

An Enhanced Transit Accessibility Evaluation Framework by Integrating Public Transport Accessibility Levels (PTAL) and Transit Gap

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BACKGROUND

- As city populations grow, it's crucial to assess if public transit systems can handle the increasing transit demand and **find a balance between public transportation needs and availability**.
- An **accessible and reliable public transit system can enhance the sustainability and livability of urban areas** by promoting mode shift from private vehicle to public transport, simplify commutes for employment, education and healthcare, and prevent social isolation of elderly population.

RESEARCH GAP

- Addressing the limitations of the existing method for **analyzing transit gaps**, which fails to differentiate whether a high transit gap arises due to **genuine shortages in transit supplies or because of the excessive demand** that overwhelms adequate supply levels.

FINDINGS

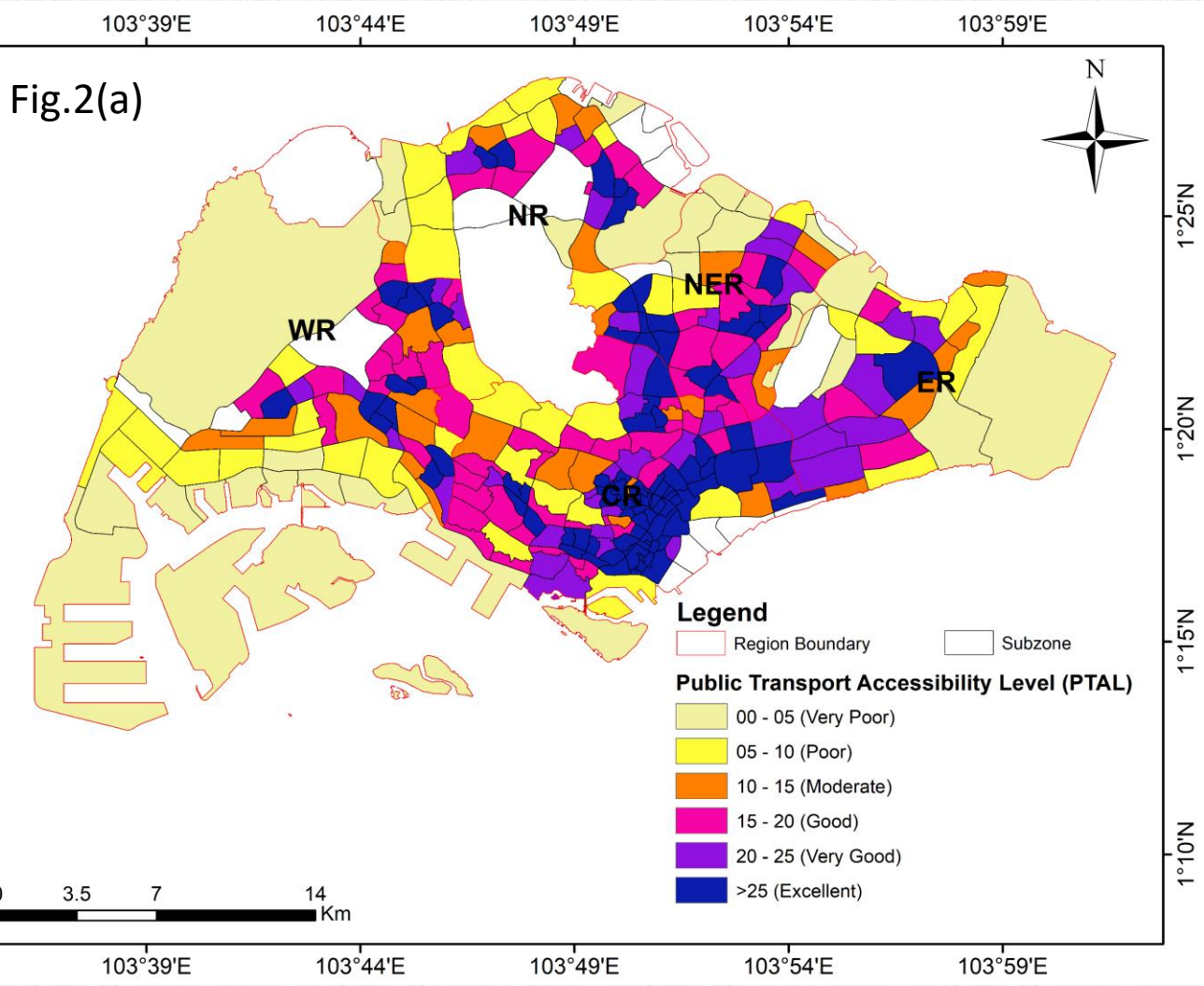


Fig. 2(a): PTAL for Singapore
Fig. 2(b): Percentage of population living in diff. PTAL
Fig. 2(c): Number of subzones lying in different PTAL

