Inception Report

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ASIAN TRANSPORTATION RESEARCH SOCIETY

Impact of COVID-19 on Carsharing Usage Behaviors

Saroch Boonsiripant
Peraphan Jittrapirom
Monthira Phamornmongkhonchai

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902/1 9th Floor, Vasu 1 Building Co., Ltd., Soi Sukhumvit 25 (Daeng Prasert),
Sukhumvit Road, Klongtoey-Nua, Wattana, Bangkok 10110, Thailand
Tel. 02-661-6248 FAX 02-661-6249
http://www.atransociety.com

LIST OF MEMBERS

Project Leader

Dr. Saroch Boonsiripant

Kasetsart University, Bangkok, Thailand

Project Members

Dr. Peraphan Jittrapirom

Radboud University, Netherlands

Monthira Phamornmongkhonchai

Kasetsart University, Bangkok, Thailand

Advisors

Mr. Silpachai Jarukasemratana

Permanent Secretary at Ministry of Transport, Thailand

Mr. Chamroon Tangpaisalkit

Chairperson and Deputy Permanent Secretary, MOT, Thailand

Dr. Alaksh Phornprapha

Board and Director of Safety Riding Training Center,

A.P. Honda Co., Ltd., Thailand

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CHAPER 1 INTRODUCTION

1.1 Background

Since its emergence in late 2019, the novel Coronavirus or COVID-19 has rapidly spread beyond nations' borders and caused significant impacts on the livelihoods of people around the world. As of early February 2021, nearly 106 million pandemic cases have been observed worldwide and resulted in 2.33 million mortalities (WHO 2021). The associated socio-economic impacts of this event have also been far-reaching as en-mass losses of employment have continued, heightening the potential large-scale collapse of global economics.

The transport sector is one among several that have been heavily affected by the outbreaks. Governments around the world have imposed travel restrictions and issued recommendations to their citizens to limit their traveling in its efforts to contain the outbreaks. The urban areas are particularly affected, several cities halt or limited the number of public transport services. The perceived risks and fear of infection that may incur during traveling (e.g., in buses and mass transit) also influence travelers to adjust their travel behaviors, switching their modes of transport, commuting time, or canceling their planned trips altogether (EIT 2020). Similarly, ridership and usages of shared mobility services, such as carsharing and ride sharing are also adversely affected (FutureBridge 2021).

In the past year, literature that addresses the elucidate how coronavirus and associated mitigation measures may affect urban mobility is growing. For instance, Zhang, Hayashi, and Frank (2021) carried out an international expert survey to collect information on the subjects, including levels of preparedness, measures implemented, and possible long-term strategies. Other studies, such as Wielechowski (2020), Arellana et al (2020) and Guan et al (2020), examined the impacts to countries specific urban transport systems in (e.g., Poland, Columbia, and France). Common findings of these studies are the reduced travel demands in motorized and transit ridership within and across the cities.

In examining specifically how the public transport systems are affected by the outbreak, two studies stood out: 1) a literature review by Gkiotsalitis & Cats (2020) that provided a list of possible impacts to public transport operations and identify possible intervention measures for transport service providers and 2) a study by Jenelius & Cebecauer (2020), which analysis ridership data in Sweden to quantify the impacts to the public transport system. Their findings highlight how public transport ridership in several cities has plummeted due to the outbreaks. Additionally, there is also a trend in increased usage of private vehicles and non-mortorised modes. Hensher (2020) also explore possible implications of the outbreak to public transport and Mobility as a Service (MaaS) under possible scenarios in the post-COVID-19 period.

Besides public transport, studies also reported severe impacts to shared mobility services. For instance, FutureBridge (2021) highlights the impacts on ride-hailing and their shared services and purport three possible scenarios for shared mobility, a slow return to normalcy, the collapse of shared mobility, and increase adoption of Autonomous Vehicles. A Delphi survey by Shokouhyar et al (2021) presented a set of challenges and opportunities for shared mobility services in the post-Covid era.

