กรมการขนส่งทางราง

PART 3

แนวทางการพัฒนาแบบจำลองกิจกรรมเน้นการขนส่งทางราง

Activity-Based Model (ABM-Railway-Focused model)

ถ่ายทอดโดย...ผศ.ดร.ธีรพจน์ ศิริไพโรจน์
(ผู้เชี่ยวด้านแบบจำลองการขนส่งและจราจร)

กิจกรรมถ่ายทอดความรู้ ครั้งที่ 1/2564

โครงการเพื่อพัฒนาแบบจำลองการคาดการณ์ความต้องการเดินทางด้วยระบบรางและการพัฒนาโครงข่ายระบบขนส่งมวลชนทางรางในเขตกรุงเทพและปริมณฑล (พื้นที่ต่อเนื่อง) ระยะที่ 2 (M-MAP 2)

วันพุทธที่ 24 พฤศจิกายน 2564

ณ ห้อง Infinity Ballroom 2 ชั้น G Pullman Bangkok King Power

Overview of ABM

The limitation of conventional transport model (4-step)

- separate the sequence of trip made by a driver or person during one day.
- ignore the interdependent decision.
- delinks human daily activities and travel pattern.

Consequently

- These limitations may undermine the accuracy/reliability of the model in estimating the effects of policies, which may significantly affect travelers' activity pattern.
- **The activity-based model (ABM)** can overcome these limitations.

Transport modelling: An activity-based approach

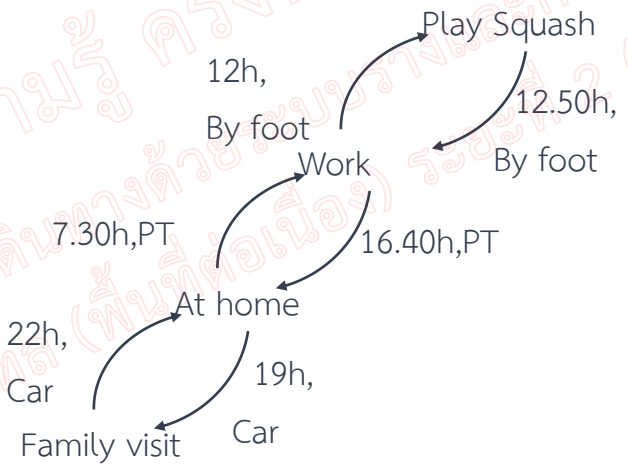
- Travel demand is derived from the activities that individuals need/wish to perform
- Sequences or patterns of behaviour are the unit of analysis
- Household and other social structures influence travel and activity behaviour
- Spatial, temporal, transportation and interpersonal interdependencies constrain activity/travel behaviour
- Activity-based approaches can reflect the scheduling of activities in time and space.

→ Activity-based approaches aim at predicting *which* activities are conducted *where*, *when*, for how *long*, with *whom*, the *transport mode* involved and ideally also the implied *route* decisions.

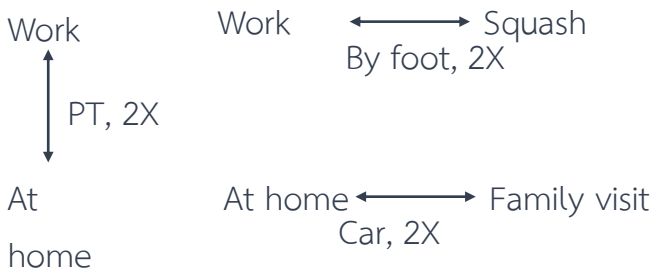
Transportation modelling: Trip-based Approach

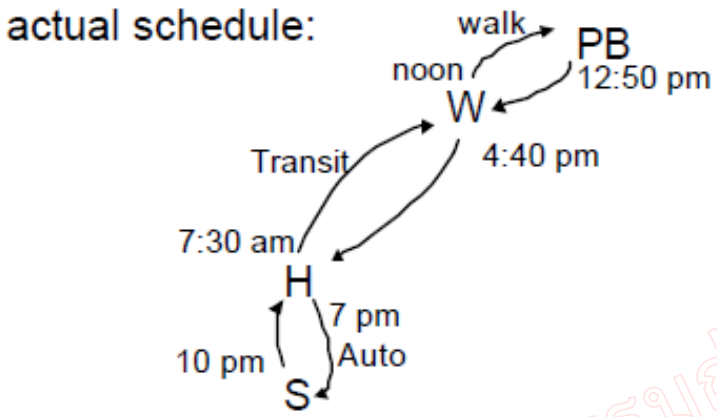
- Modelling as independent and isolated trips, no connections between the different trips
- no time component
- no direction
- no sequential infomation

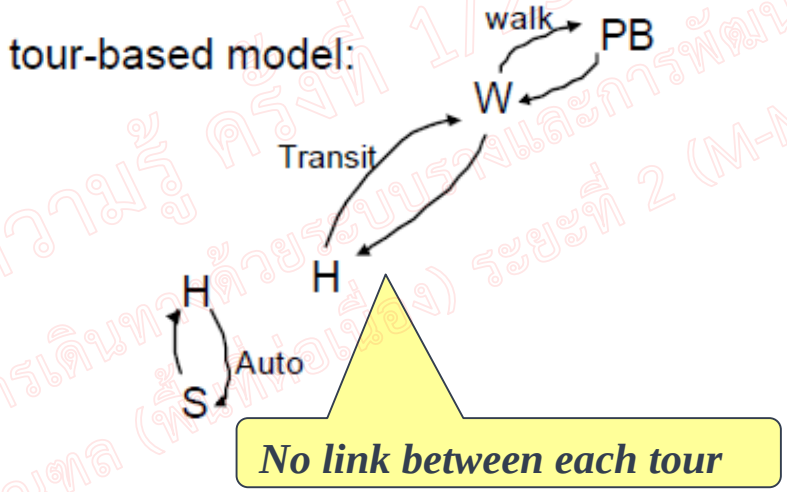
Reality

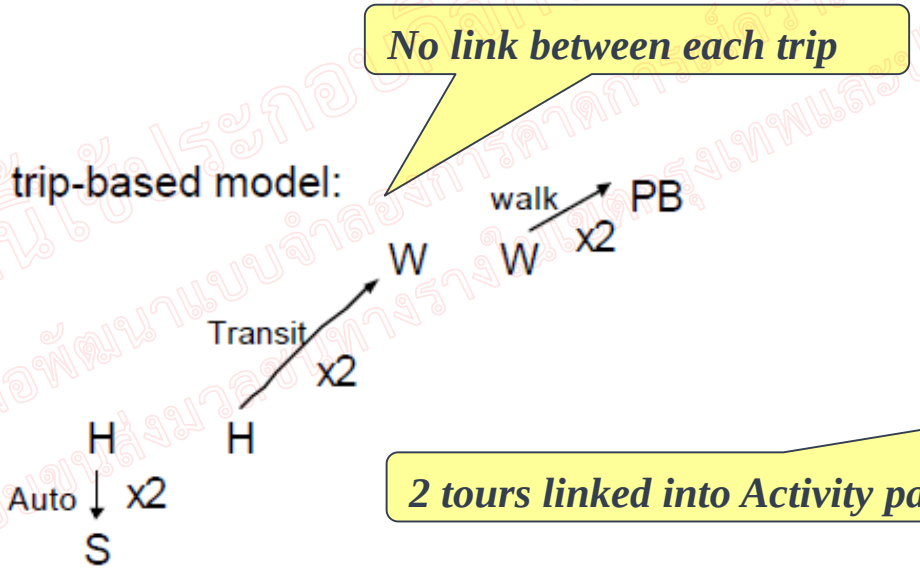


Trip-based model

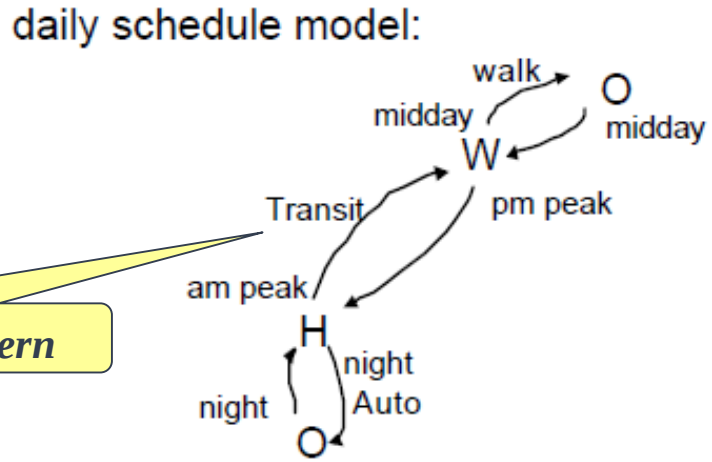








(Simple-ABM)



Definition

An activity pattern (Ben-Akiva ,1999) is the combination of making the set of activities on one day, which includes primary activity of the day (i.e. the most important activity such as work, study, and other main activities), primary tour type (e.g. H-W-H), and the number and propose of secondary tour (e.g. 1 tour, purpose others).

The activity scheduling, regarded as the complete activity-travel pattern, means the planning preceding travel that determines what activities to perform, where to perform these activities, and in what sequence, at which starting and ending times, and using which route and travel modes (Ettema (*62*)).

- The model can split the human decisions into two terms (i.e. short-term and long-term decisions). Individuals give their first priority concerning the long-term activity plan (mandatory activity).

- In addition, long-term decisions relate strongly to work and school purposes. Also, the activity location choices are dependent on the household and personal characteristics (e.g. household size, employ status, age, household/personal income, education level, and vehicle ownership).

Out-of-Home Activities / Travel Purposes

- Mandatory:
  - work/school
- Maintenance:
  - shopping
  - personal business (e.g. medical)
- Discretionary:
  - eating out
  - social/recreational

Conceptual frameworks of modelling activity pattern/scheduling generation in activity-based model.

