



กรมการขนส่งทางราง

# การประชุมสัมมนาเพื่อประชาสัมพันธ์และการรับฟังความคิดเห็นของประชาชน ครั้งที่ 2

งานศึกษาเพื่อพัฒนาแบบจำลองการคาดการณ์ความต้องการเดินทางด้วยระบบรางและการพัฒนาโครงข่ายระบบขนส่งมวลชนทางรางในเขตกรุงเทพมหานครและปริมณฑล (พื้นที่ต่อเนื่อง) ระยะที่ 2

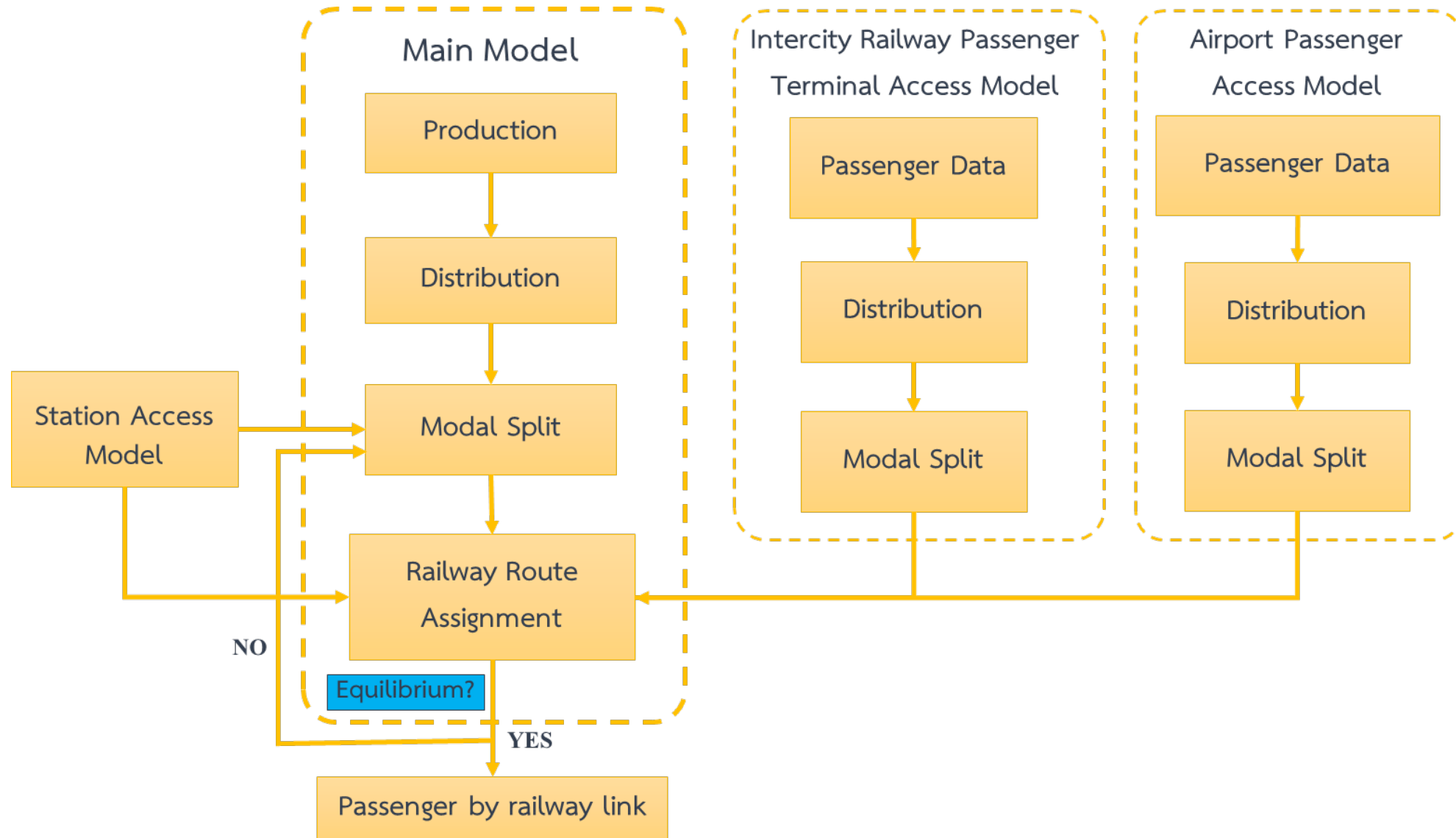
## การพัฒนา Railway Demand Forecast



วันอังคารที่ 9 ถึง วันพฤหัสบดีที่ 11 พฤษภาคม 2566 (3 กลุ่ม)

โดย ผศ.ร.อ.ดร.ศุทธิพงษ์ มีโย ผู้เชี่ยวชาญด้านแบบจำลองการขนส่งและจราจร



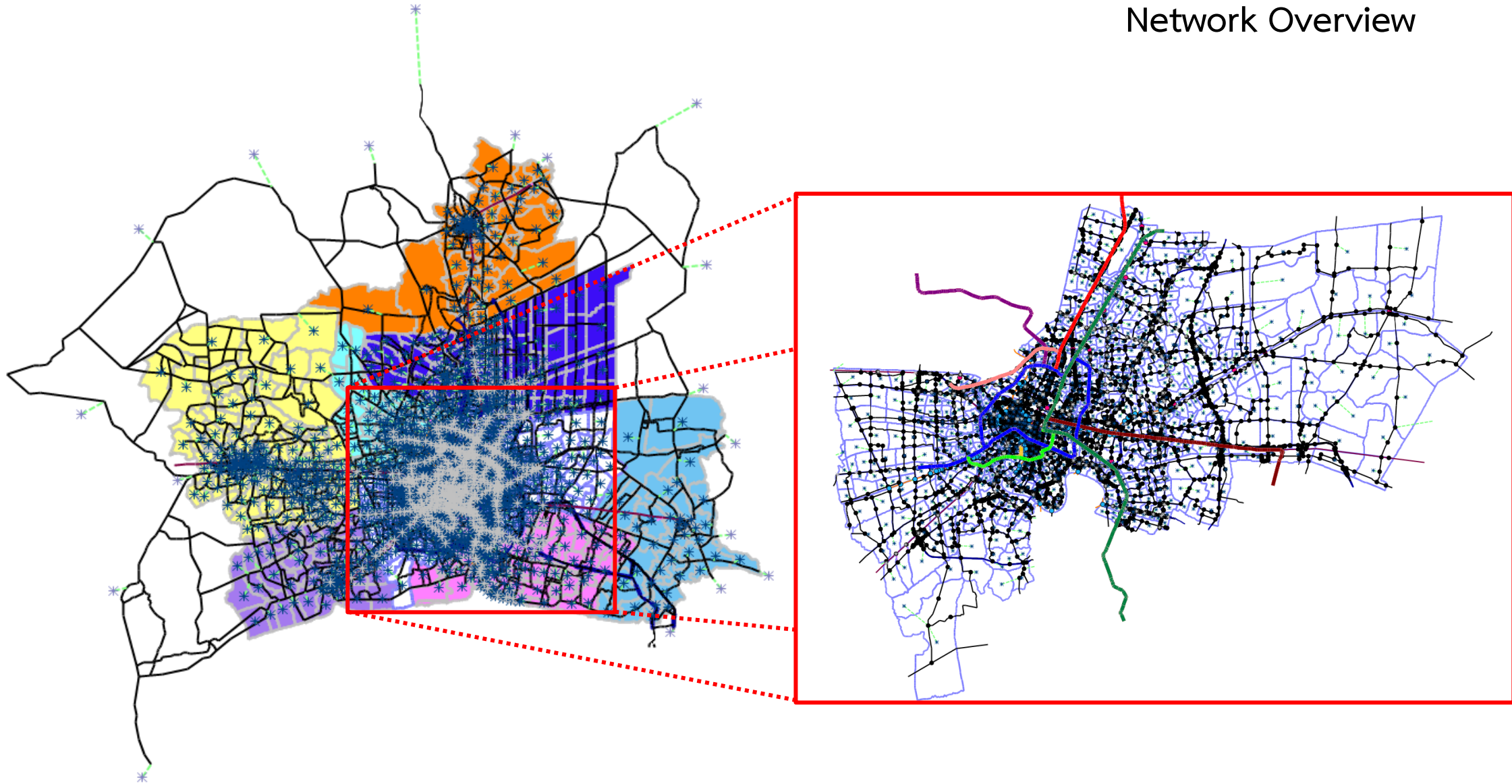




# Network Model Development



## Network Overview





# Surveying to collect network attribute especially waiting time, travel time and transfer time

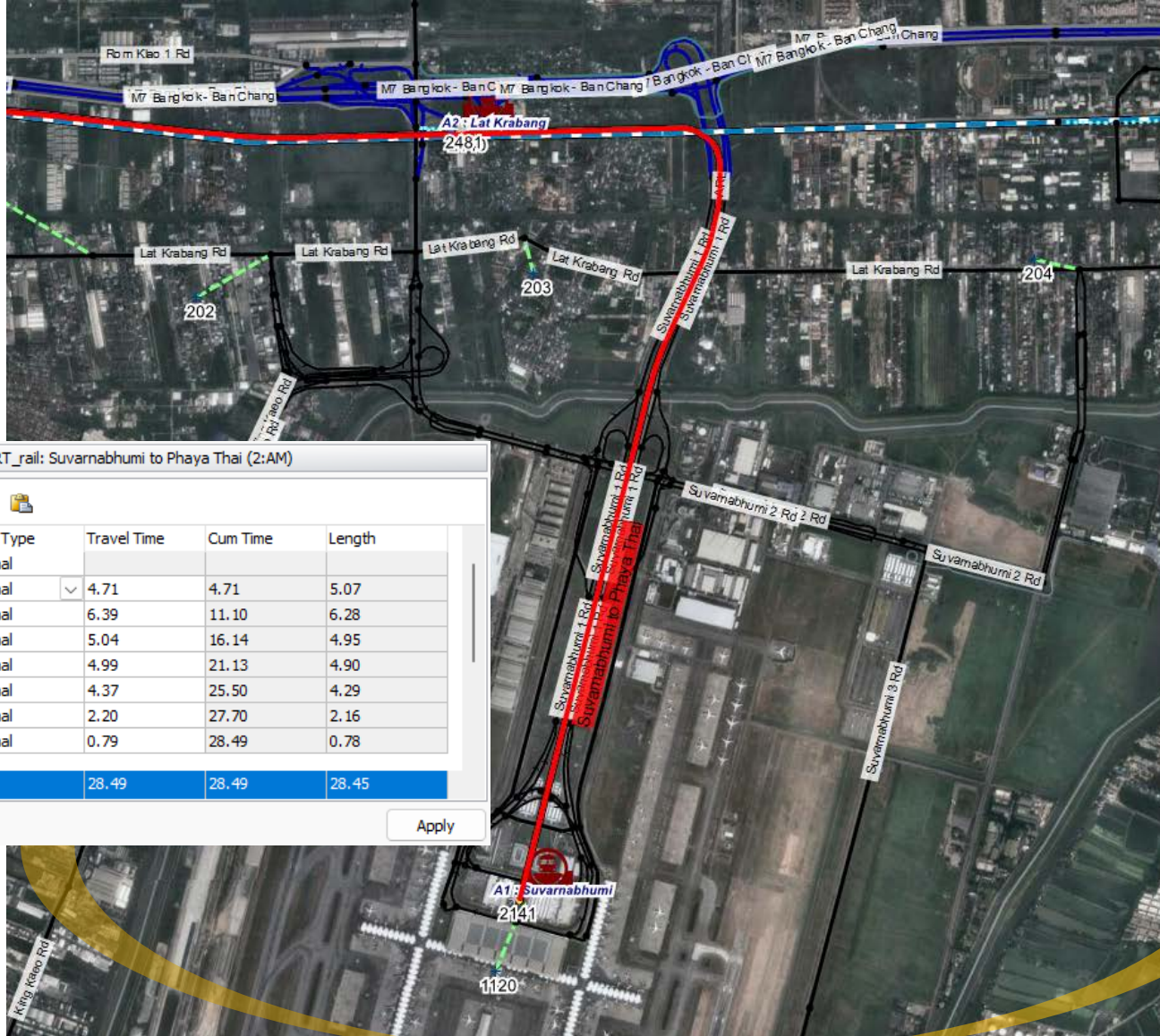
Ref. Assumpti	Survegor	Origin	Access Sta.	Egress Sta.	Destination	No. of Transfer	Interchange Sta.	Direction	No. of Sta.	Fare (Baht)	Time Unit: minutes									Distance (km)	Avg. Vehicle Speed (km/hr)	Line	
											Total Travel Time	Origin -> Entrance	Entrance -> Flap Gate	Flap Gate -> Platform	Total Waiting Time	Total Invehicle Time	Total Transfer Time	Platform -> Flap Gate	Flap Gate -> Exit				Exit -> Destination
3.1	A	Café Amazon BTS Bangwa	Bang Wa (BL34)	Silom (BL26)	7-11 Soi Sala Daeng	0	-	Tha Phra	9	35	29.97	0.63	3.38	0.92	2.77	17.7	-	2.37	0.97	1.23	10.08	34.17	MRT
	B	Café Amazon BTS Bangwa	Bang Wa (S12)	Sala Daeng (S2)	7-11 Soi Sala Daeng	0	-	National Stadium	10	52	28.50	0.63	4.02	0.72	1.02	19.05	-	1.17	0.33	1.57	9.81	30.90	BTS
3.2	C	7-11 Soi Sala Daeng	Silom (BL26)	Bang Phlat (BL07)	Kasikornbank Charan 83	1	Tha Phra -> Tha Phra	{1} Lak Song {2} Lak Song	13	42	47.83	2.42	2.88	0.93	4.83	32.28	0.73	2.12	0.70	0.93	16.73	31.09	MRT
	D	7-11 Soi Sala Daeng	Silom (BL26)	Bang Phlat (BL07)	Kasikornbank Charan 83	0	-	Tha Phra	19	42	52.68	2.40	2.80	1.07	3.30	40.37	-	1.40	0.15	1.20	21.99	32.69	MRT
3.3	A	ASSEMBLY POINT	Lat Krabang (A2)	Asok (E4)	Front of MRT Exit 2	1	Phaga Thai -> Phaga Thai	{1} Phaga Thai {2} Kheha	12	77	49.60	0.67	2.05	0.80	5.42	32.33	6.13	0.67	1.00	0.53	28.07	52.09	ARL&BTS
	B	ASSEMBLY POINT	Lat Krabang (A2)	Sukhumvit (BL22)	Front of MRT Exit 2	1	Makkasan -> Phetchaburi	{1} Phaga Thai {2} Lak Song	5	47	42.93	0.97	2.03	0.68	7.27	19.07	10.02	0.97	1.65	0.38	21.76	68.48	ARL&MRT
3.4	A	7-11 Soi Sala Daeng	Silom (BL26)	Lat Krabang (A2)	ASSEMBLY POINT	1	Phetchaburi->Makkasan	{1} Tha Phra {2} Suvarnabhumi	9	56	57.73	1.33	2.93	0.88	12.80	27.58	8.72	1.37	1.50	0.62	26.36	57.34	MRT&ARL
	B	7-11 Soi Sala Daeng	Sala Daeng (S2)	Lat Krabang (A2)	ASSEMBLY POINT	2	{1} Siam -> Siam {2} Phaga Thai -> Phaga Thai	{1} National Stadium {2} Khu Khot {3} Suvarnabhumi	10	70	57.95	1.65	1.98	0.40	9.00	32.70	8.07	1.03	1.95	1.17	27.66	50.75	BTS&ARL
	C	ASSEMBLY POINT	Lat Krabang (A2)	Sala Daeng (S2)	7-11 Soi Sala Daeng	2	{1} Phaga Thai -> Phaga Thai {2} Siam -> Siam	{1} Phaga Thai {2} Kheha {3} Bang Wa	10	70	56.13	1.82	1.65	0.92	8.22	30.43	7.80	1.37	0.70	3.23	27.66	54.53	ARL&BTS
	D	ASSEMBLY POINT	Lat Krabang (A2)	Silom (BL26)	7-11 Soi Sala Daeng	1	Makkasan -> Phetchaburi	{1} Phaga Thai, {2} Lak Song	9	56	54.90	1.82	1.43	1.30	4.03	28.05	10.18	1.27	3.42	3.40	26.36	56.39	ARL&MRT
3.5	C	Café MRT Exit 2	Bang Sue (BL11)	Lat Krabang (A2)	ASSEMBLY POINT	2	{1} Chatuchak Park -> Mo Chit {2} Phaga Thai -> Phaga Thai	{1} Lak Song {2} Kheha {3} Suvarnabhumi	13	96	70.80	5.12	1.97	0.17	7.15	37.65	12.93	2.02	3.05	0.75	31.10	49.56	MRT&BTS&ARL
	D	Café MRT Exit 2	Bang Sue (BL11)	Lat Krabang (A2)	ASSEMBLY POINT	1	Phetchaburi->Makkasan	{1} Lak Song {2} Suvarnabhumi	14	68	71.92	5.17	1.25	0.70	8.58	39.00	10.33	3.08	2.90	0.90	31.91	49.09	MRT&ARL

