

EXPLORING THE INTEGRATED PUBLIC PASSENGER TRANSPORT NETWORK PLANNING IN THE CITY OF TSHWANE MUNICIPALITY

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ABSTRACT

This paper presents the outcomes of an assessment of the City of Tshwane's Integrated Public Transport Network (IPTN) planning process, with a focus on improving urban mobility through better coordination of bus, rail, and minibus taxi services. The study identified seventeen key public transport corridors and analysed current service patterns, infrastructure limitations, and travel demand. Using a multi-criteria assessment, five alternative network configurations were evaluated, with the Restructured Network emerging as the most viable solution for enhancing sustainability, service coverage, and system integration.

International case studies from Indonesia, Brazil, Chile, and the United Kingdom were reviewed to contextualise Tshwane's challenges and inform best practices. The findings highlight the importance of aligning IPTN strategies with broader metropolitan planning frameworks and ensuring annual updates in line with the Comprehensive Integrated Transport Plan (CITP) review cycle. The paper concludes with recommendations for advancing modal integration, improving institutional coordination, and leveraging smart technologies to build a more inclusive and efficient public transport system in Tshwane.

Keywords: Integrated Public Transport Network (IPTN); urban mobility; public transport corridors; Bus Rapid Transit (BRT); minibus taxi integration; rail systems; traffic congestion; sustainable transport; Tshwane Municipality.

1. INTRODUCTION

Tshwane, a rapidly growing South African city, continues to grapple with transportation challenges rooted in apartheid-era spatial segregation, inadequate urban design, and persistent socio-economic inequality (Gumbo et al., 2022; Mphahlele, 2023). These issues have contributed to sustained traffic congestion, fragmented public transit services, and uneven access to mobility between the affluent southern suburbs and the underserved northern regions. Although public transport accounts for nearly half of all passenger trips, the city's residents, particularly workers, often endure long, inefficient commutes (Mashamaite, 2023; Mokoma & Venter, 2023).

The rise in private vehicle ownership has exacerbated congestion under Tshwane's car-oriented development model. In response, scholars and practitioners have called for more integrated and adaptive mobility systems that include expanded bus corridors, equitable

fare structures, and enhanced non-motorised transport infrastructure to support modal shift (Gumbo & Moyo, 2020; Mokoma & Venter, 2023). The Integrated Public Transport Network (IPTN), which combines Bus Rapid Transit (BRT), rail, and minibus taxi services into a unified system, represents a key strategy to improve mobility. However, persistent issues with modal interoperability and institutional coordination continue to undermine service efficiency and user experience (Gumbo et al., 2022; Risimati, 2020). This study evaluates the planning and implementation of Tshwane's IPTN by examining the interplay between BRT, rail, and minibus taxis. It further draws on international best practices from Indonesia, Brazil, Chile, and the United Kingdom to inform integrated transport planning for South African cities.

1.1 Aim and Purpose of the Paper

This study examined the planning and implementation of Tshwane's Integrated Public Transport Network (IPTN), with a focus on its contribution to long-term urban development, social equity, and economic resilience. It assessed whether the current IPTN framework effectively addresses traffic congestion, spatial inequality, and the evolving mobility needs of the city. The aim was to inform policy and planning by identifying actionable strategies to enhance connectivity, promote sustainable and cost-effective transport options, and improve multimodal integration. Particular emphasis was placed on identifying best practices that support functional interoperability across modes, aligned with Tshwane's broader developmental and spatial planning goals.

2. RESEARCH METHODOLOGY

2.1 Study Area

The City of Tshwane, the administrative capital of South Africa and the sole capital within Gauteng Province, extends approximately 121 km from east to west and 108 km from north to south, covering over 30% of Gauteng's total area of 19,055 km² (South African Cities Network, 2021; Statistics South Africa, 2021). Driven by rapid urbanization, sustained economic growth, and significant socio-political transitions, Tshwane's transport network has become increasingly complex. This evolving urban dynamic underscores the urgent need for improved mobility solutions that support seamless intra-city travel and equitable access to essential services.

A notable indicator of the city's transport challenges is the sharp rise in private car ownership, which grew from 22.9% in 2003 to 28.5% in 2013. This trend points to an overreliance on car-based travel and highlights the pressing need for more sustainable and inclusive transport alternatives to mitigate congestion and its associated environmental impacts (Duri et al., 2018).

