

The Impact of Ride-Hailing Services on Vehicle Miles Traveled: A case study in Bangkok, Thailand

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A ride-hailing service (RHS) is an emerging mode, and its impact on sustainability is an essential issue. This research uses about 1200 ride-hailing drivers' driving records in Bangkok and searches for its impact on sustainability by analyzing its deadheading and vehicle miles traveled, so expected outcomes, a ratio of deadheading miles and vehicle miles traveled with passengers.

Key Words : *ride-hailing services (RHS), vehicle miles traveled (VMT), deadheading, Bangkok*

1. INTRODUCTION

A discussion of the sustainability of a ride-hailing service is an essential issue. Whether sustainable or unsustainable depends on ride-hailing substitution for or complementing other modes such as trains or buses (Alejandro, 2020)¹. In some cases, ride-hailing services complement public transportation (Hall et al., 2018)². The impact of ride-hailing service on vehicle miles traveled (VMT) that have opportunity to increase miles traveled in cities (Schaller, 2018)⁵ because the ride-hailing service generates deadheading miles (Henao & Marshall, 2018)³.

This research uses the vehicle miles traveled to identify the sustainability impact of ride-hailing services. Vehicle miles traveled have deadheading miles and miles with passengers for analysis. Moreover, the vehicle miles traveled trips integrated public and non-public transportation trips. And the objective of this study is ride-hailing service sustainability verified by its vehicle miles traveled and relationship to public transportation.

2. METHOD

This research searches for the impact of a ride-hailing service on sustainability by analyzing its vehicle miles traveled (VMT) as deadheading and vehicle miles traveled. The method for Identifying sustainability in this research is a difference in emissions miles percentage. If based on private car, emission will be 100 percent and in case of electricity vehicle ride-hailing service been 47 percent, deadheading miles emission has been 20 percent and emissions miles with a passenger has been 27 percent (Maria et al., 2020)⁴ and display in Table 1.

Table 1 Summary of Relative Emissions , Percent Relative to Private Car.

Type of Trip	Deadheading Miles	Miles with Passenger	Total Trip Miles	High Error	Low Error
Private vehicle	0%	100%	100%		
Non-pooled, ride-hailing	62%	85%	147%	28%	16%
Pooled, ride-hailing	41%	57%	98%	19%	11%
Electric, non-pooled, ride-hailing	20%	27%	47%	43%	14%
Electric, pooled, ride-hailing	13%	18%	32%	29%	9%

Source: Ride-Hailing's Climate Risks Steering a Growing Industry toward a Clean Transportation Future- Methodology (p.13), Maria et al., 2020, a union of concerned scientist

The data used in this research was recorded by an electricity vehicle ride-hailing service (non-pooled), so deadheading miles have fewer emissions than miles with a passenger in 7 percent. If deadheading miles have a length can make more over vehicle miles traveled with passengers. The assumption for electricity vehicle ride-hailing service (non-pooled) is not sustainable, as shown in Formular1.

Formular1: $\text{Deadheading miles} \times 20\% > \text{miles with passenger} \times 27\%$

The assumption for electricity vehicle ride-hailing For the estimate, formula one can replace by the ratio of deadheading miles and vehicle miles traveled with passengers shown in Formula 2.

Formula 2 : $\text{A ratio of Deadheading miles / miles with passengers} < 1.35: 1$

For Identifying the sustainability of deadheading miles in the case of electricity vehicle ride-hailing service (non-pooled), the ratio of Deadheading miles and miles with a passenger should be less than 1.35: 1 because Deadheading miles would make more over the difference of emissions miles percentage.

3. DATA

This research obtained data from a ride-hailing service operator called "Muvmi." The Muvmi ride-hailing service is an electricity vehicle tricycle car that has been operated in many areas in Bangkok, Thailand. The data is 1200 trips, and travel behavior in each trip shows the location before hailing the

car, pick-up location, drop-off location, and a route to estimate vehicle miles traveled (VMT). The data is from five areas. The data is one day on a weekday, 16 March 2022, and a number of a trip in each area is shown in Table 2.

Table 2 A number of trips in each study area.

