be used, what might happen to this image and what rights you have. We will provide this information to you in a language you understand, either by the photographer or another person.

Australia's aid program uses photography to show people in your country and in Australia the positive impact of Australia's support and how it is benefiting your community.

If you understand this information and provide your informed consent for you to be filmed or photographed, please acknowledge by making your mark on this document.

We can also provide you with a copy of this information and the contact details of a person who can answer any questions you might have.

Declaration:

I, Participant, understand the provided information and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I voluntarily agree to take part in this study. (tick the box if yes)

Questionnaire for Face-to-Face Interview

July 2022

Date: ……..
Time Start:……**Time End:** …….
Name of interviewer: …….
Location of the site of the interview:
Commune……..…Village…….……Sangkat/district…….……Khan……..……
Province…….

Demographic information

Q00. Name (optional)	……	
Q01. Gender	☐0-Male	☐1-Female
Q02. Age/Year of birth	_____years old (Year……)	
Q03. Where do you currently live?	Commune……..…Village…….……. Sangkat/district…….……Khan……..…… Province……	
Q04. What is your latest education level?	_____years	☐14-Associate/technical school
	☐16-Bachelor	☐18-Master
	☐22-PhD	
Q05. Were you born in Phnom Penh?	☐0-Yes	☐1-No

Q06. Marital status	☐1-Single	☐2-Married
	☐3-Divorced	☐4-Other_____
Q07. What is the size of your family? How many family members do you live with?	.....	
Q08. Telephone No	.....	
Q09. Are you working now?	☐0-Yes	☐1-No
Q10. If yes,	☐0-Full-time	☐1-Part-time
Q11. And how many hours do you work per week? _____hours/week		
Q12. How many days are you working per week? _____days/week		
Q13. What is your current formal employment by occupation?		

Single Answer	☐1-Manager	☐2-Professional
	☐3-Technicians and associate professional	☐4-Clerical support worker
	☐5-Services and sales worker	☐6-Skilled agricultural, forestry and fishery worker
	☐7-Craft and related trades worker	☐8- Plant and machine operators, and assembler
	☐9-Elementary occupation	☐10- Armed force
	☐11-Study only	☐12-Other_____

Q14. Which shift are you working?	☐1-Morning	☐2-Afternoon
	☐3-Both morning and afternoon	☐1-Night
	☐3- Weekend	☐3- Weekday
	☐Others:.....	

Public and private transport available for communizing within urban neighborhoods

Q15. Which types of vehicles are you owning?		
Multiple Answer	☐1-Bicycle	☐2-Motor cycle or scooter
	☐3-Car	☐4-Lorry or van
	☐5-Tuk Tuk	☐6-Rickshaw
	☐7-Do not have any of them	☐8-Other_____

Q16. Which is your primary type of vehicle?		
Single Answer	☐1-Bicycle	☐2-Motor cycle or scooter
	☐3-Car	☐4-Lorry or van
	☐5-Tuk Tuk	☐6-Rickshaw
	☐7-Do not have any of them	☐8-Other_____

Q17. Please rate the most preferred mode of transport used to commute to your destination						
1-On foot	Not relevant	Rarely	Sometimes	Often	Very often	All the time
2-Bicycle	0☐	1☐	2☐	3☐	4☐	5☐
3-Public bus	0☐	1☐	2☐	3☐	4☐	5☐
4-Motor cycle or scooter	0☐	1☐	2☐	3☐	4☐	5☐
5-Drive a car	0☐	1☐	2☐	3☐	4☐	5☐
6-Passenger in a car	0☐	1☐	2☐	3☐	4☐	5☐
7-Lorry or van	0☐	1☐	2☐	3☐	4☐	5☐
8-Tuk Tuk	0☐	1☐	2☐	3☐	4☐	5☐
9-Rickshaw	0☐	1☐	2☐	3☐	4☐	5☐
10-Car/Taxi	0☐	1☐	2☐	3☐	4☐	5☐
11- Other:.....	0☐	1☐	2☐	3☐	4☐	5☐

