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The Future of ~~Paratransit~~ LAMAT System in Asian Developing Countries: Whether to Eliminate or Tolerate It?

(アジア諸国におけるLAMATシステムに関する研究)

LAMAT: Locally Adapted, Modified, and Advanced Transport

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To Japanese by Yoshimasa Kitano

1. What is LAMAT?

LAMATとは？

Typical Transport Modes in Asia　アジアの特徴的な交通手段

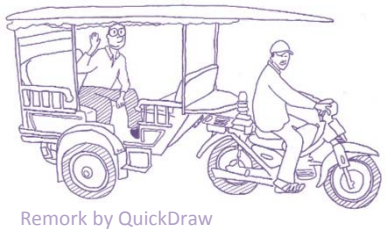
These modes are known as **Paratransit** by several scholars, but we call them as **LAMAT**.

These modes are domestically manufactured with minimal standard in response to local needs and each has its own unique design.

The Concepts of Paratransit　パラトランジットのコンセプト

- The term “paratransit” means “alongside transit”
- It was first used in mid-1960s in North America
- Its **concept differs** among developed and developing countries:

Developed countries	Developing countries
-In USA: Paratransit covers 1) Specific transport service for disabilities (ADA 1990) 2) Demand-responsive service -In Europe: Paratransit refers to particular transport services including dial-a-ride, jitneys, and shuttles	-There are several definitions and terms given for paratransit -Paratransit is called as “Informal transport,” “Low-cost transport,” “Intermediate technology,” “Third world transport,” and “Indigenous transport”



Why LAMAT, not Paratransit?
なぜパラトランジットではなくLAMATなのか？

- Paratransit in Asia is rather known by its local names (e.g., Angkot in Indonesia, Jeepney in Philippines, Tuktuk in Thailand).

- Literatures show various descriptions for paratransit, according to its operational service in a particular area. *Yet, no common description!*

➢ We propose a common description for "Paratransit" as "Indigenous public transport modes that are locally adapted, modified and advanced for a certain transport service in a particular city or region."

➢ In stead of "Paratransit," we suggest the new term "LAMAT: Locally Adapted, Modified and Advanced Transport" for particularly use in Asia.

- LAMAT are intermediate modes, ranging from non-motorized two-wheelers up to motorized four-wheelers, with maximum seating capacity of about 25.

LAMAT in its Description　LAMATの意味

L: Locally

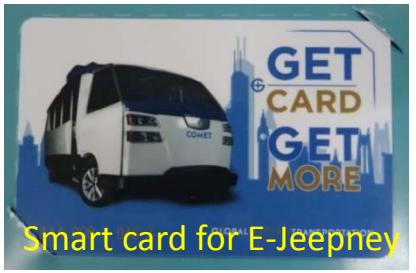
A: Adapted—a vehicle imported without physical alteration

M: Modified—a vehicle that is physically modified based on local needs

A: Advanced—a vehicle that is upgraded with the available technologies

T: Transport

E.g., E-LAMAT in Philippines



Classification of LAMAT System[1]　LAMATシステムの分類

Engine type	Wheeler	Vehicle	Seat	Route	Schedule	Example of LAMAT (Country)
Non-motorized	Two-wheeler	Bicycle Taxi	1-2	Flexible	Flexible	Kangdop (Cambodia), Ojek Sepeda (Indonesia)
	2輪	Pulled Rickshaw	1-2	Flexible	Flexible	Man-pulled rickshaw (India)
		Animal-cart	2-6	Flexible	Flexible	Andomg/Delman (Indonesia), Calesa (Philippines), Dokar (Bangladesh), Tanga (India, Pakistan)
動力無	Three-wheeler	Cycle Rickshaw	1-2	Flexible	Flexible	Becak (Indonesia), Cyclo (Cambodia, Vietnam), Pedicap (Indonesia, Philippines), Rickshaw (Bangladesh), Samlor (Thailand), Sidecar (Myanmar), Trishaw (Malaysia)
	3輪					
Motorized	Two-wheeler	Motorcycle Taxi	1-2	Flexible	Flexible	Habal-habal & Skylab (Philippines), Motodup (Cambodia), Ojek (Indonesia)
	2輪					
	Three-wheeler	Auto Rickshaw	2-4	Flexible	Flexible	Baby taxi/CNGs (Bangladesh), Bajaj/Bemo/Helicak (Indonesia), Jambo (Laos), Tricycle (Philippines), Tuktuk (Thailand), Tempo (Nepal, India), Trishaw (Sri Lanka)
動力有	3輪					
	Four-wheeler	MC Rickshaw	2-6, 12-20[2]	Flexible Fixed	Flexible Flexible	Motorela (Philippines), Remork (Cambodia)
	4輪	Car Taxi	3-4	Flexible	Flexible	Taxi or Taximeter (in general)
		Microbus (Pick-up, Van)	4-14	Fixed	Semi-fixed	Angkot (Indonesia), FX (Philippines) Nilo/Setu microbus (Nepal), Selman (Vietnam), Songtaew (Thailand), Wagon (Pakistan)
		Minibus	12-24	Fixed	Semi-fixed	Jeepney (Philippines)
		Conventional Bus[3]	25-60	Fixed	Fixed	City bus or Public bus (in general)

[1] Classification based on previous studies; e.g., Hokao and Tanaboriboon (1993), Shimazaki and Rahman (1996), and Cervero (2000).
[2] Typical Cambodian Remork with a long carriage pulled by a motorcycle,
[3] Conventional bus is a special case of LAMAT

(Phun and Yai, 2016)

2. Motivation & Objectives

研究の背景と目的

Benefits of LAMAT　LAMATのメリット

- Inadequate mass transit system in most Asian developing cities ➔ Citizens mainly depend on LAMAT as public transport mode.

- LAMAT plays a significant role in urban mobility because **it provides**:
  - ➢ Personalized and flexible transport services
  - ➢ Transport needs to the low-incomes, students, elderly, and disabled
  - ➢ Service coverage between private vehicles and mass transit
  - ➢ Job opportunities to the poor or low-skilled people, etc.
- LAMAT requires low energy consumption & operational costs, little policy intervention, no public investment or subsidy, etc.

Drawbacks of LAMAT　LAMATのデメリット

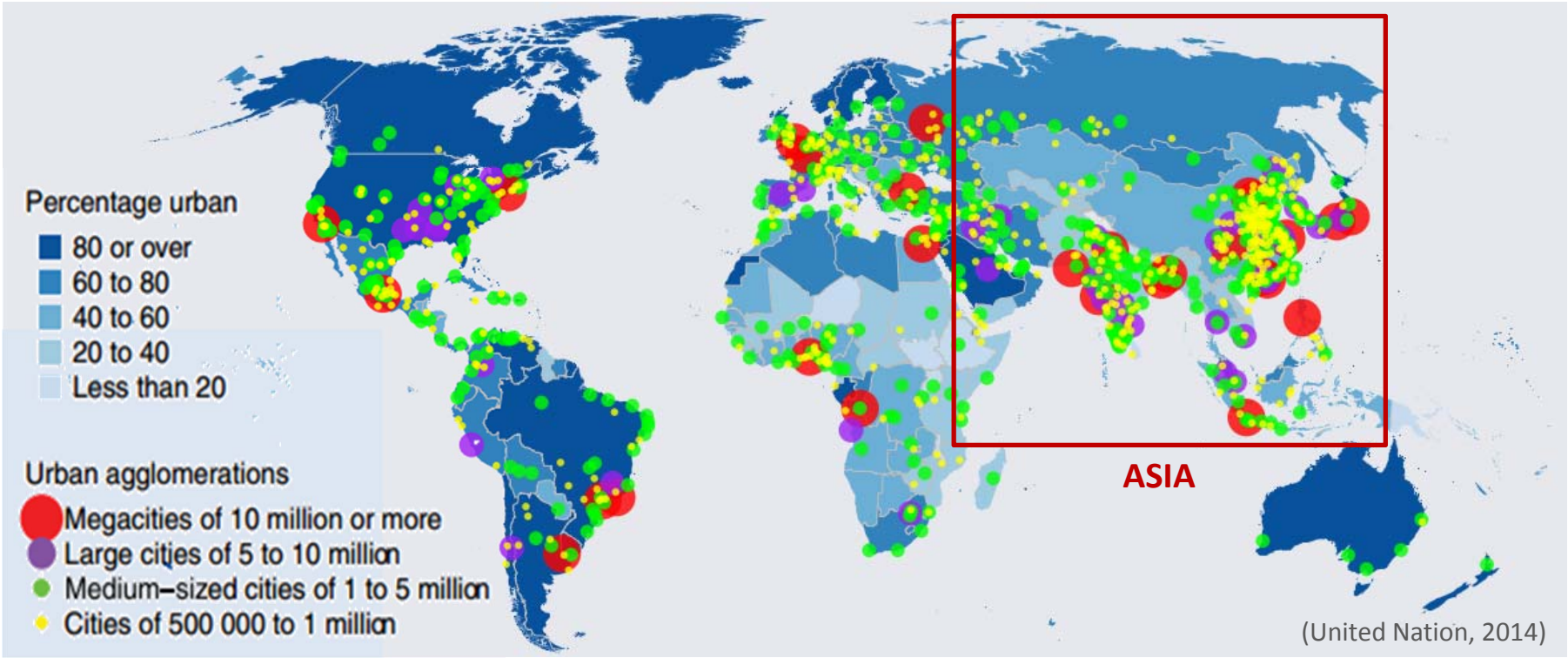
- With lack of control and regulation by the government, LAMAT operations often cause traffic issues such as congestion, accidents, and emission.

Recto Avenue, Manila

- LAMAT is also considered as unreliable with minimal comfort, inhuman working condition, and criminal-style structure.