- Tour formulation (especially, home-based tours) is normally the core structure of the model. In addition, many models structure their activity scheduling on 3-decision levels:

  a) person/household-level: a choice of activity patterns that span the entire day for at least one person in the household.

  b) tour-level: a choice of destinations, travel modes, begin/end times, and number of stops.

  c) trip-level: a choice of stop locations, travel modes, and departure times of each trip.

Daily Activity Patterns (Bowman et al., 1995)

Decision	Choice Alternative	Description
Daily Activity Pattern		
Primary activity	home	at home all day
	work	the daily activity pattern includes at least 1 work activity
	school	the daily activity pattern includes no work activities and at least 1 school activity
	other	the daily activity pattern includes no work or school activities
Primary tour type	HWH	simple tour from home to work and back
	HWH+	work tour with at least 1 additional stop for another activity
	HW+WH	work tour with a work-based subtour, and any number of additional stops
	HWHWH	work tour with an intermediate stop at home
	HWHWH+	work tour with an intermediate stop at home, plus 1 or more additional stops
	HSH	simple tour from home to school and back
	HSH+	school tour with at least 1 additional stop for another activity
	HOH	simple tour with purpose other than work or school
	HOH+	tour with purpose other than work or school, with atat least 1 additional stop for another activity
Number and purpose of secondary tours	0	no secondary tours
	1,C	one secondary tour, with a purpose (ie the primary activity of the tour) which is time constrained (work, work related, school, banking/personal business)
	1,U	one secondary tour with a purpose which is not time constrained (social, recreational, eat out, shopping)
	2+,C	two or more secondary tours, all time constrained
	2+,CU	two or more secondary tours, 1 or more time constrained and 1 or more not time constrained
	2+,U	two or more secondary tours, none time constrained

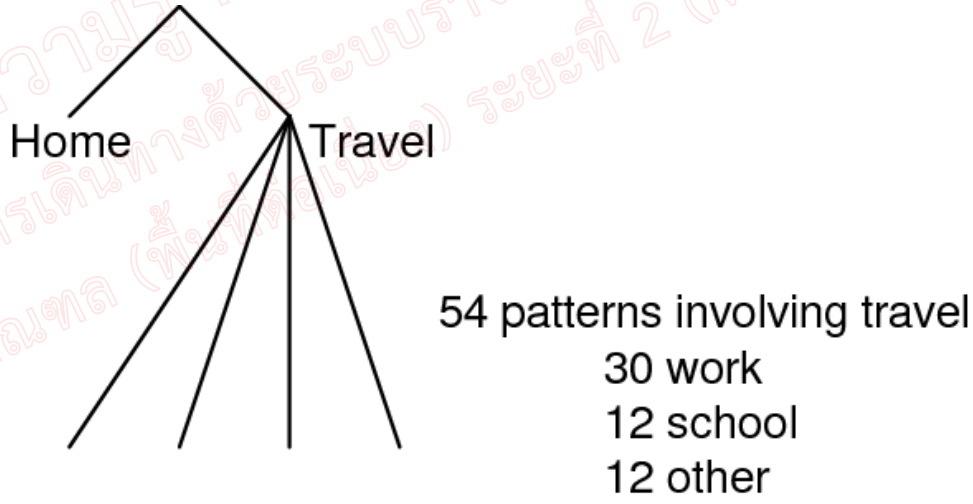


Figure 4.4
Nested logit model of the daily activity pattern

Activity pattern model (Cemdap, Pinjari et al., 2006)

1.) Generation allocation model

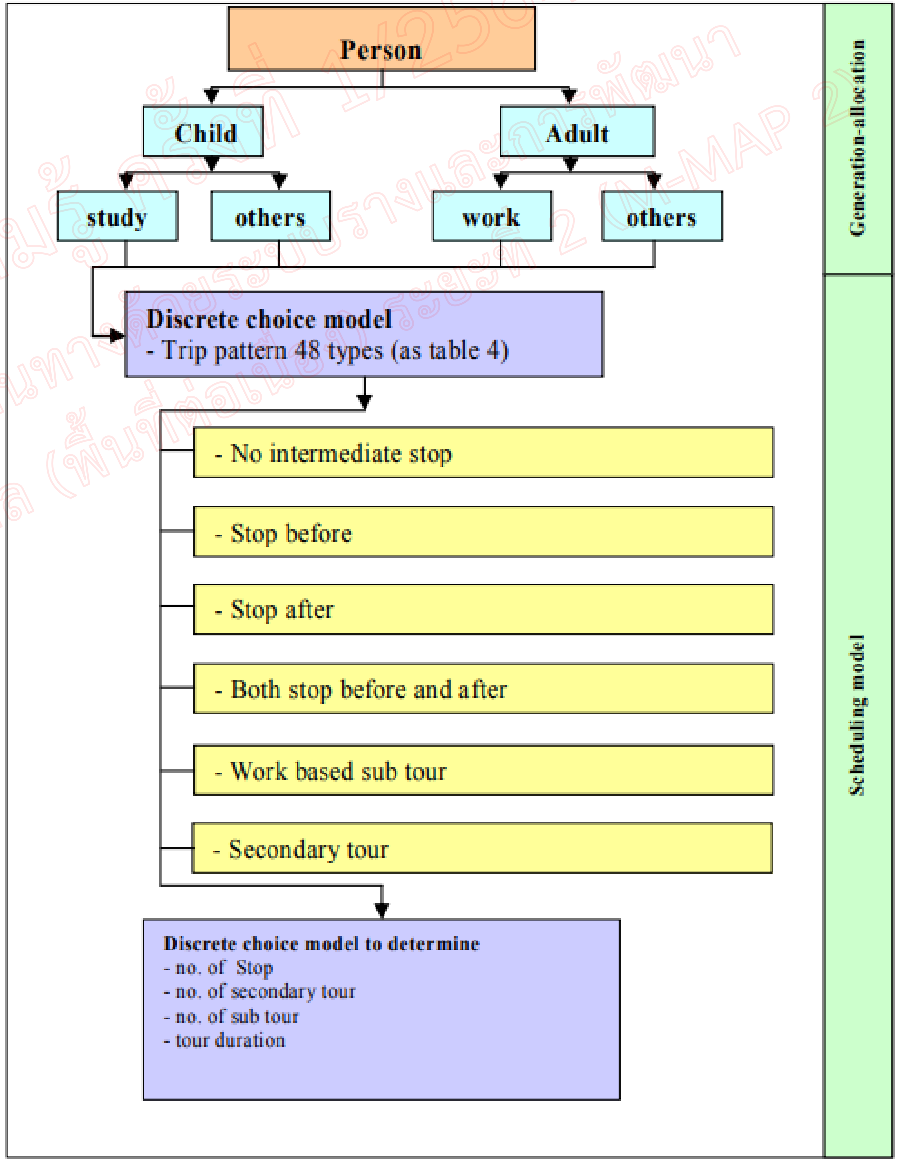
At this stage of the model, the decision is made for every child and adult for their main activity during the day, the mandatory activity including:

- decision to go to work/school; or decision to go to other places

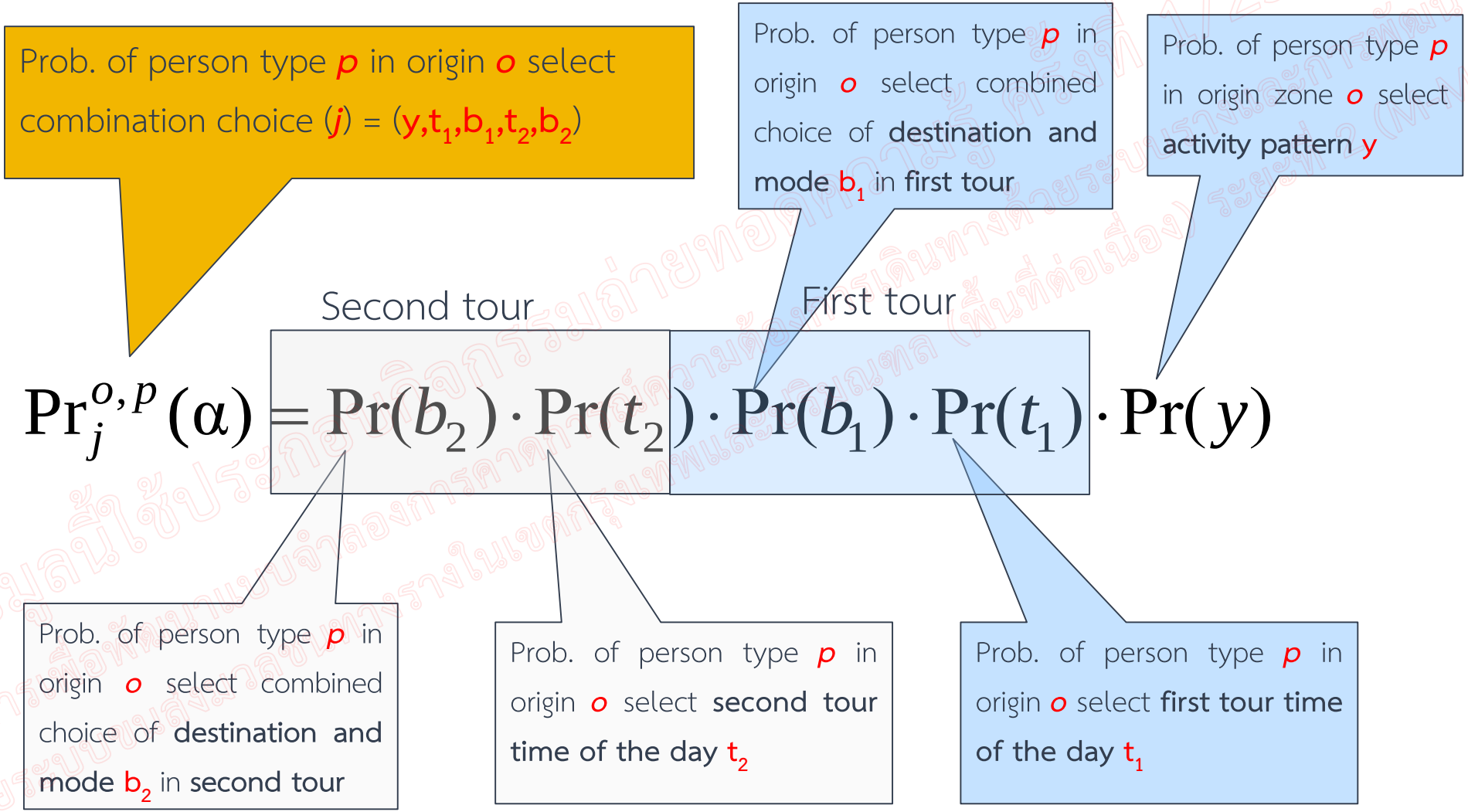
2.) Scheduling model

This stage classifies the trips in term of 3 levels: Primary tour Secondary tour and Stop level (Pinjari et al. (2006)):