However, there is still a lack of academic studies that use empirical data to elucidate the impacts on shared mobility due to the outbreak. As shared mobility is an integral part of solutions to enhance sustainability and accessibility of the transport system, such a study can be highly beneficial. Transport planning agencies and mobility providers can utilize such evident-based analysis to support their efforts in responding to the changes in users' traveling behavior of shared mobility in this critical period.

This study aims to address this niche by identifying how car sharing users in Bangkok changed their behavior as a result of the outbreaks, what may be the factors (e.g., risk perception, change in work pattern, and governmental advice) that influence these changes. Moreover, it will highlight users' preference on how shared mobility should be provided in this uncertain period. The case study of this project will be a carsharing service in Bangkok city.

1.2 Research Objectives

To achieve the goal of the study, the objectives are five folds:

1) Undertake a literature review on the impacts of the Coronavirus outbreak and its effects on shared mobility with a focus on carsharing services. We look to identify trends in how travelers adjust their travel behavior and the underlying factors, such as attitudinal and preferences that influence their behaviors.
2) Identify changes in the travel behavior of car sharing users in 2020 from the past year through big data analysis and in-person survey.
3) Collect trip activity data from a carsharing operator and develop algorithms to analyze travel behavior.
4) Collect actual trip information (actual trip purpose and activity) through the questionnaire survey to validate the algorithm's results.
5) Formulate recommendations on service operations, measures, and policies using the results of this analysis and the previous outcomes of ATRANS project on carsharing group model building (2020).

The results of this study are expected to provide a better insight into how users alter the ways they use carsharing services during the COVID-19 period. This insight will help decision-makers and service providers to identify possible policies, measures, and service configurations that would enable car sharing and other sharing services to meet the changing needs of travelers.

CHAPER 2 LITERATURE REVIEW

This section presents a literature review on three main topics including carsharing in Bangkok and factors affecting carsharing and mobility usages.

2.1 Carsharing in Bangkok

Bangkok is the capital of Thailand and is part of the country's largest urban agglomeration called Bangkok Metropolitan Region (BMR). The city is often cited as an example of a poorly organized and unplanned urban transport system (OTP, 2015). Cars and motorcycles are essential modes of transport for Bangkokians. With more than 6 million cars and nearly 4 million motorcycles registered in Bangkok, around 64% of daily trips are made by these private transport modes (OTP, 2018). The government of Thailand has sought to address the dependency of these private modes through various means, such as constructions of Bangkok's mass rapid transit system, and the reorganization of the city's public bus network. In the recent years, the government has also proposed several sustainable transport measures, such as the promotion of walking and cycling and implementation of car sharing system as solutions to address Bangkok's transport issues (OTP, 2015).

Car sharing system in Bangkok city is still at an early stage with only a handful of service providers, such as Ha:mo by Toyota, asap GO, and Haupcar. Haupcar is the main carsharing operator in Bangkok. The company has provided station-based carsharing services since 2016 and currently has 140 carsharing stations serving more than 16,000 members. The majority of the stations are located near mass transit stations (33%) or shopping malls (24%) and provide a round-trip service (A-to-A) except for ten stations that also provide a one-way service (A-to-B). The service has more than 300 vehicles with vehicle selection ranging from economy, sub-compact, compact, and SUV. The business model of Haupcar is B2B2C, i.e., it provides carsharing services to general customers using vehicles from traditional car rental and leasing companies. This model is different from other carsharing operators, which typically own and have full control over their vehicle fleet.

2.2 Factors Affecting Carsharing and Other Shared Mobility Use Behaviors

Several researchers study about factors that effects on carsharing use behaviors. Filippo Lerro (2015) study users' behavior and factors of adoption of carsharing service, several interesting outcome such as:

- Usage of private vehicles: The respondents that were carsharing member or not, the mostly traveled less than 10,000 km/year that mean these users could be advantageous adhering to car-sharing services including distant and frequency.
- Costs: The respondents awareness about fixed costs related the car owning represent, services and the possible associated savings of carsharing may be enough to convince users to forego the purchasing of a car and choose economic alternative transportation modes, including car-sharing.