➢ Because of these drawbacks ➔ Some LAMAT modes were almost eliminated! (e.g., Non-motorized LAMAT, Diesel 3-Wheelers)

Urbanization and City Sizes　都市化とその規模



- In 2050, world population will be 8.3-10.9 Billion, 86% in developing countries, 66% in urban areas , and 54% in Asia
- The fast urbanization in Asia has lead to more cities with population < 5 Million

Urban sprawl in Asian developing cities ➔ Increase urban mobility ➔ Posing a massive challenge for transport authorities in term of infrastructure development and traffic management ➔ **Consider mass transit operation.**

Urban Mass Transit System　都市の大量輸送交通システム

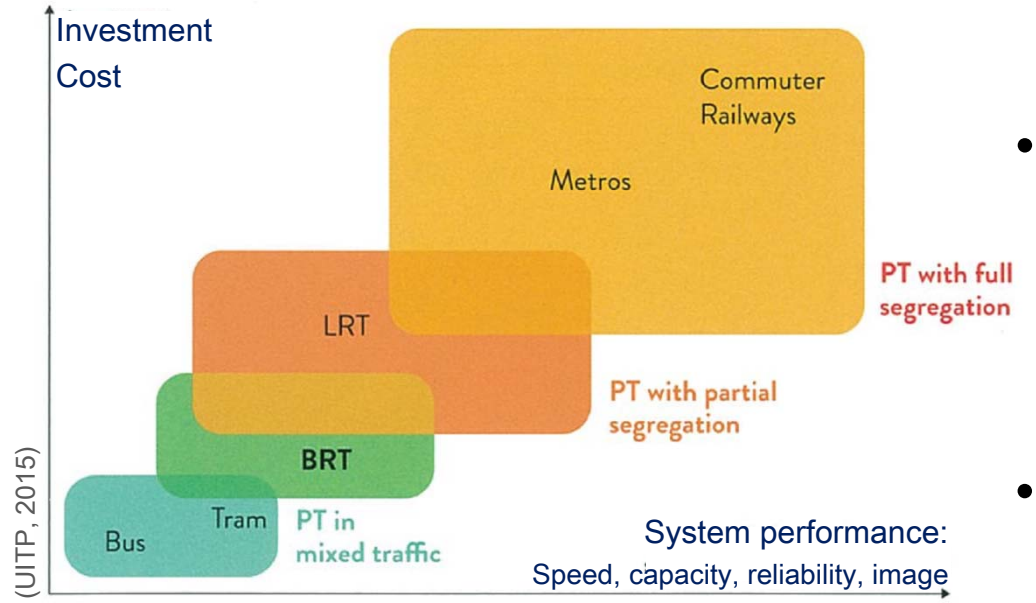


Fig. Comparing modes: System Performance vs Cost

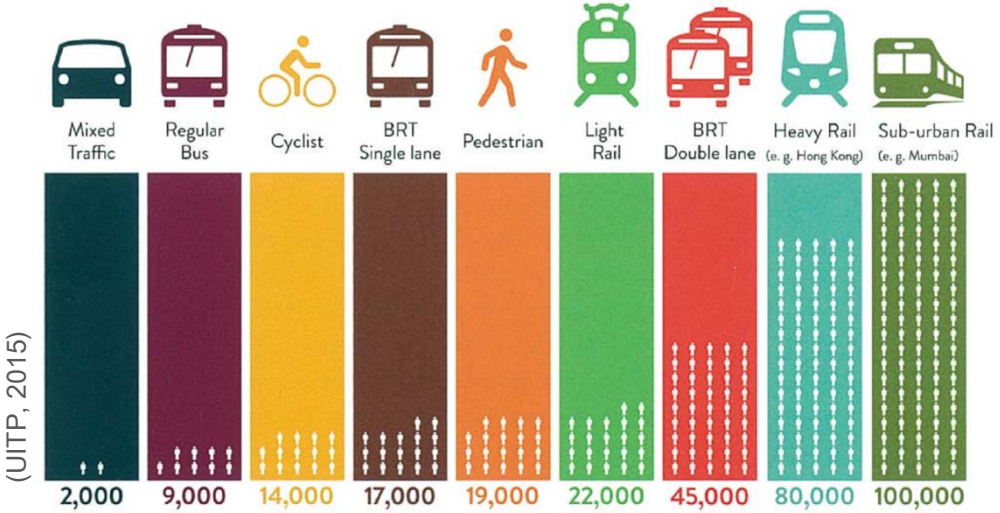


Fig. Corridor max. capacity in persons/h in both directions

- JICA: Constructing more roads might not be the option to serve the increasing urban mobility and traffic issues.
- Recent years, BRT gains its popularity while LRT ranges 2nd in term of cost & capacity.
- BRT or LRT system appears to be more suitable for many Asian developing (small & medium-sized) cities for current traffic conditions.

Effects of Mass Transit on LAMAT
大量輸送機関のLAMATへの影響

- Either newly introduction or expansion of a mass transit system could improve the social economy and reduce traffic issues. However, it also affects the existing LAMAT operations:
  - LAMAT services (Change of servicing route/area)
  - LAMAT drivers' quality of life (Satisfaction)
  - Daily LAMAT demand (Income), etc.

- Example:
  - Reforms of Jeepney operations have been considered following BRT implementation in Cebu. The impacted drivers would be prioritized in BRT-relevant jobs. Yet, several operators are not happy with the BRT plan.

Motivation 背景

Problems

-Drawbacks of LAMAT
-Urbanization
-Economic growth
-Effects of mass transit services

Concerns

The future of LAMAT system is questionable!

Research Questions

① Should the current LAMAT system be left as it is? or

② Should it be completely eliminated from urban public transport? or

③ Should it be substituted/promoted with a better LAMAT mode? or

④ Should it be harmonized with entire urban public transport system?

⑤ What are the relevant planning issues and policies to tackle with ①-④, in order to manage, regulate, and sustain the LAMAT services in Asian developing countries?

Objectives 目的

- Corresponding to the Research Questions, the objectives are:

  I. To identify the current (planning) issues associated with LAMAT services in several Asian developing countries

  II. To propose alternative solutions and policy & regulation to solving LAMAT relevant issues

  III. To discuss on future directions beneficial for transport authorities/planners and governments to effectively manage and regulate the LAMAT operations in their cities

- The research goals are to discus on planning issues, policies, and feasible action plans for LAMAT operations in Short-term, Medium-term, and Long-term perspectives.

- Keywords: Asian developing countries, Integrated public transport, LAMAT/Paratransit, Sustainable transport

3. Research Framework

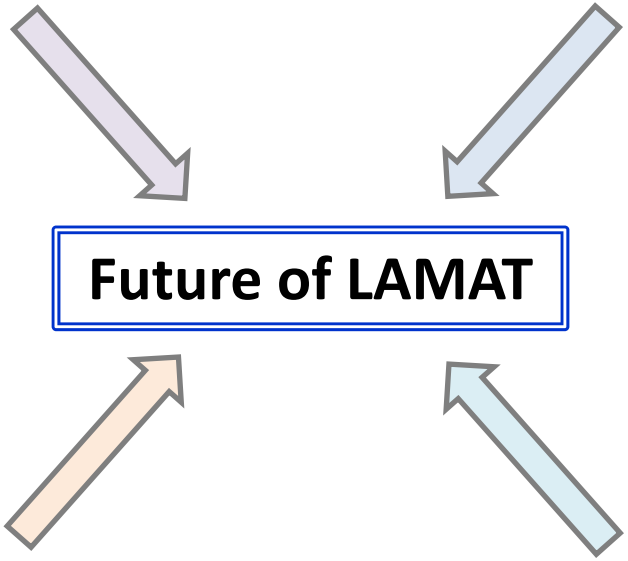
研究の構成

Factors Influencing on the Future of LAMAT

LAMATの将来に影響を与える要素

Passengers
-Modal choice
-Access/egress mode
-User satisfaction
-Perceived service quality
-Negative experiences
-etc.

Operators/drivers
-Service quality
-Comfort & convenience
-Safety & security
-Drivers' quality of life
-Job mobility
-Service & envir. efficiency
-Driver association & internal regulations
-etc.



The government
-Policy & regulation
-Control & management
-Infrastructure supports
-Environmental policy
-Traffic safety policy
-etc.

Vehicle & Technology
-Vehicle & design standard
-Fuel alternatives & EV
-Fare system
-ICT
-LAMAT vehicle size
-etc.

The future of LAMAT can be discussed from several different aspects!