Q18. Please rate the purposes of using different types of vehicles for transportation.						
	Not relevant	Rarely	Sometimes	Often	Very often	All the time
1- Working place	0☐	1☐	2☐	3☐	4☐	5☐
2- Traveling to market	0☐	1☐	2☐	3☐	4☐	5☐
3- Bringing children to school	0☐	1☐	2☐	3☐	4☐	5☐
4- Bringing family member to hospital	0☐	1☐	2☐	3☐	4☐	5☐
5- Visiting other place for pleasure	0☐	1☐	2☐	3☐	4☐	5☐
6- Going to religious places like pagoda	0☐	1☐	2☐	3☐	4☐	5☐
7- Transporting rice production	0☐	1☐	2☐	3☐	4☐	5☐
8- Transporting crop production	0☐	1☐	2☐	3☐	4☐	5☐
9- Transporting livestock production	0☐	1☐	2☐	3☐	4☐	5☐
10- Transporting stuff for business activities	0☐	1☐	2☐	3☐	4☐	5☐
11- Other purposes:.....	0☐	1☐	2☐	3☐	4☐	5☐

Q19. How often are you using vehicles for transportation with the following person?						
	Not relevant	Rarely	Sometimes	Often	Very often	All the time

1- Spouse	0☐	1☐	2☐	3☐	4☐	5☐
2- Children	0☐	1☐	2☐	3☐	4☐	5☐
3- Relatives	0☐	1☐	2☐	3☐	4☐	5☐
4- Colleagues / co-workers	0☐	1☐	2☐	3☐	4☐	5☐
5- Friends	0☐	1☐	2☐	3☐	4☐	5☐
6- Clients						
7- Others……..						

Q20. How many kilometers are you travelling to different destinations per week? _____ kilometers/week
Q21. How much do you pay for taxi per week? _____Khmer Riels/week
Q22. How much do you pay for tuk tuk per week? _____ Khmer Riels/week
Q23. How much do you pay for Rickshaw per week? _____ Khmer Riels/week
Q24. How much do you pay for gasoline for your own vehicles per week? _____ Khmer Riels/week

The existing sustainable transport systems which make a positive contribution to economic development, environmental preservation, and social development of the urban neighborhoods they are serving.

Q25. Please rate your satisfaction towards transport systems that you wish to be.

	Not relevant	Strongly disagree	Disagree	Moderate	Agree	Strongly agree
Economic outcome						
1-Easy to access by residents	0☐	1☐	2☐	3☐	4☐	5☐
2-Affordable transportation operation cost	0☐	1☐	2☐	3☐	4☐	5☐
3-High productivity/efficiency	0☐	1☐	2☐	3☐	4☐	5☐
4-High benefit to national economy	0☐	1☐	2☐	3☐	4☐	5☐
Environmental outcome						
5-High resource use	0☐	1☐	2☐	3☐	4☐	5☐
6-Low direct ecological intrusion	0☐	1☐	2☐	3☐	4☐	5☐

7-Low Emission to airs	0☐	1☐	2☐	3☐	4☐	5☐
8-Low emission to soil and water	0☐	1☐	2☐	3☐	4☐	5☐
9-Low noise	0☐	1☐	2☐	3☐	4☐	5☐
10-Low waste	0☐	1☐	2☐	3☐	4☐	5☐
Social outcome						
11-Affordability to residents	0☐	1☐	2☐	3☐	4☐	5☐
12-Safety and security	0☐	1☐	2☐	3☐	4☐	5☐
13-Fitness and health	0☐	1☐	2☐	3☐	4☐	5☐
14-Livability and amenity	0☐	1☐	2☐	3☐	4☐	5☐
15-Social cohesion	0☐	1☐	2☐	3☐	4☐	5☐
16-Working conditions in transport sector	0☐	1☐	2☐	3☐	4☐	5☐

Q26. What are the most important features you would like to see in Cambodian transport system in the future?