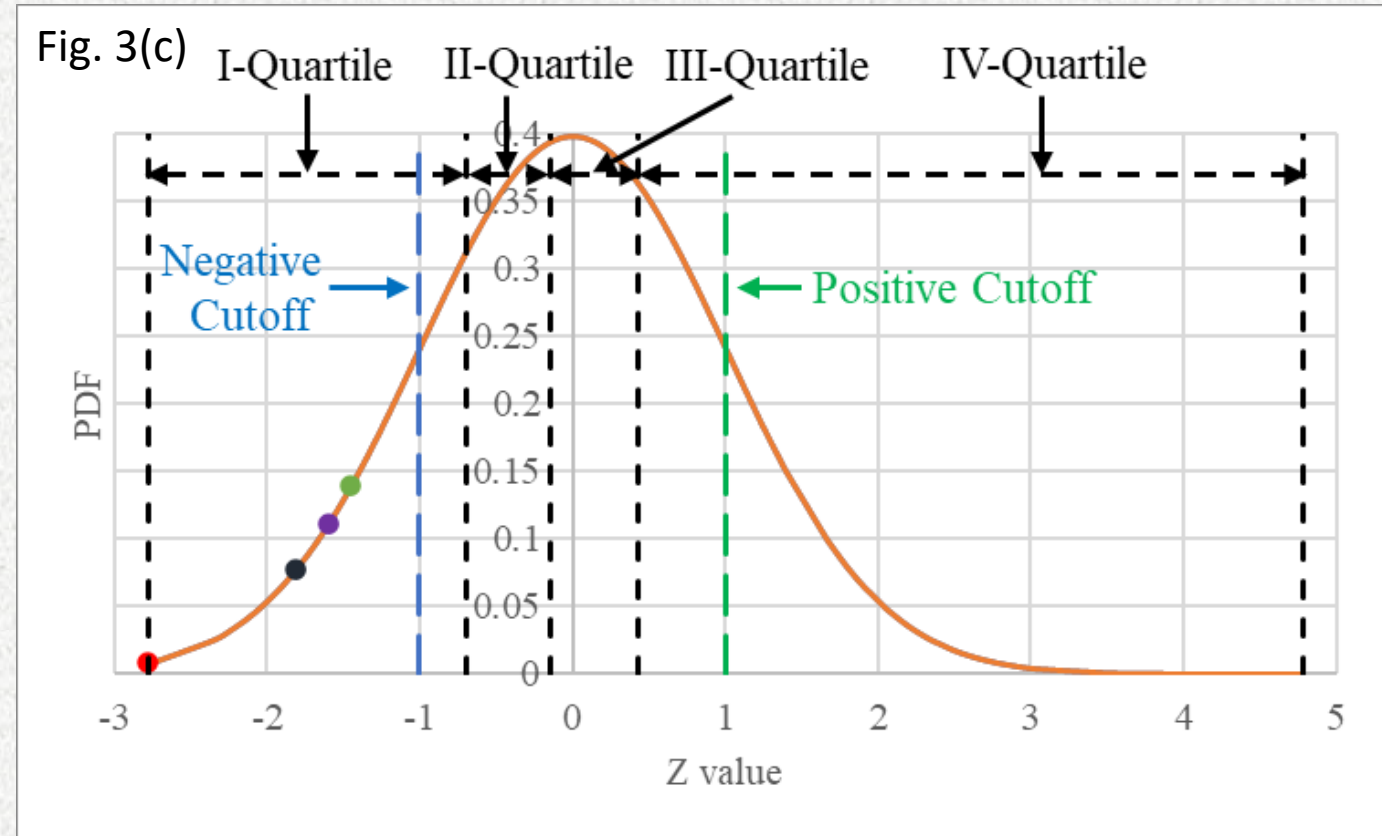
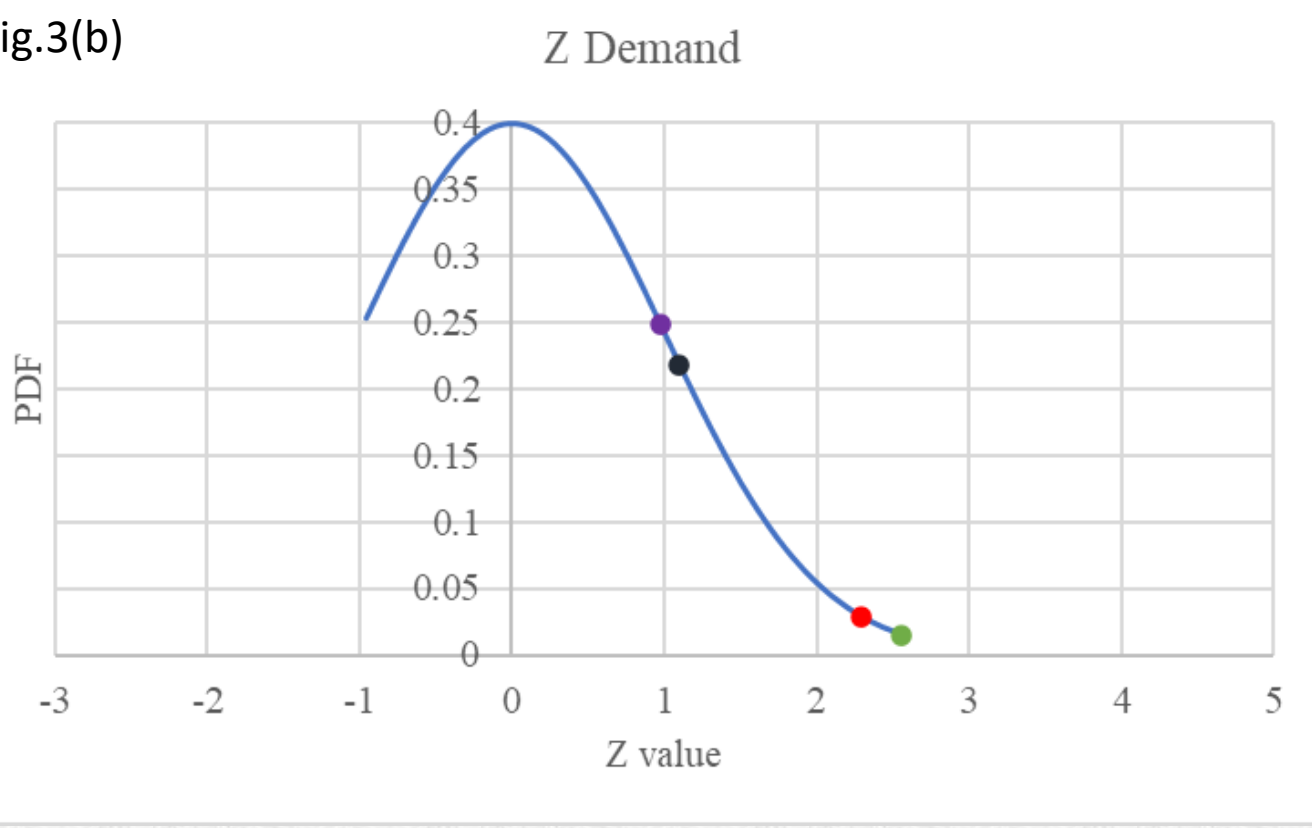