Study Area	Number of trips
Chula - Samyan	246
Asoke - Nana	274
Phahol - Kaset	210
On-Nut	215
Ari - Pradipat	255
total	1200

4. STUDY AREA

A Study Area is five areas where Muvmi has operated, and every area has public transit as a train subway or Skytrain in Bangkok or a bus route and station. A Chula – Samyan and an Asoke – Nana areas are located in Bangkok's Central Business District (CBD) and have university campuses. A Phahol – Kaset area is located in the middle of the city and out from the city's core but has mixed use such as a department store, office building, market, or many residential types and has a university campus. An On-Nut area is a residential zone that has many types of housing. An Ari – Pradipat area locate in the city center and is a mixed-use area.

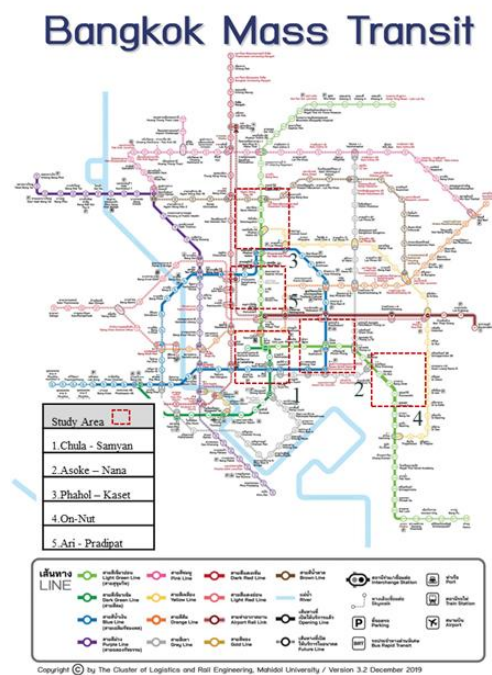


Fig. 1 The study areas on Bangkok mass transit map.

5. RESULT

The result is analyzed from data on vehicle miles traveled (VMT) of the ride-hailing service mentioned above. The results focus on vehicle miles traveled with passengers and deadheading miles in study areas. The vehicle miles traveled will be divided by a relationship with public transportation such as a train or bus. A trip without a relationship with public transportation will call non-public transit in this paper.

To understand the five study areas, explain the number of ride-hailing service trips in each area.

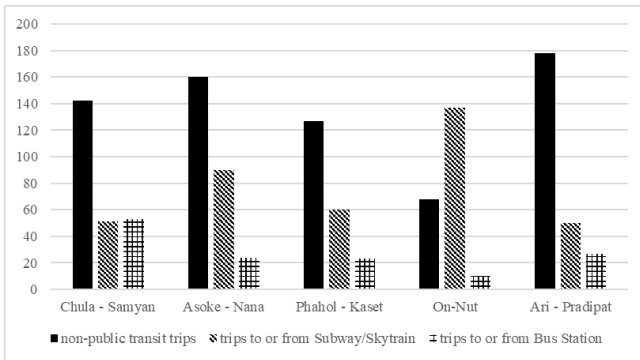


Fig. 2 The number of ride-hailing service trips in each study area.

Several ride-hailing service trips in each study area are displayed by a ride-hailing service, non-public transit trips, ride-hailing service trips to or from the train station, and ride-hailing service trips to or from the bus station. In general ride-hailing service, non-public transit trip is the highest number of trips in the study area, except for the On-nut area, which is a residential area (figure 2) and coherent with vehicle miles traveled (VMT) in Table 3. The On-nut area has the lowest total of vehicle miles traveled. However, a number of the trip are near the other study areas displayed in Table 2, and the vehicle miles traveled of non-public transit in the On-nut area is the lowest, as shown in Table 5.

Table 3 The vehicle miles traveled (VMT) of ride-hailing service in each study area.

Study Area / VMT	VMT with passenger	Deadheading Miles	VMT total	Ratio VMT D : P
Chula - Samyan	209.966	225.059	435.025	1.072:1
Asoke - Nana	239.668	228.286	467.955	0.953:1
Phahol - Kaset	226.937	318.119	545.055	1.402:1
On-Nut	173.909	97.745	271.654	0.562:1
Ari - Pradipat	332.529	352.024	684.552	1.059:1
total	1183.009	1221.233	2404.242	1.032:1

VMT: vehicle miles traveled
 D: Deadheading Mile
 P: Mile with passenger

The total vehicle miles traveled (VMT) of ride-hailing services from these dates are 2404.242 miles. The deadheading miles traveled is 50.79 percent, and vehicle miles traveled with a passenger are 49.21 percent. The total deadheading and vehicle miles traveled with the passenger are approximate percentages. For identifying the sustainability of the electricity ride-hailing service, the total vehicle miles traveled ratio between deadheading miles and miles with a passenger is 1.032:1. The electricity ride-hailing service is sustainable.