- *Primary tour* is the round trip travel from home to make the main activity, then back to home in the one day.
- *Secondary tour* level is the tour occurred after they finish the primary tour
- *Stop level is the unusual events that may happen sometimes. An example of stop level is stops before or stops after main activity.*



Probability of making the choices of activity chains



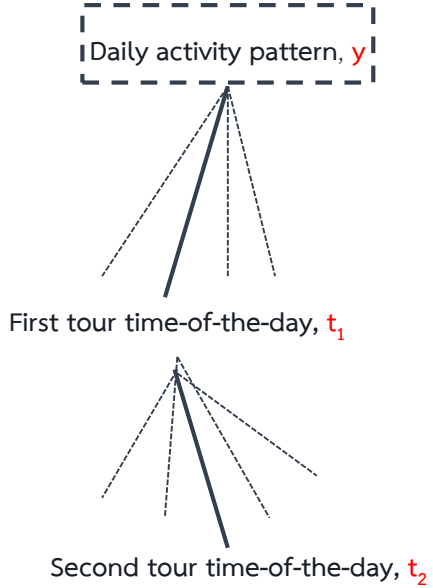
Probability of selecting daily activity pattern y:

$$\Pr(y) = \frac{\exp(V_y + V'_y)}{\sum_{y'} \exp(V_{y'} + V'_{y'})}$$

Choice = H-W-H, H-O-W-H, H-W-O-H, and H-W-H-O-H

where, $V_y = \text{Asc}_1(y) + \alpha_6 X_6 + \alpha_7 X_7 + \alpha_8 X_8$ and $V'_y = \frac{1}{\mu^{t_1}} \ln \sum_{t'_1} \exp[(V_{t'_1} + V'_{y,t'_1})\mu^{t_1}]$

No.	Model	Variable name	Type of variable	Coeff. (α)
1	Ap	H-O-W-H specific const. (Asc_1 of H-W-H = 0)	Asc_1	-4.42
2		H-W-O-H specific const.	Asc_1	-3.12
3		H-W-H-O-H specific const.	Asc_1	-0.84
4		Scaled parameter (μ^{t1})	μ^{t1}	1.28
5		Scaled parameter (μ^{t2})	μ^{t2}	1.00
6		Dummy[a]: Female + H-O-W-H or H-W-O-H	X_6 = 1 or 0	1.56
7		Dummy: Family with at least one child+ H-O-W-H	X_7 = 1 or 0	3.16
8		Dummy: Family without child + H-W-O-H	X_8 = 1 or 0	0.70



Probability of selecting tour time-of-day t_1 in the first tour:

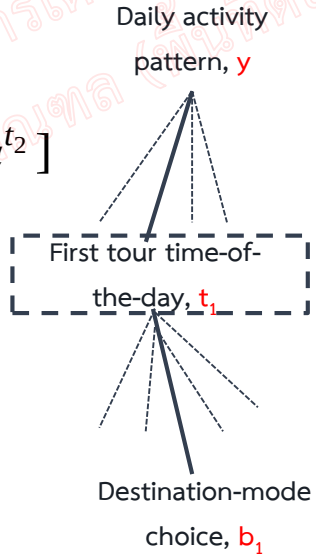
$$\Pr(t_1 \mid y) = \frac{\exp(V_{t_1} + V'_{y,t_1})}{\sum_{t'_1} \exp(V_{t'_1} + V'_{y,t'_1})}$$

Choice =

	First tour	
t_1	Start	End
1	AM[a]	MD[a]
2	AM	PM
3	AM	OP[a]

where $V_{t_1} = \text{Asc}_2(t_1) + \alpha_{11}X_{11} + \alpha_{12}X_{12}$ and $V'_{y,t'_1} = \frac{1}{\mu^{t_2}} \ln \sum_{t'_2} \exp[(V_{t'_2})\mu^{t_2}]$

No.	Model	Variable name	Type of variable	Coeff. (α)
9	Ftod	AM to PM specific const. (Asc_2 of AM-MD = 0)	Asc_2	-0.54
10		AM to OP specific const.	Asc_2	-2.24
11		Dummy: Full time worker + tour time: AM to MD	X_{11} = 1 or 0	-4.00
12		Dummy: Part-time worker + tour time: AM to OP	X_{12} = 1 or 0	1.92



Time in the model is classified into 4 periods (covering MRT service hours 6:00-24:00) as follows :

- AM period (6.01 – 9.00)
- MD period (9.01 – 16.00)
- PM period (16.01 – 19.00)
- OP period (19.01 – 6.00)

All possible trip chain period (from start time to end time)

period	Start time	End time	period	Start time	End time
1	AM	AM	8	PM	PM
2	AM	MD	9	PM	OP
3	AM	PM	10	OP	AM
4	AM	OP	11	OP	MD
5	MD	MD	12	OP	PM
6	MD	PM	13	OP	OP
7	MD	OP			

First tour destination/mode choice model

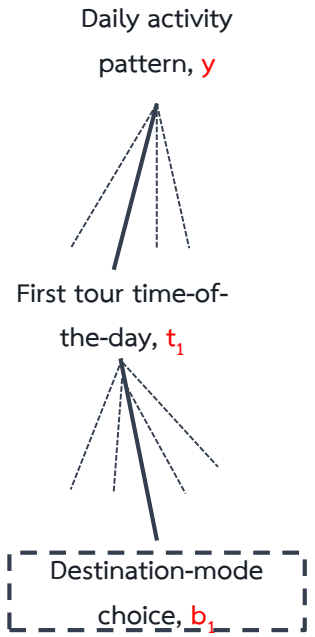
Probability of selecting destination/mode choice b_1 in the first tour:

$$\Pr(b_1 \mid y, t_1) = \frac{\exp(V_{b_1})}{\sum_{b_1'} \exp(V_{b_1'})}$$

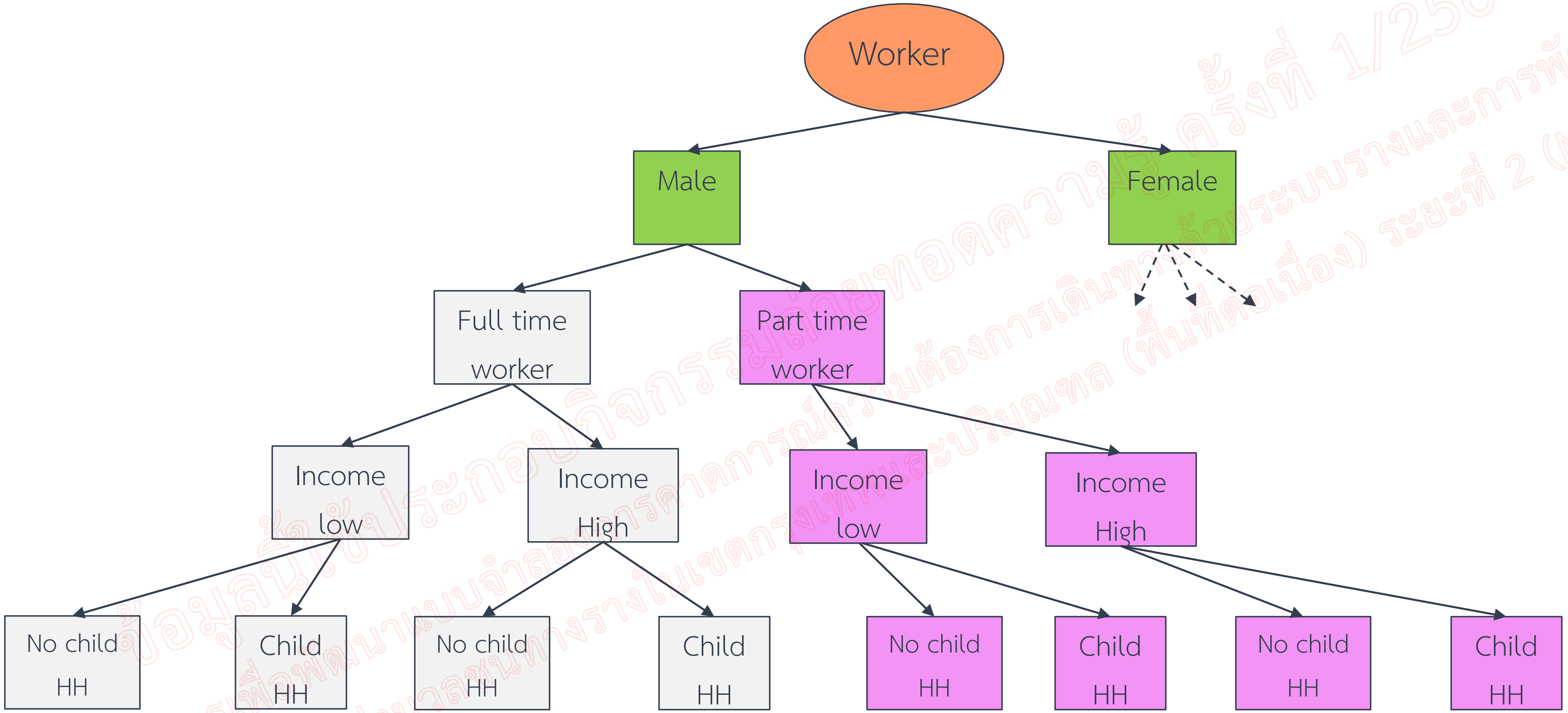
where $V_{b_1} = \text{Asc}_3(b_1) + \alpha_{14} TT_{14} + \alpha_{15} Emp + \alpha_{16} X_{16}$