	Not sure	Not important at all	Slightly important	Moderate	Important	Highly important
1-Improved/integrated public transport	0☐	1☐	2☐	3☐	4☐	5☐
2-Improved cycle facilities	0☐	1☐	2☐	3☐	4☐	5☐
3-Reduced demand/growth	0☐	1☐	2☐	3☐	4☐	5☐
4-New technologies	0☐	1☐	2☐	3☐	4☐	5☐
5-Modal shift	0☐	1☐	2☐	3☐	4☐	5☐
6-Attitude/cultural change	0☐	1☐	2☐	3☐	4☐	5☐
7-Car pooling	0☐	1☐	2☐	3☐	4☐	5☐
8-Sustainable car travel	0☐	1☐	2☐	3☐	4☐	5☐

9-Flexible working	0☐	1☐	2☐	3☐	4☐	5☐
10-Bus tracking	0☐	1☐	2☐	3☐	4☐	5☐
11-No need for much change in current transport service	0☐	1☐	2☐	3☐	4☐	5☐
12-Zero-emission, accessible, cheaper	0☐	1☐	2☐	3☐	4☐	5☐
13-Cable car system	0☐	1☐	2☐	3☐	4☐	5☐

Perception of domestic commuters within urban neighbourhoods concerning on-demand services and sustainable transport.

Q27. How long do you have to wait for a bus ? _____ minutes
Q28. How long do you have to wait for a taxi ? _____ minutes
Q29. How long do you have to wait for a tuk tuk ? _____ minutes
Q30. How long do you have to wait for a rickshaw? _____ minutes

Commute Satisfaction

Q31. Rate your feeling during your traveling by public transport.

	Not relevant	Strongly dissatisfied	Dissatisfied	Moderate	Satisfied	Strongly Satisfied
1-When I am travelling to work, I feel crowded	0☐	1☐	2☐	3☐	4☐	5☐
2-Commuting is stressful for me	0☐	1☐	2☐	3☐	4☐	5☐
3-My commute to work each day takes a lot of effort	0☐	1☐	2☐	3☐	4☐	5☐
4-Commuting to work is consistent on a day to day basis	0☐	1☐	2☐	3☐	4☐	5☐
5-My commute affects my productivity on the job	0☐	1☐	2☐	3☐	4☐	5☐
6-Commuting decreases the time and energy I have for recreation/socialising	0☐	1☐	2☐	3☐	4☐	5☐

7-Transporting livestock production	0☐	1☐	2☐	3☐	4☐	5☐
8-Transporting stuff for business activities	0☐	1☐	2☐	3☐	4☐	5☐
9- Other feeling……..	0☐	1☐	2☐	3☐	4☐	5☐

Q32. Please rate your satisfaction for your trip by vehicles provided by public service in Phnom Penh.						
	Not relevant	Strongly dissatisfied	Dissatisfied	Moderate	Satisfied	Strongly Satisfied
1-Seat stability	0☐	1☐	2☐	3☐	4☐	5☐
2-Travel stability	0☐	1☐	2☐	3☐	4☐	5☐
3-Wait for service	0☐	1☐	2☐	3☐	4☐	5☐
4-Driver attitude	0☐	1☐	2☐	3☐	4☐	5☐
5-Ease of boarding and alighting	0☐	1☐	2☐	3☐	4☐	5☐
6-Internal temperature	0☐	1☐	2☐	3☐	4☐	5☐
7-Walking distance to stations or stops	0☐	1☐	2☐	3☐	4☐	5☐
8-Travel time and reliability	0☐	1☐	2☐	3☐	4☐	5☐
9-The condition of station or stop	0☐	1☐	2☐	3☐	4☐	5☐

Q33. Please rate your satisfaction for your trip by vehicles provided by private companies in Phnom Penh.						
	Not relevant	Strongly dissatisfied	Dissatisfied	Moderate	Satisfied	Strongly Satisfied
1-Seat stability	0☐	1☐	2☐	3☐	4☐	5☐
2-Travel stability	0☐	1☐	2☐	3☐	4☐	5☐
3-Wait for service	0☐	1☐	2☐	3☐	4☐	5☐
4-Driver attitude	0☐	1☐	2☐	3☐	4☐	5☐

5-Ease of boarding and alighting	0☐	1☐	2☐	3☐	4☐	5☐
6-Internal temperature	0☐	1☐	2☐	3☐	4☐	5☐
7-Walking distance to stations or stops	0☐	1☐	2☐	3☐	4☐	5☐
8-Travel time and reliability	0☐	1☐	2☐	3☐	4☐	5☐
9-The condition of station or stop	0☐	1☐	2☐	3☐	4☐	5☐

Transit satisfaction

Q34. Please rate your agreement or disagreement on the following statement.