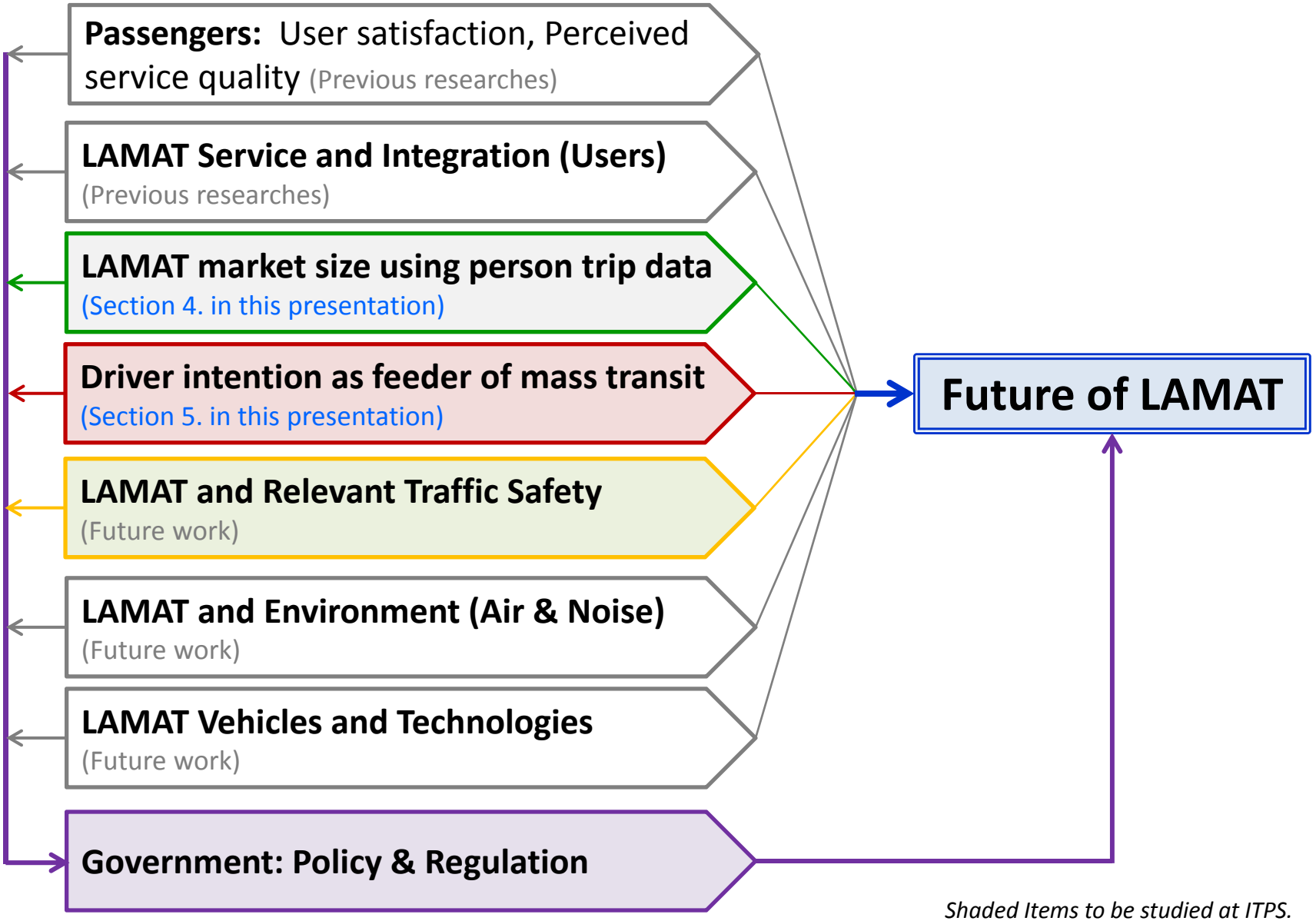
Existing LAMAT Studies in Asia LAMATに関する既往の研究

Study fields	Country/Area	Authors	Year
Physical and operational characteristics of paratransit, and its position in transportation system	Asian	Hokao and Tanaboriboon	1993
	Asian	Shimazaki and Rahman	1995
	Asian	Shimazaki and Rahman	1996
	World	Cervero	2000
	Indonesia	Joewono and Kubota	2005
Policy & regulation, cost & benefit, and market structure of paratransit	Malaysia	Walters	1979
	Philippines	Bayan *et al.*	1995
	Philippines	Diaz and Cal	2005
	World	Cervero an Golub	2007
	India	Anjali Prabhu *et al.*	2011
	Bangladesh	Newaz *et al.*	2014
The role of paratransit as feeder services to a transit system, and paratransit performance in transportation system	Philippines	Okada *et al.*	2003
	Thailand	Satiennam *et al.*	2006
	Hong Kong	Loo	2007
	Thailand	Tangphaisankun *et al.*	2009
Fare structure of paratransit	Indonesia	Nugroho *et al.*	2012
User perception and the sustainability assessment of paratransit service	Indonesia	Joewono and Kubota	2007
	Indonesia	Tarigan *et al.*	2010
	Indonesia	Sumaedi *et al.*	2012
	Pakistan	Javid *et al.*	2013
	Philippines	Okamura *et al.*	2013
Paratransit drivers relevant aspects such as drivers' satisfaction, job performance, and quality of life	Cambodia	Etherington and Simon	1995
	Indonesia	Li *et al.*	2011
	Indonesia	Nugroho *et al.*	2013
	Indonesia	Weningtyas *et al.*	2013
Paratransit-adaptive transportation policies for transition to sustainability and social & environmental impacts	Nepal	Roy *et al.*	2001
	Philippines	Regidor *et al.*	2009
	India	Mani *et al.*	2012
	Indonesia	Fujiwara and Zhang	2013

- Both supply & demand sides were studied and some policy implications were suggested
- Lack of study on:
  - -Market share of LAMAT in Asia
  - -Feeder intention of operators
  - -Relevant traffic accidents
  - -etc.

(Phun and Yai, 2016)

Research Framework　研究の構成



Shaded Items to be studied at ITPS.

4. Analysis of LAMAT Market Share

Results from Analyses of Person Trip Data

LAMATの市場シェアの分析

パーソントリップデータの分析結果

Why LAMAT Market Share? なぜLAMATの市場シェアを分析するのか?

Background

- To consider the future of each LAMAT mode in Asian developing cities, there is a need to explore the market share of those LAMAT modes.
- Why some LAMAT modes are still actively in operations, while some modes facing extinction?

Purposes

- ➢ To review on the existing market shares of LAMAT modes
- ➢ To examine the relationship between LAMAT modes and economic variables (e.g., GDP/capita)
- ➢ To discuss on the future of each LAMAT mode with respects to the market share and to the existing policies & regulations

Person Trip Data　パーソントリップデータ

- JICA conducted Person Trip (PT) surveys at several cities for Urban Transport Master Plan studies (= 21 cities, 3.7 million trips).

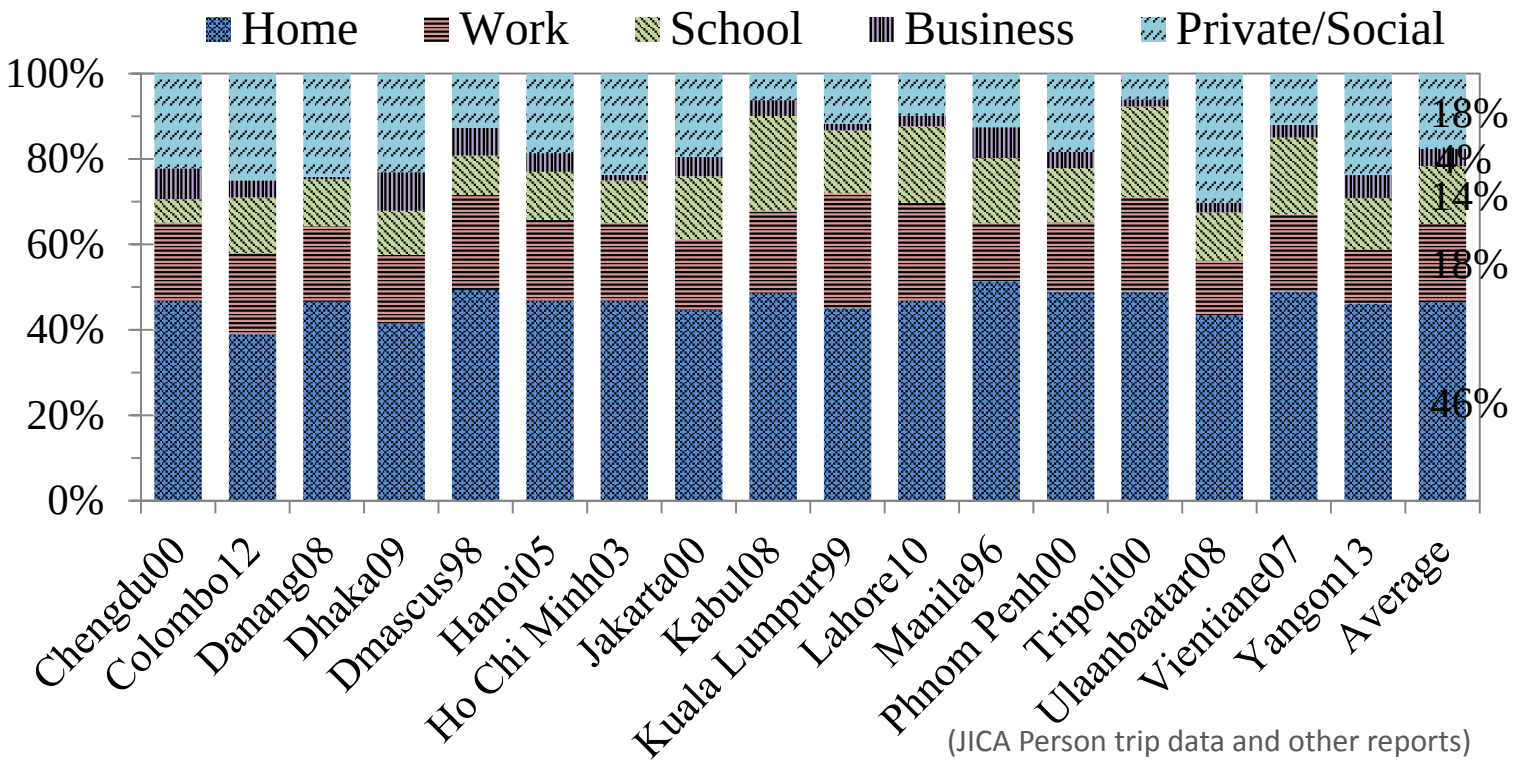


Fig. The share of Trip Purposes in 17 Asian Developing Cities

➢ In average, trips to Home (46%), Work (18%), School (14%), Business (4%), and Private/social (18%).

