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Analysis and mitigation of spatial and social inequality in the distribution of low-floor trams in Melbourne

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Abstract: Melbourne has the longest and most comprehensive tram network in the world, but its accessibility remains uneven, particularly for vulnerable groups who rely on low-floor trams. Despite numerous commitments made through policies or regulations, only 38% trams in the fleet and 27% tram stops are currently accessible. Thus, this paper critically examines spatial and social inequities embedded in the distribution of low floor trams across Melbourne tram network. Findings reveal the prioritization of high patronage routes over areas with more social need, limited funding commitments, and fragmented infrastructure upgrades, collectively causing social exclusion for vulnerable groups. This study argues that efficiency-driven strategies have entrenched social inequity, focusing on the need for social justice, participatory, and redistributive strategies to make public transport more inclusive.

Keywords: inclusive city; social equality; transport planning; urban planning; network planning

1 Introduction

Melbourne is one of the major cities in the world with well-developed public transport (PT) systems. Among all types of transport modes, tram system owns the longest distance in the world with 250 kilometers of double tram track [1]. In addition, trams are the most popular and convenient PT mode for people to move around in cities or between inner suburbs, with more than 200 million passenger trips taken each year [2]. Currently, there are 9 classes of trams in the entire tram fleet (Figure 1), with only C, D, E classes being low-floor accessible trams (LFTs). This issue paper aims to analyze the spatial and social inequality of LFTs' distribution in Melbourne, where vulnerable groups are not easy or available to board on LFTs.

2 Key terminologies

2.1 Inclusive city

The terminology "inclusive city" is conceptualized as urban environment which ensures people have equal access to resources, opportunities and participation, regardless of their socioeconomic status, gender, race, or physical abilities [3]. This urban environment extends beyond removal of spatial barriers to create a sense of belonging, representation, and dignity in residents' life [4]. Therefore, urban inclusivity extends beyond physical accessibility to includes social justice, diversity, and recognition in planning circumstances.

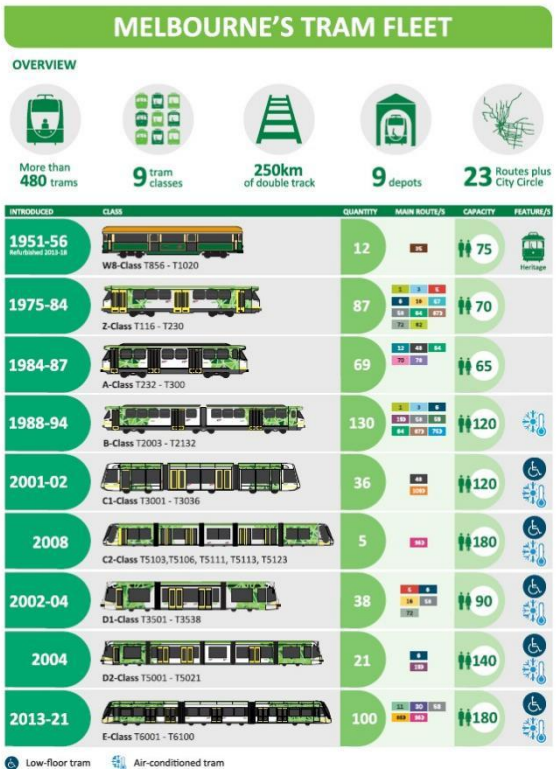

Figure 1. Yarra Trams Fleet (Source: Yarra Trams, 2024)

2.2 Social equality

"Social equality" can be broadly defined as equitable distribution of resources and opportunities in society to ensure that people are able to participate in social, economic, and environmental aspects. The word "social equality" contains both redistributions of addressing material inequality and recognition of diverse identities [5]. In the contexts of urban governance policies, social equality aims to eliminate structural disadvantages and promote social fair in governance and service provision [6]. Thus, social equality is recognized as a normative framework guiding towards equitable and inclusive urban environment.

3 Issue statement

This issue paper analyses the inequality of LFTs' spatial distribution in Melbourne. Figure 2 illustrates the current tram network intervals without LFTs services. It pointed out an obvious spatial inequality between north-east suburb routes and other places, where the south-east suburbs along Routes 3, 64 and 67 (operated by Glen Huntly Tram Depot) and north-west suburbs along Routes 57, 59 and 82 (operated by Essendon Tram Depot) have the lowest LFTs coverage rate. In contrast, north-east suburbs along Routes 11, 86 and 96 operated by New Preston Tram Depot, have the fully access to LFTs. Groups using trolley, baby carriage, wheelchair and those who need LFTs services are experiencing large social inequality of transport mode choice [7]. The following paragraphs will explain possible reasons for this imbalance.

Figure 2. Intervals without LFTs (in red)

(Source: Base map by Yarra Trams, 2025; Drawn by Author, 2025)

3.1 Imbalance on accessibility upgrade priorities

One of the key factors for LFTs' spatial inequality is the prioritization accessibility upgrade projects on high-patronage routes. The policy decisions favours to upgrade routes with larger passenger volumes to maximize route efficiency and network capacity, but lacks addressing the need for vulnerable groups who needs to use LFTs. As a result, tram routes serving along hospitals, rehabilitation centers, and high concentrations of local residents with disabilities received lower priority compared to higher passenger flow tram routes [8]. This upgrade strategy reflects utilitarian planning logic, but underestimated equality objectives. In addition, although this strategy allocated LFTs resources to majority passengers, people who most rely on LFTs services are ignored or not put into first considerations [9].