	Not relevant	Strongly disagree	Disagree	Moderate	Agree	Strongly agree
Connectivity						
1. Connection to lines of the same operator	0☐	1☐	2☐	3☐	4☐	5☐
2. Connection to lines of other operators	0☐	1☐	2☐	3☐	4☐	5☐
3. Line diversity (number of lines of the transit network)	0☐	1☐	2☐	3☐	4☐	5☐
Accessibility						
4. Accessibility of the bus network (number of bus stops)	0☐	1☐	2☐	3☐	4☐	5☐
5. Reduced mobility users' accessibility	0☐	1☐	2☐	3☐	4☐	5☐
6. Adequacy of the most used bus stop location	0☐	1☐	2☐	3☐	4☐	5☐
Information						
7. Service information availability	0☐	1☐	2☐	3☐	4☐	5☐
8. Availability of timetables and line plans	0☐	1☐	2☐	3☐	4☐	5☐
9. Line information explicitness	0☐	1☐	2☐	3☐	4☐	5☐

10. Information panels on terminals and bus stops	0☐	1☐	2☐	3☐	4☐	5☐
11. Information panel on next stop	0☐	1☐	2☐	3☐	4☐	5☐
12. Information on passes and tariffs	0☐	1☐	2☐	3☐	4☐	5☐
Time satisfaction						
13. Bus punctuality	0☐	1☐	2☐	3☐	4☐	5☐
14. Service frequency	0☐	1☐	2☐	3☐	4☐	5☐
15. Trip duration	0☐	1☐	2☐	3☐	4☐	5☐
16. Line reliability	0☐	1☐	2☐	3☐	4☐	5☐
17. Service time window	0☐	1☐	2☐	3☐	4☐	5☐
User Attendance	0☐	1☐	2☐	3☐	4☐	5☐
18. Driver kindness	0☐	1☐	2☐	3☐	4☐	5☐
19. Staff kindness	0☐	1☐	2☐	3☐	4☐	5☐
Comfort						
20. Physical state of vehicles (quality, conservation, new/old)	0☐	1☐	2☐	3☐	4☐	5☐
21. Bus cleanliness	0☐	1☐	2☐	3☐	4☐	5☐
22. Bus comfort	0☐	1☐	2☐	3☐	4☐	5☐
23. Bus illumination	0☐	1☐	2☐	3☐	4☐	5☐
24. Bus temperature adequacy	0☐	1☐	2☐	3☐	4☐	5☐
25. Average user volume (occupancy)	0☐	1☐	2☐	3☐	4☐	5☐
26. Professionality/caution/driver skillfulness	0☐	1☐	2☐	3☐	4☐	5☐
27. Bus stop coziness (weather conditions)	0☐	1☐	2☐	3☐	4☐	5☐
28. Bus stop conservation and cleanliness	0☐	1☐	2☐	3☐	4☐	5☐
29. Bus stop illumination	0☐	1☐	2☐	3☐	4☐	5☐

30. Adequate visual arrival of buses at bus stops	0☐	1☐	2☐	3☐	4☐	5☐
Security/Safety						
31. Bus safety (vehicles)	0☐	1☐	2☐	3☐	4☐	5☐
32. Security on buses	0☐	1☐	2☐	3☐	4☐	5☐
33. Bus stop safety	0☐	1☐	2☐	3☐	4☐	5☐
Environmental impact						
34. Noise	0☐	1☐	2☐	3☐	4☐	5☐
35. Bus contribution to traffic fluidity	0☐	1☐	2☐	3☐	4☐	5☐