Analyzed Data　分析するデータ

- 2.7 million trip data from 11 developing Asian cities were analyzed

No.	Country	City	Year[a]	Pop[b] (1000)	GDPPC[c] (USD)	Analyzed trips
1	Bangladesh	Dhaka	2009	14216	685	153848
2	Cambodia	Phnom Penh	2000	1149	300	40369
3	China	Chengdu	2000	4222	932	67961
4	Indonesia	Jakarta	2000	8390	790	1083280
5	Malaysia	Kuala Lumpur	1999	3902	3735	218460
6	Mongolia	Ulaanbaatar	2008	1051	2136	37784
7	Pakistan	Lahore	2010	7487	1008	126602
8	Philippines	Manila	1996	9538	1290	471035
9	Vietnam	HCMC	2003	4866	475	262375
10	Vietnam	Hanoi	2005	2160	623	188700
11	Vietnam	Danang	2008	751	1043	50509

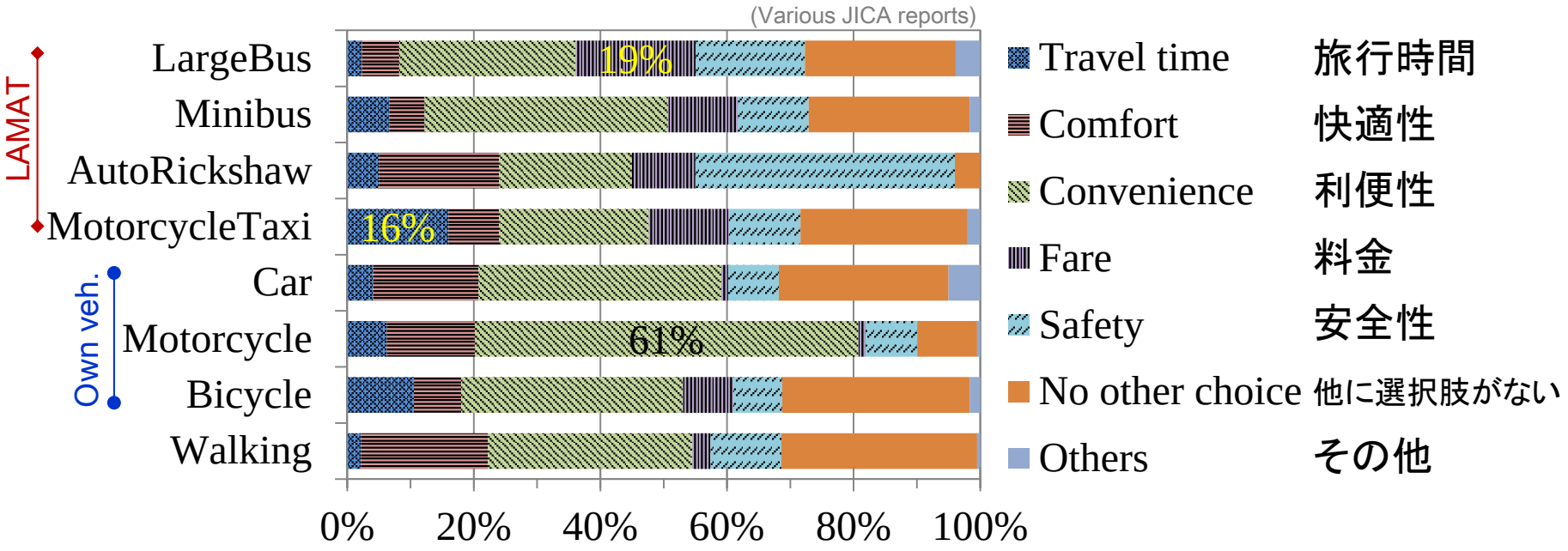
[a]The year of data collected, one limitation of this study　Total =2700923

[b]Numbers obtained from Department of Economic and Social Affairs, United Nations

[c]The GDP per Capita (GDPPC) for corresponding countries, obtained from United Nations, are used instead because the GDPPC for each city appeared to be unreliable sources.

- Various transport modes were first classified into 1) Walking, 2) Own vehicles, 3) LAMAT, 4) Mass transit, and 5) Others

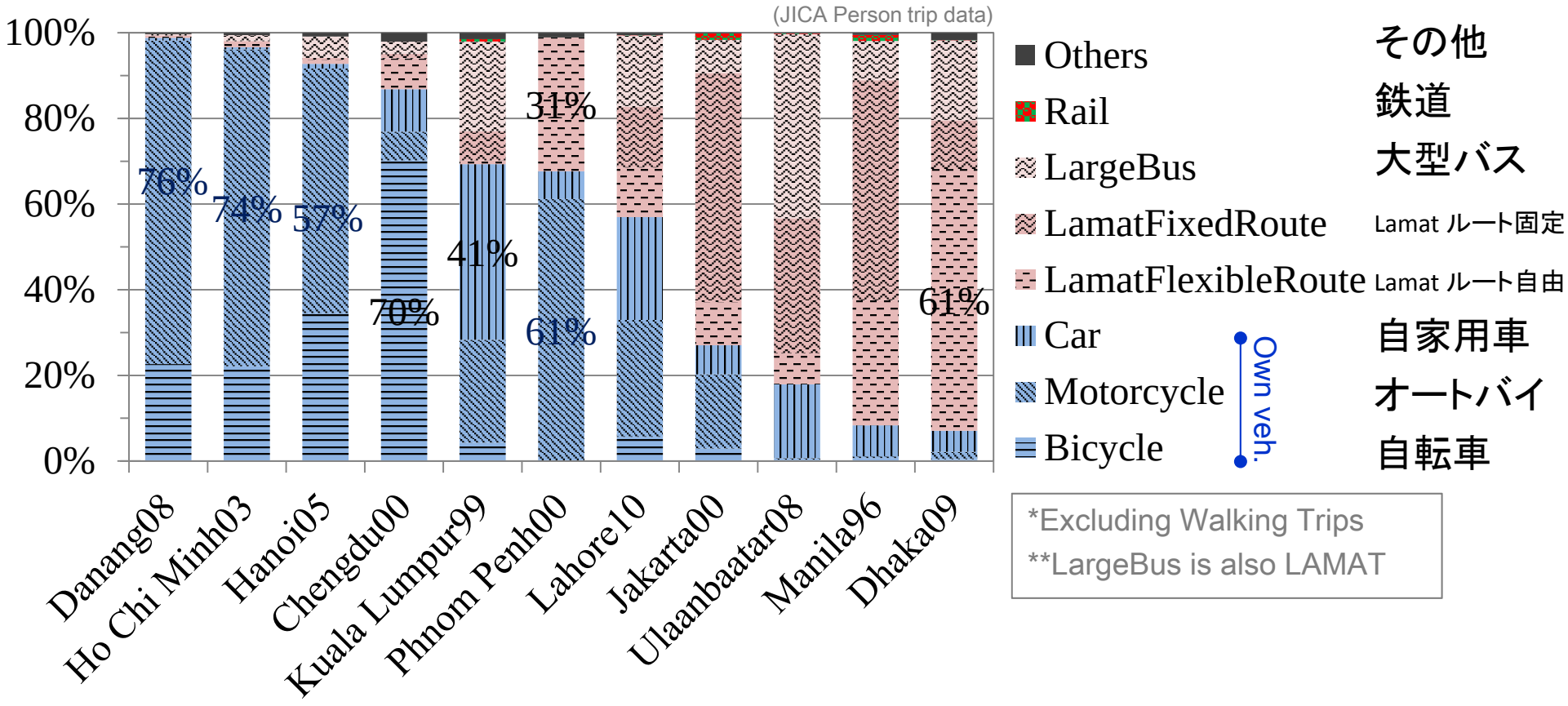
Reasons to Choose a Transport Mode 交通手段の選択理由



- Figure shows the share for various reasons to choose a travel mode in some cities (Ulaanbaatar, Ho Chi Minh, Danang, Chengdu, and Phnom Penh).
- Motorcycle taxi is chosen because of its speed, among other factors.

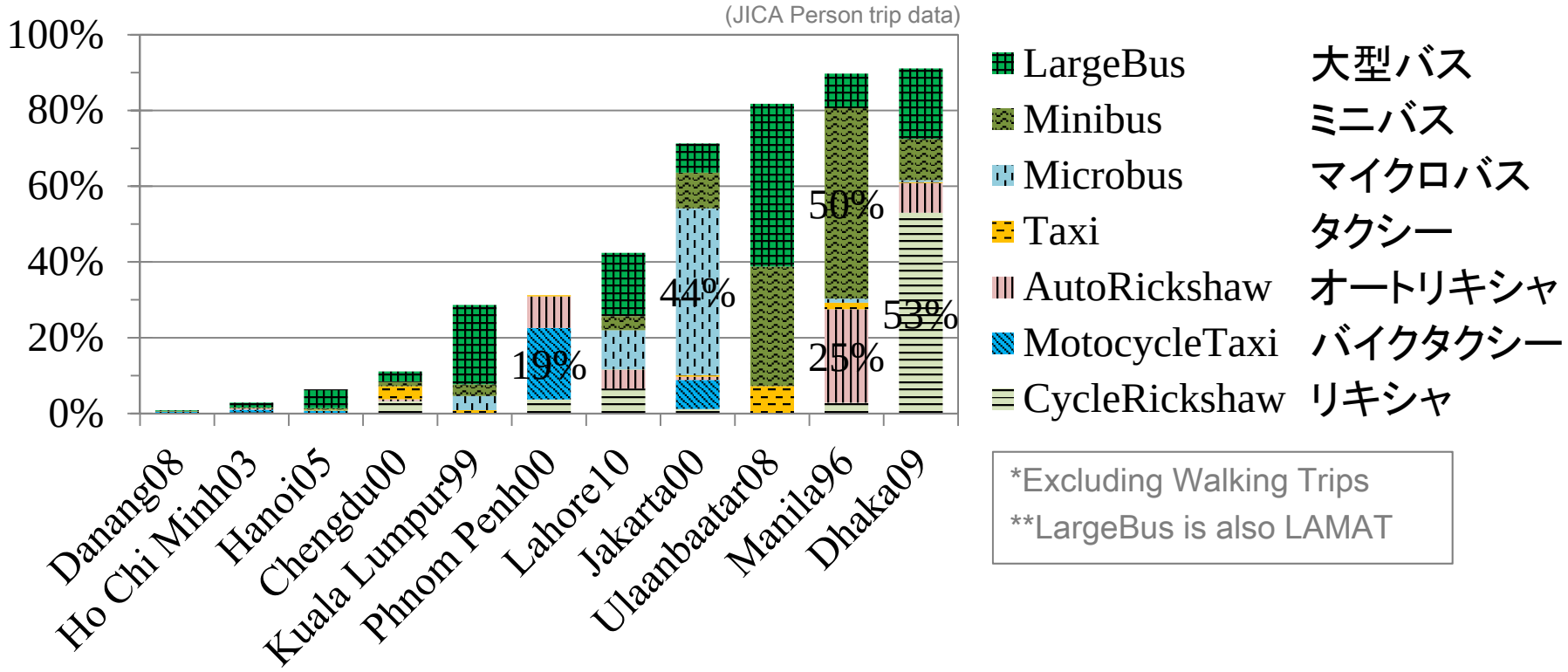
➢ Overall, majority of people chose a transport mode which was convenient to them, and when there is no other choice.