Legend :  
MRT Blue Line  
BTS Sukhumvit Line  
BTS Silom Line  
ARL  
 Sta. Station



## Example

## MRT



Totally22: Transit line 4711, MRT\_rail: Suvarnabhumi to Phaya Thai (2:AM)

Stop	Stop Tag	Stop Type	Travel Time	Cum Time	Length
6028:A1 : Suvarnabhumi		Normal			
6027:A2 : Lat Krabang		Normal	4.71	4.71	5.07
6026:A3 : Ban Thap Chang		Normal	6.39	11.10	6.28
5736:A4 : Hua Mak		Normal	5.04	16.14	4.95
5737:A5 : Ramkhamhaeng		Normal	4.99	21.13	4.90
5738:A6 : Makkasan		Normal	4.37	25.50	4.29
6025:A7 : Ratchaprarop		Normal	2.20	27.70	2.16
5739:A8 : Phaya Thai		Normal	0.79	28.49	0.78
<b>Total</b>			<b>28.49</b>	<b>28.49</b>	<b>28.45</b>

Interarrival time  
in each stop

Go to: 4711 Find Extended

Property	Value
<b>general</b>	
number	4711
mode	71:MRT_rail
pictures	
transittag	
farenr	102: AERA1_ARL
route_no	
name	Suvarnabhumi to Phaya Thai
schedule	No runs
<b>types</b>	
operator	43:AERA1_ARL
year	1:Existing
mrt_line	3:ARL
owner	2:SRT
mrt_type	1:Commuter Train
<b>frequency</b>	
frequency (2:AM)	6.67
frequency (3:PM)	6.67
<b>reliability</b>	
reliability (2:AM)	1.00
reliability (3:PM)	1.00
<b>speedfactor</b>	
speedfactor (2:AM)	1.00
speedfactor (3:PM)	1.00
<b>seats</b>	
seats (2:AM)	150.00
seats (3:PM)	150.00
<b>crushcapacity</b>	
crushcapacity (2:AM)	1100.00
crushcapacity (3:PM)	1100.00
<b>travel + dwell time</b>	
travel + dwell time (2:AM)	28.49 + 0.00 = 28.49
travel + dwell time (3:PM)	28.49 + 0.00 = 28.49



## Example

## MRT Fare table

Project Setup

Dimensions Link Type & Modes Types Zonal Data Combinations Transit Transfers Transit Fares Extended Parameters

**Transit Fares** This page is used to define fare tables.  
Each transitline can be associated with one of these fare tables.

Matrix	5739: A8 : Phaya Thai	6025: A7 : Ratchaprarop	5738: A6 : Makkasan	5737: A5 : Ramkhamhaeng	5736: A4 : Hua Mak	6026: A3 : Ban Thap Chang	6027: A2 : Lat Krabang	6028: A1 : Suvarnabhumi
5739: A8 : Phaya Thai	15.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00
6025: A7 : Ratchaprarop		15.00	15.00	20.00	25.00	30.00	35.00	40.00
5738: A6 : Makkasan			20.00	15.00	20.00	25.00	30.00	35.00
5737: A5 : Ramkhamhaeng				20.00	15.00	20.00	25.00	30.00
5736: A4 : Hua Mak					20.00	15.00	20.00	25.00
6026: A3 : Ban Thap Chang						20.00	15.00	20.00
6027: A2 : Lat Krabang							15.00	20.00
6028: A1 : Suvarnabhumi								15.00

Report... OK Cancel



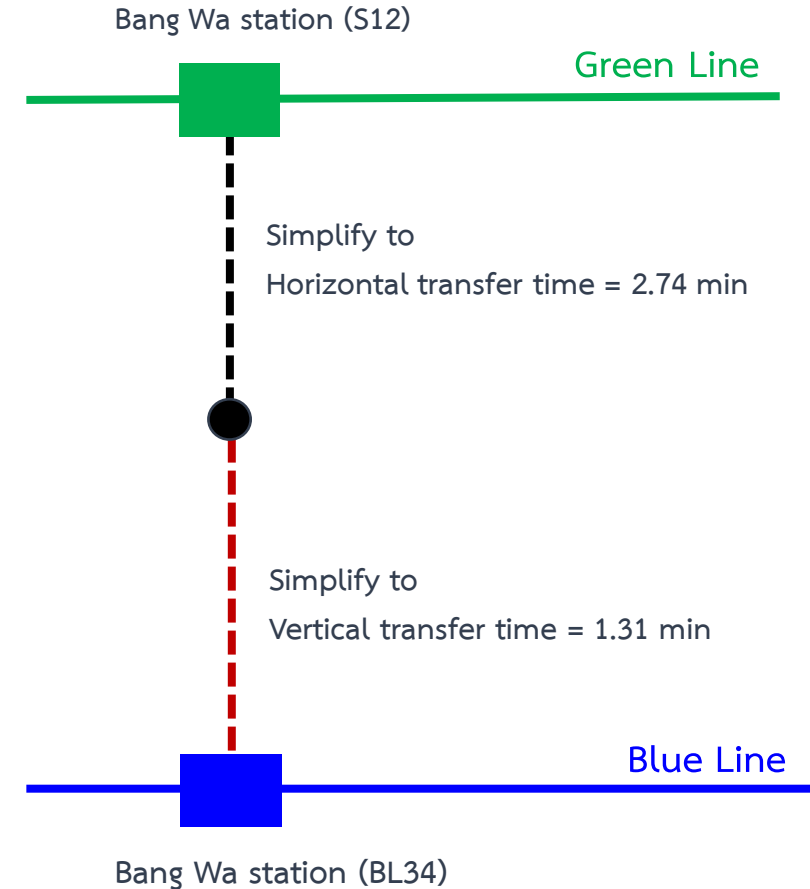
## Transfer Time Survey between Platforms (Time Survey)

Start	Line Name	BTS Silom Line	Station	Bang Wa (S12)	Direction to	National Stadium
End	Line Name	MRT Blue Line	Station	Bang Wa (BL34)	Direction to	Tha Phra
First Name	Chatchawan		Length of Step	55.5	Day	Thursday
Last Name	Simalorit		DD/MM/YY	17/02/2022	Time	7:00 - 9:00

	1	2	3	4	5	6	7	8	9	10	11	12	13
Length	Number of Steps on Foot	13		45	80		31	10	33		10		
	Number of Steps at Stairs		42			55			42				
Use of Escalator (○)					○				○				
Time (S) 7:00 No Ticket	00:12	00:35	01:05	01:43	02:11	03:26	03:34	03:51	04:16	04:24			
Time (S) 7:00 With Ticket	00:13	00:37	01:06	01:45	02:15	02:39	02:48	03:05	03:31	03:39			
Time (S) 8:00 No Ticket	00:15	00:39	01:10	01:49	02:20	03:35	03:41	03:56	04:19	04:28			
Time (S) 8:00 With Ticket	00:14	00:38	01:09	01:48	02:19	02:42	02:50	03:06	03:32	03:41			

Time and distance shall be recorded separately in the survey. When there are escalator and stairs, escalator will be selected to record the time. To measure distance, stairs will be selected.

Start/Finish Point	Stairs	Escalator	Elevator	[Overall of Route]										
●	→	▷	□	Up (Stairs/Escalators): /	Down (Stairs/Escalators): \	Path: —	Latch: □	Ticket Machine: ▲						
Start Platform														
( Bang Wa (S12) ) Platform														
(To National Stadium )→														







- xxx = Silom Line
- xxx = Blue Line
- xxx = Purple Line
- xxx = Gold Line
- xxx = Red N-S Line
- xxx = Red E-W Line

Bang Wa (S12)

Bang Wa (BL34)

Bang Wa (S12)

Krung Thon Buri (S7)

Krung Thon Buri (G1)

Krung Thon Buri (S7)

Bang Sue (BL11)

Bang Sue (RN01)

Bang Sue (BL11)

Bang Son (PP15)

Bang Son (RW02)

Bang Son (PP15)

Tha Phra (BL01) Platf. 1-2

Tha Phra (BL01) Platf. 3-4

Tha Phra (BL01) Platf. 1-2

**Legend**

- Up
- Down
- Path
- Latch
- Ticket Machine
- Escalator
- Stairs
- Start/ Finish Point



**สัญลักษณ์ Legend**

	สายสีเขียวเข้ม Dark Green Line (สายสุขุมวิท-ใต้)		สายสีแดงเข้ม Dark Red Line (สายหมอ-ใต้)
	สายสีเขียวอ่อน Light Green Line (สายสีลม)		สายสีแดงอ่อน Light Red Line (สายหมอ-บน-ตะวันตก)
	สายสีน้ำเงิน Blue Line (สายฉลองรัชธรรม)		สายท่าอากาศยาน Airport Rail Link
	สายสีม่วง Purple Line (สายฉลองรัชธรรม)		สายสีฟ้า Light Blue Line
	สายสีชมพู Pink Line		สายสีน้ำตาล Brown Line
	สายสีเหลือง Yellow Line		สายสีทอง Gold Line
	สายสีส้ม Orange Line		แม่น้ำ River
	สายสีเทา Grey Line		เส้นทางที่เปิดให้ใช้บริการแล้ว Opening Line
	ท่าเรือ Port		เส้นทางที่คาดว่าจะเปิดให้บริการในอนาคต Future Line
	สถานีรถไฟ Train Station		สถานีร่วม/เชื่อมสาย Interchange Station
	สนามบิน Airport		สถานีร่วม/เชื่อมสาย Junction Station
	ที่จอดรถ Parking		ทางเดินเชื่อมสาย Skywalk

**Bang Son**  
 Purple Line → Red Line : 6 (7) min  
 Red Line → Purple Line : 7 (7) min

**Bang Sue**  
 Blue Line → Red Line: 6 (7) min  
 Red Line → Blue Line: 6 (6) min

**Tao Poon**  
 Blue Line → Purple Line: 3 min  
 Purple Line → Blue Line: 4 min

**Mo Chit / Chatuchak**  
 Sukhumvit Line → Blue Line: 6 (7) min  
 Blue Line → Sukhumvit Line : 7 (7) min

**Siam**  
 Sukhumvit Line → Silom Line: 2 min  
 Silom Line → Sukhumvit Line: 2 min

**Phaya Thai**  
 Sukhumvit Line → ARL: 4 (7) min  
 ARL → Sukhumvit Line: 6 (6) min

**Tha Phra**  
 Platf.1-2 Blue Line → Platf.3-4 Blue Line: 1 min  
 Platf.3-4 Blue Line → Platf.1-2 Blue Line: 1 min

**Makkasan / Phetchaburi**  
 ARL → Blue Line : 9 (10) min  
 Blue Line → ARL : 9 (10) min

**Bang Wa**  
 Silom Line → Blue Line : 4 (4) min  
 Blue Line → Silom Line : 4 (5) min

**Asok / Sukhumvit**  
 Sukhumvit Line → Blue Line: 6 (7) min  
 Blue Line → Sukhumvit Line: 5 (5) min

**Krung Thon Buri**  
 Silom Line → Gold Line : 4 (5) min  
 Gold Line → Silom Line : 4 (5) min

**Saladaeng / Silom**  
 Silom Line → Blue Line: 11 (13) min  
 Blue Line → Silom Line: 10 (11) min

- Consultant survey on February 17, 2022
- JICA team survey during 28-30 Nov 2017

\*The value in brackets is the transfer time using the ticket machine, \*Platf. = Platform





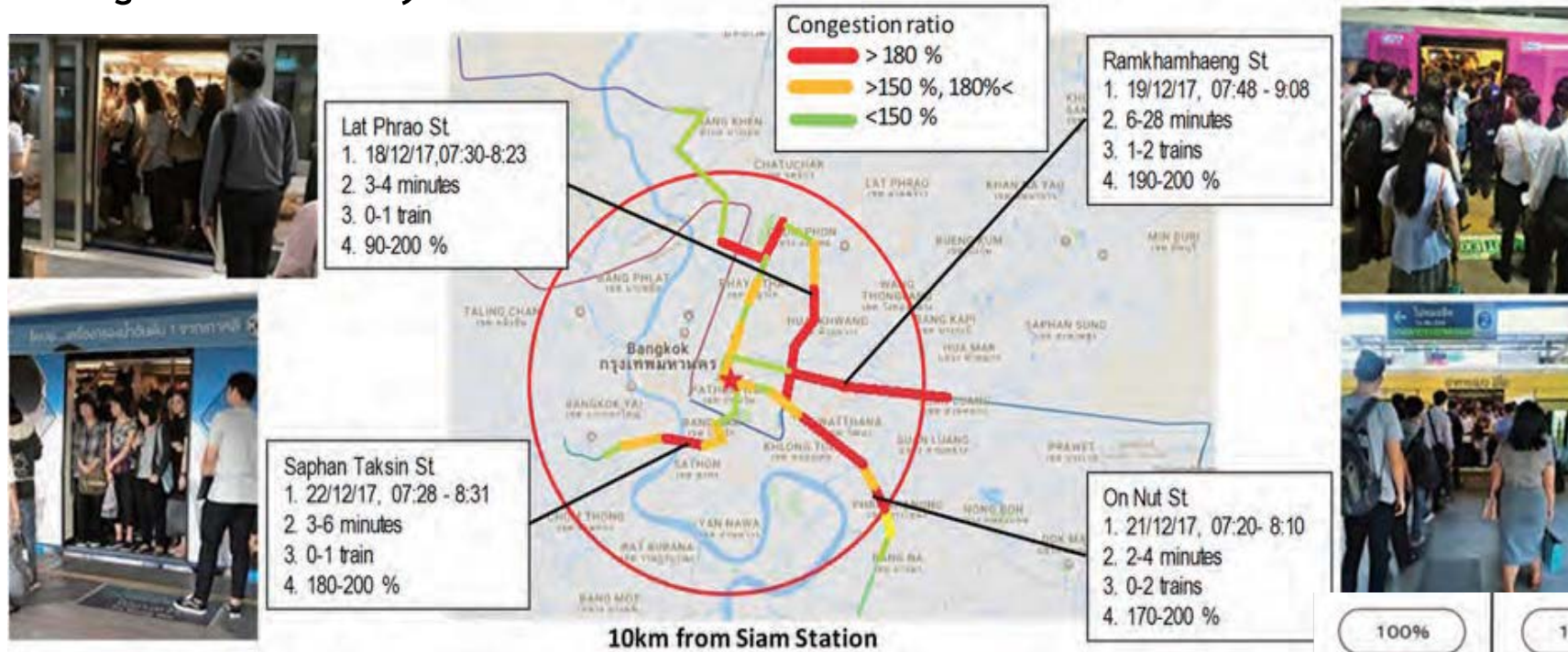
## Example

### Transfer station



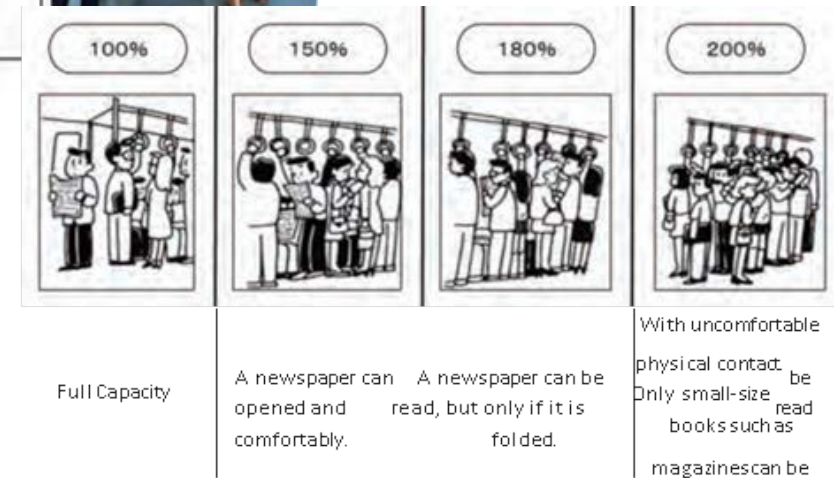


# Congestion survey



Note: Numbers 1 is survey date and time, 2 is head between trains (in minutes), 3 is number of trains the passengers miss due to congestion, and 4 is congestion ratio