- Multimodality: a correlation between carsharing with public transport, the satisfaction towards the available public transport modes that influence on the propensity to carsharing service.

In the next report, we will review research works related to big data for travel behavior analysis.

CHAPER 3 RESEARCH PLAN AND METHODOLOGY

3.1 Research Framework

This research project consists of two parts including trip chain algorithm, data analysis and recommendation.

For Part 1, there are three tasks including:

- Task 1: Literature Review
- Task 2: Algorithm Development
- Task 3: Algorithm Validation

For Part 2, there are three tasks including:

- Task 4: Behavior Analysis
- Task 5: Policy Development
- Task 6: Reporting

The research framework is illustrated in Figure 3-1.

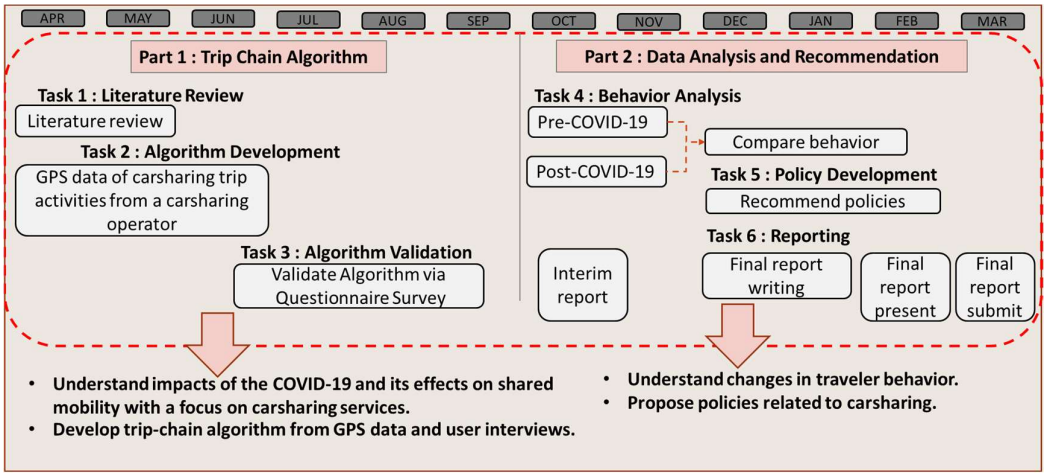

Figure 3-1 Research Design Framework

This research is composed of 5 key tasks including developing travel pattern identification algorithms, validating the proposed algorithms using survey data, analyzing trip activity data, and finally, developing policies for decision-makers and carsharing operators to cope with new travel patterns affected by COVID-19. The details are as follows:

Task 1: Literature Review

In the first step of this research, we will undertake a literature review on the impacts of the Coronavirus outbreak and its effects on the following elements:

- Shared mobility
- Travel behaviour, and

- Factors that effects on behaviors

Task 2: Trip Chaining Identification Algorithm Development

To have an understanding of what users use carsharing for, we will develop an algorithm to automatically identify trip destinations and trip chaining from carsharing trip activity data. GPS data attributes used in this study include latitude and longitude, speed, engine status, and timestamp. This information enables us to deduce destination activity based on nearby Point of Interests (POIs), stop time, and stop duration. For example, if one trip stopped at a restaurant at 6 pm for a period of 2 hours, the user likely stopped at this location for a dinner (see Figure 3-2).