3.2 Lack of funding

The absence of funding on LFTs strategy is considered as another reason for the inequality of LFTs network. Although Federal government proposed "Disability Standards for Accessible Public Transport 2002", which has a clear requirement of 100% compliance by 2022 on disability accessible PT infrastructure upgrade and 2032 for whole PT fleet, Victorian Government did not allocate adequate funding and establish a comprehensive framework to reach these requirements. In fact, the upgrade process was scattered and slow progressed, which caused slow upgrade progress and fragmented outcomes [9]. The lack of fundings and policy gaps entrenched the imbalance of social justice, which led to vulnerable groups still facing barriers to get the access to tram network.

3.3 Uneven distribution of accessible stations and LFTs

The uneven distribution of LFTs and accessible stations is one of the most significant reasons for the spatial inequality in Melbourne LFTs network. Although policies have specific requirement for LFTs mentioned before, only 38% of trams are currently LFTs and only 27% stations are wheelchair access platforms [9], resulting in merely 16% of services being considered as fully accessible by combining accessible stations and LFTs by calculation. This measurement represents that although LFTs are available for vulnerable groups, these groups may still face problems when travelling from and to stations, which makes trips inconsistent. Dramatically, the distribution of stops satisfied for both LFTs and wheelchair accessible stops is not widely spread across the network, where tram stops in Melbourne CBD and high passenger flow routes are most intensified to satisfy this circumstance. However, majority suburb stops are remaining underserved [7]. This uneven supply reflects the mismatch between network efficiency goals and social justice goals, and ultimately will leave vulnerable groups disproportionately excluded from using PT as their mode of choice.

3.4 Slow progress of infrastructure upgrade

According to the data from "Victorian Auditor-General's Office Report" in 2021, 27% tram stops are wheelchair access stops in Melbourne. In addition, there are only approximately 21 tram stops upgrade annually for wheelchair access upgrade. To achieve the goal of fully compliance of wheelchair access upgrade is quite a long-term process to finish, which is further beyond the guidance requirements of "Disability Standards for Accessible Public Transport 2002". The slow upgrade efficiency also caused wheelchair accessible and inaccessible stops appearing along single route such as Route 5, 58, 82, 109 etc. This phenomenon also creates barriers for passengers with mobility needs even travelling on single route. Therefore, the slow progress of infrastructure upgrade not only delayed compliance goal, but also entrenches spatial inequality of vulnerable groups to get access for trams.

3.5 Impact on vulnerable groups

Based on previous analysis, there are several potential reasons for the spatial imbalance of LFTs. Furthermore, Lope and Dolgun's (2019) report offered a detailed statistical analysis as evidence of the unequal distribution of LFTs services in Melbourne [7]. Researchers used Gini coefficient which is a coefficient applied to measure income inequality. They examined distribution of LFTs and wheelchair access stops across tram network and revealed a Gini value of 0.66 for people with disabilities and 0.48 for general public, which demonstrated that accessibility for LFTs services are further uneven distributed for disabled people who rely on trams as their mode of choice. To be more specific, their findings illustrated that 70% of people with disabilities only have access to 22% tram services, while the access for general public is comparatively more balanced. The disparity of access highlights the imbalance of LFTs spatial distribution and wheelchair access platforms will systematically cause inconvenience for passengers with disabilities. Moreover, they argued that accessibility should be evaluated not only through aggregate progress, but also by examining distribution outcomes to reveal who are benefited and who are excluded. This study provided strong evidence to illustrate that current policies exacerbate the inequality by quantifying imbalance phenomenon. Therefore, it is essential to integrate social equality and justice into network planning to ensure that accessibility improvement projects genuinely meet the need of PT users, particularly those most in need of inclusive design.

4 Future actions

Addressing social inequality of LFTs requires a coordinated and integrated strategy. In the future, the priority upgrading zones can be the stops along routes serving hospitals, aged-care facilities rather than focusing on high patronage routes. The LFTs can be allocated to different depot equally to avoid the lack of LFTs in certain regions. In addition, it is better for LFTs operating on fixed schedules to eliminate situations where people wait LFTs at stations based on "their

luck". Furthermore, increased investment is important to accelerate new LFTs manufacturing and wheelchair access tram stops upgrade. The investment should be supported by fully funded government plan with clear timelines and accountability measures to ensure that projects are proceeding in order. Moreover, integrating PT accessibility targets into broader master plan and transport policies can ensure consistency in accessibility improvement projects. The most important thing is to engage with vulnerable group and allow them to participate in decision-making process to ensure that future LFTs services are able to directly respond to their needs.

5 Conclusion

The spatial inequality of LFTs distribution in Melbourne reflects the challenges at structural, financial, and governance levels. Several factors mentioned in this issue paper such as prioritizing LFTs on high passenger flow routes, the absence of fully funded PT accessibility upgrade plan, and slow progress on LFTs and wheelchair access platform upgrade projects collectively cause potential social exclusion of vulnerable groups. The statistical analysis demonstrates quantified imbalances are embedded within current circumstance. To address these imbalances, a transformation from efficiency based strategies into social equality strategies is required to ensure that future accessibility improvements prioritize vulnerable groups and reach broader goals of social justice in urban planning.

Conflicts of interest

The author declares no conflicts of interest regarding the publication of this paper.

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