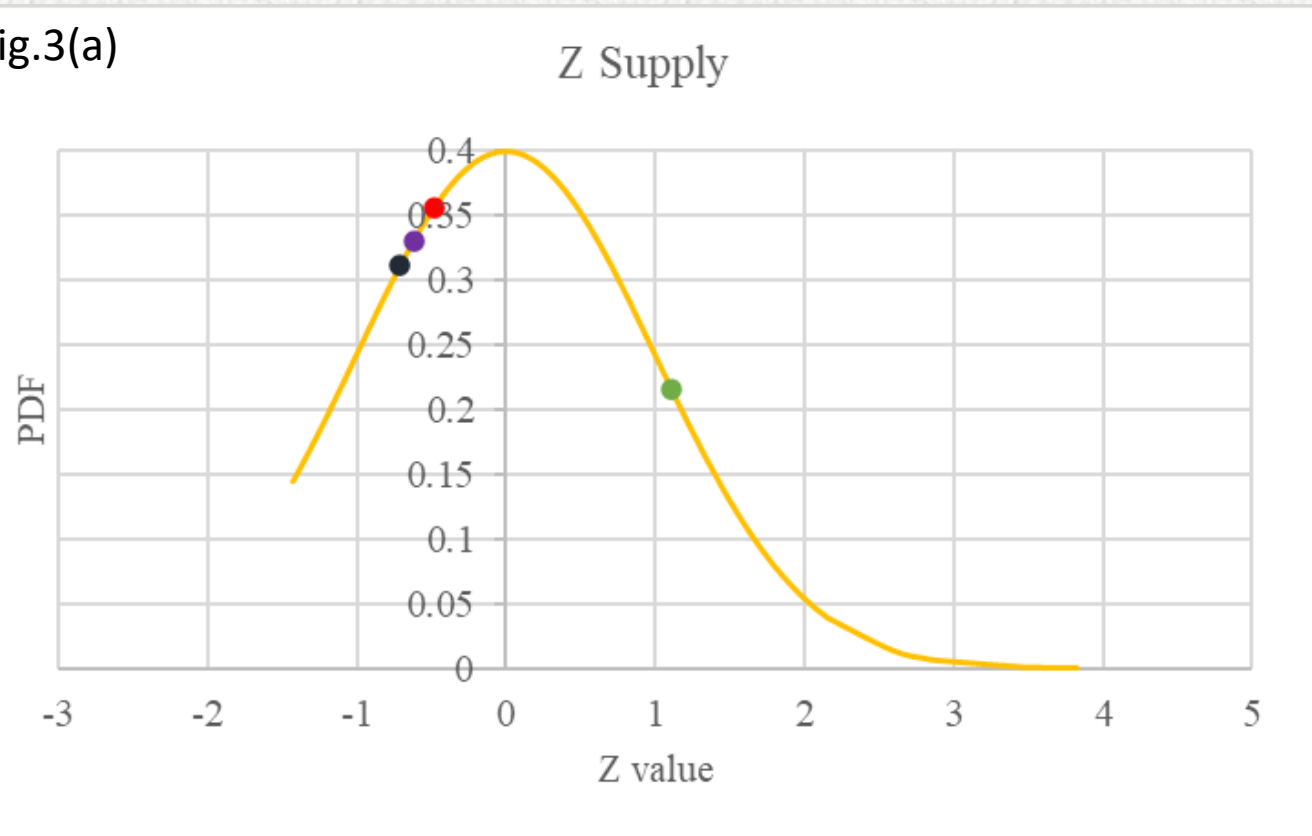