2.2 Study Methods

Developing a unified public transport system required both broad and detailed datasets to inform effective planning and implementation (Gumbo et al., 2022). This study utilized a combination of primary and secondary data sources, including stakeholder interviews with municipal planning officials from the City of Tshwane. Primary data collection involved ranking facility surveys and key informant interviews (KII). Trained field surveyors administered structured questionnaires and conducted manual traffic counts at key intersections and city entry/exit points to identify congestion hotspots. To forecast travel demand, the study employed a standard four-step transportation modelling process using the EMME/4 software platform. Passenger movement patterns were projected for a base

year (2021) and future horizon years (2026, 2031, and 2041). The modelled network encompassed approximately 6,300 km of urban, peri-urban, and gravel roads. Public transport corridors, including those used by minibus taxis, municipal buses, Metrorail, and Gautrain, were mapped using field validation and secondary spatial datasets.

Trip generation and attraction were estimated using regression analysis, while a calibrated gravity model was applied for trip distribution, accounting for land use and socio-economic factors. Modal split was assessed using a multi-modal logit model that integrated service availability, travel time, and commuter preferences. Calibration relied on recent field surveys and inputs from key transport stakeholders. The 2022 AM peak hour simulation projected increased rail ridership following anticipated Metrorail upgrades. These modelling results supported the development and comparison of multiple IPTN planning scenarios, enabling more robust intermodal integration across Tshwane's transport system.

3. LITERATURE REVIEW

3.1 Integrated Public Transport Networks in Global Cities

Traffic congestion continues to intensify in urban centres across the globe, with significant negative implications for economic productivity, environmental sustainability, and overall quality of life (Abbasova, 2024). In response, researchers and planners have explored the application of emerging technologies such as Intelligent Transportation Systems (ITS), the Internet of Things (IoT), and artificial intelligence (AI) to enhance traffic management and urban mobility solutions. These innovations support more accurate travel time predictions, dynamic route optimization, and real-time traffic monitoring, ultimately enabling cities to reduce congestion and improve commuter experiences (El-afifi & Sakr, 2023; Ait Ouallane et al., 2022). Within the broader agenda of sustainable urban mobility, smart urban planning and integrating public transport networks have been recognised as essential strategies. These approaches contribute to shifting travel behaviour towards more sustainable modes while enhancing environmental resilience (Mokoma & Venter, 2023; Mashamaite, 2023.1). Recent advances in traffic management systems have been facilitated by the growing use of geospatial analytics, sensor networks, and real-time passenger information. These tools help optimize traffic flows, reduce emissions, and increase operational efficiency (Mphahlele, 2023; Gumbo et al., 2002). However, persistent challenges remain, particularly in the areas of data integration, institutional coordination, and infrastructure adaptation. These complexities highlight the ongoing need for innovation, cross-sector collaboration, and policy support to advance the effectiveness of transportation networks. The following subsections present comparative case studies from Indonesia, Brazil, Chile, and London, four cities implementing large-scale integrated public transport reforms to draw lessons applicable to the South African context.

3.1.1 Indonesia Public Transport

Indonesia is home to one of the largest and most sustainable Bus Rapid Transit (BRT) systems globally: TransJakarta. Since its inception, TransJakarta has provided millions of residents in Jakarta and surrounding areas with affordable and efficient mobility options. The integration of TransJakarta with commuter rail services and the Mass Rapid Transit (MRT) system has significantly enhanced intermodal connectivity and overall travel efficiency (Firman & Pane, 2023; Utomo & Wisnantoro, 2022). Originally launched in 2009, the BRT system was designed to offer comprehensive service coverage across urban and peri-urban communities. The operating network comprises privately owned buses, paratransit and taxi services, and a substantial fleet of government-operated DAMRI buses, which experienced significant expansion in 2012 (Wicaksono et al., 2022).