Modal Share Results　交通手段シェアの分析結果



- Reduction in share of own vehicles ➔ higher share of LAMAT modes
- Cities of Vietnam and Cambodia had the highest share of own motorcycle (One reason: due to inadequate public transport services)
- LAMAT is not popular in Chengdu, but own bicycles (city bans motorcycles)

Market Share of LAMAT　LAMATの市場シェア



- Bicycle taxi, Pulled rickshaw, animal-cart are almost disappeared
- Motorcycle Taxi is popular in Phnom Penh, among other cities
- Microbus (Angkot) is popular in Jakarta
- Minibus (Jeepney) and Auto rickshaw (Tricycle) are popular in Manila
- Cycle rickshaws remain active in Dhaka

Cycle Rickshaws in Dhaka, Bangladesh

リキシャ（バングラディシュ、ダッカ）

- Cycle rickshaws are banned from entering the main streets of city
  リキシャはメインストリートへの侵入を禁止されている

Modes: Cycle rickshaw, Auto rickshaw, Minibus, Microbus, and Large bus

Tim Chatterton, 2009

Existing Policies & Regulations　既存の政策と規制

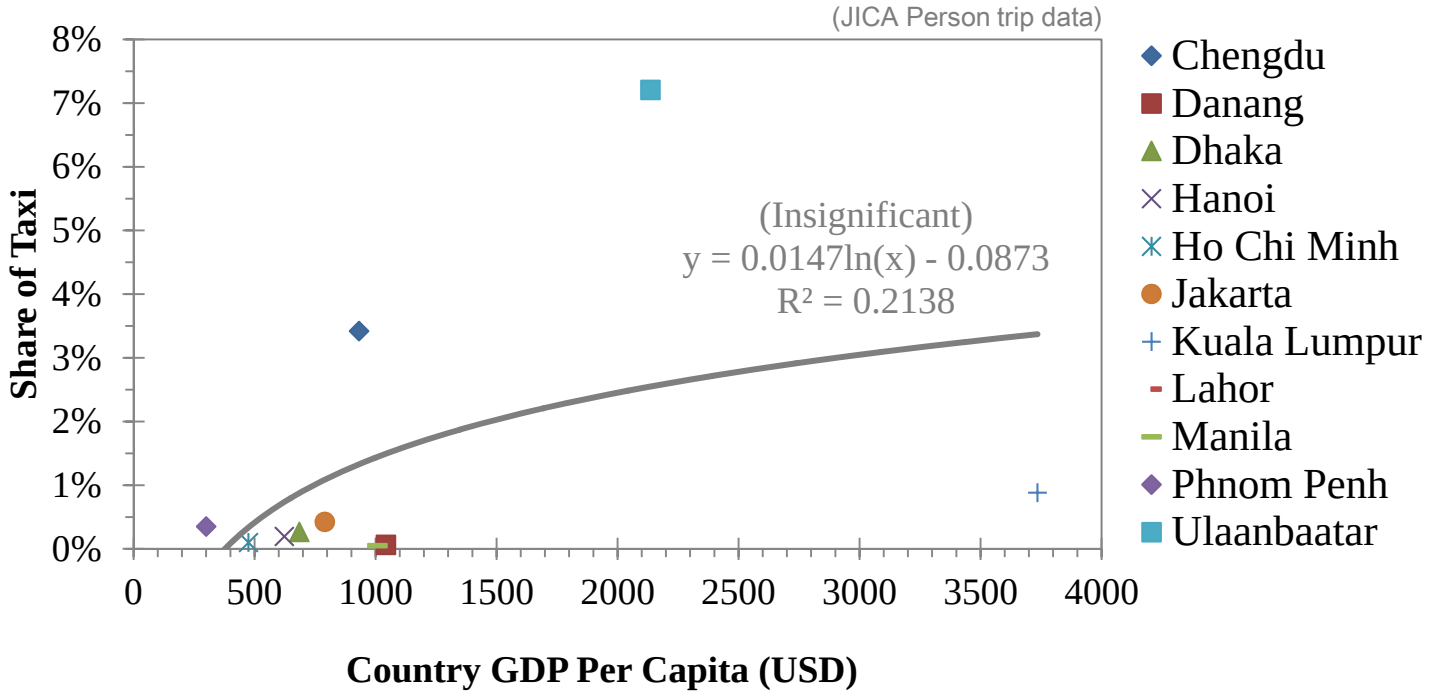
- LAMAT market share is closely linked to existing policies & regulations
- Banning non-motorized LAMATs at CBDs while are preserved for tourists (e.g., reducing Becak 10%/year In Indonesia since 1995).
- Banning motorcycles on urban main streets (e.g., Yangon, Chengdu).
- Regulating auto rickshaws (e.g., Tuktuk is banned on country's expressways, Diesel Tri-wheelers are prohibited in Kathmandu, Tricycles are only seen on small/local roads at suburb of Cebu).
- Regulating fare rate for most fixed-route LAMATs (microbus, minibus, bus) and for some flexible-route LAMATs (e.g., Motorcycle taxi in Bangkok).
- Attempting to use fuel alternatives (CNGs, Electricity)
- Upgrading LAMAT vehicles with new designs to cope with emission and safety issues.

➢ Some policies & regulations have been proposed to eliminate LAMAT while some to tolerate LAMAT.

Economic Growth and the Taxi Share

経済成長とタクシーのシェア

- Whether higher income people prefer better LAMAT mode like Taxi?

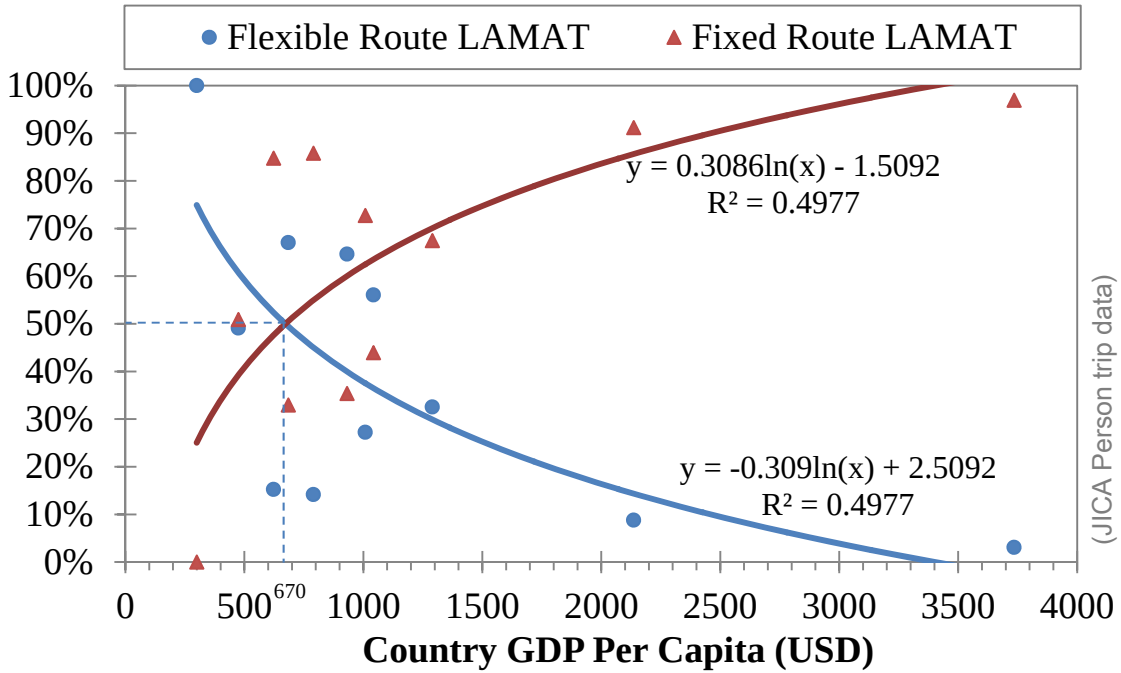


- The share of Taxi was in range from 0.4% in Phnom Penh up to 7.2% in Ulaanbaatar, with the average of 1.3%.

➢ The share of Taxi slightly increases with GDP/capita, but insignificant
➔ Providing more Taxi services in higher-income Asian cities might not be the option.

Flexible vs Fixed Route LAMAT

ルート自由のLAMATとルート固定のLAMAT



- Figure shows the share of Flexible route LAMAT (Cycle rickshaw, Motorcycle taxi, Auto rickshaw, and Taxi) vs Fixed-route LAMAT (Microbus, Minibus, and Large bus), focusing on LAMAT users only.
- When the GDP/capita is higher than 670USD, fixed-route LAMAT gained its majority share comparing to its counterpart.

➢ Operation of fixed-route LAMAT should be considered when GDP/capita becomes higher than certain threshold (i.e., 670USD).