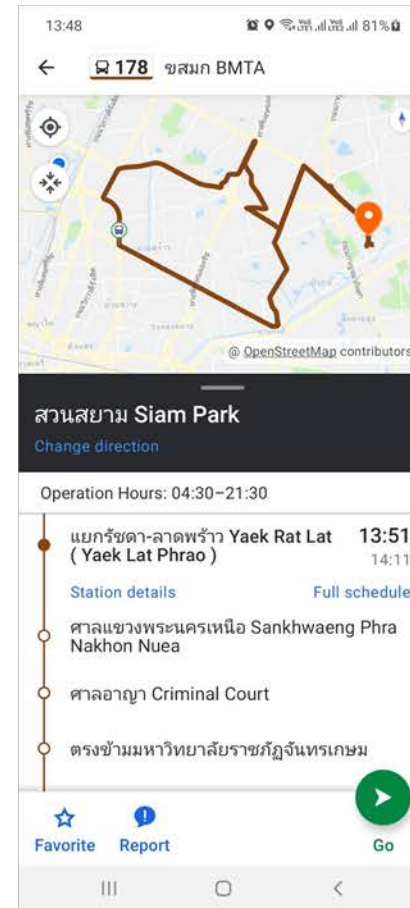
Source: M-MAP2 blueprint, JICA 2018





Actual Headway and Travel time for bus

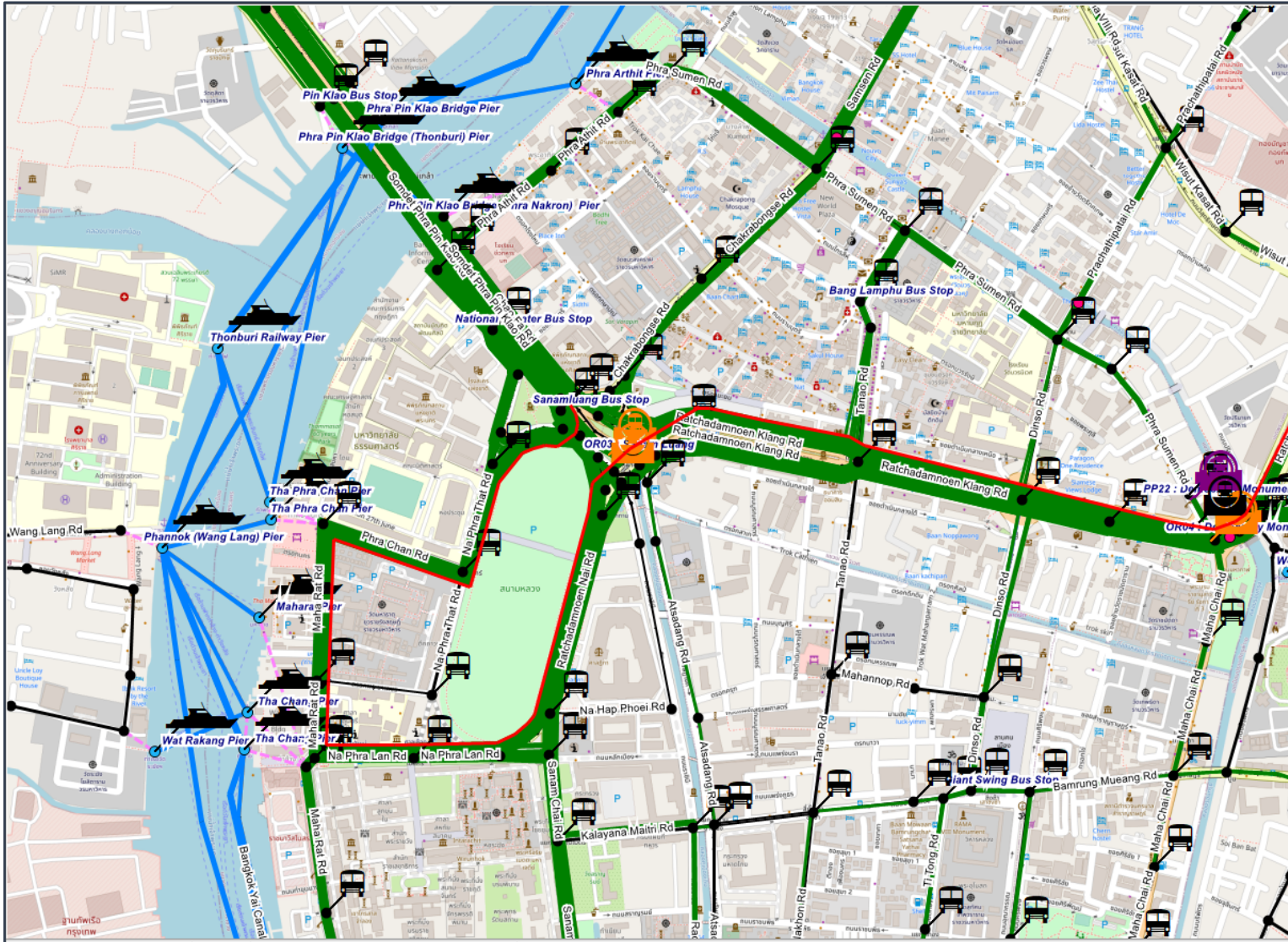
- Viabus App, Moovit App: Travel time, Headway, Schedule, Arrival time.





## Example

## Bus



Total: Transit Lines

Go to: 5168 Find Extended

Property	Value
<b>general</b>	
number	5168
mode	64:Air_con_bus
pictures	
transittag	
farenr	5: FareSystem5_AirCon(Euro2)
route_no	503
name	No 503 : Sanam Luang to Rangsit
schedule	No runs
<b>types</b>	
operator	1:BMTA_z01
year	1:Existing
mrt_line	0:<undefined>
owner	0:<undefined>
mrt_type	0:<undefined>
<b>frequency</b>	
frequency (2:AM)	4.00
frequency (3:PM)	4.00
<b>reliability</b>	
reliability (2:AM)	1.00
reliability (3:PM)	1.00
<b>speedfactor</b>	
speedfactor (2:AM)	1.00
speedfactor (3:PM)	1.00
<b>seats</b>	
seats (2:AM)	35
seats (3:PM)	35
<b>crushcapacity</b>	
crushcapacity (2:AM)	50
crushcapacity (3:PM)	50
<b>travel + dwell time</b>	
travel + dwell time (2:AM)	101.00 + 0.00 = 101.00
travel + dwell time (3:PM)	101.00 + 0.00 = 101.00



Link Type	Details	Free-Flow Speed (kph)	Capacity (Vehicle/direction)	Mode				
				Car	Truck	Mc	Walk	PT
1	Centroid connector (general)	15	0	Y	Y	Y	Y	Y
2	Centroid (PT + link-based highway assignment)	15	0	Y	Y	Y	Y	Y
3	Centroid connector to MRT	15	0				Y	Y
4	Walk link	4.4	0				Y	
5	Ferry link	15	0					Y
6	SRT rail link	35	0					Y
7	MRT rail link	35	0					Y
8	One way road 1 lane/direction	40	1,250	Y	Y	Y	Y	Y
9	One way road 2 lane/direction	40	2,500	Y	Y	Y	Y	Y
10	One way road 3 lane/direction	40	3,750	Y	Y	Y	Y	Y
11	One way road 4 lane/direction	40	5,000	Y	Y	Y	Y	Y
12	One way road 6 lane/direction	40	7,500	Y	Y	Y	Y	Y
13	Dual carriageways with frontage road 1 lane/direction	95	1,500	Y	Y	Y	Y	Y
14	Dual carriageways with frontage road 2 lane/direction	95	3,000	Y	Y	Y	Y	Y
15	Dual carriageways with frontage road 3 lane/direction	95	4,500	Y	Y	Y	Y	Y
16	Dual carriageways with frontage road 4 lane/direction	95	6,000	Y	Y	Y	Y	Y
17	Dual carriageways with frontage road 5 lane/direction	95	7,500	Y	Y	Y	Y	Y
18	Flyover 1 lane/direction	30	1,250	Y	Y	Y		Y
19	Flyover 1 lane/direction	50	1,250	Y	Y	Y		Y
20	Flyover 2 lane/direction	50	2,500	Y	Y	Y		Y
21	Flyover 2 lane/direction	70	2,500	Y	Y	Y		Y
22	Flyover 3 lane/direction	50	3,750	Y	Y	Y		Y



Link Type	Details	Free-Flow Speed (kph)	Capacity (Vehicle/direction)	Mode				
				Car	Truck	Mc	Walk	PT
23	Flyover 4 lane/direction	50	5,000	Y	Y	Y		Y
24	Bus only link 1 lane/direction	40	1,200				Y	Y
25	Minor road 1 lane/direction	30	1,200	Y	Y	Y	Y	Y
26	Minor road 1 lane/direction	40	800	Y	Y	Y	Y	Y
27	Minor road 1 lane/direction	60	1,000	Y	Y	Y	Y	Y
28	Minor road 1 lane/direction	60	1,200	Y	Y	Y	Y	Y
29	Minor road 2 lane/direction	60	2,400	Y	Y	Y	Y	Y
30	Minor road 3 lane/direction	60	3,600	Y	Y	Y	Y	Y
31	Major road 1 lane/direction	50	1,250	Y	Y	Y	Y	Y
32	Major road 2 lane/direction	50	2,500	Y	Y	Y	Y	Y
33	Major road 3 lane/direction	50	3,750	Y	Y	Y	Y	Y
34	Major road 4 lane/direction	50	5,000	Y	Y	Y	Y	Y
35	Major road 5 lane/direction	50	6,250	Y	Y	Y	Y	Y
36	Major road 6 lane/direction	50	7,500	Y	Y	Y	Y	Y
37	Major road 2 lane/direction	70	2,500	Y	Y	Y	Y	Y
38	Major road 3 lane/direction	70	3,750	Y	Y	Y	Y	Y
39	Major road 4 lane/direction	70	5,000	Y	Y	Y	Y	Y
40	Major road 5 lane/direction	70	6,250	Y	Y	Y	Y	Y
41	Major road 6 lane/direction	70	7,500	Y	Y	Y	Y	Y
42	Major road 3 lane/direction	95	3,750	Y	Y	Y	Y	Y
43	Major road 4 lane/direction	95	5,000	Y	Y	Y	Y	Y
44	Major road 5 lane/direction	95	6,250	Y	Y	Y	Y	Y



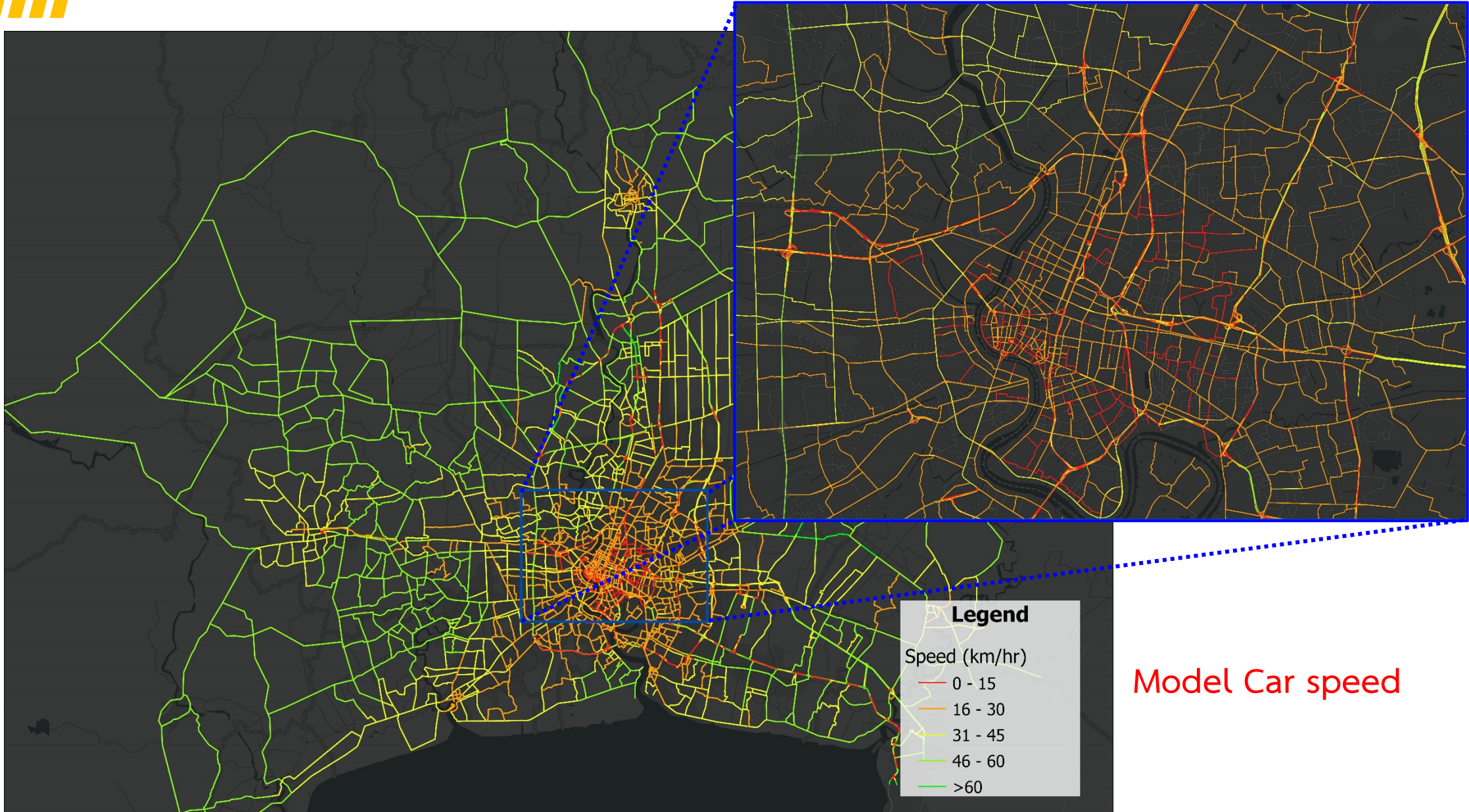


Link Type	Details	Free-Flow Speed (kph)	Capacity (Vehicle/direction)	Mode				
				Car	Truck	Mc	Walk	PT
45	Major road 6 lane/direction	95	7,500	Y	Y	Y	Y	Y
46	Ramp expressway 1 lane/direction	40	1,800	Y	Y			Y
47	Ramp expressway 2 lane/direction	40	3,600	Y	Y			Y
48	Ramp expressway 3 lane/direction	40	5,400	Y	Y			Y
49	Expressways and tollway 1 lane/direction	95	1,800	Y	Y			Y
50	Expressways and tollway 2 lane/direction	95	3,600	Y	Y			Y
51	Expressways and tollway 3 lane/direction	95	5,400	Y	Y			Y
52	Expressways and tollway 4 lane/direction	95	7,200	Y	Y			Y
53	Expressways and tollway 5 lane/direction	95	9,000	Y	Y			Y
54	U-turn 1 lane/direction	25	600	Y	Y	Y	Y	Y
55	Special link for junction modelling 3 lane/direction	40	3,000	Y	Y	Y	Y	Y
56	Vertical Transfer link	4.4	0				Y	
57	Horizontal Transfer link	4.4	0				Y	
58	Rail Station Access link	25	0	Y	Y	Y	Y	Y
59	Rail Station Entry Exit_link	25	0	Y	Y	Y	Y	Y
60	Dummy Controid Connector	15	0	Y	Y	Y	Y	Y