Choice = (car,destination 1), (car,destination 2), (car,destination 3),
(bus,destination 1), (bus,destination 2), (bus,destination 3)

No.	Model	Variable name	Type of variable	Coeff. (α)
13	Fdm	Bus specific const. (Asc_3 of car = 0)	Asc_3	0.24
14		Generalised travel time	*TT*	-0.08
15		Number of employments (log scale)	*Emp*	0.80
16		Dummy: High household income + car	X_{16} = 1 or 0	5.36



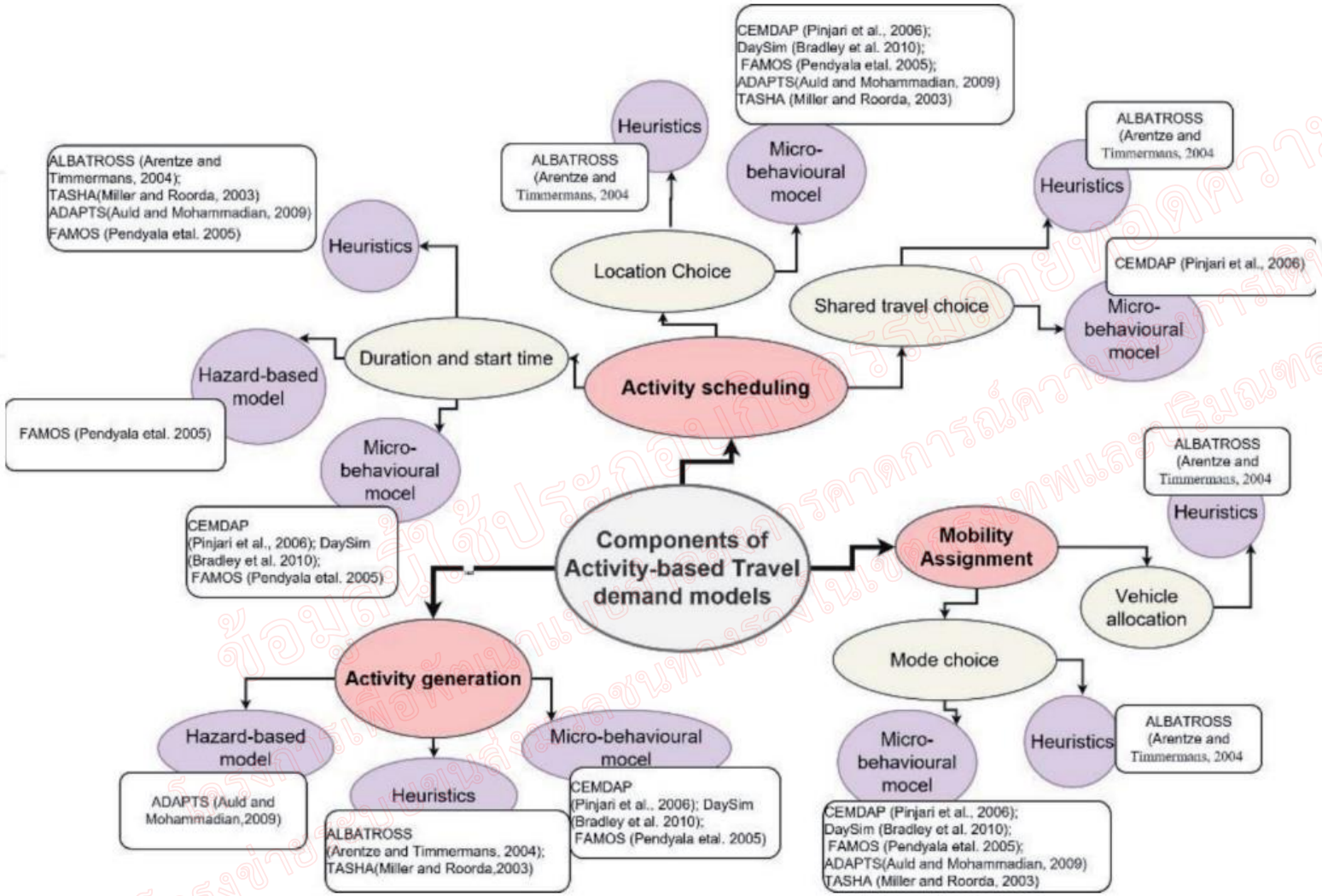
16 groups of population Synth



Note: the utility of activity-travel's decisions can be varied by type of population.

(e.g. Bifulco et al., 2010; Bowman et al., 2006, 2008; Vovsha et al., 2004).

Reviews of ABMs:



ABM type + year of proposal	Examples	Model limitations
Constraint-based models 1967	PESASP [12]	Consider only individual accessibility, rather than household-level accessibility Some system features, like open hours and travel times, are considered fixed [11]
	CARLA [13]	
	BSP [14]	
	MAGIC [15]	
	GISICAS [16]	
Utility maximization-based models 1978 - recent	Portland METRO [17]	• Assume that all decision-makers are fully rational utility maximizers which are not realistic in practice [10] • Unable to reflect latent behavioral mechanisms in the decision processes [11]
	San Francisco SFCTA [18]	
	New York NYMTC [19]	
	Columbus MORPC [20]	
	Sacramento SACOG [21, 22]	
	CEMDAP [23, 24]	
	FAMOS [25]	
	CT-RAMP [26]	
Computational process models 2000 - recent	ALBATROSS [27, 28]	Focus more on scheduling and sequencing of activities than the underlying rules in decision-making [11]
	TASHA [29, 30]	
	ADAPTS [31–33]	
	Feathers [34]	
Agent-based modeling 2004 - recent	ALBATROSS [27, 28]	• High computational complexity • No transparency in the mechanical process of agents interacting with other agents and environment which depends on the parameters' values • Requires well-defined conditions and constraints • Non-reproducibility due to the non-streamlined process of calibrating and imputing parameters for the models [39]
	Feathers [34]	
	MATSim [35]	
	TRANSIMS [36]	
	SimMobilitiy [37]	
	POLARIS [38]	

Bradley, Bowman and Griesenbeck, Journal of Choice Modelling, 3(1), pp. 5-31

Existing activity-based model

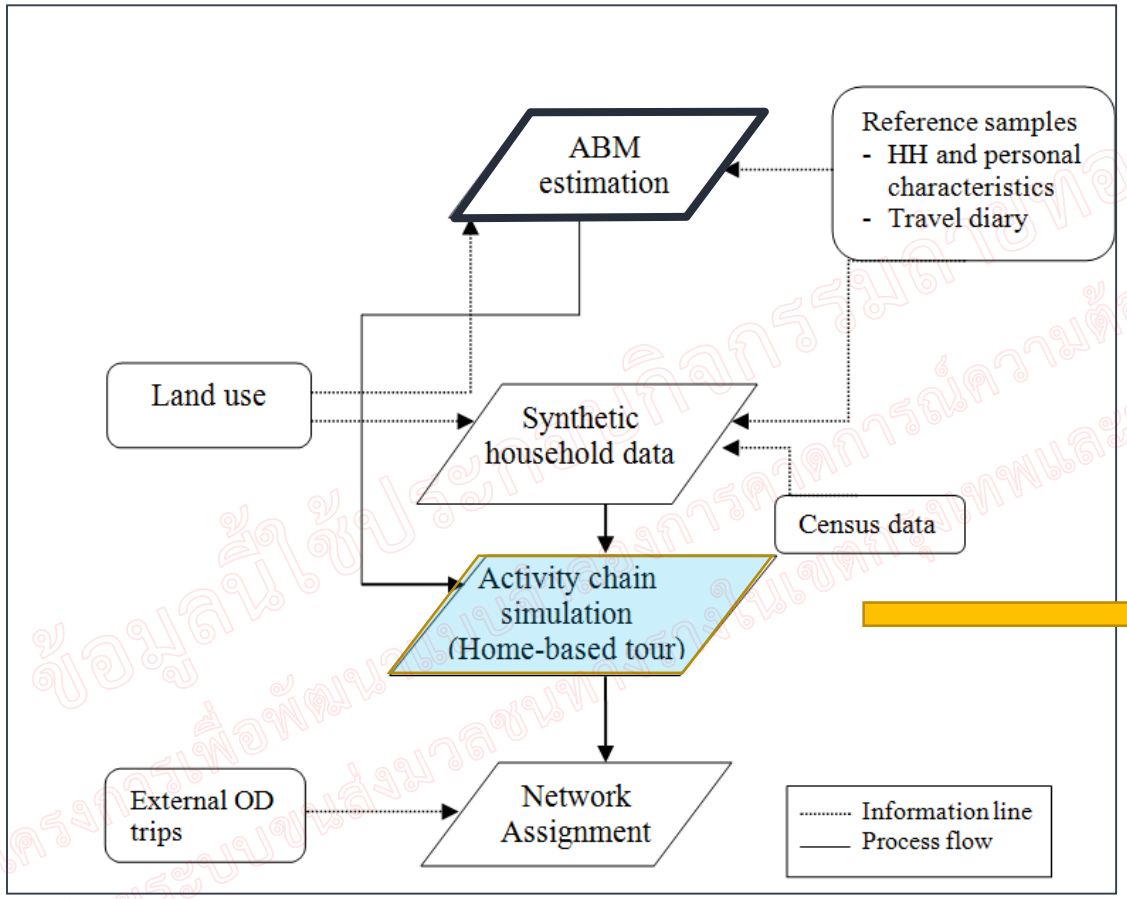
AB model	Authors	Model framework	Activity pattern/scheduling consideration								
			Model type	Model decision	Activity priority	Timing	Tour formulation	Spatial constraint	Temporal constraint	Route choice	On-road VI data
Albatross	Arentze	Sequential	Rule-based	S&L	y	min	y	y	y	shortest	n
Amos	Kimatura	Sequential	Rule-based	S	n	seq	y	n	n	n	n
Bowman's model	Bowman	Simultaneous	Nested logit	RUM	n	seq	y	n	n	shortest	n
Carla	Jones	Sequential	Constraints-based	S	y	seq	y	y	y	n	n
Catgw	Bhat	Simultaneous	Hybrid logit	RUM	n	min	y	n	n	n	n
Cemdap	Bhat	Simultaneous	Logit and Harzard	RUM	n	min	y	n	n	n	n
Chase	Doherty	Sequential	Rule-based	S	y	min	y	y	y	iterative	n
Cobra	Wang	Simultaneous	Nested logit	RUM	n	n	y	n	n	n	n
Gisicas	Kwan	Sequential	Rule-based	S	y	seq	y	y	y	n	n
Happ /Harp	Recker	Simultaneous	Math prog	UM,SM	n	min	y	y	y	shortest	n
Mastic	Dijst	Simulation	Constraints-based	UM	n	seq	y	y	n	n	n
Pcats	Kitamura	Sequential	Rule-based	S	y	min	y	y	y	n	n
Pcats-rum	Kitamura	Simultaneous	MNL	RUM	y	min	y	y	y	n	n
Petra	Fosgerau	Simultaneous	Nested logit	RUM	n	n	y	n	n	n	n
Scheduler	Garling	Sequential	Rule-based	S	-	min	n	n	n	n	n
Smash	Ettema	Sequential	Rule-based	S&RUM	y	n	y	y	y	n	n
Starchild	Recker and McNally	Simultaneous	MNL	RUM	y	seq	y	y	y	n	n
Wen's model	Koppelman& Wen	Simultaneous	Nested logit	RUM	y	seq	y	n	n	n	n
Tasha	Miller	Sequential	Rule-based	S&RUM	y	min	y	n	n	iterative	n