5. Driver Intention of Feeder Service to Mass Transit

Results from a Case Study in Phnom Penh

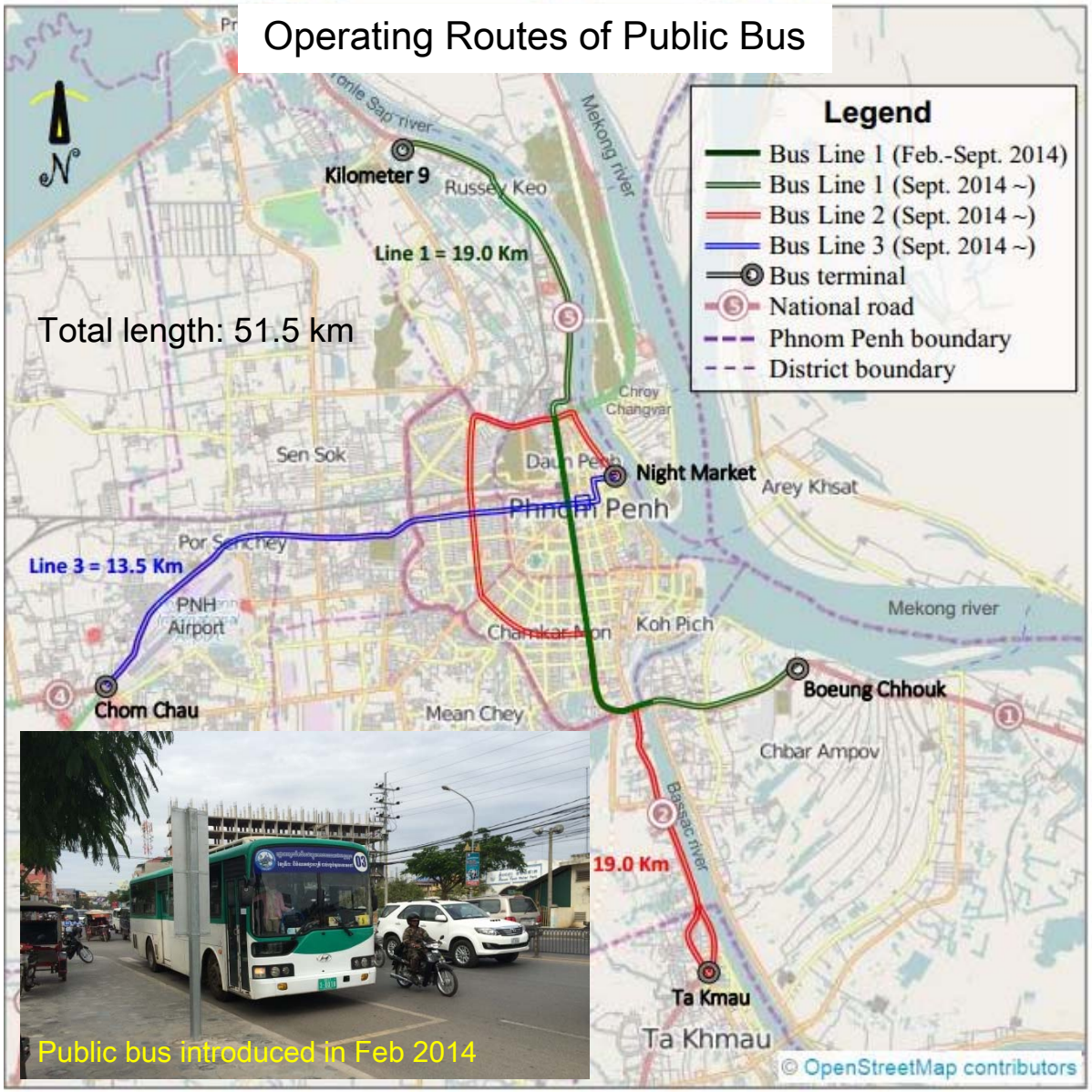
大量輸送機関のフィーダー輸送に対するドライバーの意向

プノンペンにおけるケーススタディの結果

Public Transport Modes in Phnom Penh

プノンペンの公共交通手段

Operating Routes of Public Bus



(Phun et al., 2015)

The Roles of LAMAT　LAMATの役割

- For a given home-destination trip, alternative choices of public transport modes are LAMAT, private vehicles, walking, and a mass transit.

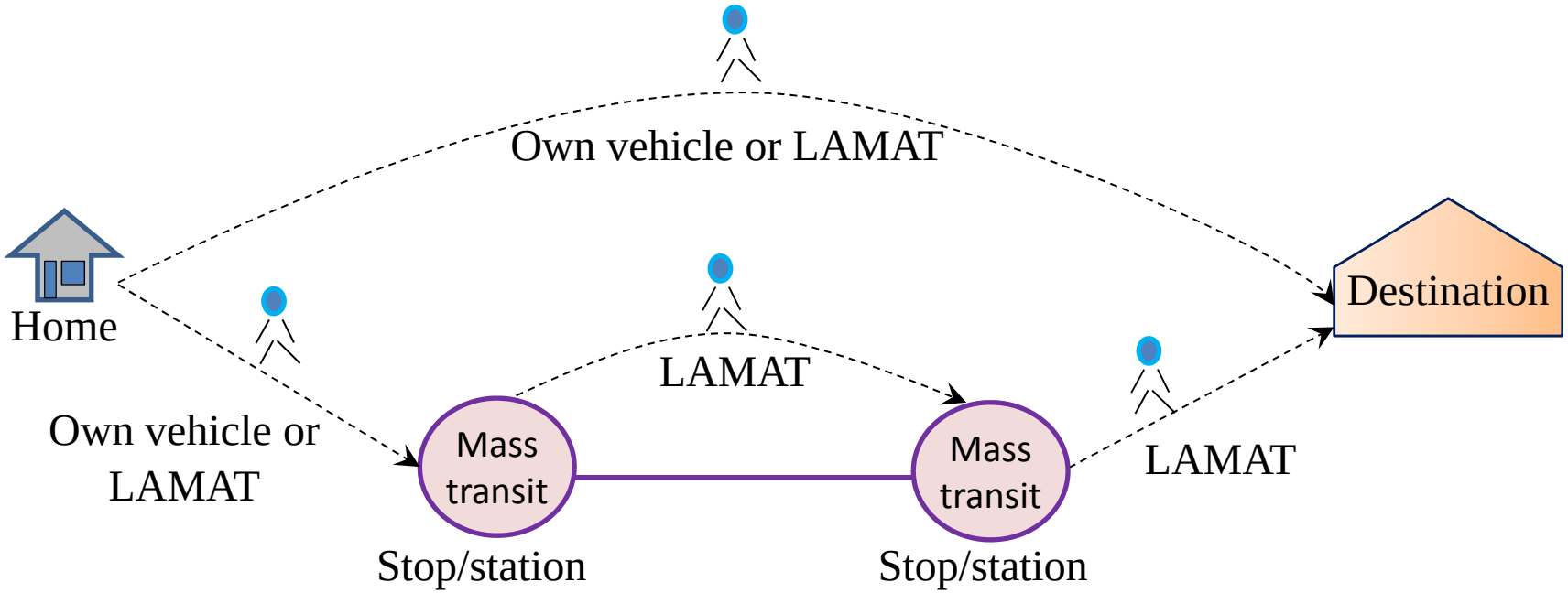


Fig. Illustrative example of modal choices for a given trip

➢ LAMAT can serves as alternative mode, Access mode, Transfer mode, and Egress mode (Connective mode to mass transit system).

LAMAT vs Public Bus　LAMATと路線バス

Purpose　目的

To investigate the attitudes of LAMAT drivers towards the newly-introduced public bus in Phnom Penh and their intention to operate as feeder of the bus.

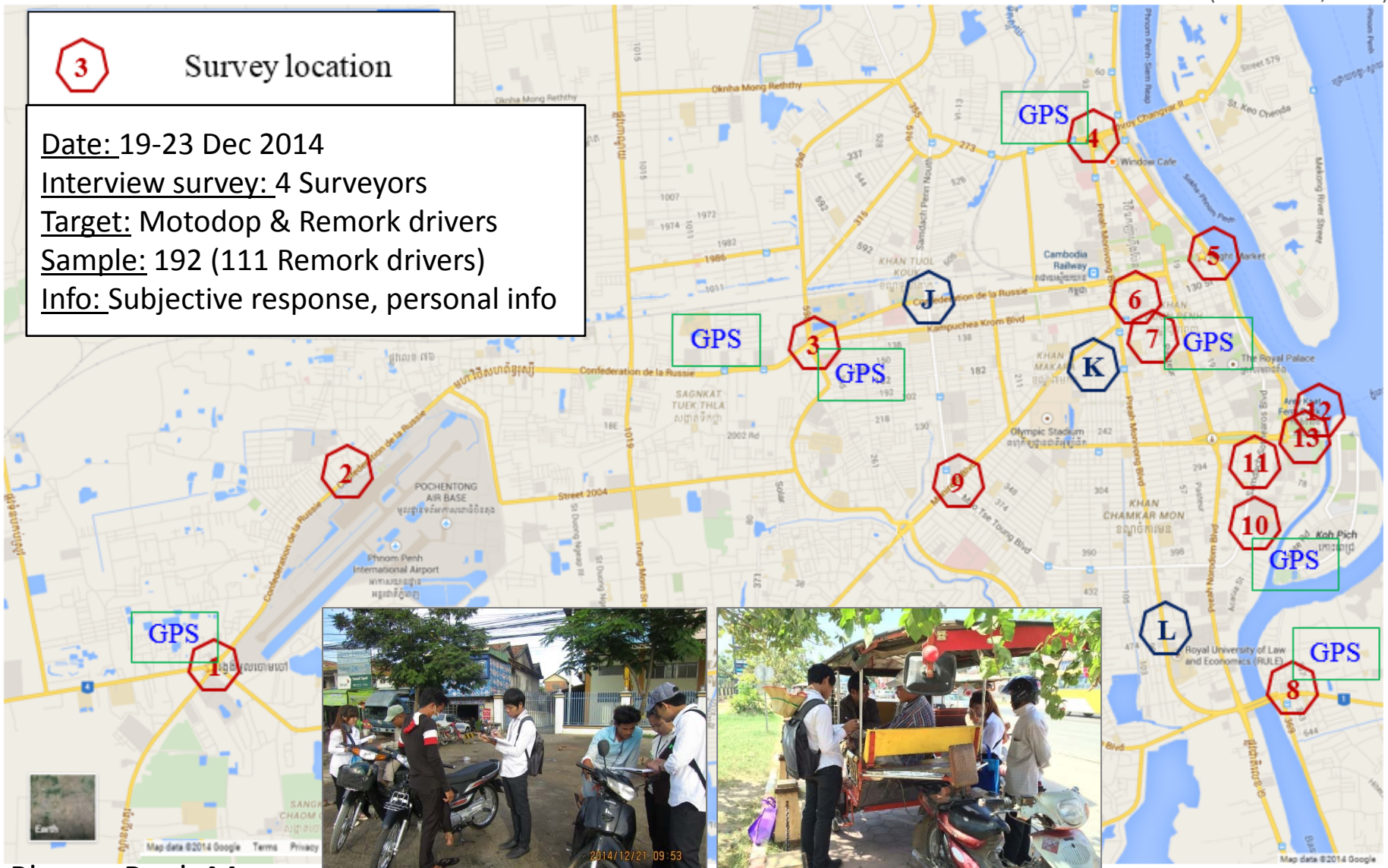
プノンペンで新しく整備された路線バスに対するLAMATドライバーの意見と
バスのフィーダー輸送を担うことに対する彼らの意向を調査する。