Go to: 17966 Find Extended

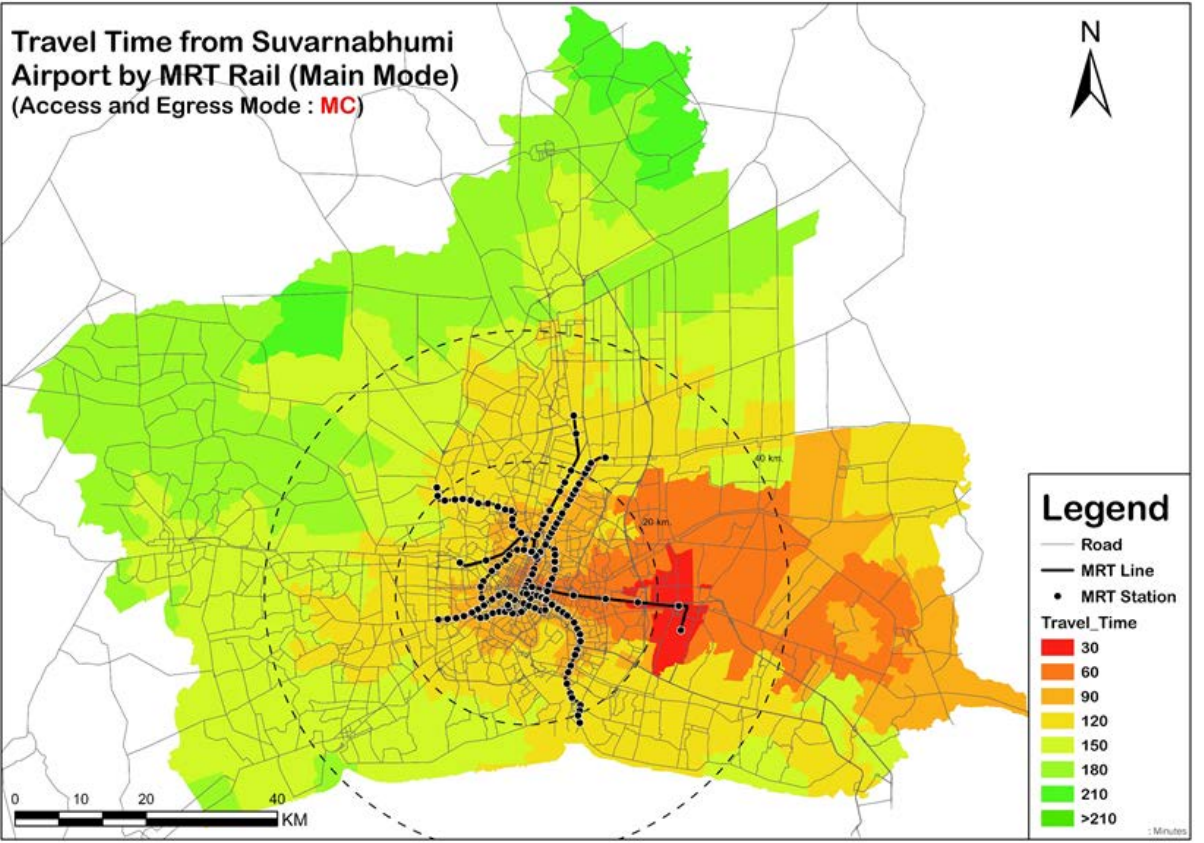
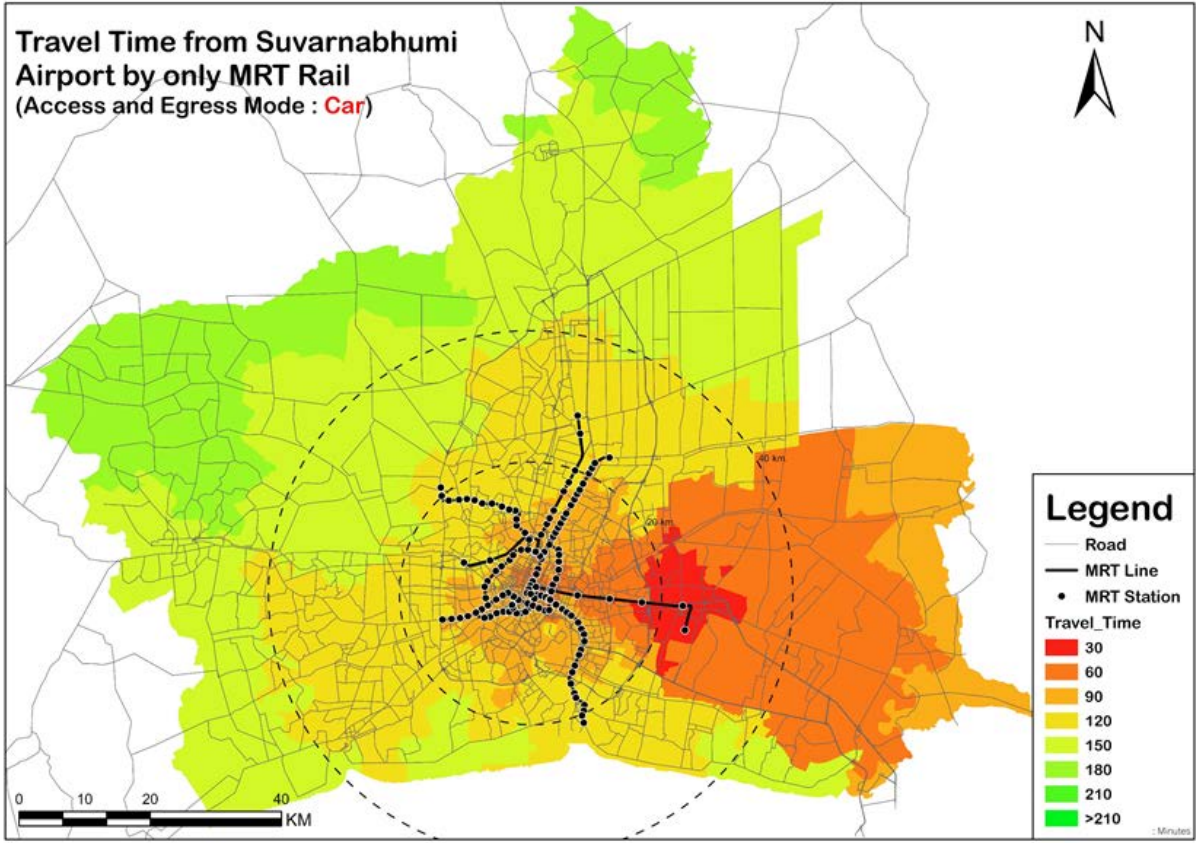
Property	Value
linktag	
roadnumber	
link_type	51
authority	
remark	
type	
brt	
doh_code	0
expressway	YES
proj_name	
tds_proj	
lanes	0
name	Chalerm Maha Nakhon Expy ...
<b>types</b>	
roadtype *	51:Expressways and Tollways ...
jurisdiction_code	3:JC_code_3
capacity_indicator	8:CI_code_8
sector	1:CBD
sub_sector	7:sub_sector_7
year	1:Existing
f_authority_type	0:<undefined>
<b>speed</b>	
speed (2:Car,2:AM)	95.00
speed (2:Car,3:PM)	95.00
speed (3:Truck,2:AM)	80.00
speed (3:Truck,3:PM)	80.00
speed (4:Motorcycle,2:AM)	
speed (4:Motorcycle,3:PM)	Disable mode
speed (5:Walk,2:AM)	
speed (5:Walk,3:PM)	
speed (6:PT,2:AM)	63.65
speed (6:PT,3:PM)	63.65
speed (7:Car_loaded,2:AM)	42.75
speed (7:Car_loaded,3:PM)	42.75
speed (8:Motorcycle_loaded,2:AM)	
speed (8:Motorcycle_loaded,3:PM)	
speed (9:Feeder,2:AM)	28.64
speed (9:Feeder,3:PM)	28.64
<b>capacity</b>	
<b>watch</b>	



Model Car speed

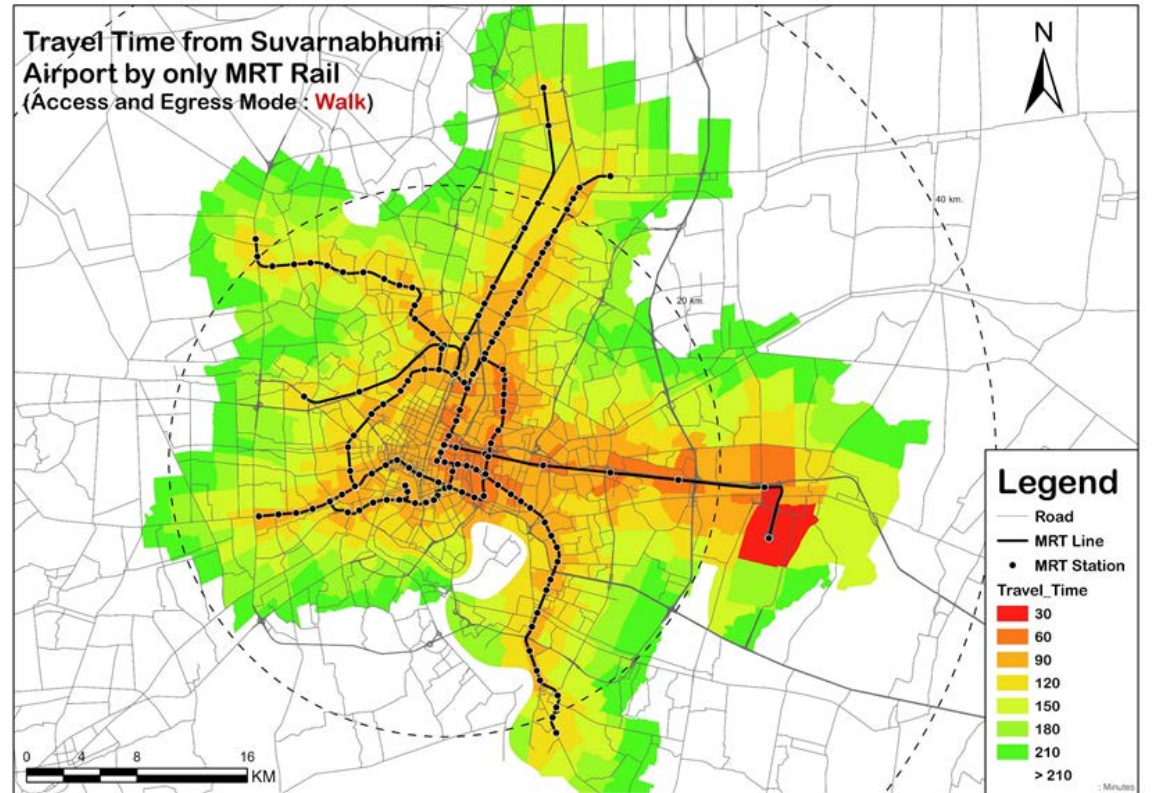
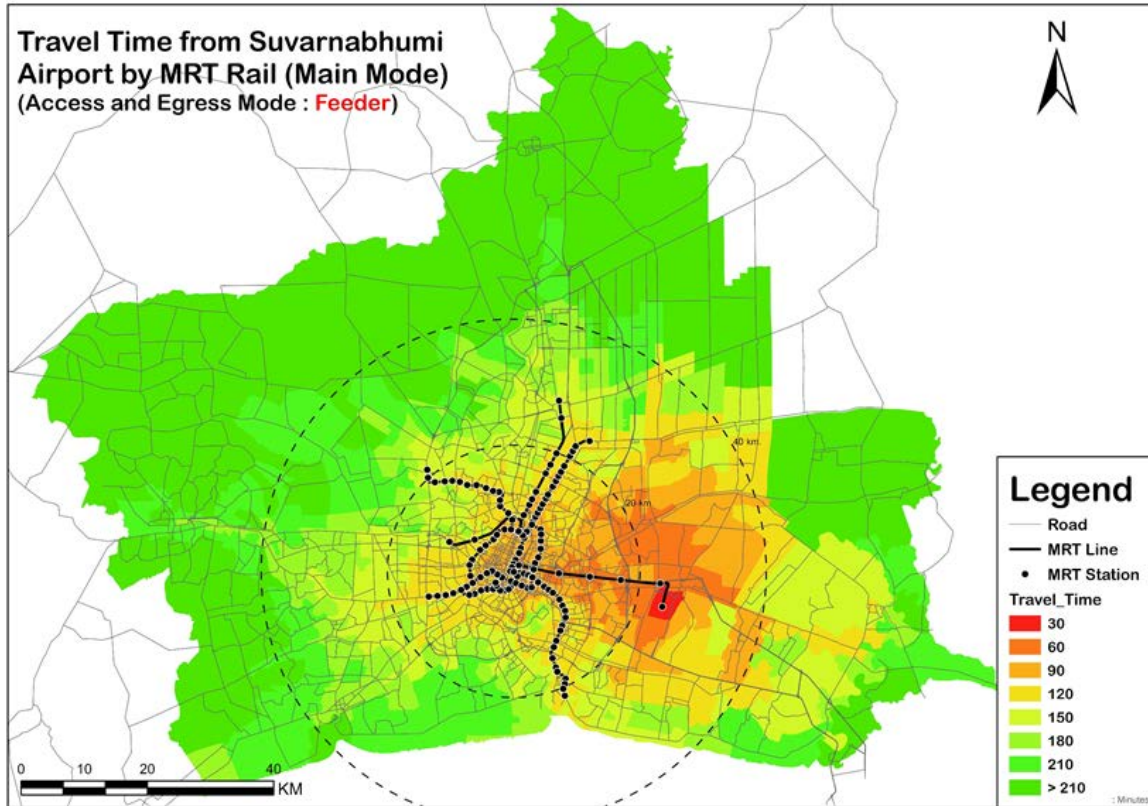


# Validation travel time





## Validation travel time





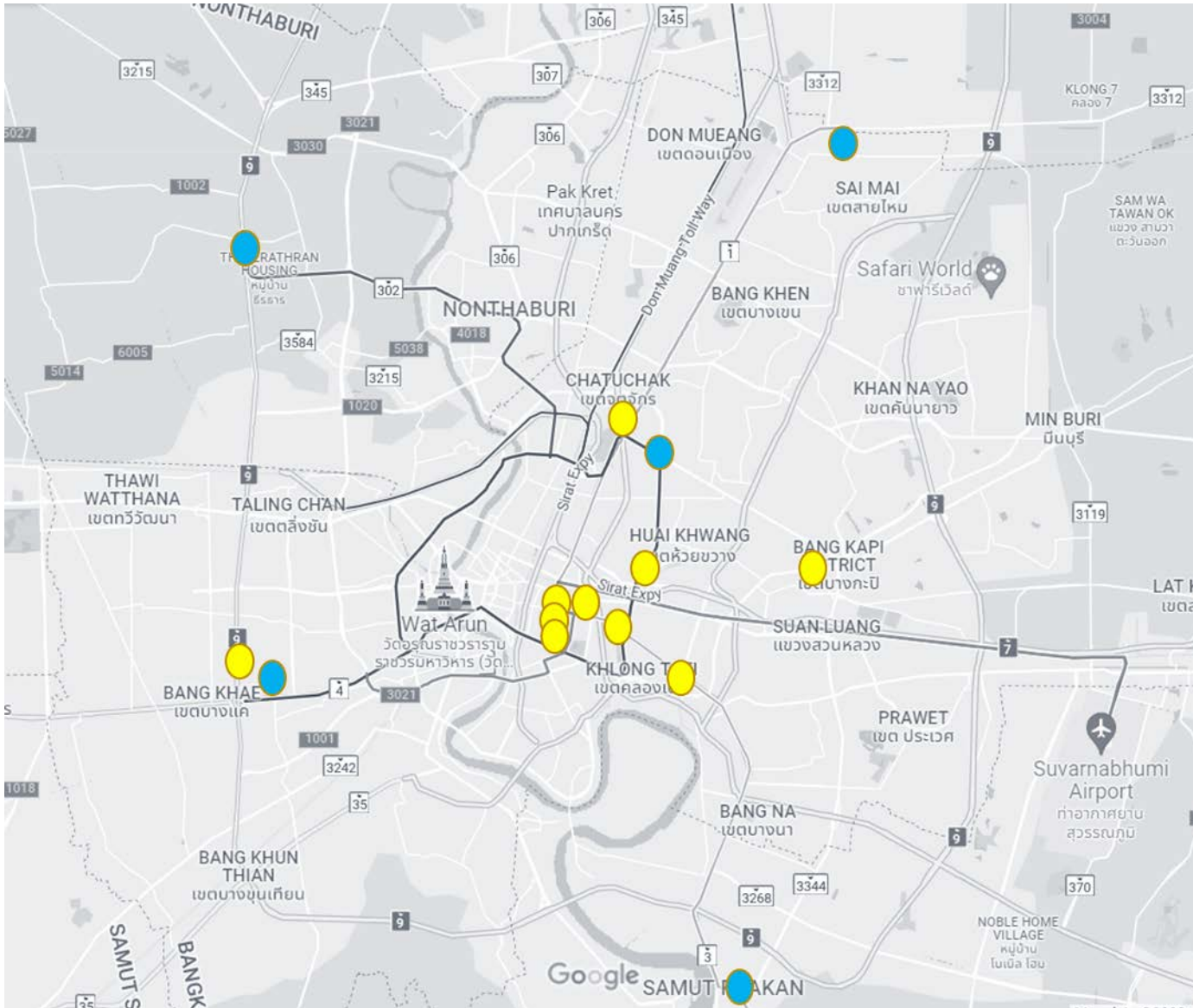
Dimensions | Link Type & Modes | Types | Zonal Data | Combinations | Transit Transfers | Transit Fares | Extended Parameters