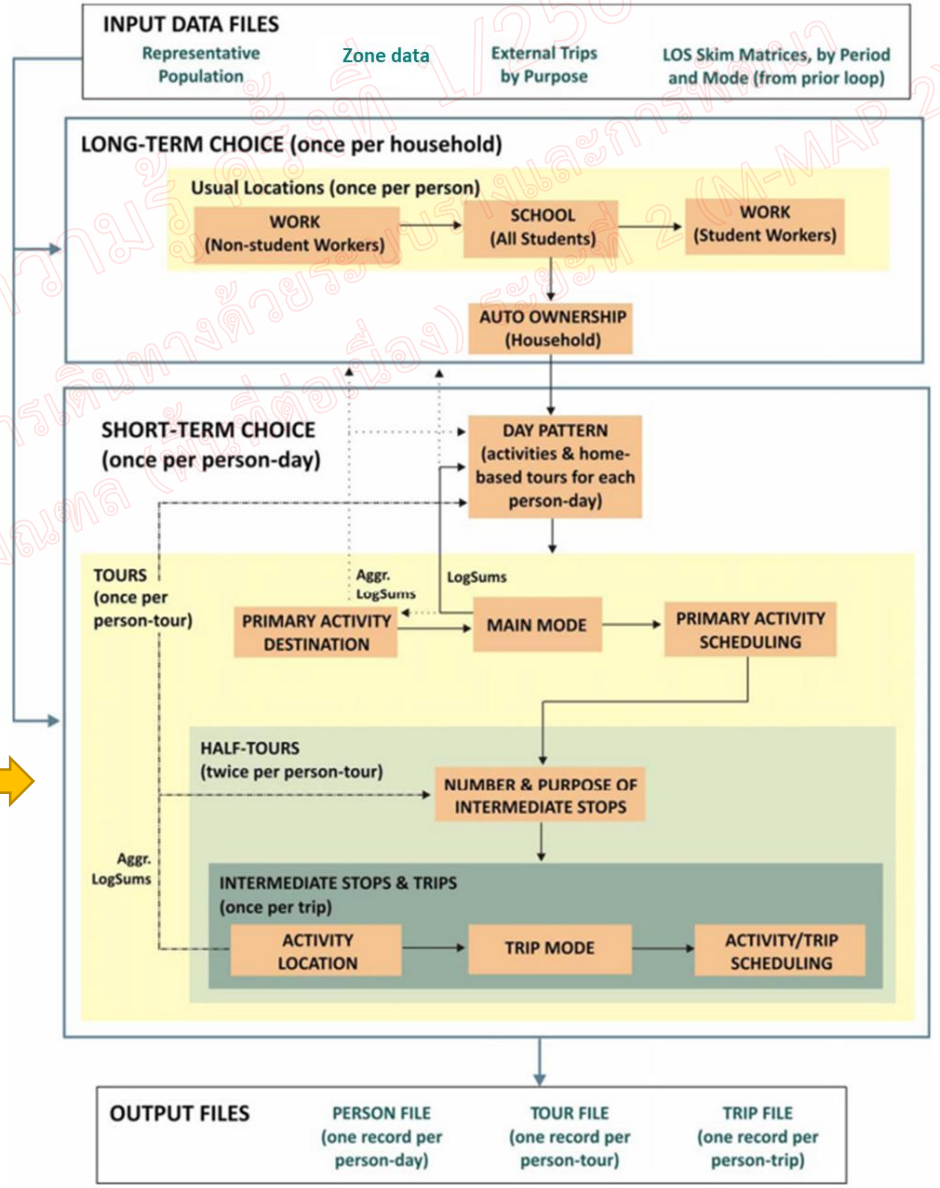
Note seq: sequence, UM: utility maximization, SM: similarity maximization, RUM: random utility maximization,

L: a learning decision tree, S: satisfying the rule, Math prog: mathematical program, MNL: multinomial logit, shortest: shortest path assignment, iterative: iterative assignment.

| (TOR 3.2.5) ศึกษาแนวทางการพัฒนาแบบจำลองความต้องการเดินทางด้วยระบบรางเชิงกิจกรรม (Railway Activity-Based Model) โดย Railway Activity-Based Model ให้จัดทำในรูปแบบโครงการนำร่อง (Pilot Project) อย่างน้อย 1 พื้นที่ โดยพิจารณาจำนวนตัวอย่างการสำรวจ และเก็บข้อมูลให้มีจำนวนเพียงพอตามหลักสถิติเพื่อให้เหมาะสมสำหรับการวิเคราะห์ข้อมูล |

Concept of Activity-Based Model



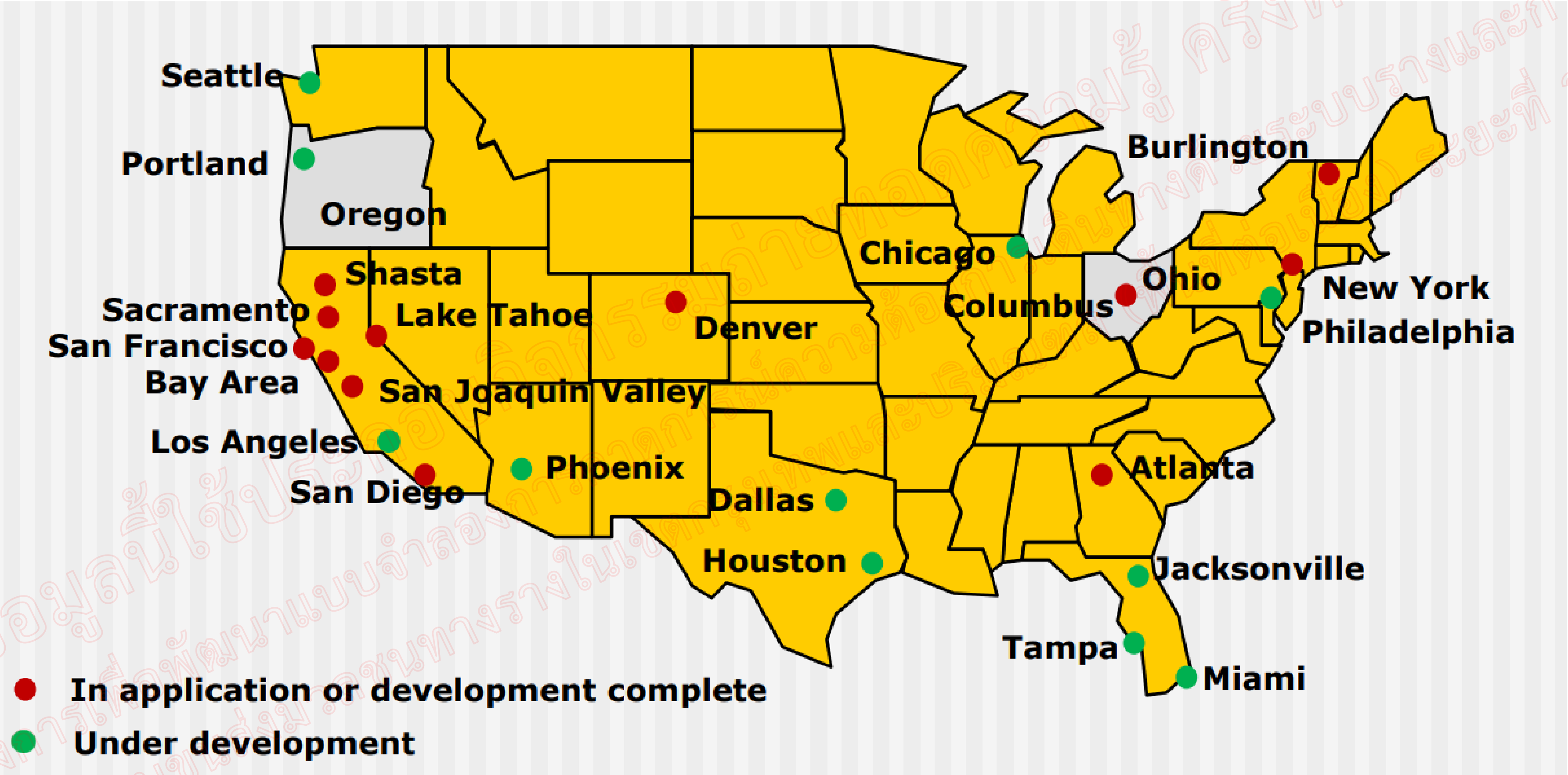


Activity purposes: work, school, personal business, shopping, meal and social/recreational

Travel pattern: occurrence of tours (0 or 1+) and extra stops (0 or 1+) for each purposes.