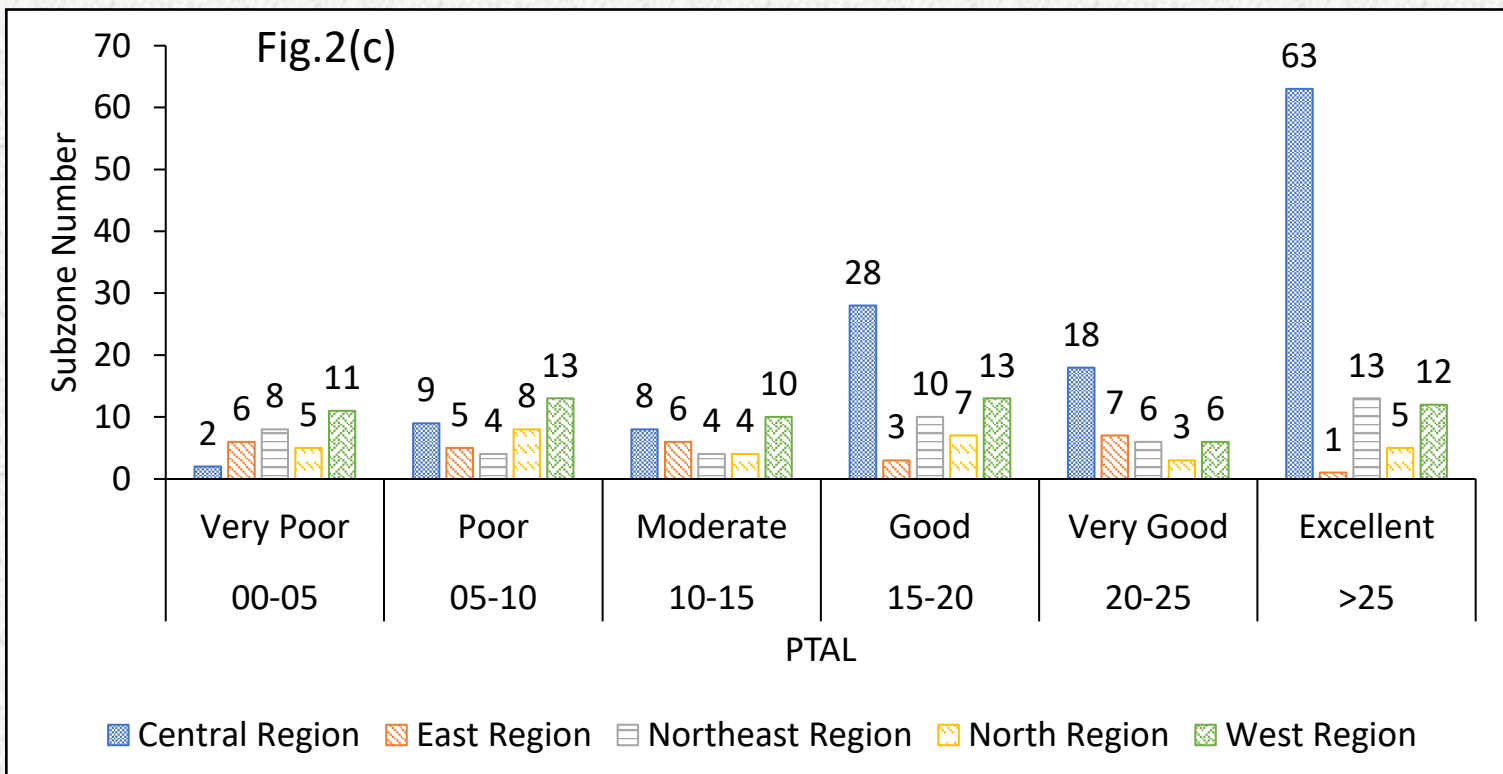
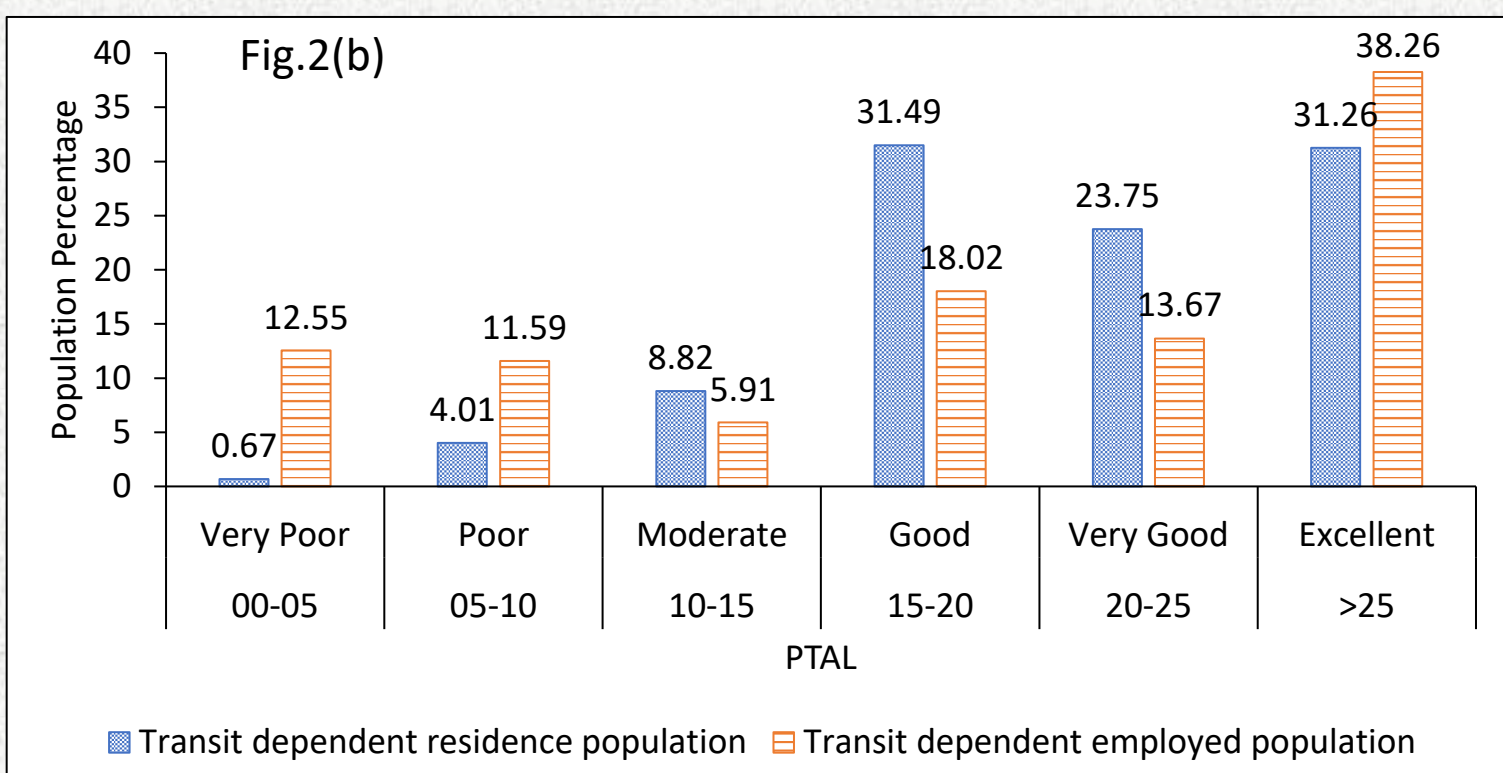