**Dimensions** This page is used to define how the major dimensions in your project are structured.

- 1: Total
  - 10: Urban\_passenger
    - 11: Home\_to\_work
    - 12: Home\_to\_school
    - 13: Home\_to\_private
      - 131: Home\_to\_private\_unemployed
      - 132: Home\_to\_private\_wfh
      - 133: Home\_to\_private\_elder
    - 14: Non\_home\_based\_private
    - 15: Work\_business
    - 16: Work\_to\_home
    - 17: School\_to\_home
    - 18: Private\_to\_home
      - 181: Private\_to\_home\_unemployed
      - 182: Private\_to\_home\_wfh
      - 183: Private\_to\_home\_elder
  - 20: Urban\_goods
  - 30: Intercity\_passenger
  - 40: Intercity\_goods
- Mode
  - 1: Total
    - 2: Car
    - 3: Truck
    - 4: Motorcycle
    - 5: Walk
    - 6: PT
      - 61: Ordinary\_bus
      - 62: Non\_air\_con\_expway\_bus
      - 63: Air\_con\_expway\_bus
      - 64: Air\_con\_bus
      - 65: Local\_bus
      - 66: Provincial\_bus
      - 67: Inter\_provincial\_bus
      - 68: Ordinary\_ferry
      - 69: Express\_ferry
      - 70: SRT\_rail
      - 71: MRT\_rail
      - 72: BRT
    - 7: Car\_loaded
    - 8: Motorcycle\_loaded
    - 9: Feeder
    - 10: Bus
    - 11: Rail
- Time
- User
- Result
- Iteration

## Dimensions

Purpose, Mode, Time, User,  
Result and Iteration



Parking Fee	
1	Paragon
2	The Mall Bang Kae
3	The Mall Bang Kapi
4	Emporium
5	Central World
6	Central Ladprao
7	Central Rama 9
8	Terminal 21 Asok
9	MBK Center

Park&Ride Fee	
1	Lad Prao Station
2	Bang Phi Station
3	Lak Sog Station
4	Yak Kor Por Aor Station
5	Khaeha Station



# Trip Generation Model Development





- Using trip rate by trip purposes (age groups are considered in trip purposes)

$$\text{Production or Attraction rate}_i = \frac{\text{Total trip for purpose}_i}{\text{Population index}_i}$$

- Trip purpose  $i$ :
  1. Home to Work
  2. Home to School
  3. Home to Private unemployed
  4. Home to Private WFH
  5. Home to Private elder
  6. Non Home-based Private
  7. Work-Business
  8. Work to Home
  9. School to Home
  10. Private to Home unemployed
  11. Private to Home WFH
  12. Private to Home elder



Trip purpose	Production (Origin)		Attraction (Destination)	
	Population Index	Trip Rate	Population Index	Trip Rate
Home to work	จำนวนประชากรที่มีงานทำ ช่วงอายุ 15 – 60 ปี	<b>0.998</b>	จำนวนการจ้างงาน	<b>0.990</b>
Home to school	จำนวนประชากรที่เรียนช่วง อายุ 5 – 21 ปี	<b>0.995</b>	จำนวนที่นั่งเรียน	<b>0.888</b>
Home to private unemployed	จำนวนประชากรที่อายุ 22 – 60 ปี ที่ไม่มีงานทำ	<b>0.374</b>	จำนวนการจ้างงานภาคบริการ	<b>0.021</b>
Home to private WFH	จำนวนประชากรที่อายุ 22 – 60 ปี ที่ทำงานที่บ้าน	<b>0.671</b>	จำนวนการจ้างงานภาคบริการ	<b>0.152</b>
Home to private elder	จำนวนประชากรที่อายุมากกว่า 60 ปี	<b>0.274</b>	จำนวนการจ้างงานภาคบริการ	<b>0.041</b>
Non home-based to private	จำนวนการจ้างงาน	<b>0.039</b>	จำนวนการจ้างงานภาคบริการ	<b>0.064</b>
Work-business	จำนวนการจ้างงาน	<b>0.055</b>	จำนวนการจ้างงาน	<b>0.055</b>
Work to home	จำนวนการจ้างงาน	<b>0.972</b>	จำนวนประชากรที่มีงานทำ ช่วงอายุ 15 – 60 ปี	<b>0.979</b>
School to home	จำนวนที่นั่งเรียน	<b>0.842</b>	จำนวนประชากรที่เรียนช่วง อายุ 5 – 21 ปี	<b>0.944</b>
Private to home unemployed	จำนวนการจ้างงานภาคบริการ	<b>0.026</b>	จำนวนประชากรที่อายุ 22 – 60 ปี ที่ไม่มีงานทำ	<b>0.459</b>
Private to home WFH	จำนวนการจ้างงานภาคบริการ	<b>0.172</b>	จำนวนประชากรที่อายุ 22 – 60 ปี ที่ทำงานที่บ้าน	<b>0.761</b>
Private to home elder	จำนวนการจ้างงานภาคบริการ	<b>0.041</b>	จำนวนประชากรที่อายุมากกว่า 60 ปี	<b>0.266</b>



**Combinations** This page is used to define how PMTU Trip Ends are combined for the Gravity Model (PRODUCTIONS and ATTRACTIONS)

Purpose: 1:Total Mode: 1:Total Time: 1:Daily User: 1:Total

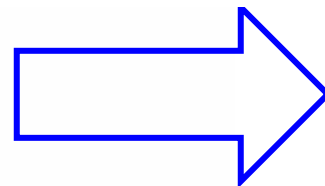
**PRODUCTIONS**

- 501: Home\_to\_work\_Non\_vehide
- 502: Home\_to\_work\_Motorcycle\_only
- 503: Home\_to\_work\_Car\_only
- 504: Home\_to\_work\_Multi\_vehide
- 505: Home\_to\_school\_Non\_vehide
- 506: Home\_to\_school\_Motorcycle\_only
- 507: Home\_to\_school\_Car\_only
- 508: Home\_to\_school\_Multi\_vehide
- 509: Home\_to\_private\_unemployed\_Non\_vehide
- 510: Home\_to\_private\_unemployed\_Motorcycle\_only
- 511: Home\_to\_private\_unemployed\_Car\_only
- 512: Home\_to\_private\_unemployed\_Multi\_vehide
- 513: Home\_to\_private\_wfh\_Non\_vehide
- 514: Home\_to\_private\_wfh\_Motorcycle\_only
- 515: Home\_to\_private\_wfh\_Car\_only
- 516: Home\_to\_private\_wfh\_Multi\_vehide
- 517: Home\_to\_private\_elder\_Non\_vehide
- 518: Home\_to\_private\_elder\_Motorcycle\_only
- 519: Home\_to\_private\_elder\_Car\_only
- 520: Home\_to\_private\_elder\_Multi\_vehide
- 521: Non\_home\_based\_private\_Non\_vehide
- 522: Non\_home\_based\_private\_Motorcycle\_only
- 523: Non\_home\_based\_private\_Car\_only
- 524: Non\_home\_based\_private\_Multi\_vehide
- 525: Work\_business\_Non\_vehide
- 526: Work\_business\_Motorcycle\_only
- 527: Work\_business\_Car\_only
- 528: Work\_business\_Multi\_vehide
- 529: Work\_to\_home\_Non\_vehide
- 530: Work\_to\_home\_Motorcycle\_only
- 531: Work\_to\_home\_Car\_only
- 532: Work\_to\_home\_Multi\_vehide
- 533: School\_to\_home\_Non\_vehide
- 534: School\_to\_home\_Motorcycle\_only
- 535: School\_to\_home\_Car\_only
- 536: School\_to\_home\_Multi\_vehide
- 537: Private\_to\_home\_unemployed\_Non\_vehide
- 538: Private\_to\_home\_unemployed\_Motorcycle\_only
- 539: Private\_to\_home\_unemployed\_Car\_only
- 540: Private\_to\_home\_unemployed\_Multi\_vehide
- 541: Private\_to\_home\_wfh\_Non\_vehide
- 542: Private\_to\_home\_wfh\_Motorcycle\_only
- 543: Private\_to\_home\_wfh\_Car\_only
- 544: Private\_to\_home\_wfh\_Multi\_vehide
- 545: Private\_to\_home\_elder\_Non\_vehide
- 546: Private\_to\_home\_elder\_Motorcycle\_only
- 547: Private\_to\_home\_elder\_Car\_only
- 548: Private\_to\_home\_elder\_Multi\_vehide

**ATTRACTIONS**

- 501: Home\_to\_work\_Non\_vehide

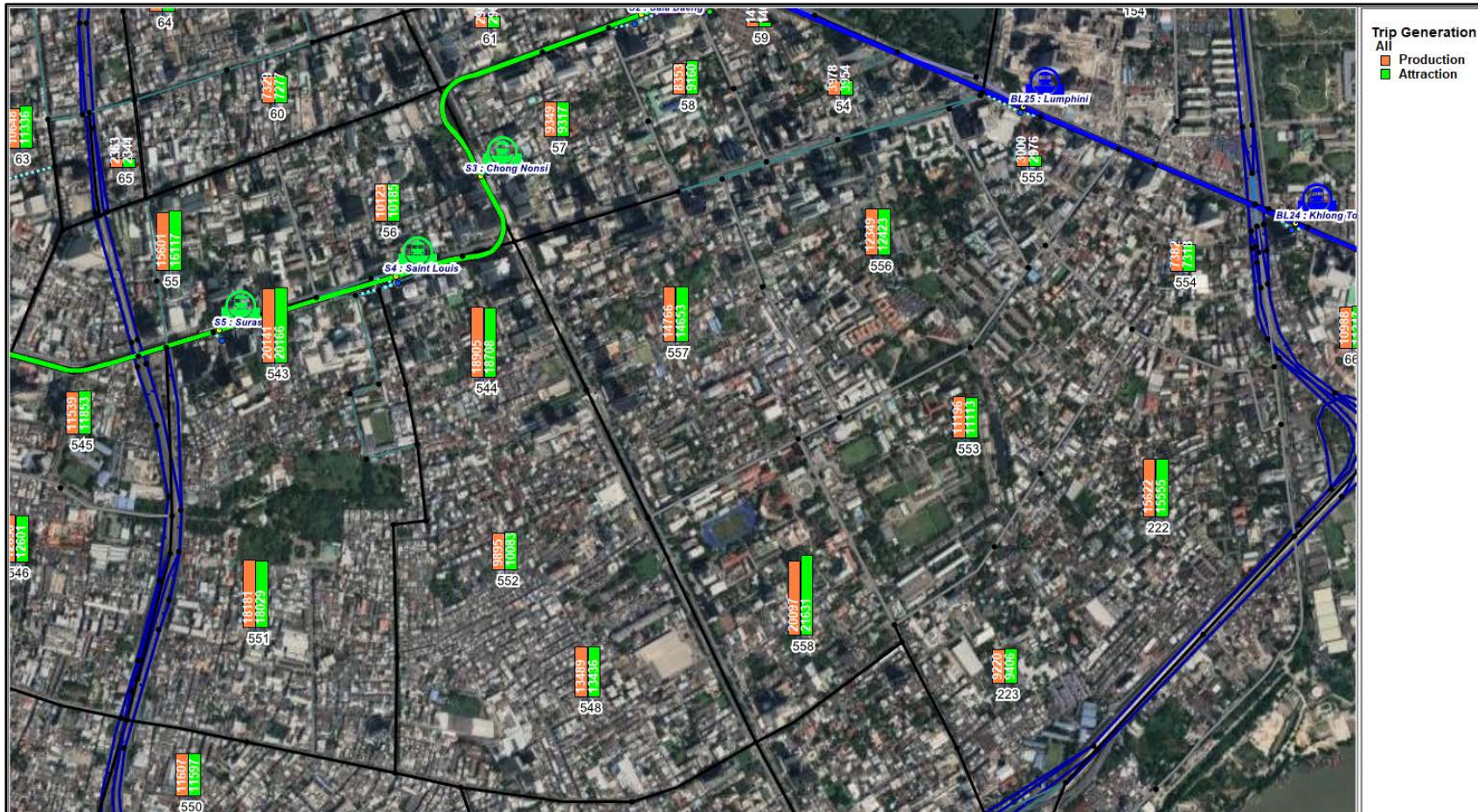
Trip Matrix



Zone

	P501: Home_to_work_Non_vehide	P502: Home_to_work_Motorcycle_or	P503: Home_to_work_Car_only	P504: Home_to_work_Multi_vehide
1	256	274	444	488
2	157	168	271	298
3	196	209	338	372
4	1604	1715	2776	3053
5	497	531	860	946
6	487	521	843	927
7	826	882	1428	1571
8	329	352	570	627
9	364	389	629	692
10	368	393	636	699
11	287	307	497	547
12	591	632	1023	1125
13	407	435	705	775
14	349	373	604	664
15	351	375	607	668
16	249	266	431	474
17	186	199	322	354
18	766	819	1326	1458
19	533	570	923	1015
20	633	677	1096	1205
21	539	577	933	1026
22	491	525	849	934
23	666	712	1153	1268
24	421	450	729	802
25	359	384	622	684
26	350	374	605	665
27	602	643	1041	1145
28	495	529	857	943
29	1525	1630	2639	2902
30	981	1049	1698	1867
31	931	995	1611	1771
32	925	989	1601	1760
33	714	763	1235	1358
34	694	742	1200	1320
35	1509	1613	2610	2871
36	733	783	1268	1395
37	713	762	1234	1357
38	3669	3922	6348	6982
39	773	826	1337	1470
40	2354	2516	4072	4478
<b>Total</b>	<b>1906582</b>	<b>2038015</b>	<b>3298742</b>	<b>3627812</b>

Trip production 48 combinations and trip attraction 48 combinations (12 trip purposes X 4 vehicle availability)



Trip purpose	Trip/day
Home to work	10,808,456
Home to School	2,194,965
Home to private unemployed	142,958
Home to private WFH	1,025,931
Home to private elder	282,367
Non home-based private	422,741
Work-Business	596,173
Work to Home	10,535,998
School to Home	2,020,476
Private to Home unemployed	172,303
Private to Home WFH	1,139,850
Private to Home elder	265,081
<b>Total</b>	<b>29,607,298</b>



# Trip Distribution Model Development



- Using Gravity model by 12 trip purposes and 4 vehicle availability
- Trip purposes consist of:
  1. Home to Work
  2. Home to School
  3. Home to Private unemployed
  4. Home to Private WFH
  5. Home to Private elder
  6. Non Home-based Private
  7. Work-Business
  8. Work to Home
  9. School to Home
  10. Private to Home unemployed
  11. Private to Home WFH
  12. Private to Home elder
- Vehicle availability consist of:
  1. No vehicle
  2. Motorcycle only
  3. Passenger car only
  4. Multi vehicles (both motorcycle and passenger car)



- Gravity models:

$$T_{ij} = a_i b_j P_i A_j f(c_{ij})$$

$T_{ij}$  = Trips from traffic zone  $i$  to traffic zone  $j$

$P_i$  = Trip production of traffic zone  $i$

$A_j$  = Trip attraction of traffic zone  $j$

$f(c_{ij})$  = Deterrence function of generalized cost from traffic zone  $i$  to traffic zone  $j$