However, If considered in each area, The Phahol – Kaset area where the vehicle miles traveled (VMT) of ride-hailing service is not sustainable because it has high deadheading miles. For example, the vehicle miles traveled ratio between deadheading and miles with a passenger in the Phahol – Kaset area is 1.402 :1. The Phahol – Kaset case confirms deadheading miles is a factor of ride-hailing service for sustainability even in the electricity vehicle ride-hailing service.

Table 4 The vehicle miles traveled (VMT) of ride-hailing service divided by public transit.

VMT	non-public transit trip	trip to Subway/Skytrain	trip to Bus Station
VMT with passenger	626.664	420.037	136.308
Deadheading miles	762.910	335.202	123.121
total	1389.573	755.240	259.429
percentage	57.797	31.413	10.790
Ratio VMT D : P	1.217	0.798	0.903

From table 4, The vehicle miles traveled of ride-hailing service trips to train or train station, and their

ratio is 0.798: 1, so more sustainably because they are the trip to public transit in case of vehicle miles traveled trip to bus or from bus station too.

Table 5 The non-public transit vehicle miles traveled (VMT) of ride-hailing service.

Study Area	VMT with passenger	deadheading miles	VMT total	Ratio VMT D : P
Chula - Samyan	128.796	130.377	259.173	1.012
Asoke - Nana	116.402	117.735	234.137	1.011
Phahol - Kaset	131.871	257.537	389.408	1.953
On-Nut	38.3764	19.495	57.872	0.508
Ari - Pradipat	210.597	238.387	448.984	1.132
total	626.042	763.531	1389.573	1.220

The non-public transit vehicle miles traveled (VMT) of ride-hailing service in four areas have nearby vehicle miles traveled between miles with passenger and deadheading miles, except the Phahol – Kaset, which has higher deadheading miles that impact sustainability in this study area that show in Table 5

Every study area except the On-nut, which has a high vehicle miles traveled of non-public transit in the city center or mixed-use area. The Chula – Samyan and Asoke-Nana areas are the central business center of Bangkok. The Ari-Pradipat area is a mixed-use area located in the city center. The Phahol-Kaset area is a mixed-use area.

The sustainable effect of vehicle miles traveled by ride-hailing services that are mentioned in the Methods. The non-public transit vehicle miles traveled ratio between deadheading miles and miles with a passenger is 1.22 :1, so the non-public transit vehicle miles traveled are sustainable by the different emission percentages.

6. CONCLUSION

The electricity ride-hailing service is sustainable by vehicle miles traveled (VMT), but the deadhead-

ing miles is a factor that impacts the sustainability of ride-hailing service, even electric vehicles. Therefore, the ride-hailing service provider should promote their vehicle to be an electric vehicle and control deadheading miles. They should not make over the different emission percentages between deadheading miles and vehicle miles traveled with a passenger.

The vehicle miles traveled on non-public transit trips are more than on public transit trips (Table 4), but deadheading miles and miles with a passenger in non-public transit trips are sustainable, as shown in Table 5.

7. FUTURE RESEARCH

Further study about deadheading trips to understand the factor that impacts generated or non generate deadheading miles, such as a service area or land use, is necessary. And study about impact of ride-hailing service on sustainability in the case of the Phahol – Kaset and the On-nut, which have a significant ratio of vehicle miles traveled between miles with passenger and miles of deadheading, is also necessary (Table 3 and Table 5).

REFERENCES

- 1) Alejandro T. : Ride-hailing, travel behaviour and sustainable mobility: an international review, Springer Science+Business Media, LLC, part of Springer Nature, 2019.
- 2) Hall, J.D., Palsson, C., Price, J.: Is Uber a substitute or complement for public transit? J. Urban Econ.
- 3) Henaio, A., Marshall, W.E.: The impact of ride-hailing on vehicle miles traveled. Transportation 1, 2 (2018). <https://doi.org/10.1007/s11116-018-9923-2>
- 4) Maria, C. P. M., Don, A., Jeremy, M. and Joshua, G. : Ride-Hailing's Climate Risks Steering a Growing Industry toward a Clean Transportation Future Methodology, Union of Concerned Scientists, 2020
- 5) Schaller, B.: The New Automobility: Lyft, Uber and the Future of American Cities. Report, Schaller Consulting (2018)