Fig. 3: Z Score curves for (a) transit supply (b) transit demand and (c) transit gap

Table 1: Transit gap, PTAL and color code (correspond to Fig. 3)				
Demand	Supply	Gap	PTAL Level	Color
2.56	1.11	-1.45	Excellent	Green
2.29	-0.48	-2.77	Good	Yellow
0.98	-0.62	-1.60	Moderate	Orange
1.10	-0.71	-1.81	Poor	Red

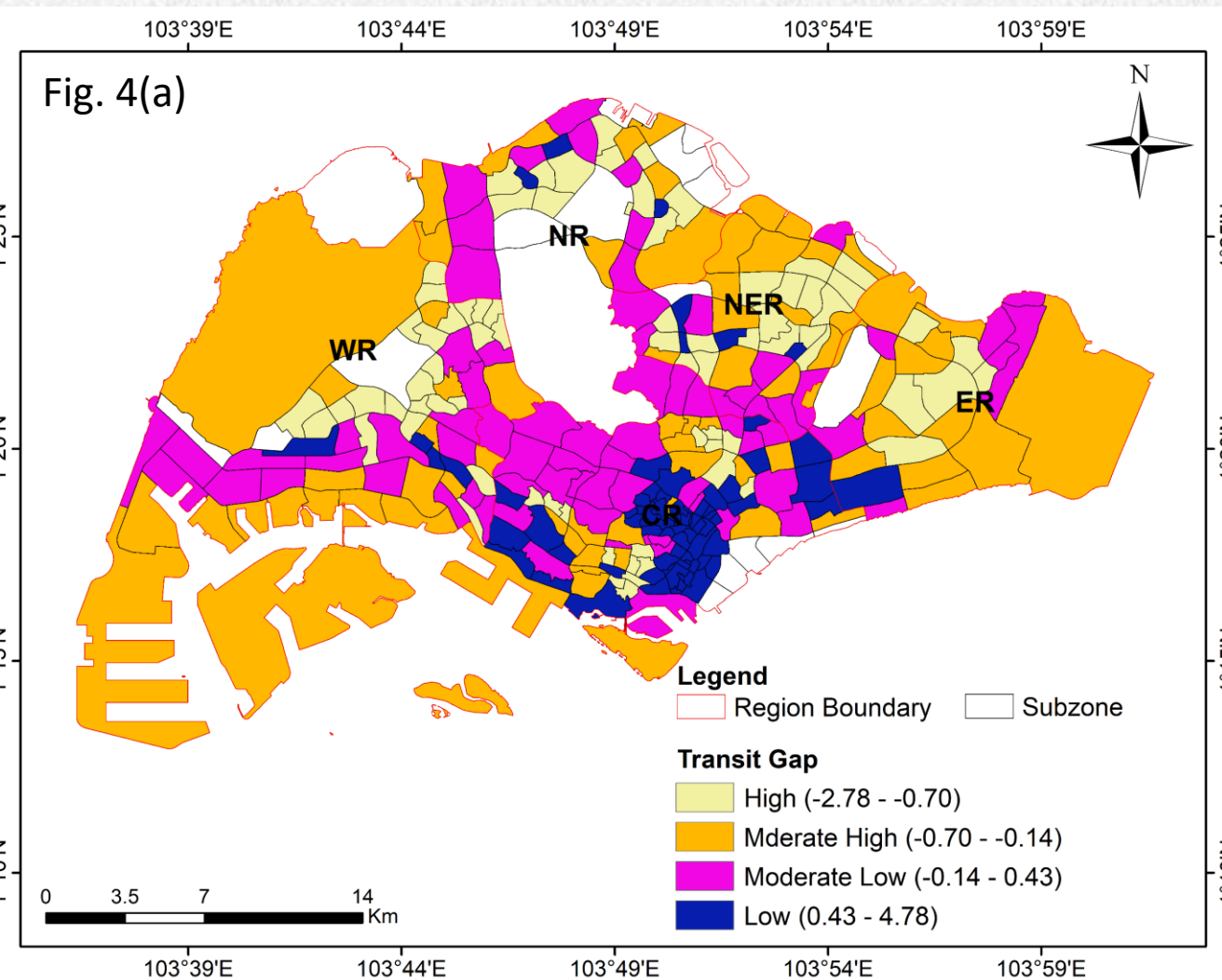


Fig. 4: Spatial distribution of transit gap (a) transit dependent residence population (b) transit dependent employed population (Work location)