$a_i, b_j$  = Adjustment factor of traffic zone  $i$  and traffic zone  $j$



- Gamma Distribution:

$$f(x) = \frac{x^{\alpha-1} e^{-\beta x} \beta^{\alpha}}{\Gamma(\alpha)}$$

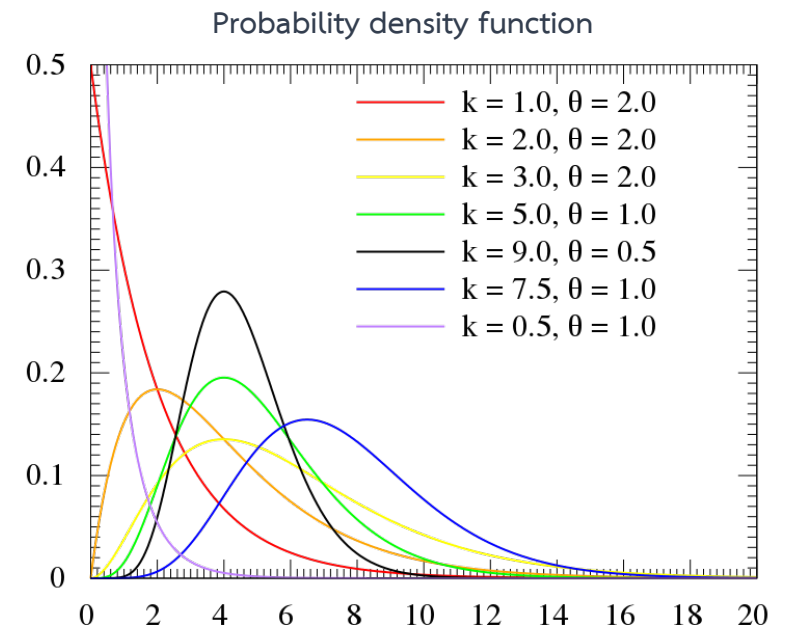
for  $x > 0$        $\alpha, \beta > 0$

$\Gamma(\alpha)$  = Gamma function

$\alpha, \beta$  = Parameters

With a shape parameter  $k$  and a scale parameter  $\theta$

With a shape parameter  $\alpha = k$  and an inverse scale parameter  $\beta = 1/\theta$ , called a rate parameter



Source: [https://en.wikipedia.org/wiki/Gamma\\_distribution](https://en.wikipedia.org/wiki/Gamma_distribution)





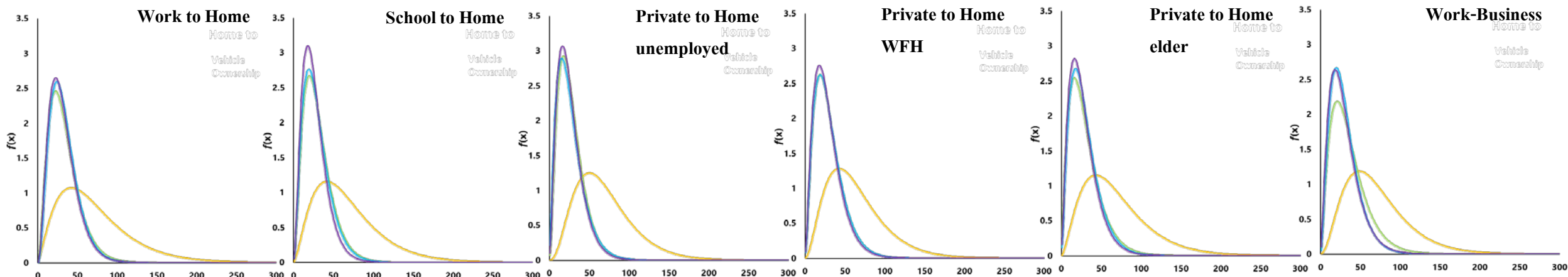
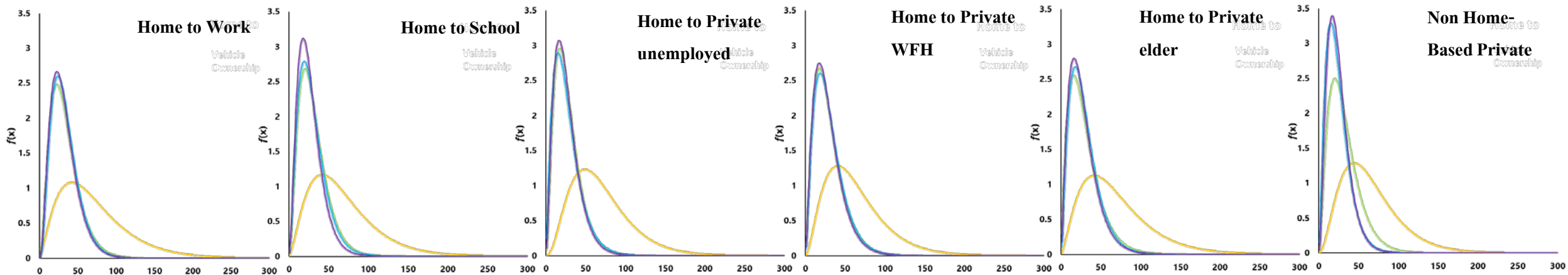
Trip Purpose	Vehicle Ownership	Shape	Rate	Loglikelihood	AIC	BIC
Home to Work	Non vehicle	2.666	0.041	-12,432	24,868	24,880
	Motorcycle only	3.290	0.124	-46,650	93,305	93,319
	Car only	3.904	0.147	-52,302	104,609	104,624
	Multi vehicle	3.519	0.140	-90,746	181,496	181,513
Home to School	Non vehicle	2.988	0.048	-2,213	4,429	4,437
	Motorcycle only	2.916	0.114	-4,043	8,090	8,100
	Car only	3.059	0.135	-3,980	7,964	7,974
	Multi vehicle	2.992	0.145	-9,007	18,017	18,029
Home to Private unemployed	Non vehicle	3.681	0.057	-956	1,915	1,922
	Motorcycle only	2.839	0.134	-1,710	3,423	3,432
	Car only	2.532	0.122	-4,773	9,549	9,560
	Multi vehicle	2.843	0.140	-5,705	11,414	11,424
Home to Private WFH	Non vehicle	3.026	0.052	-5,076	10,155	10,165
	Motorcycle only	2.772	0.119	-16,333	32,670	32,682
	Car only	2.783	0.117	-26,806	53,616	53,630
	Multi vehicle	2.673	0.119	-41,394	82,792	82,807



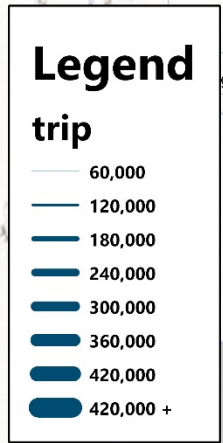
Trip Purpose	Vehicle Ownership	Shape	Rate	Loglikelihood	AIC	BIC
Home to Private elder	Non vehicle	2.767	0.043	-3,789	7,582	7,592
	Motorcycle only	2.314	0.098	-3,568	7,141	7,150
	Car only	2.726	0.118	-10,563	21,129	21,141
	Multi vehicle	2.507	0.115	-12,613	25,229	25,241
Non Home-based Private	Non vehicle	3.621	0.062	-1,575	3,153	3,161
	Motorcycle only	2.968	0.118	-3,098	6,200	6,210
	Car only	2.948	0.150	-4,791	9,585	9,595
	Multi vehicle	3.497	0.181	-5,779	11,562	11,573
Work-Business	Non vehicle	3.482	0.054	-2,019	4,043	4,051
	Motorcycle only	2.661	0.093	-4,238	8,479	8,489
	Car only	3.154	0.128	-4,906	9,815	9,826
	Multi vehicle	2.860	0.120	-5,316	10,635	10,646
Work to Home	Non vehicle	2.643	0.041	-11,348	22,701	22,712
	Motorcycle only	3.250	0.122	-43,354	86,711	86,726
	Car only	3.915	0.147	-48,578	97,160	97,174
	Multi vehicle	3.501	0.139	-84,537	169,079	169,095



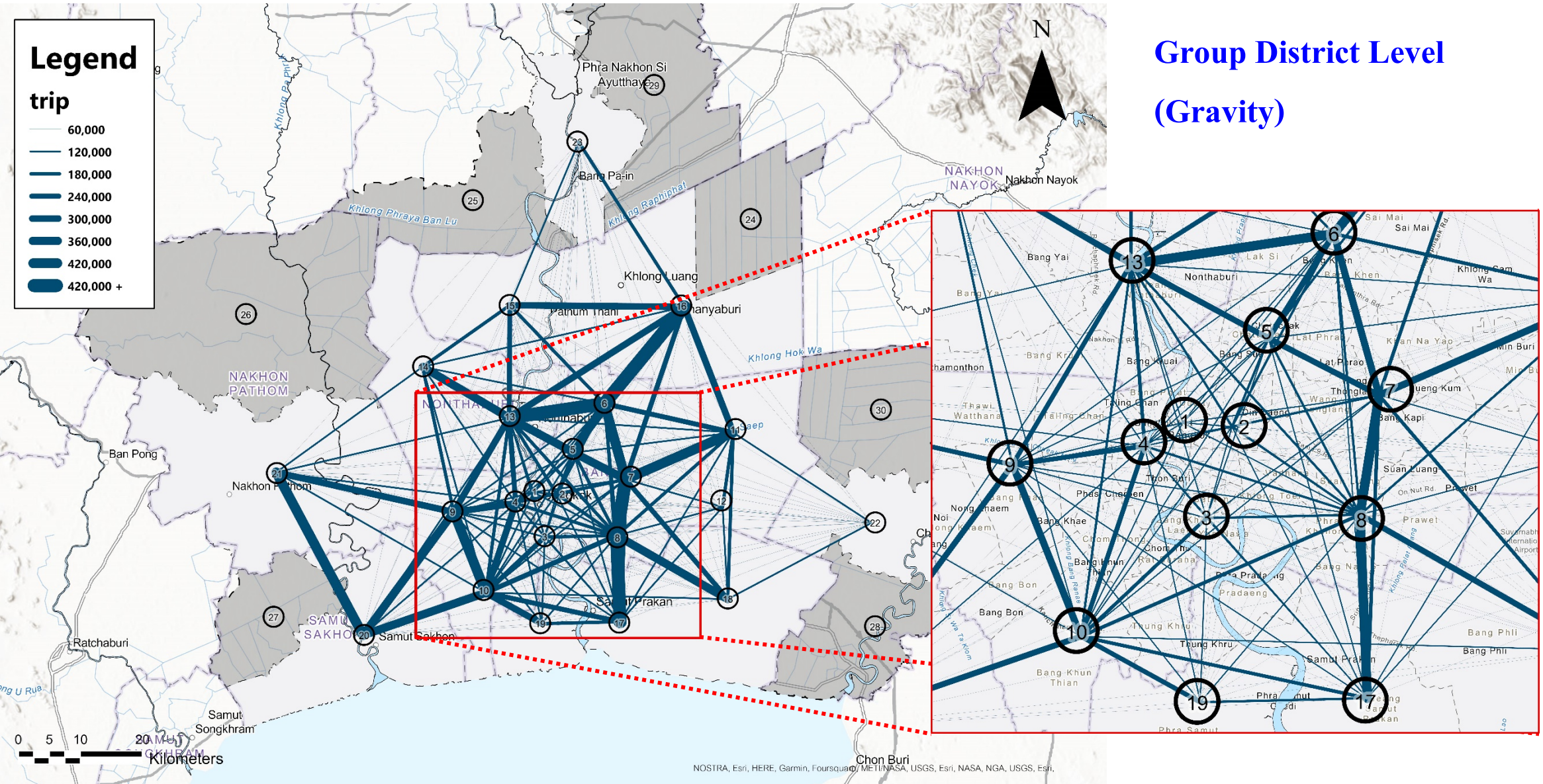
Trip Purpose	Vehicle Ownership	Shape	Rate	Loglikelihood	AIC	BIC
School to Home	Non vehicle	2.997	0.049	-2,258	4,519	4,527
	Motorcycle only	2.998	0.118	-4,145	8,294	8,304
	Car only	2.976	0.131	-4,127	8,257	8,267
	Multi vehicle	3.001	0.145	-9,050	18,103	18,115
Private to Home unemployed	Non vehicle	3.818	0.060	-975	1,955	1,961
	Motorcycle only	2.922	0.136	-1,750	3,505	3,513
	Car only	2.566	0.122	-4,832	9,668	9,678
	Multi vehicle	2.815	0.138	-5,734	11,473	11,483
Private to Home WFH	Non vehicle	3.221	0.054	-6,560	13,125	13,135
	Motorcycle only	2.883	0.120	-20,433	40,871	40,884
	Car only	2.883	0.120	-31,348	62,699	62,713
	Multi vehicle	2.760	0.122	-47,995	95,994	96,009
Private to Home elder	Non vehicle	2.896	0.046	-3,858	7,721	7,730
	Motorcycle only	2.358	0.099	-3,641	7,285	7,295
	Car only	2.725	0.118	-10,695	21,395	21,407
	Multi vehicle	2.542	0.117	-12,686	25,376	25,388



— Non\_vehicle    
 — MC\_only    
 — Car\_only    
 — Multi\_vehicle



## Group District Level (Gravity)





# Station Access Model Development



## Station Access Model

Calculate the share of mode used for railway station access from walk, motorcycle taxi, feeder and car

$$P_i = \frac{\exp(V_i)}{\sum_{j=1}^n \exp(V_j)}$$

$$V_i = \sum_k (\theta_k \cdot X_{ik}) \longrightarrow$$

Where:

$P_i$  = Probability of selecting mode  $i$

$V_i$  = Utility of selecting mode  $i$

$n$  = Number of transport access/egress modes:

4 (walk, motorcycle taxi, feeder and car)

$\theta_k$  =  $k^{th}$  utility parameter

$X_{ik}$  =  $k^{th}$  utility variable of mode  $i$

### Model Variables

Variables	Detail
ASC	Alternative specific constant for each mode. Walk/bike as reference
Non-Motorized Travel Time (Minute)	(Walk only) Walk: walking time between origin or destination to station
Motorized Travel Time (Minute)	(Motorcycle taxi, feeder, car) Motorcycle taxi: travel time and waiting time between origin or destination to station Feeder: travel time and waiting time between origin or destination to station, access/egress time to station included Car: travel time between origin or destination to station, parking time included
Travel Cost (Baht)	Total cost spent between origin or destination to station
Waiting Time (Minutes)	(Feeder, Motorcycle taxi) Waiting time for feeder bus or motorcycle taxi



## Mixed Logit model

Note: Random coefficient of travel time assume normal distribution

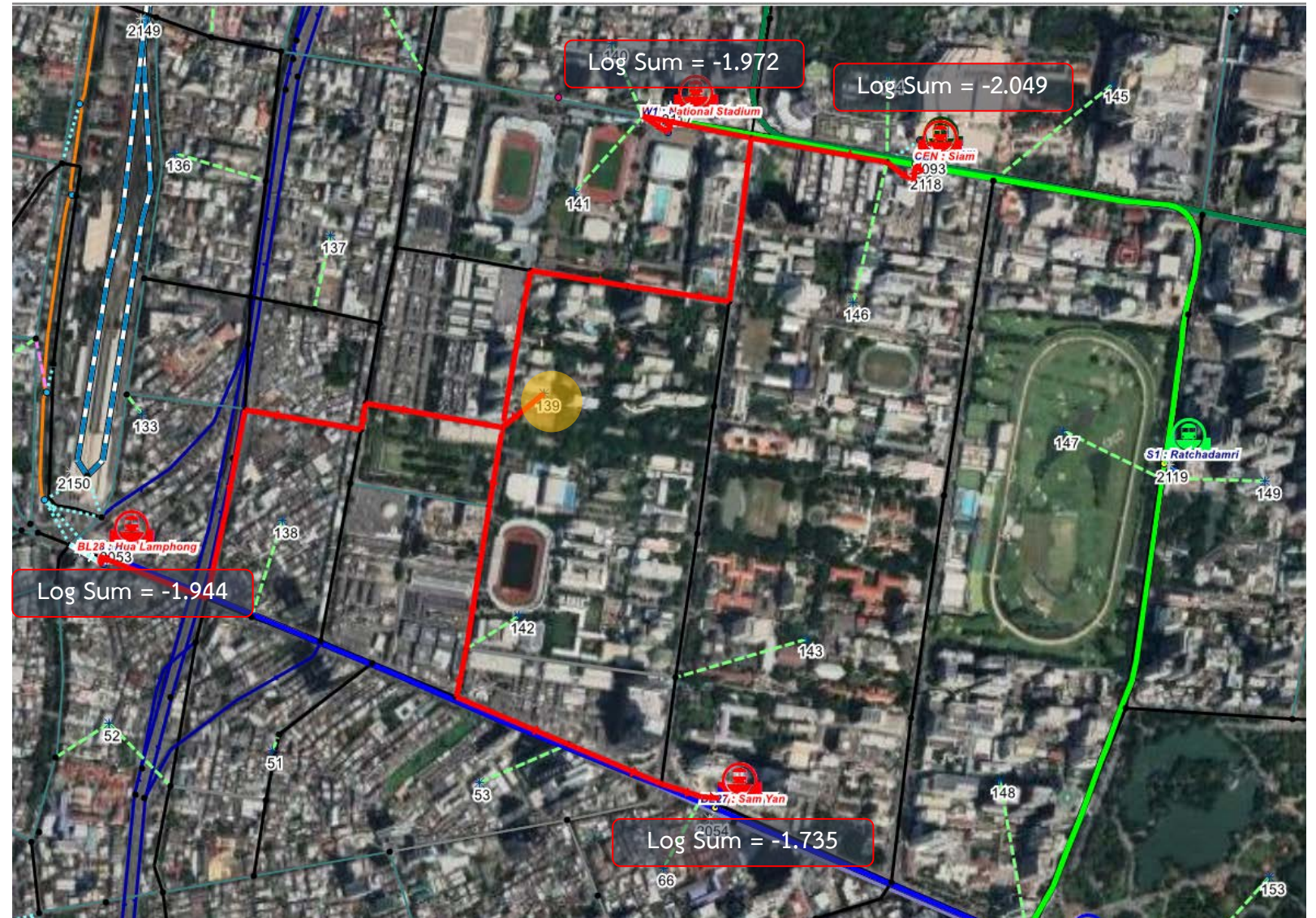
Variables		All Purpose			
		parameter	t-stat	SD	t-stat
ASC	WALK/BIKE	-	-		
	MC	-1.828	-22.598		
	FEEDER	-3.907	-31.744		
	CAR	-3.395	-52.684		
Travel time (min)	WALK/BIKE	-0.093	-38.908	-3.332e-07	-1.5042e-04
	Motorized	-0.041	-8.101	2.3160e-04	0.02220
Travel Cost (baht)	Motorized	-0.033	-11.323	-	-
Number of obs.		10,079			
Rho <sup>2</sup>		0.4425			
AIC		15,500			
BIC		15,558			
Final Log Likelihood		-7,742.24			
Travel time VOT (baht/min)	WALK	2.79			
	Motorized	1.23			