Bradley, Bowman and Griesenbeck, Journal of Choice Modelling, 3(1), pp. 5-31

ABMs in many cities of US



Bradley, Bowman and Griesenbeck, Journal of Choice Modelling, 3(1), pp. 5-31

One of main obstacle of a practical implementation or application of ABM is *the model calibration*.

Why?

- Typically, the calibration of ABM involves calibrating the activity pattern generation parameters from the ***travel diary survey*** based on ***questionnaire***

Consequently

- The sampling data size may be limited and the accuracy of the behavior record may be uncertain.
- The bias in model calibration due to not well understand the questions (SP) or memorize the prior travel diary (RP).

ABMs and the emerging of big data:

Improvements in activity-based travel demand modeling using mobile phone data (CDR)

- CDR data of Singapore was used by Jiang et al. (2017) to produce activity-based human mobility patterns. Also, a probabilistic induction was proposed using motifs (daily mobility network), time of day activity sequence, and land use classification to produce activity types.
- Zilske et al. (2015) replaced travel diaries with CDRs as input data for agent-based traffic simulation. They first generated the synthetic CDR data, then the MATSim simulation software was used to identify every observed person as an agent to convert call information into activity.
- Treeapot et al. (2015) proposed statistical method to calibrate ABM using GPS-based data

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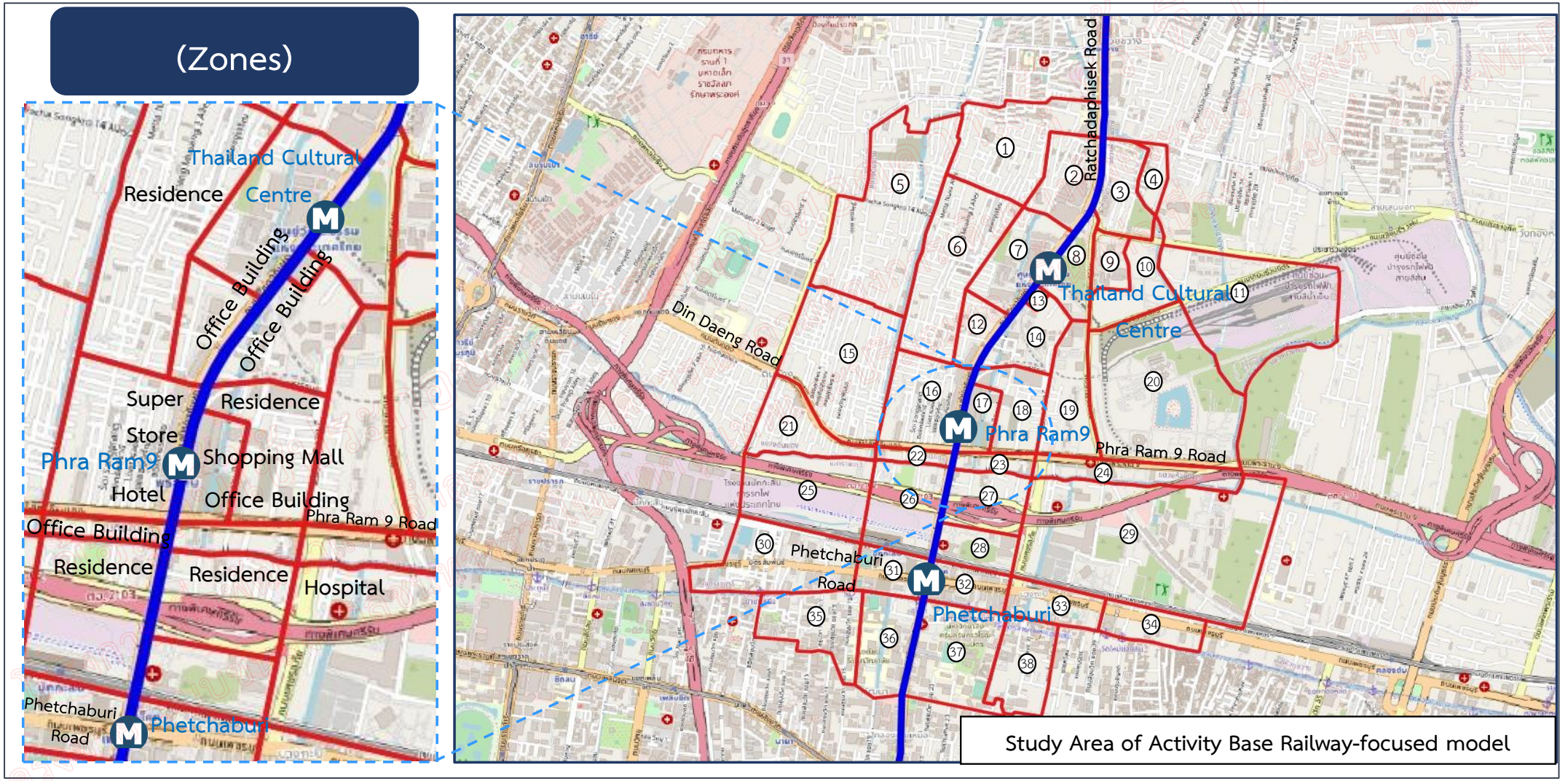


Activity-based model development needs more spatial and temporal data

Variables	Traditional Surveys	CDR Data
SAMPLING RATE	Between 0.5% and 2%	Between 15% and 35%
SAMPLING STRATA		Higher sample size
Unit of Analysis	Individual and household	Cell phone
Sampling by Geography	Can be fine-grained	Feasible at aggregate level
Sampling by Market Segment	Yes	N/A
SOCIOECONOMIC INFORMATION		Age and gender from TRUE corp.
Respondent Attributes	Rich data	Location of cell phone
Household Attributes	Rich data	N/A
SURVEY EXPANSION		
Sampling Rate and Size	Careful sampling/expansion	Robust sample sizes
Household Attributes	Used in expansion	N/A
Geography Attributes	Often at county-level	Some expansion feasible

Benefit of using cell phone data in ABM:

- High sample size
- Capable to obtain non-mandatory activities
- Compensate missing trips from traditional survey
- Increase resolution of time of day modelling

Mobile phone data (CDR from TRUE corp.)

Data attributes:

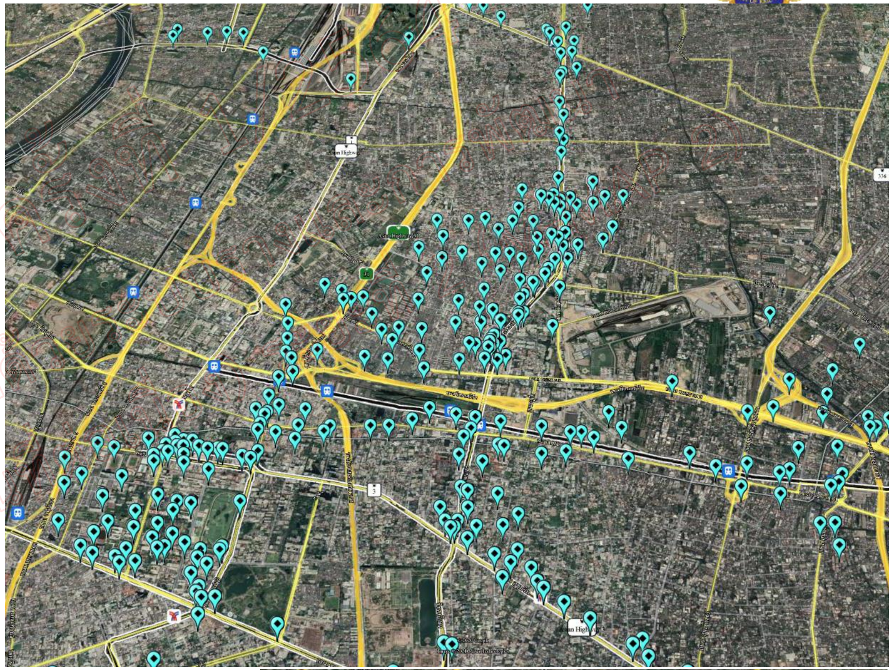
1. Person characteristics – sim id (unique_number), gender, age range, mobile/internet usage
2. Mobile phone information
   - cell site location (LAT, LON), time stamp, stop duration (in hours)
   - probability of making activities (analyzed by TRUE)
   - activity purposes including primary activity (home/work) and other activities
   - possibly classified railway OD trip (analyze from cell sites at origin-destination MRT stations from TRUE corp.)