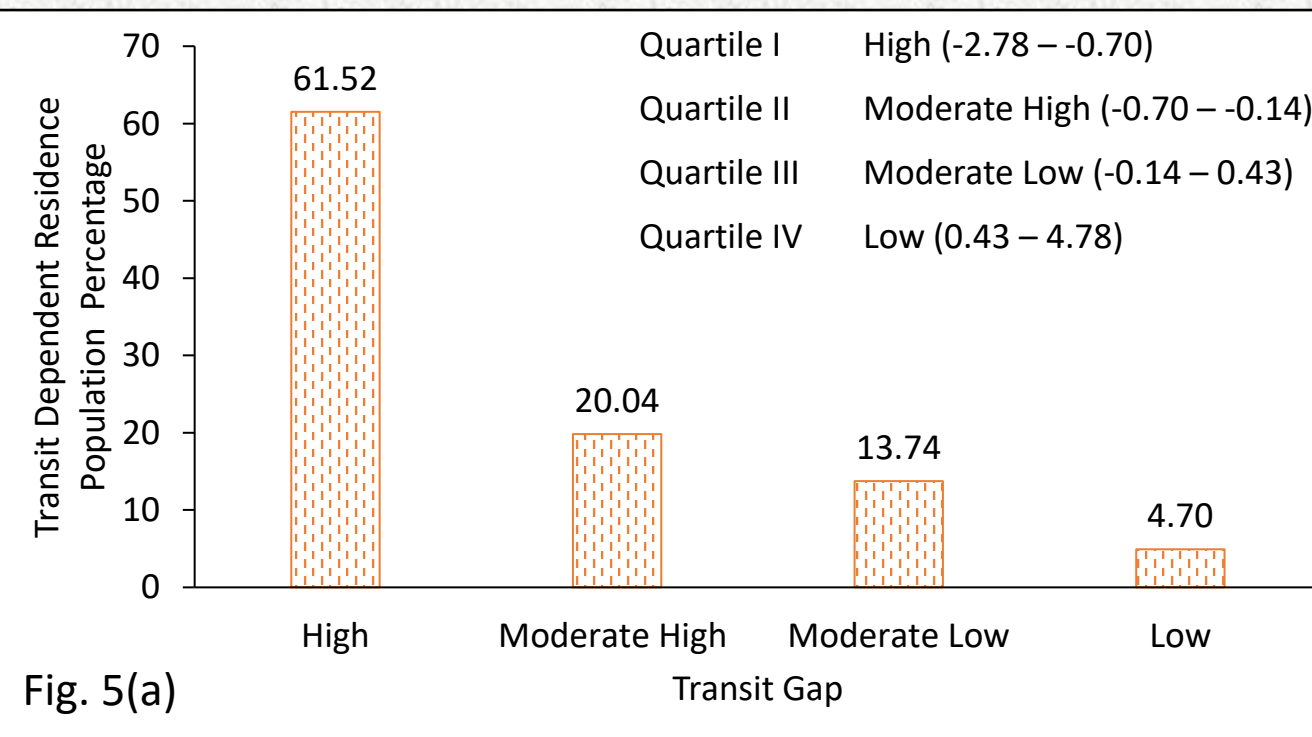
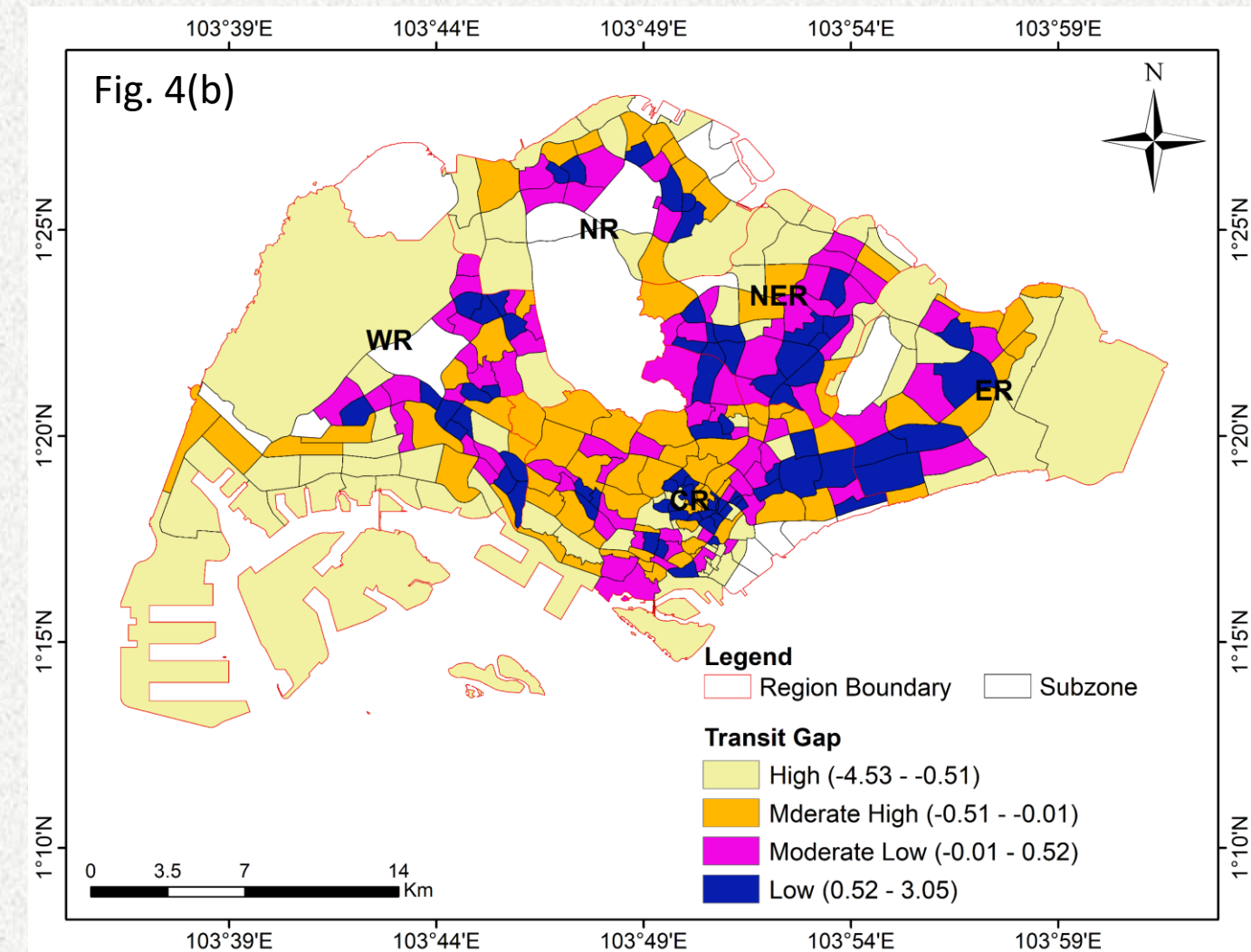
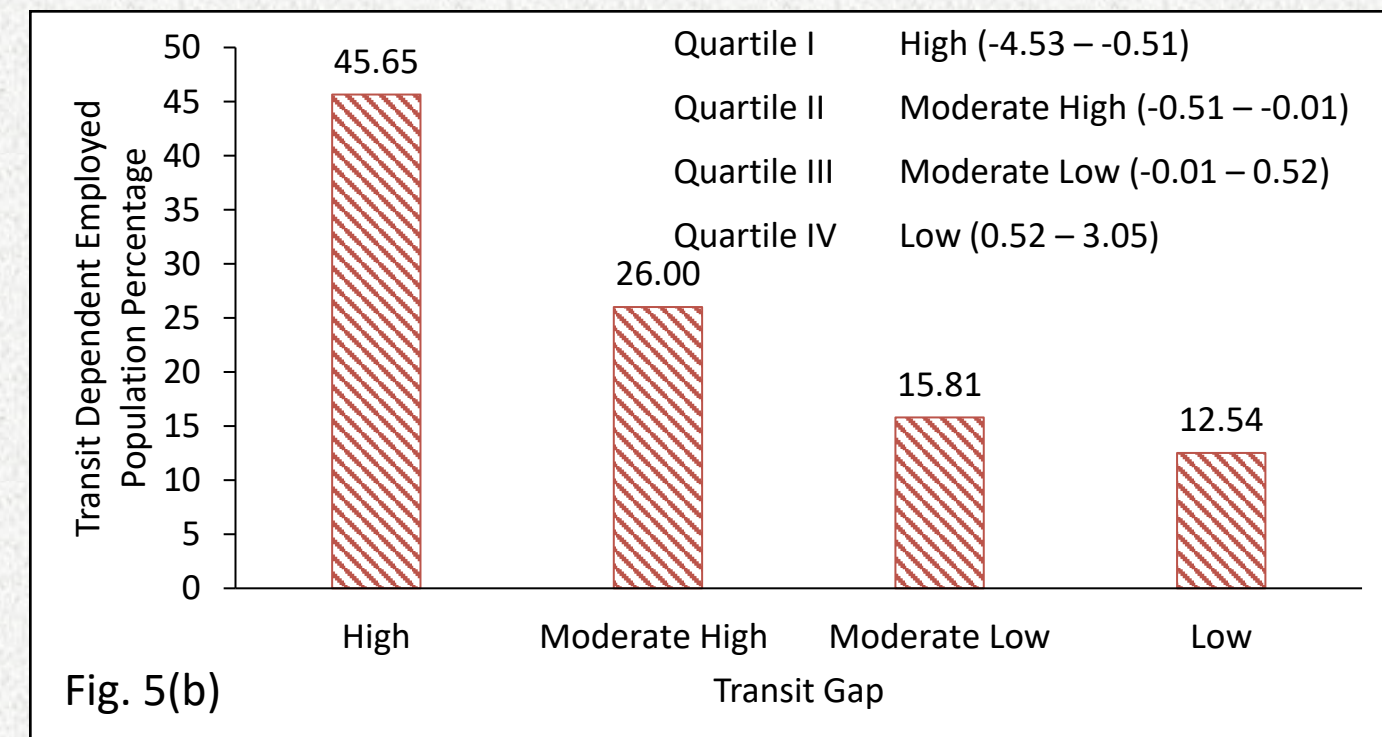