## Example

Log Sum Station Access  
from zone 139





# Modal Split Model Development



$$P_i = \text{Captive}_i + (1 - \sum_{j=1}^n \text{Captive}_j) \frac{\exp(V_i)}{\sum_{j=1}^n \exp(V_j)}$$

$$V_i = \sum_k (\theta_k \cdot X_{ik})$$

Where:

$\text{Captive}_i$  = Probability of captive mode  $i$

$P_i$  = Probability of selecting mode  $i$

$V_i$  = Utility of selecting mode  $i$

$n$  = Number of transport main modes:

4 (rail, bus and other public transport, motorcycle, and car)

$\theta_k$  =  $k^{\text{th}}$  utility parameter

$X_{ik}$  =  $k^{\text{th}}$  utility variable of mode  $i$

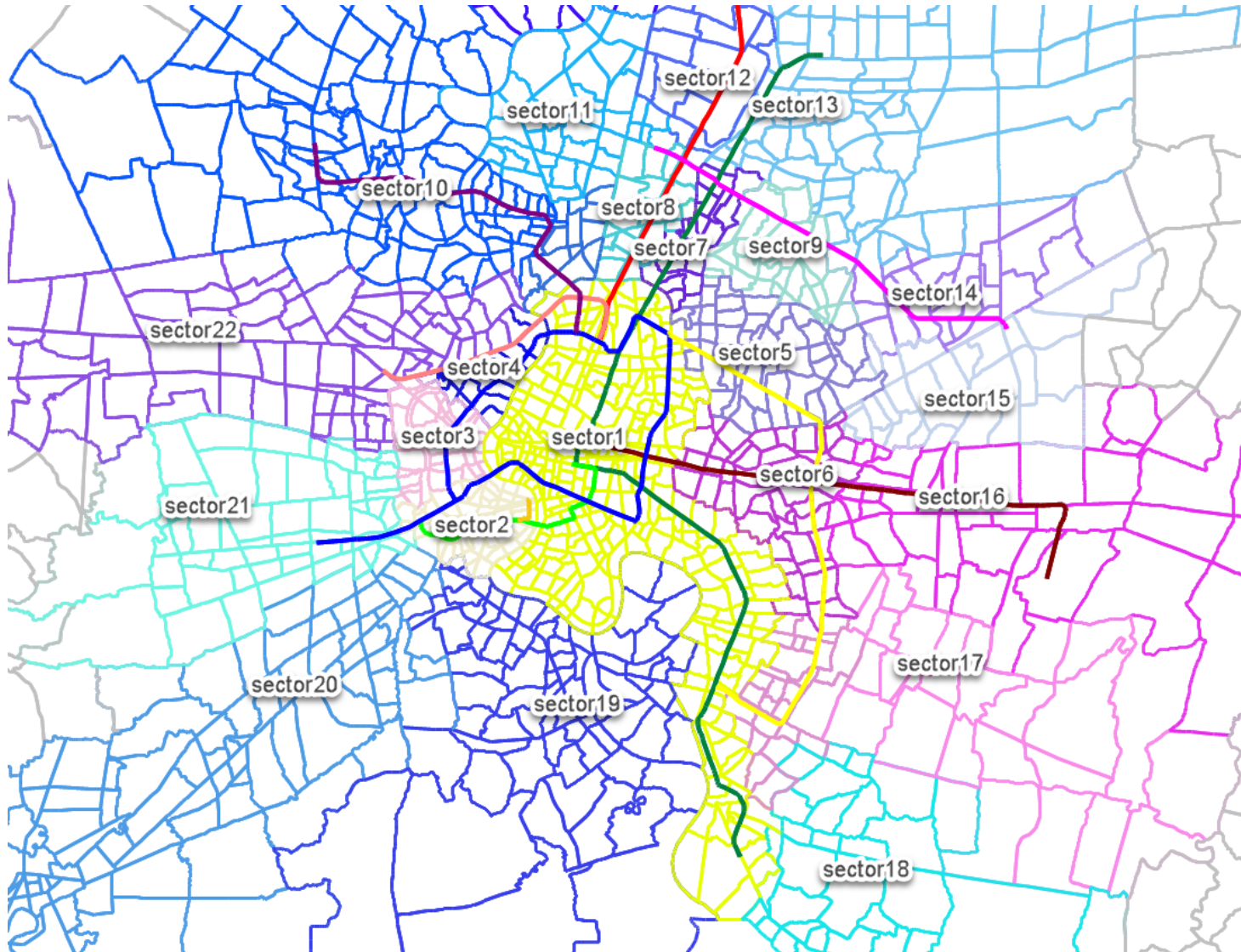
Variables	Detail
ASC	Alternative specific constant for each mode. Car as reference
Travel Time (Minute)	Rail: boarding + transfer + waiting time Bus and other public transports: boarding + waiting + access/egress to bus/other public transports stop time Car and motorcycle: driving + parking time
Travel Cost (Baht)	Rail: rail fare Bus and other public transports: bus and other public transports fare Car: VOC (fuel, maintenance) + toll fee + parking fee Motorcycle: VOC (fuel, maintenance) + parking fee
Short Trip Dummy	(Car and Motorcycle) 1 for OD with distance less than 5 km, 0 otherwise;
Station Access	(Rail alternative specific only) The log-sum of utility of access/egress modes



## Mixed Logit model

\*Note: Random coefficient of travel time assume Normal distribution

		Trip purpose					
		H-W + W-H	H-S + S-H	H-P + P-H (unemp)	H-P + P-H (wfh)	H-P + P-H (elder)	OH-P + W-B
<b>ASC</b>	CAR						
	MC	1.139	-0.170	0.358	-0.653	1.738	-0.360
	BUS	2.045	1.385	1.555	0.922	1.907	1.431
	RAIL	5.259	5.094	3.918	2.531	3.961	4.728
<b>Travel time (min)</b>	ALL	-0.053	-0.024	-0.045	-0.067	-0.058	-0.028
<b>Travel cost (baht)</b>	ALL	-0.015	-0.019	-0.047	-0.027	-0.015	-0.012
<b>Vehicle Ownership</b>	CAR	3.408	2.089	2.355	2.054	3.983	1.838
	MC	1.710	1.602	1.897	1.230	1.777	2.166
<b>CBD Dummy</b>	CAR						
<b>Short Trip Dummy</b>	CAR	1.710	2.007	1.055	1.409	1.654	1.137
	MC	2.028	3.540	1.818	3.007	2.107	2.011
<b>Station Access</b>	RAIL	0.397	0.602	0.501	0.368	0.291	0.468
<b>Number of obs.</b>		2335	1252	463	1729	202	1090
<b>Rho<sup>2</sup></b>		0.562	0.357	0.326	0.367	0.577	0.647
<b>Final Log Likelihood</b>		-1378.820	-1091.050	-409.250	-1472.880	-116.170	-526.920
<b>Travel time VOT</b>		<b>3.63</b>	<b>1.26</b>	<b>0.95</b>	<b>2.47</b>	<b>3.88</b>	<b>2.33</b>
		(baht/min)					



## Different ASC Rail in each sector

### Example

CBD (sector1, sector2)

- ASC rail = 1.0

Urban (sector3, sector4, sector5, sector6, sector7, sector8, sector9)

- ASC rail = 0.85

Suburban (sector10, sector11, ..)

- ASC rail = 0.25

Suburban red line (sector12, sector20, sector22)

- ASC rail = 0.10



## Example For CBD (1.0)

## Mixed Logit model

\*Note: Random coefficient of travel time  
assume Normal distribution

		Trip purpose					
		H-W + W-H	H-S + S-H	H-P + P-H (unemp)	H-P + P-H (wfh)	H-P + P-H (elder)	OH-P + W-B
ASC	CAR						
	MC	1.139	-0.170	0.358	-0.653	1.738	-0.360
	BUS	2.045	1.385	1.555	0.922	1.907	1.431
	RAIL	<b>5.259</b>	<b>5.094</b>	<b>3.918</b>	<b>2.531</b>	<b>3.961</b>	<b>4.728</b>
Travel time (min)	ALL	-0.053	-0.024	-0.045	-0.067	-0.058	-0.028
Travel cost (baht)	ALL	-0.015	-0.019	-0.047	-0.027	-0.015	-0.012
Vehicle Ownership	CAR	3.408	2.089	2.355	2.054	3.983	1.838
	MC	1.710	1.602	1.897	1.230	1.777	2.166
CBD Dummy	CAR						
Short Trip Dummy	CAR	1.710	2.007	1.055	1.409	1.654	1.137
	MC	2.028	3.540	1.818	3.007	2.107	2.011
Station Access	RAIL	0.397	0.602	0.501	0.368	0.291	0.468
Number of obs.		2335	1252	463	1729	202	1090
Rho <sup>2</sup>		0.562	0.357	0.326	0.367	0.577	0.647
Final Log Likelihood		-1378.820	-1091.050	-409.250	-1472.880	-116.170	-526.920
Travel time VOT		<b>3.63</b>	<b>1.26</b>	<b>0.95</b>	<b>2.47</b>	<b>3.88</b>	<b>2.33</b>
		(baht/min)					



## Example For Urban (0.85)

## Mixed Logit model

\*Note: Random coefficient of travel time  
assume Normal distribution

		Trip purpose					
		H-W + W-H	H-S + S-H	H-P + P-H (unemp)	H-P + P-H (wfh)	H-P + P-H (elder)	OH-P + W-B
ASC	CAR						
	MC	1.139	-0.170	0.358	-0.653	1.738	-0.360
	BUS	2.045	1.385	1.555	0.922	1.907	1.431
	RAIL	<b>4.470</b>	<b>4.330</b>	<b>3.331</b>	<b>2.151</b>	<b>3.367</b>	<b>4.019</b>
Travel time (min)	ALL	-0.053	-0.024	-0.045	-0.067	-0.058	-0.028
Travel cost (baht)	ALL	-0.015	-0.019	-0.047	-0.027	-0.015	-0.012
Vehicle Ownership	CAR	3.408	2.089	2.355	2.054	3.983	1.838
	MC	1.710	1.602	1.897	1.230	1.777	2.166
CBD Dummy	CAR						
Short Trip Dummy	CAR	1.710	2.007	1.055	1.409	1.654	1.137
	MC	2.028	3.540	1.818	3.007	2.107	2.011
Station Access	RAIL	0.397	0.602	0.501	0.368	0.291	0.468
Number of obs.		2335	1252	463	1729	202	1090
Rho <sup>2</sup>		0.562	0.357	0.326	0.367	0.577	0.647
Final Log Likelihood		-1378.820	-1091.050	-409.250	-1472.880	-116.170	-526.920
Travel time VOT		<b>3.63</b>	<b>1.26</b>	<b>0.95</b>	<b>2.47</b>	<b>3.88</b>	<b>2.33</b>
		(baht/min)					



## Captive

HH Vehicle	Car_captive	MC_captive	Bus_captive
Non vehicle	-	-	9.75%
Motorcycle only	-	17.43%	-
Car only	45.01%	-	-
Multi vehicle	23.59%	16.84%	-

Source: Main Mode Choice Survey





# Rail Route Assignment Model Development



## Rail Route Assignment

Calculate the route choice based on the mixed logit model:

$$P_i = \frac{\exp(V_i)}{\sum_{j=1}^n \exp(V_j)}$$

$$V_i = \sum_k (\theta_k \cdot X_{ik})$$



Where:

$P_i$  = Probability of selecting route  $i$

$V_i$  = Utility of selecting route  $i$

$n$  = Number of candidate routes

$\theta_k$  =  $k^{th}$  utility parameter

$X_{ik}$  =  $k^{th}$  utility variable of route  $i$

### Model Variables

Variables	Detail
Fare (Baht)	Total route fare from origin station to destination station
Boarding Time (Minute)	Total boarding time from origin station to destination station
Transfer Time, Horizontally (Minute)	Time spent on walking horizontally while transferring the train
Transfer Time, Vertically (Minute)	Time spent on moving vertically (elevator, escalator, etc.) while transferring the train
Waiting Time (Minute)	Total time waiting for train boarding, including the first ride. Assume as a half of headway.
Station Access	Log-sum of the utility of every mode calculated railway station access model
Congestion Index	Calculated from travel time and congestion rate, see below

### Congestion Index

$$CI_m = \sum_j \left( B_{mj} \cdot \left( \frac{CR_{mj}}{100} \right)^2 \right)$$

Where:

$CI_m$  = Congestion index of route  $m$

$B_{mj}$  = Boarding Time of link  $j$ , route  $m$

$CR_{mj}$  = Congestion rate of link  $j$ , route  $m$



Variables		All purpose			
		parameter	t-stat	SD	t-stat
Station Access (log-sum)		0.710	4.497	-	-
Waiting time (min)		-0.894	-6.057	0.639	7.343
In-vehicle time (min)		-0.621	-3.796	0.887	4.652
Horizontal transfer time (min)		-0.587	-3.121	0.400	3.365
Vertical transfer time (min)		-0.651	-6.213	0.439	7.048
Congestion		-1.508	-5.250	1.583	6.259
Fare (baht)		-0.191	-17.273	-	-
Number of obs.		12,456			
Rho <sup>2</sup>		0.3154			
AIC		3,466.81			
BIC		3,563.40			
Final Log Likelihood		-1,720.4			
VOT (baht/min)	In-vehicle	3.3			
	Horizontal Transfer	3.1			
	Vertical Transfer	3.4			
	Waiting	4.7			