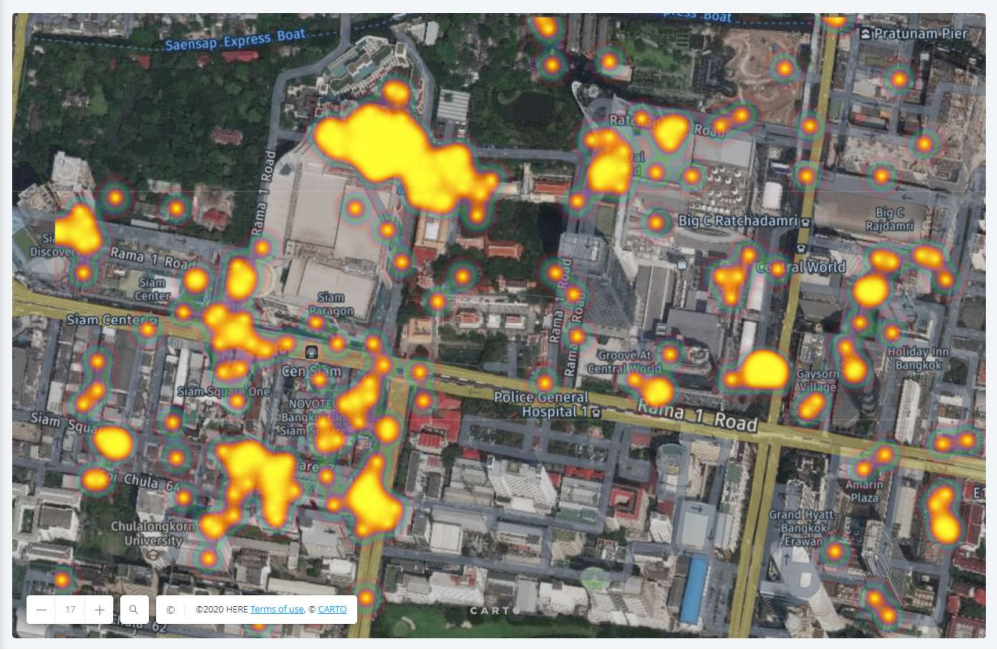

Figure 3-2 Example of GPS data points showing where users stopped for activities

Several tasks are required to determine the trip activity type include:

- Acquiring GPS data of carsharing trip activities from a carsharing operator
- Cleaning GPS data
- Identifying POI/destination type via Google Place APIs
- Identifying activity type (based on POIs and other attributes such as time of day, day of the week, activity duration, etc.), and
- Determining trip chaining of each reservation.

Task 3: Algorithm Validation: Questionnaire Survey

Once the algorithms have been developed from the first step, it is crucial to verify the accuracy of the algorithm. Algorithm Validation based on the actual users. The questionnaires should include the following topics:

- Destination type validation: Where did the user go?
- Activity type validation: What did the user do at the destination?

- How COVID-19 affected their general travel behaviors in terms of perception, preference, and behaviors?
- How COVID-19 affects their carsharing usage behaviors in terms of perception, preference, and behaviors?

The user interview will be conducted via phone. Our target is to validate 150-200 trips. The actual trip data will be compared with the results generated from the algorithm. The algorithm will be fine-tuned based on the interview evidence.

Task 4: Behavior analysis

Once we have fine-tuned the algorithm, the behavior analysis will be conducted to determine the impact of COVID-19 on travel patterns of carsharing users in Bangkok. Two sets of data will be processed:

- Pre-COVID-19 analysis - Trip data in 2019
- During COVID-19 analysis - Trip data in 2020

Next, we will compare the changes in characteristics between 2019 and 2020 data, as well as data obtained from the questionnaire.

Task 5: Policy development

In the final step, the research team will propose policies based on the findings in Task 4 and building on the outcomes of the previous project in 2020.

3.2 Project Schedule

The duration of this study is 12 months starting from April 2021 to March 2022 as shown in Table 3-1.

Table 3-1 Schedule/timeframe of the project

Task	2021									2022		
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Task 1 - Literature Review												
Literature Review												
Task 2 - Trip Chaining Identification Algorithm Development												
Acquire GPS data of carsharing trip activities												
Data cleaning												
POI/destination type identification												
Activity type identification												
Trip chaining determination												
Task 3 - Algorithm Validation: Questionnaire Survey												
Design questionnaires												
Interview actual users												

Task	2021									2022		
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Compare the algorithm results with the actual data												
Improve the identification accuracy												
Task 4 - Behavior analysis												
Analyze trip data in 2019												
Analyze trip data in 2020												
Compare the changes in characteristics												
Task 5 - Policy development												
Propose policies based on the findings in Task 4												
Task 6 - Reporting												
Interim reporting												
Final report writing												
Final report presentation												
Final report submission												

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