Fig. 5: Transit dependent (a) residence population (b) employed population in different transit gap levels



AIM

- To develop a **comprehensive framework for understanding the transit gap**, incorporating the Public Transport Accessibility Level (PTAL) as a measure of transit supply.
- To investigate **spatial disparities in accessibility to public transit** across Singapore and identify potential policy measure for improvement.

METHOD

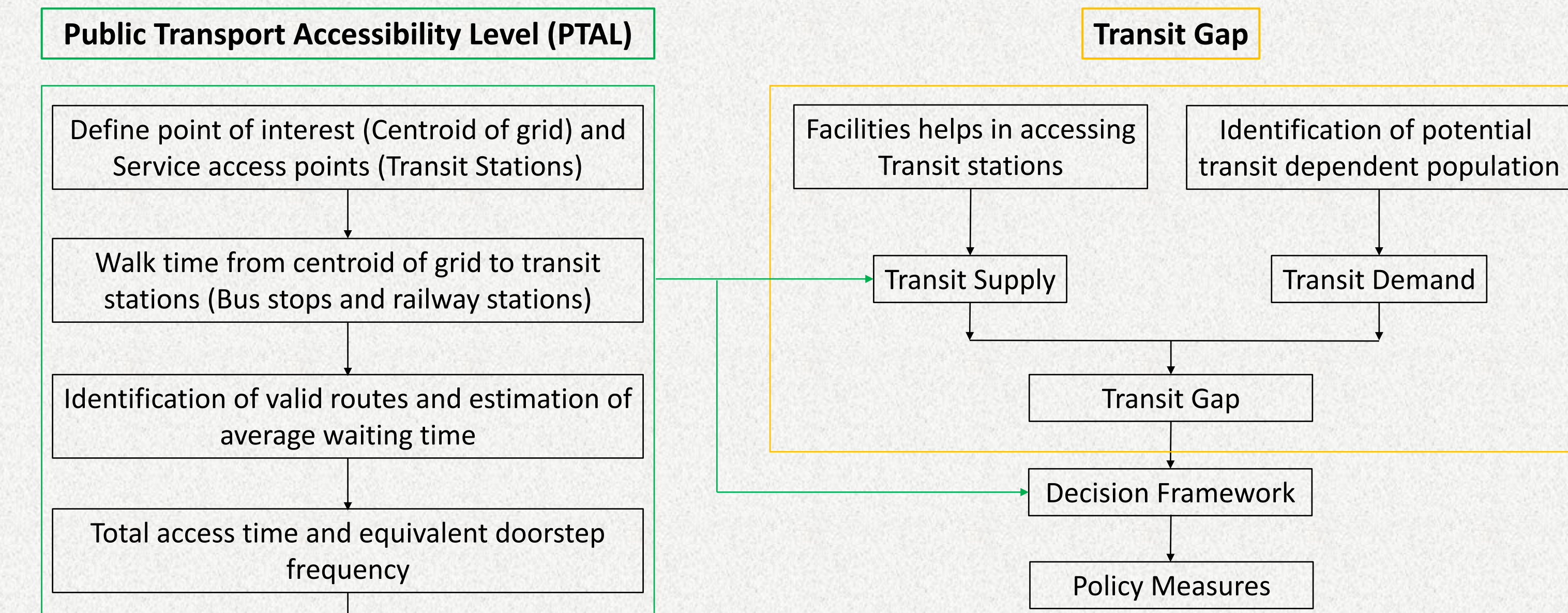


Fig. 1: Overview of Methodology

- PTAL is highly detailed **origin distance-based** measure, suitable for **urban areas** and used to identify areas with **high and low public transit accessibility**.
- Transit gap examine the **disparity** between the transit service level (**transit supply**) and the population transit demand.

Transit Demand (Potential Transit Dependent Population s_z)
 $= Pop\ five\ years\ and\ above_{s_z} - No.\ of\ cars_{s_z} * average\ passenger\ occupancy\ per\ car - No.\ of\ two\ wheelers_{s_z}$

$$Z\ score_{supply} = \alpha Z_{PTAL} + \beta Z_{Cycle\ racks\ density} + \gamma Z_{footpath\ density}$$
$$Z\ score = \frac{Observed\ Value - Mean}{Standard\ Deviation}$$
$$Transit\ Gap_{s_z}\ Z\ score = Z\ score_{supply} - Z\ score_{Demand}$$

Where, α (0.693-0.984), β (0.003-0.138) and γ (0.002-0.275) represents the fraction of people using public transit, cycle and walk as their mode for work trips in the subzone.