## Mixed Logit model

\*Note: Random coefficient of time assume Normal distribution



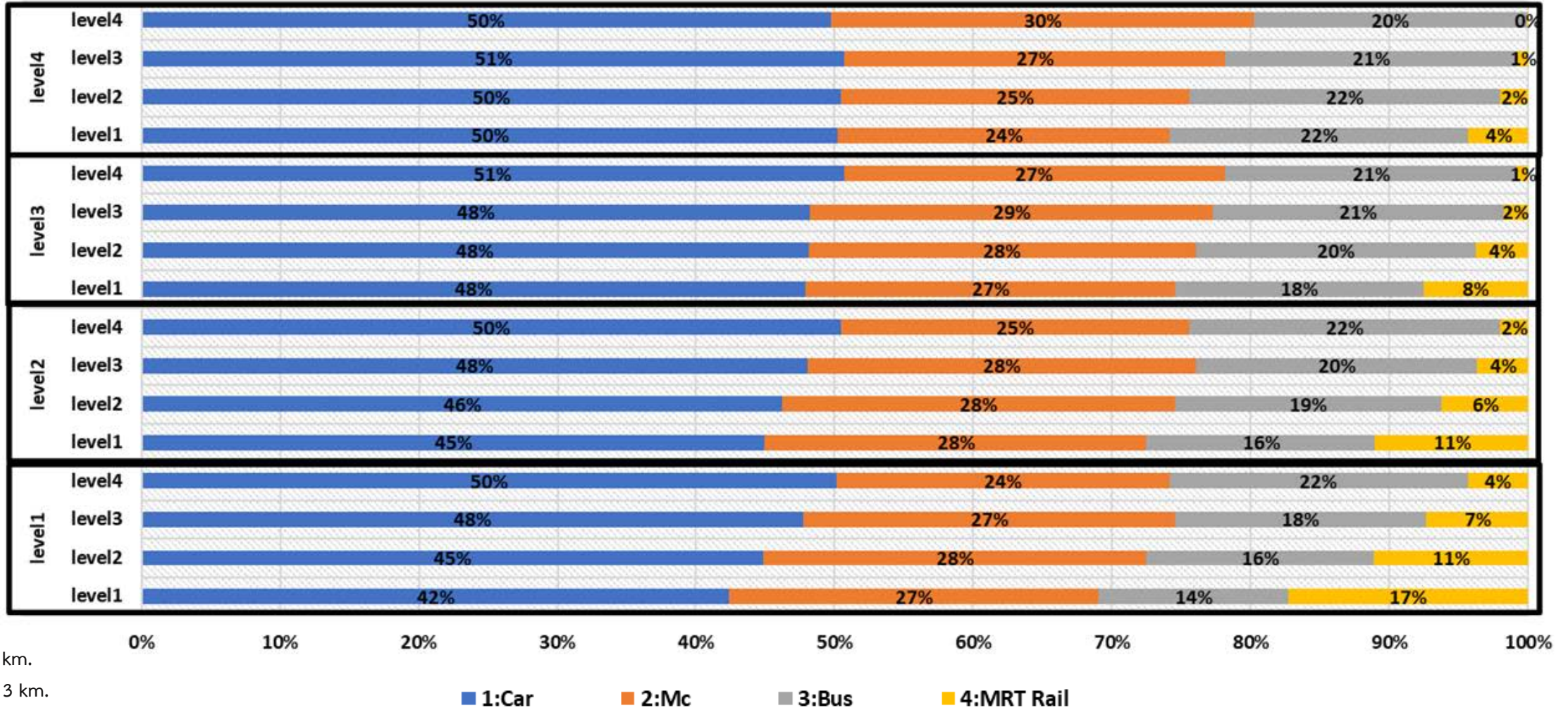
# Model Validation



Source	Mode Share			
	Car	Motorcycle	Bus	Rail
TDS survey	43.56%	29.53%	25.74%	1.18%
BTDS survey	52.61%	35.16%	9.73%	2.50%
Model (Base year)	49.84%	27.55%	19.94%	2.67%



### Mode share by access and egress level (Model\_Y19)



Level 1 : < 1 km.

Level 2 : 1 - 3 km.

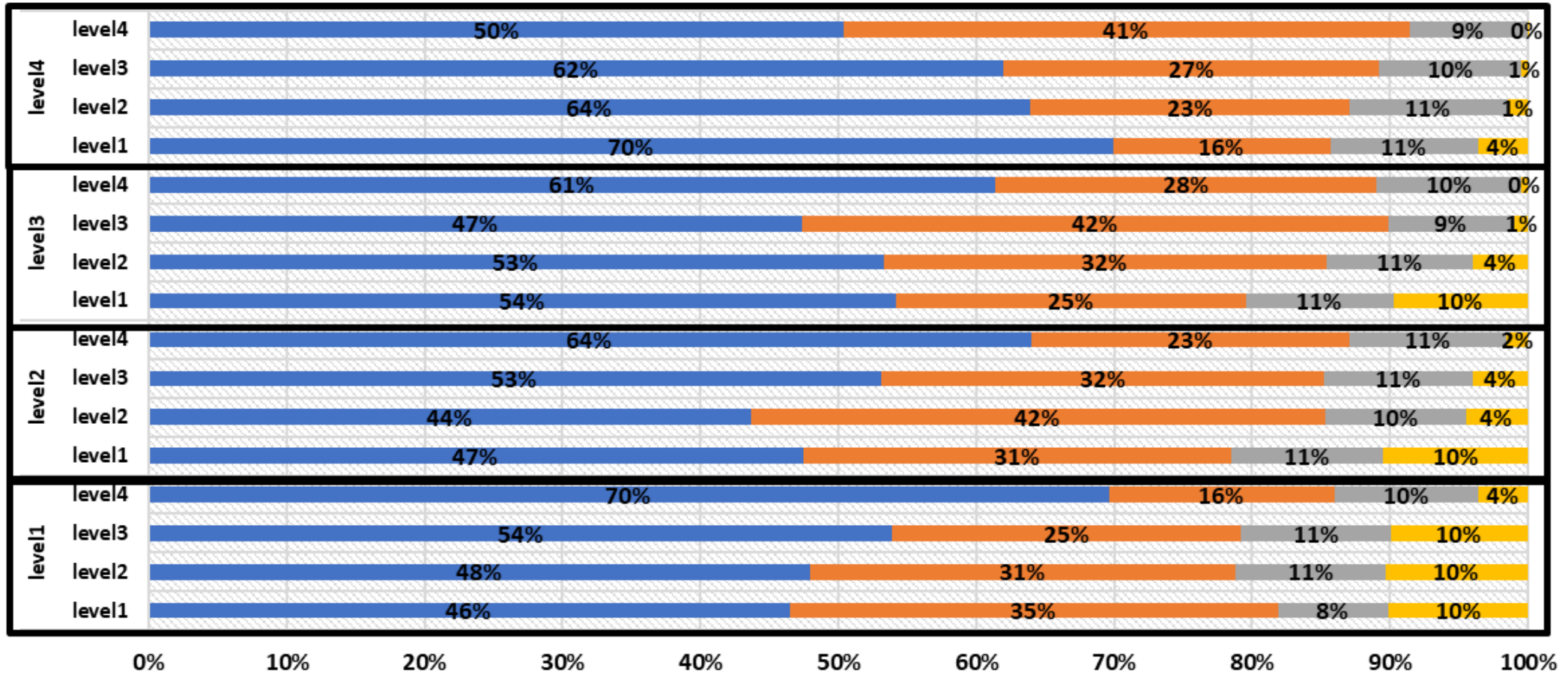
Level 3 : 3 - 7 km.

Level 4 : > 7 km.





### Mode share by access and egress level (BTDS Survey)



Level 1 : < 1 km.  
 Level 2 : 1 - 3 km.  
 Level 3 : 3 - 7 km.  
 Level 4 : > 7 km.

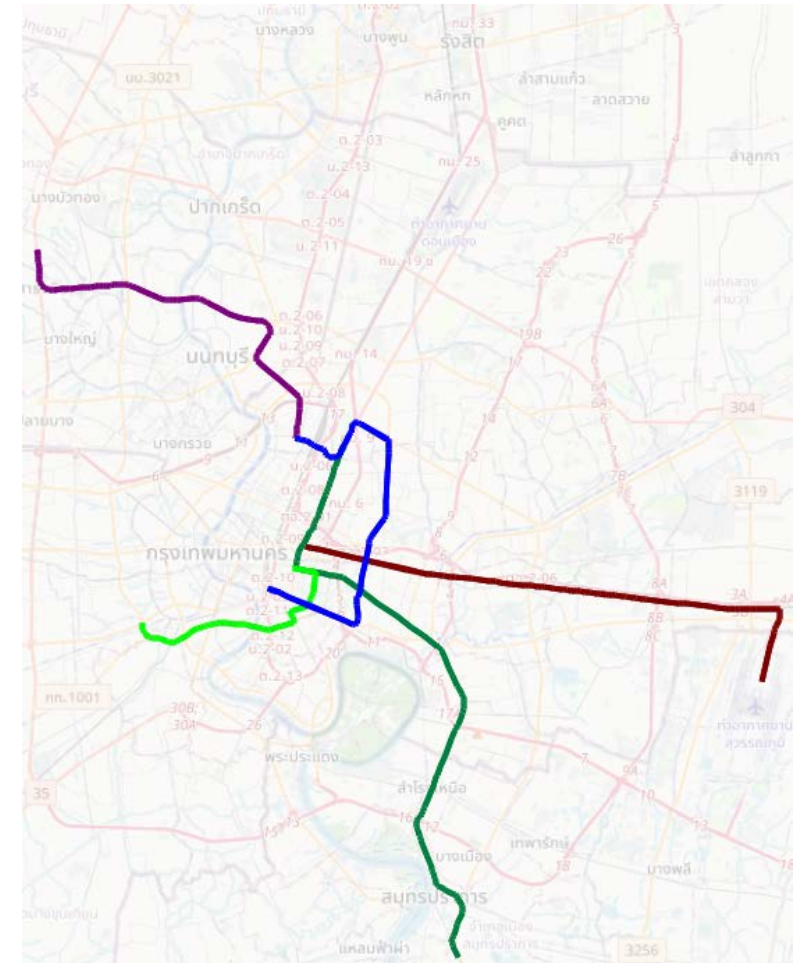
■ 1:Car    ■ 2:Mc    ■ 3:Bus    ■ 4:MRT Rail



### Boarding Passenger

Line	Base Year 2019 (million trip-person/day)		
	Model	Observe	%diff
ARL	0.067	0.079	-15%
Purple	0.075	0.072	4%
Green Sukhumvit	0.509	0.743	-8%
Green Silom	0.174		
Blue	0.313	0.322	-3%

หมายเหตุ : ข้อมูลผู้โดยสารในแบบจำลองยังไม่รวม Hub Access Model



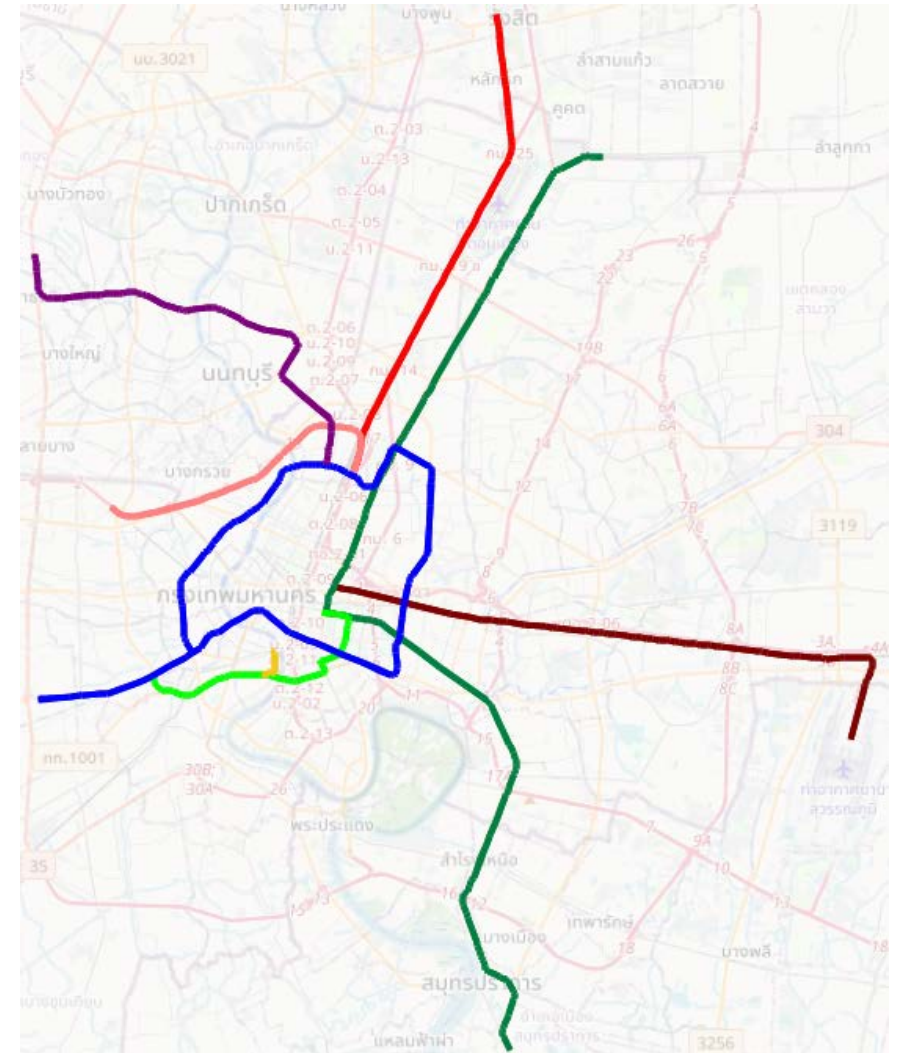




Boarding Passenger

Line	Year 2023 (million trip-person/day)
ARL	0.062
Purple	0.074
Green Sukhumvit	0.622
Green Silom	0.159
Blue	0.437
Red NS	0.019
Red EW	0.006
Gold	0.006

หมายเหตุ : ข้อมูลผู้โดยสารในแบบจำลองยังไม่รวม Hub Access Model

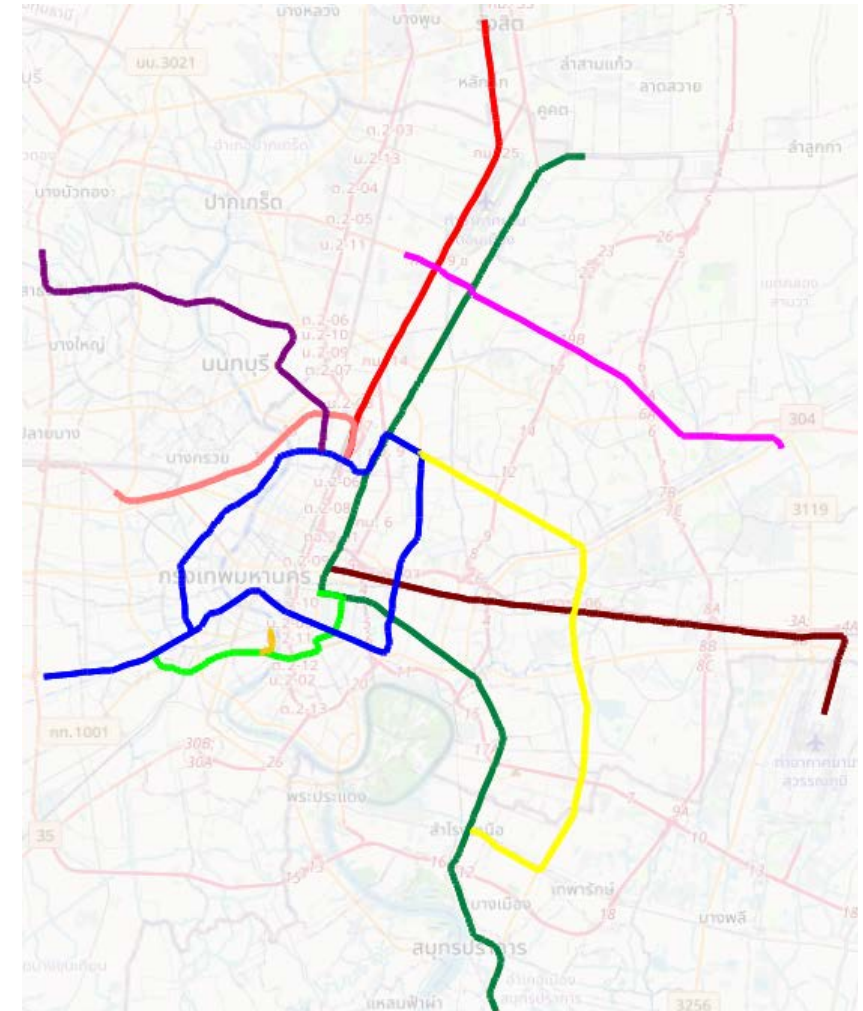




Boarding Passenger

- **Pink line** from PK12 : Government Complex to PK30 : Min Buri (Exclude PK13 : TOT and PK26 : Nopparat)
- **Yellow line** from YL01 : Lat Phrao to YL23 : Samrong

Line	Year 2023 (million trip-person/day)
ARL	0.073
Purple	0.075
Green Sukhumvit	0.674
Green Silom	0.161
Blue	0.467
Red NS	0.026
Red EW	0.007
Gold	0.006
Pink	0.057
Yellow	0.143



หมายเหตุ : ข้อมูลผู้โดยสารในแบบจำลองยังไม่รวม Hub Access Model