Data Collection　データ収集

(Phun et al., 2015)

3 Survey location

Date: 19-23 Dec 2014
Interview survey: 4 Surveyors
Target: Motodop & Remork drivers
Sample: 192 (111 Remork drivers)
Info: Subjective response, personal info



Phnom Penh Map

Measurement Models of Structural Equation Model (SEM)

構造方程式モデリングの測定モデル

- Each of 4 latent constructs is operationalized using three indicators
- Each indicator is from the 5-point (1: Very Unlikely, 3: Neither, 5: Very Likely)

Table Descriptive statistics of the variables for SEM ($N = 186$)

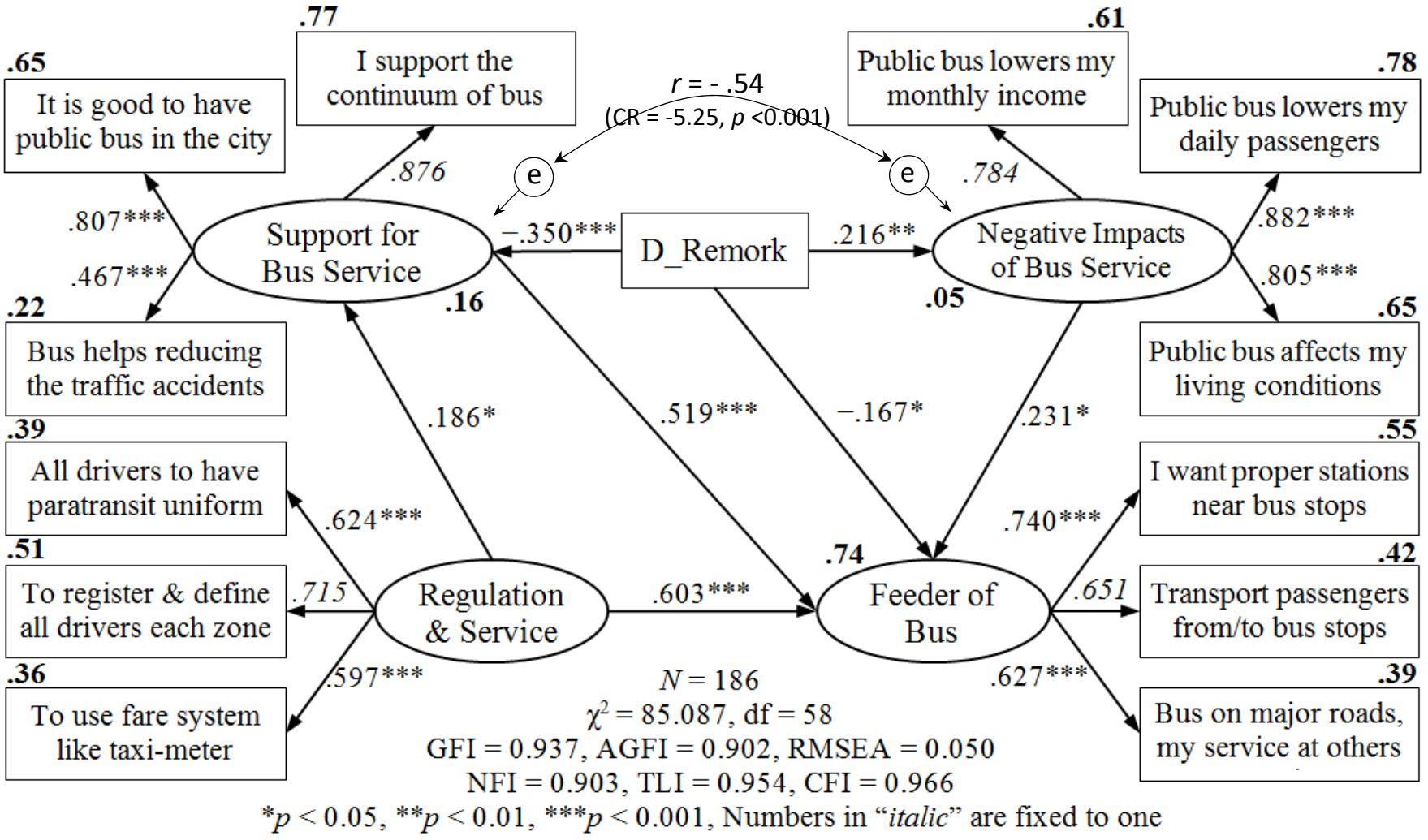
Variables	Mean	SD	Min	Max
Feeder of Bus				
I want proper stations near bus stops	4.05	1.14	1	5
Transport passengers from/to bus stops	3.67	1.20	1	5
Bus on major roads, my service at others	3.84	1.26	1	5
Support for Bus Service (Positive image)				
I support the continuum of bus	2.96	1.55	1	5
It is good to have public bus in the city	3.02	1.45	1	5
Bus helps reducing the traffic accidents	3.90	1.02	1	5
Negative Impacts of Bus Service (Negative image)				
Public bus lowers my monthly income	3.54	1.36	1	5
Public bus lowers my daily passengers	3.58	1.36	1	5
Public bus affects my living conditions	3.25	1.44	1	5
Regulation & Service				
All drivers to have paratransit uniform	4.46	1.08	1	5
To register & define all drivers each zone	3.97	0.99	1	5
To use fare system like taxi-meter	3.53	1.60	1	5
Vehicle Size				
D_Remork (1 if a driver of Remork, 0: Otherwise)	0.57	0.50	0	1

(Phun and Yai, 2015)

Results of Structural Equation Model (SEM) (1/2)

構造方程式モデリングの結果

- Good model fits, all effects are significant, the hypotheses are confirmed



Bold numbers are percentage of explained variance

(Phun and Yai, 2015)

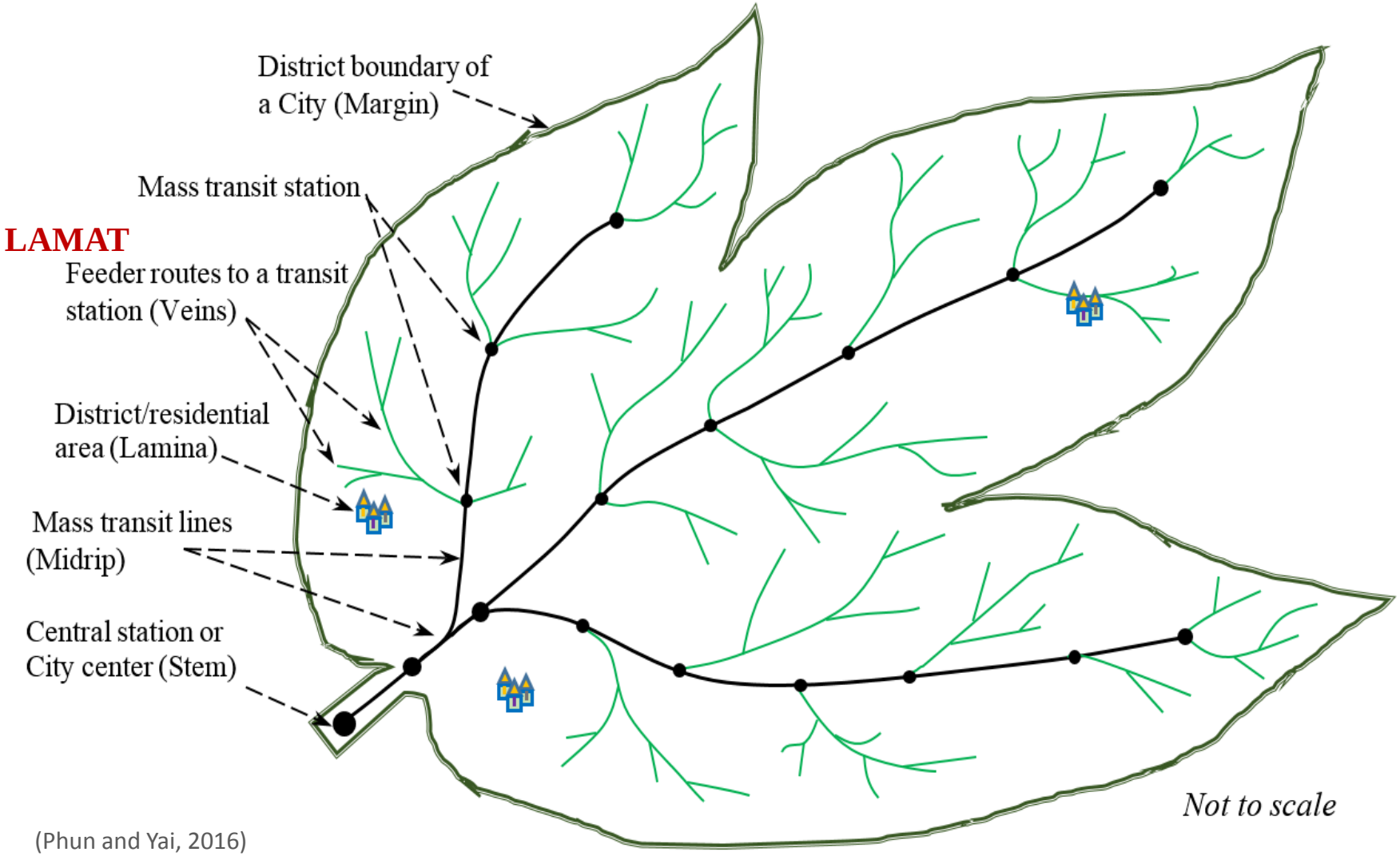
Results of Structural Equation Model (SEM) (2/2)

構造方程式モデリングの結果

- Motodop drivers had intention to operate as feeder service to public bus regardless they supported or did not support for the bus service.
- Remork drivers did not support for bus service and no intention to operate as feeder mode to bus. This suggests that operations of Remorks should be left as it is, competing to the public bus.
- Previous studies showed conflicting results on vehicle sizes of LAMAT as feeder (Thailand vs Indonesia). However, which size of LAMAT suitable for feeder depends on both supply and demand sizes, given that it is safe, comfortable, and sufficient.
- A more effective regulation (e.g., standard LAMAT service & fare, uniform) is needed to encourage more drivers to operate as feeder mode to the bus in a harmonized manner.