DISCUSSION

- High transit gap in many areas are driven by the excess demand (transit over utilized) by transit dependent populations, not just limited transit supply (transit desert).**

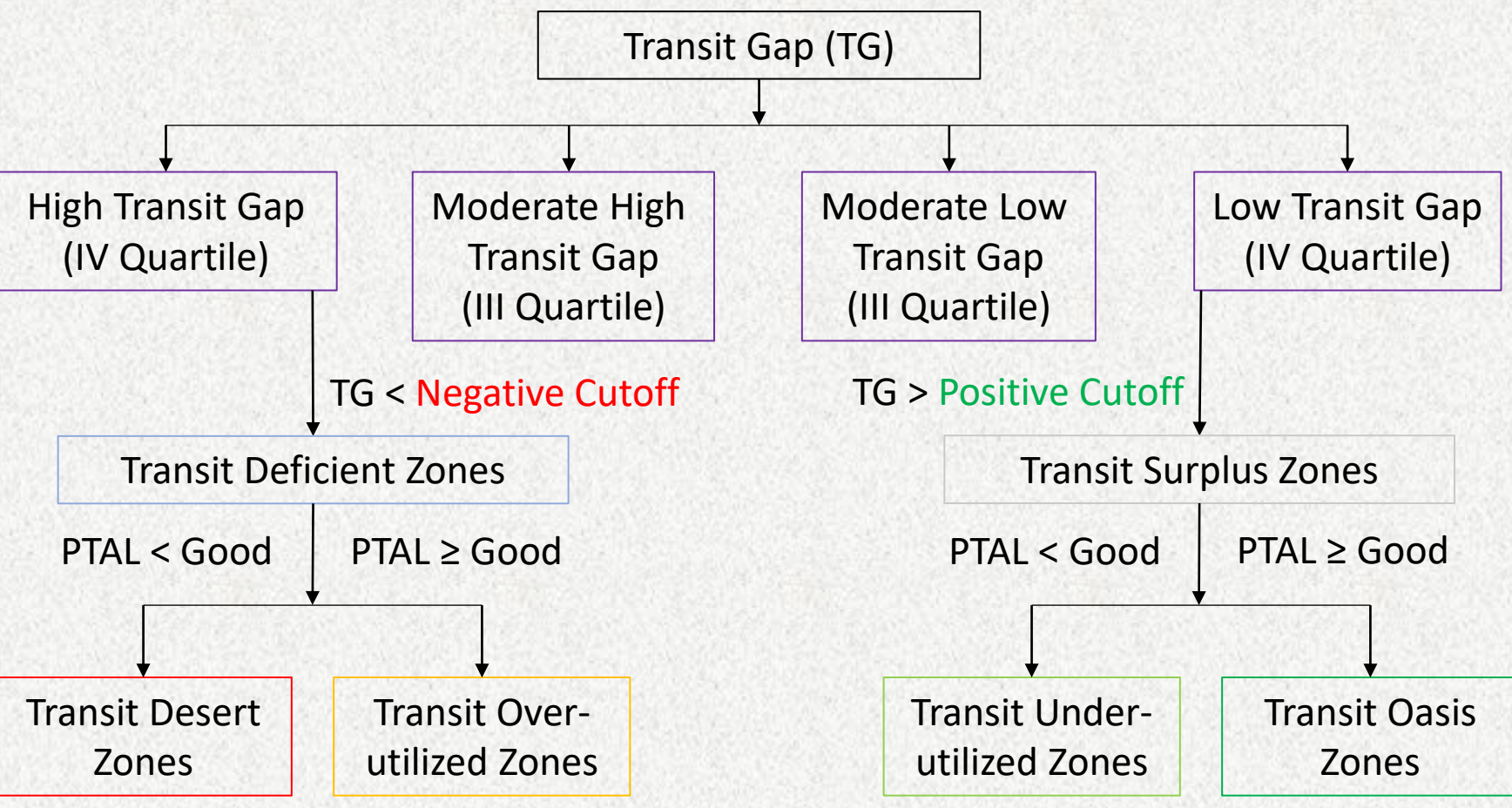


Fig. 6: Proposed framework for classifying transit desert and transit oasis

Transit Gap	PTAL	Transit Underutilized Zones			Transit Oasis Zones		
		Very Poor	Poor	Moderate	Good	Very Good	Excellent
IV Quartile	Low (more than positive cutoff value)	00 (0.00)	00 (0.00)	00 (0.00)	00 (0.00)	01 (0.00)	42 (0.98)
III Quartile	Low	Low Accessibility - Low Gap (LA-LG)			High Accessibility - Low Gap (HA-LG)		
	Moderate Low	00 (0.00)	01 (0.00)	01 (0.00)	11 (0.42)	09 (1.60)	08 (1.70)
II Quartile	Moderate High	32 (0.67)	12 (2.80)	04 (1.46)	16 (4.69)	06 (2.68)	07 (3.41)
I Quartile	High	Low Accessibility - High Gap (LA-HG)			High Accessibility - High Gap (HA-HG)		
	High (less than negative cutoff value)	00 (0.00)	00 (0.00)	02 (0.92)	09 (1.73)	10 (4.33)	12 (9.72)
		Transit Desert Zones			Transit Overutilized Zones		
		00 (0.00)	01 (0.48)	05 (4.21)	20 (18.96)	12 (10.82)	14 (10.35)

Fig. 7: Cross-classification between PTAL and transit gap (no. of subzones with transit dependent population % in brackets)

City	Population (millions)	Area (Sq. km.)	Area in TG < -1.0 (%)	Population in TG < -1.0 (%)
Grand Paris	7.02	814.86	40.6	48.1
Greater London	8.91	2049.17	58.8	54.5
Madrid	3.18	601.86	48.3	45.1
Milan	1.30	181.77	33.0	61.9
Singapore	4.04	701.48	07.3	44.8

Table 2: Comparison of transit gap results with other European cities

CONCLUSION

- Transit supply in **Singapore** is generally good, high transit demand from concentrated transit dependent population **strains the existing system in few areas**.
- Subzone may appear as **transit oasis** when examine by **residential data**, the same zone may act as **transit desert** using **employment data**, shows **temporal variation**.
- The **PTAL map combined with transit gap**, can be a valuable tool for city planners and policymakers to **identify critical areas at a micro level**.

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