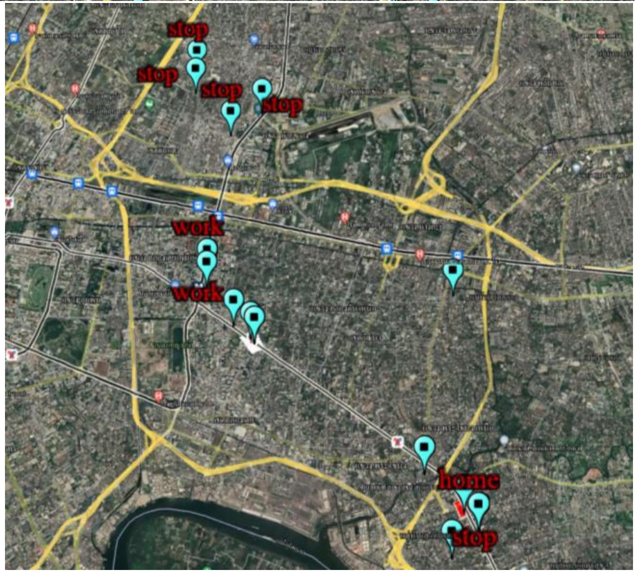
Unique_number	probability	cluster	LAT	LON	first_par_datetime	province_	district_th	sub_district_	duration	last_par_datetime	subs_type	monthly_payment_TMH	gender	age_grp	location2
Uq1	1	57	13.78112	100.5775	1/12/2019 0:00	กรุงเทพม	ห้วยขวาง	ห้วยขวาง	1440	2/12/2019 0:00	POST	3.Pay_200to599	female	19-25	home
Uq1	1	57	13.78112	100.5775	2/12/2019 2:00	กรุงเทพม	ห้วยขวาง	ห้วยขวาง	360	2/12/2019 8:00	POST	3.Pay_200to599	female	19-25	home
Uq1	0.035878181	60	13.76228	100.5688	2/12/2019 8:00	กรุงเทพม	ห้วยขวาง	ห้วยขวาง	0	2/12/2019 8:00	POST	3.Pay_200to599	female	19-25	work
Uq1	1	60	13.76228	100.5688	2/12/2019 9:00	กรุงเทพม	ห้วยขวาง	ห้วยขวาง	540	2/12/2019 18:00	POST	3.Pay_200to599	female	19-25	work
Uq1	0.003824092	57	13.78112	100.5775	2/12/2019 19:00	กรุงเทพม	ห้วยขวาง	ห้วยขวาง	0	2/12/2019 19:00	POST	3.Pay_200to599	female	19-25	home
Uq1	0.072657744	62	13.77789	100.5774	2/12/2019 19:00	กรุงเทพม	ห้วยขวาง	ห้วยขวาง	0	2/12/2019 19:00	POST	3.Pay_200to599	female	19-25	
Uq1	1	57	13.78112	100.5775	2/12/2019 20:00	กรุงเทพม	ห้วยขวาง	ห้วยขวาง	660	3/12/2019 7:00	POST	3.Pay_200to599	female	19-25	home
Uq1	0.058342624	60	13.76228	100.5688	3/12/2019 8:00	กรุงเทพม	ห้วยขวาง	ห้วยขวาง	0	3/12/2019 8:00	POST	3.Pay_200to599	female	19-25	work
Uq1	1	60	13.76191	100.5682	3/12/2019 9:00	กรุงเทพม	ห้วยขวาง	ห้วยขวาง	600	3/12/2019 19:00	POST	3.Pay_200to599	female	19-25	work
Uq1	0.277149709	57	13.78112	100.5775	3/12/2019 20:00	กรุงเทพม	ห้วยขวาง	ห้วยขวาง	0	3/12/2019 20:00	POST	3.Pay_200to599	female	19-25	home

3. The chosen data was collected on 4-10 November 2019.

Sample of CDR data (analyzed from TRUE corp.)

Unique_n	probability	LAT	LON	first_par_datetime	province_th	district_th	sub_district_th	duration	last_par_datetim	subs_type	monthly_payment	gender	age_grp	location2
Uq1	1	13.78112	100.5775	1/12/2019 0:00	กรุงเทพมหานคร	ห้วยขวาง	ห้วยขวาง	1440	2/12/2019 0:00	POST	3.Pay_200to599	female	19-25	home
Uq1	1	13.78112	100.5775	2/12/2019 2:00	กรุงเทพมหานคร	ห้วยขวาง	ห้วยขวาง	360	2/12/2019 8:00	POST	3.Pay_200to599	female	19-25	home
Uq1	0.035878181	13.76228	100.5688	2/12/2019 8:00	กรุงเทพมหานคร	ห้วยขวาง	ห้วยขวาง	0	2/12/2019 8:00	POST	3.Pay_200to599	female	19-25	work
Uq1	1	13.76228	100.5688	2/12/2019 9:00	กรุงเทพมหานคร	ห้วยขวาง	ห้วยขวาง	540	2/12/2019 18:00	POST	3.Pay_200to599	female	19-25	work
Uq1	0.003824092	13.78112	100.5775	2/12/2019 19:00	กรุงเทพมหานคร	ห้วยขวาง	ห้วยขวาง	0	2/12/2019 19:00	POST	3.Pay_200to599	female	19-25	home
Uq1	0.072657744	13.77789	100.5774	2/12/2019 19:00	กรุงเทพมหานคร	ห้วยขวาง	ห้วยขวาง	0	2/12/2019 19:00	POST	3.Pay_200to599	female	19-25	
Uq1	1	13.78112	100.5775	2/12/2019 20:00	กรุงเทพมหานคร	ห้วยขวาง	ห้วยขวาง	660	3/12/2019 7:00	POST	3.Pay_200to599	female	19-25	home
Uq1	0.058342624	13.76228	100.5688	3/12/2019 8:00	กรุงเทพมหานคร	ห้วยขวาง	ห้วยขวาง	0	3/12/2019 8:00	POST	3.Pay_200to599	female	19-25	work
Uq1	1	13.76191	100.5682	3/12/2019 9:00	กรุงเทพมหานคร	ห้วยขวาง	ห้วยขวาง	600	3/12/2019 19:00	POST	3.Pay_200to599	female	19-25	work
Uq1	0.277149709	13.78112	100.5775	3/12/2019 20:00	กรุงเทพมหานคร	ห้วยขวาง	ห้วยขวาง	0	3/12/2019 20:00	POST	3.Pay_200to599	female	19-25	home
Uq1	0.004841549	13.78112	100.5775	4/12/2019 8:00	กรุงเทพมหานคร	ห้วยขวาง	ห้วยขวาง	0	4/12/2019 8:00	POST	3.Pay_200to599	female	19-25	home
Uq1	0.381956649	13.76191	100.5682	4/12/2019 9:00	กรุงเทพมหานคร	ห้วยขวาง	ห้วยขวาง	0	4/12/2019 9:00	POST	3.Pay_200to599	female	19-25	work
Uq1	0.13877551	13.75874	100.5651	4/12/2019 10:00	กรุงเทพมหานคร	ดินแดง	ดินแดง	0	4/12/2019 10:00	POST	3.Pay_200to599	female	19-25	
Uq1	0.428571429	13.76225	100.5682	4/12/2019 10:00	กรุงเทพมหานคร	ห้วยขวาง	ห้วยขวาง	0	4/12/2019 10:00	POST	3.Pay_200to599	female	19-25	work
Uq1	0.325868504	13.75772	100.5648	4/12/2019 11:00	กรุงเทพมหานคร	ดินแดง	ดินแดง	0	4/12/2019 11:00	POST	3.Pay_200to599	female	19-25	
Uq1	0.999260355	13.75661	100.5667	4/12/2019 12:00	กรุงเทพมหานคร	ห้วยขวาง	ห้วยขวาง	60	4/12/2019 13:00	POST	3.Pay_200to599	female	19-25	stop
Uq1	0.761406844	13.76225	100.5682	4/12/2019 14:00	กรุงเทพมหานคร	ห้วยขวาง	ห้วยขวาง	240	4/12/2019 18:00	POST	3.Pay_200to599	female	19-25	work
Uq1	0.006334581	13.78112	100.5775	4/12/2019 19:00	กรุงเทพมหานคร	ห้วยขวาง	ห้วยขวาง	0	4/12/2019 19:00	POST	3.Pay_200to599	female	19-25	home
Uq1	0.978661494	13.78112	100.5775	4/12/2019 20:00	กรุงเทพมหานคร	ห้วยขวาง	ห้วยขวาง	300	5/12/2019 1:00	POST	3.Pay_200to599	female	19-25	home
Uq1	1	13.78112	100.5775	5/12/2019 1:00	กรุงเทพมหานคร	ห้วยขวาง	ห้วยขวาง	300	5/12/2019 6:00	POST	3.Pay_200to599	female	19-25	home
Uq1	1	13.78112	100.5775	5/12/2019 8:00	กรุงเทพมหานคร	ห้วยขวาง	ห้วยขวาง	240	5/12/2019 12:00	POST	3.Pay_200to599	female	19-25	home
Uq1	0.004610656	13.78112	100.5775	5/12/2019 13:00	กรุงเทพมหานคร	ห้วยขวาง	ห้วยขวาง	0	5/12/2019 13:00	POST	3.Pay_200to599	female	19-25	home
Uq1	0.689140811	13.81618	100.5606	5/12/2019 14:00	กรุงเทพมหานคร	จตุจักร	จตุจักร	120	5/12/2019 16:00	POST	3.Pay_200to599	female	19-25	stop
Uq1	1	13.78112	100.5775	5/12/2019 20:00	กรุงเทพมหานคร	ห้วยขวาง	ห้วยขวาง	600	6/12/2019 6:00	POST	3.Pay_200to599	female	19-25	home
Uq1	0.5432	13.78112	100.5775	6/12/2019 7:00	กรุงเทพมหานคร	ห้วยขวาง	ห้วยขวาง	0	6/12/2019 7:00	POST	3.Pay_200to599	female	19-25	home
Uq1	0.746196958	13.76191	100.5682	6/12/2019 8:00	กรุงเทพมหานคร	ห้วยขวาง	ห้วยขวาง	120	6/12/2019 10:00	POST	3.Pay_200to599	female	19-25	work
Uq1	1	13.76228	100.5688	6/12/2019 14:00	กรุงเทพมหานคร	ห้วยขวาง	ห้วยขวาง	180	6/12/2019 17:00	POST	3.Pay_200to599	female	19-25	work
Uq1	1	13.78112	100.5775	6/12/2019 18:00	กรุงเทพมหานคร	ห้วยขวาง	ห้วยขวาง	1020	7/12/2019 11:00	POST	3.Pay_200to599	female	19-25	home