✓ The potential role of LAMAT as feeder should be considered for a sustainable urban public transport in term of easy accessibility/connectivity and transit ridership.

Conceptual Design of “Public Transport Network”
公共交通ネットワークのコンセプトデザイン



(Phun and Yai, 2016)

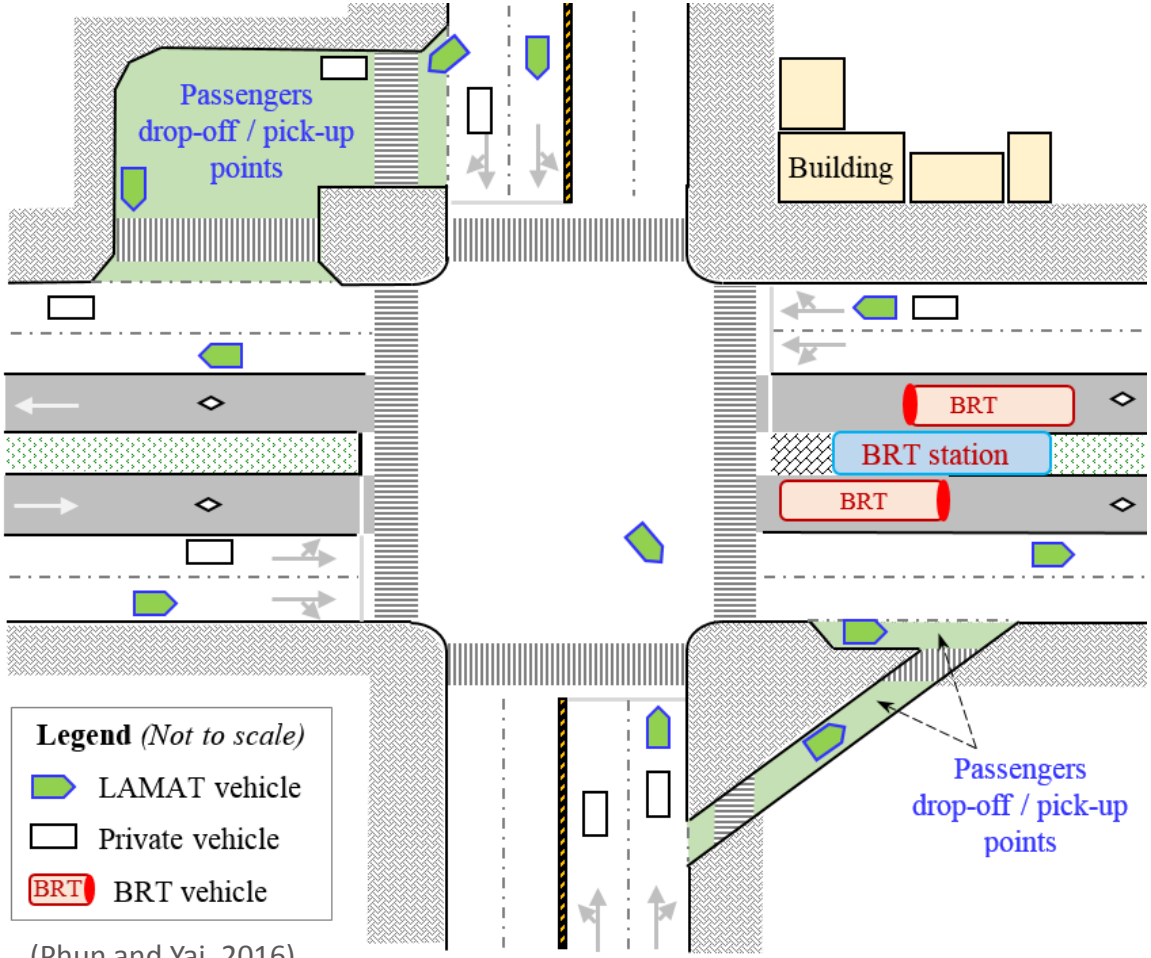
Fig. Feeder routes and mass transit network (A Tree-Leaf Concept) in a part of a city

Conceptual Design of “Seamless Transfer”

シームレス乗換のコンセプトデザイン

At the intersection

At mid-block



(Phun and Yai, 2016)

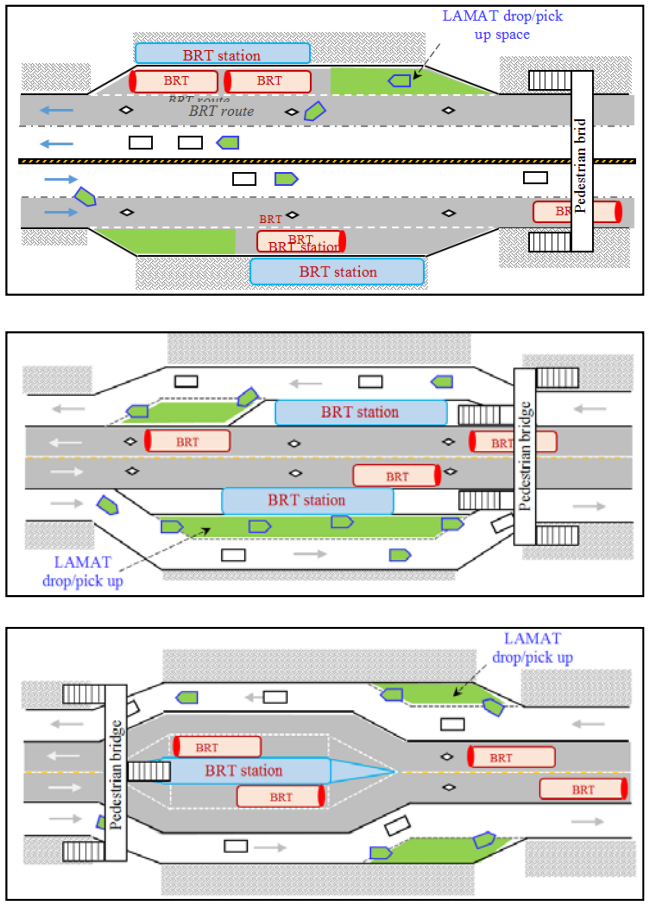


Fig. Seamless Intermodal Transfer Between BRT and LAMAT (Shared space)

6. Summary & Conclusions

結論とまとめ

Summary　まとめ

Elimination of LAMAT

- Non-motorized LAMAT modes are almost disappear and are used particularly in touristic places.
- Ordinary auto rickshaws are being converted using fuel alternatives or being replaced by E-Trikes.
- New designs for ordinary Angkot and Jeepney are on their ways

Tolerance of LAMAT (Phun and Yai, 2016)

From literatures, I identified FOUR strategies to sustain LAMAT system:

1- LAMAT and the improvement on service quality
(Comfort, Customer service, Fare, Safety, ICT, etc.)

2- LAMAT and the integrated public transport system
(Feeder service, design of whole route & servicing network, coordinated transport service, shared facilities & fare, etc.)

3- LAMAT and the environment
(Alternative fuel usage or E-LAMAT)

4- LAMAT and the government roles
(Policy & regulation, supporting infrastructures, green transport policy, etc.)

Conclusions 結論

- This study discusses on the future of LAMAT system in Asian developing cities.

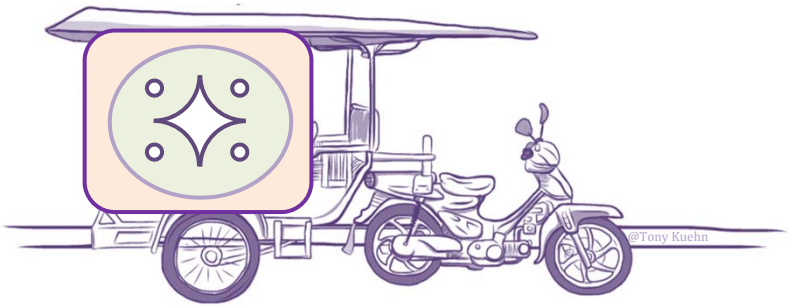
✓ Most non-motorized LAMAT modes have been gradually disappeared due to its operational characteristics.

✓ Motorized LAMAT modes have been improved by fuel alternatives (E-LAMAT), Vehicle designs, Ticketing system, etc.

✓ Although LAMAT associations were established with internal regulations, further policies & regulations have been imposed for better traffic flow and LAMAT services in urban streets
(e.g., Prohibition of cycle rickshaw & motorcycle).

➢ LAMAT services could not be simply eliminated from urban public transport system due to the stability of social economy (e.g., jobs for the poor or low-skilled people) and inevitable needs for transport poor.

☐ Further researches (e.g., traffic safety issues) are needed for a concrete conclusion on the future of LAMAT in Asian developing countries.



Thanks for Your Attention!

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