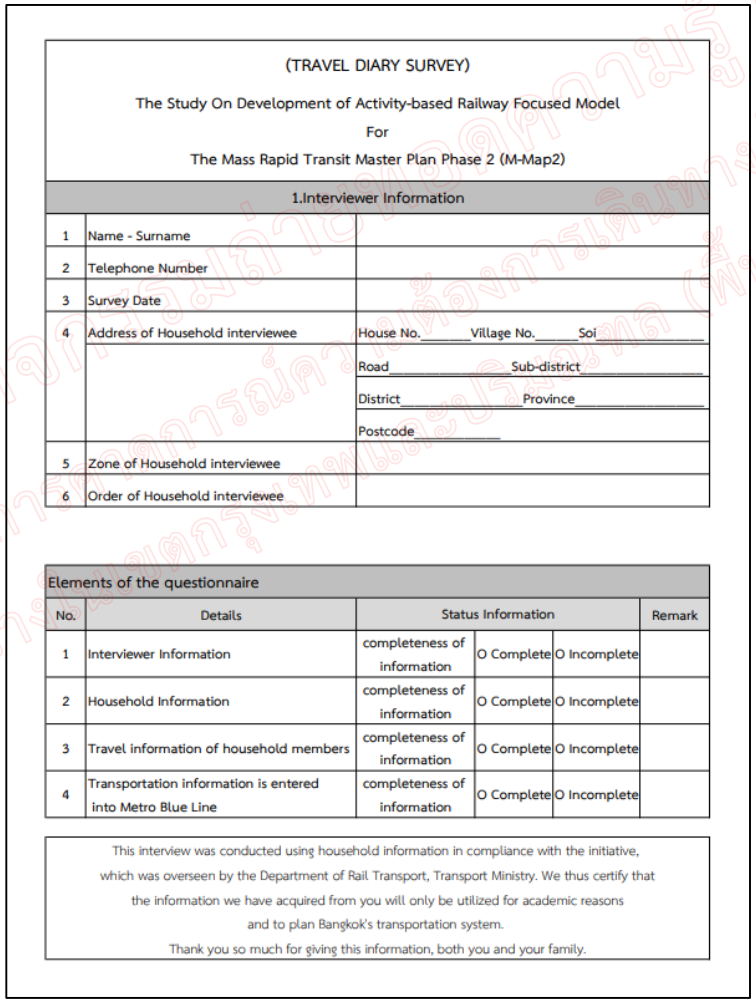




Travel Diary Survey (paper-base approach)

Element of questionnaire:

- More focus on the activity-travel information of travelers such as:
  - activity type,
  - activity duration,
  - and activity pattern than trip purpose.



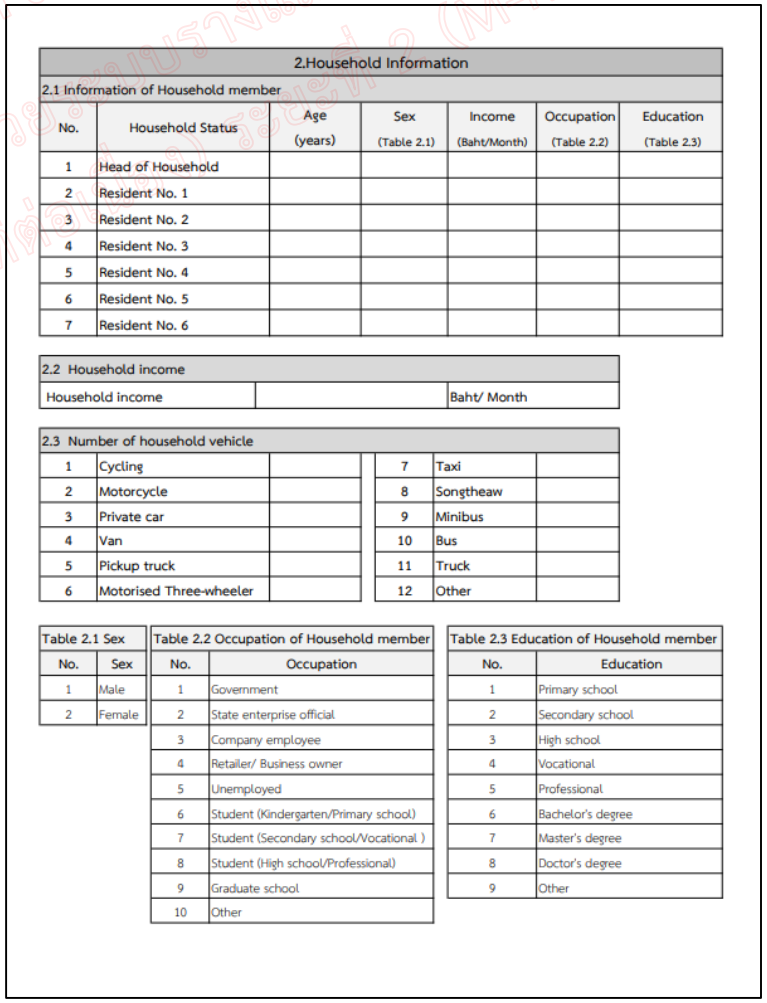
(TRAVEL DIARY SURVEY)

The Study On Development of Activity-based Railway Focused Model
For
The Mass Rapid Transit Master Plan Phase 2 (M-Map2)

1.Interviewer Information		
1	Name - Surname	
2	Telephone Number	
3	Survey Date	
4	Address of Household interviewee	House No._____Village No._____Soi_____ Road_____Sub-district_____ District_____Province_____ Postcode_____
5	Zone of Household interviewee	
6	Order of Household interviewee	

Elements of the questionnaire					
No.	Details	Status Information			Remark
1	Interviewer Information	completeness of information	O Complete	O Incomplete	
2	Household Information	completeness of information	O Complete	O Incomplete	
3	Travel information of household members	completeness of information	O Complete	O Incomplete	
4	Transportation information is entered into Metro Blue Line	completeness of information	O Complete	O Incomplete	

This interview was conducted using household information in compliance with the initiative, which was overseen by the Department of Rail Transport, Transport Ministry. We thus certify that the information we have acquired from you will only be utilized for academic reasons and to plan Bangkok's transportation system.
Thank you so much for giving this information, both you and your family.



2.Household Information						
2.1 Information of Household member						
No.	Household Status	Age (years)	Sex (Table 2.1)	Income (Baht/Month)	Occupation (Table 2.2)	Education (Table 2.3)
1	Head of Household					
2	Resident No. 1					
3	Resident No. 2					
4	Resident No. 3					
5	Resident No. 4					
6	Resident No. 5					
7	Resident No. 6					

2.2 Household income		
Household income		Baht/ Month

2.3 Number of household vehicle					
1	Cycling		7	Taxi	
2	Motorcycle		8	Songtheaw	
3	Private car		9	Minibus	
4	Van		10	Bus	
5	Pickup truck		11	Truck	
6	Motorised Three-wheeler		12	Other	

Table 2.1 Sex	
No.	Sex
1	Male
2	Female

Table 2.2 Occupation of Household member	
No.	Occupation
1	Government
2	State enterprise official
3	Company employee
4	Retailer/ Business owner
5	Unemployed
6	Student (Kindergarten/Primary school)
7	Student (Secondary school/Vocational)
8	Student (High school/Professional)
9	Graduate school
10	Other

Table 2.3 Education of Household member	
No.	Education
1	Primary school
2	Secondary school
3	High school
4	Vocational
5	Professional
6	Bachelor's degree
7	Master's degree
8	Doctor's degree
9	Other

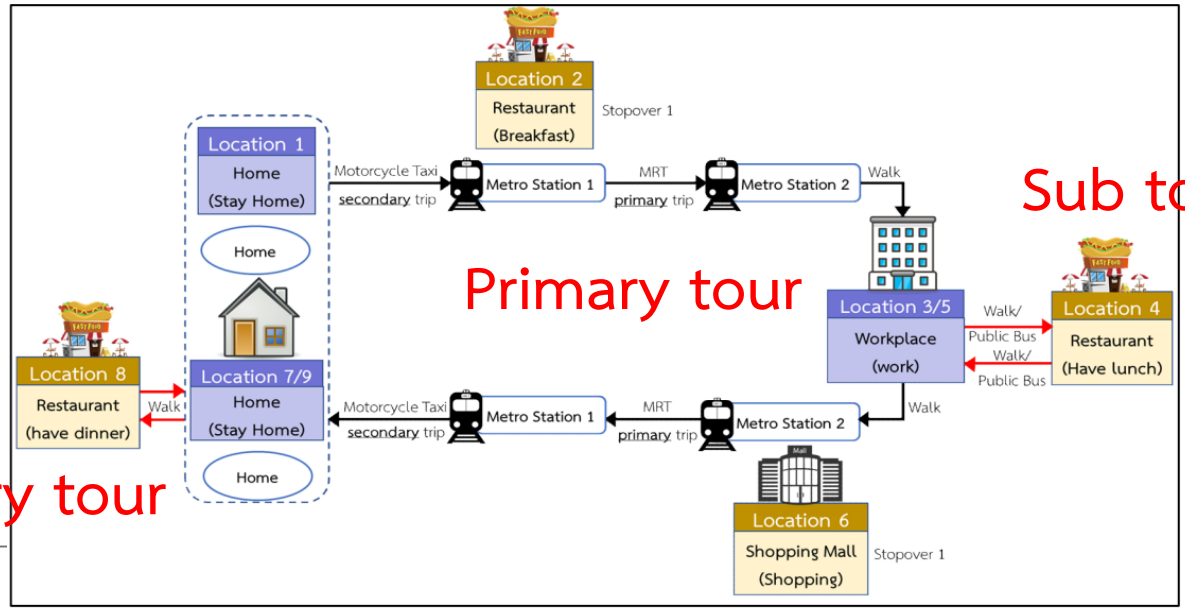
Paper-based survey integrated with CDR data :

How many sample size is planed?

- 500-700 paper based survey samples + 2,500 mobile phone data (7 days) = about 1% of population

In section 1, 2 and 3, what will be the major difference to HIS

- The survey more focus on tour, activity and time information.
- The ABM structure is formulated into full-day activity and travel pattern, the additional information include activity type, intermediate stop before or after making primary activity, work-based sub tour, and secondary tour is needed to be collected.



Points to be confirmed in the pilot study of ABM

Final output of the pilot study of ABM:

- Trip chain demand at different levels for each representative group of persons and households in the study area:
  - Work and school locations
  - Household-days/Person-days/Tours
  - Trips (origin and destination zone/mode/departure and arrival periods
- Railway demand (3 MRT stations in study area) by zone, period and person type

Plans to utilize the output:

- comparing the railway demand result (boarding/alighting MRT stations) with the main model
- testing of the change in population composition/characteristics responding railway demand such as higher proportion of older adults (responding to trend of aging society)