One of the primary goals of the BRT system was to alleviate congestion caused by "angkot", informal, minibus-style vehicles widely used for local travel. The restructuring of services under the Bandung Raya initiative further improved public transport in Greater Bandung, addressing both mobility needs and environmental concerns. A notable development was the integration of angkot services into the formal public transport network, an initiative that became a key focus area for enhancing multimodal accessibility across Bandung's metropolitan municipalities (Priambodo & Fitriani, 2023). In response to rising urbanisation and increasing demand for efficient transport, the Indonesian government introduced the Buy The Service (BTS) programme. This initiative consolidated fragmented operators under a regulated service model, resulting in higher daily ridership and reaffirming the government's commitment to providing safe, reliable, and affordable public transport (Santoso et al., 2023; Gunawan, 2022).

3.1.2 Brazil Public Transport

Curitiba's Bus Rapid Transit (BRT) system, one of the earliest globally, began operations in 1974 and has undergone extensive upgrades, particularly by 2009, to improve its efficiency, passenger experience, and environmental sustainability. Notable enhancements included the development of two improved Green Lines, which were integrated into a more unified, high-capacity corridor-based network. The success of Curitiba's BRT is largely attributed to its strong integration with land-use planning, enabling seamless travel across the city while promoting equitable access to transport (Bieberbaum et al., 2022; Silva & Duarte, 2023).

Public transport in Curitiba accounts for approximately 50% of daily trips, significantly outperforming private car use, which stands at around 26%. This mode share reflects the system's effectiveness in reducing congestion and supporting sustainable urban mobility (da Silva et al., 2021). In comparison, São Paulo operates one of the most extensive metro systems in Latin America. The system complements its bus and BRT services through frequent operations and well-coordinated multimodal transfers. This has helped to mitigate persistent traffic congestion in one of Brazil's most densely populated urban areas (de Andrade et al., 2023). Together, Curitiba and São Paulo illustrate the potential of transit-oriented development in rapidly urbanising contexts. Their experiences demonstrate how well-integrated public transport systems can enhance mobility, reduce environmental impacts, and contribute meaningfully to urban quality of life.

3.1.3 Chile Public Transport- Santiago

Chile's Transantiago system, now rebranded as RED, was established to create a fully integrated public transport network in Santiago, with the aim of enhancing accessibility and operational efficiency. Key features included a centralized fare structure and unified network management across multiple modes of transport (Bowen, 2017). The system comprises five metro lines and 391 direct Bus Rapid Transit (BRT) routes, which collectively contributed to a substantial increase in passenger trips between 2015 and 2016.

Despite its expansive reach, Transantiago has faced ongoing operational challenges. Issues such as inconsistent service reliability and weak operator performance have undermined overall system effectiveness and user satisfaction (World Bank, 2016). Nevertheless, Transantiago remains a noteworthy example of large-scale transport reform. It illustrates both the potential and the complexities involved in implementing seamless urban mobility systems in rapidly growing metropolitan contexts.

3.1.4 UK Public Transport London - UK

London’s public transport system, managed by Transport for London (TfL), is widely regarded as one of the most integrated multimodal networks globally, combining buses, light rail, and the Underground. Key developments that enhanced system accessibility and affordability included the introduction of the Travelcard in 1983 and implementing a flat fare structure for buses in 2000 (Lucas & Martens, 2021). TfL’s comprehensive integration strategy covering network design, service coordination, fare policy, and infrastructure led to improvements in operational efficiency, reduced boarding times, increased throughput, and lower unit costs (Zhou & Currie, 2020). A defining feature of the system is its single-payment platform, incorporating Oyster cards and contactless payment technologies. This unified fare mechanism allows passengers to transfer seamlessly between buses, the Tube, overground trains, river buses, trams, and cable cars, significantly enhancing user experience and convenience (Wardman et al., 2021). While London serves as a global benchmark for efficient, user-centred public transport design, it continues to face challenges such as overcrowding during peak hours in high-demand corridors. These pressures underscore the importance of continuous investment and adaptive capacity planning to meet evolving urban mobility needs (Mulley & Nelson, 2023).

3.1.5 Comparative Insights From International IPTN Models

This section compares four international cities that have implemented integrated public transport systems at scale to contextualise the Tshwane IPTN within global best practices.

Table 1: Summary of international public transport systems illustrating key integration mechanisms, strengths, and implementation challenges relevant to the Tshwane IPTN context

City / Country	Key Features	Integration Strengths	Challenges
Jakarta, Indonesia	TransJakarta BRT integrated with MRT and commuter rail; BTS model unifies services	Strong multimodal access; expanded affordable mobility (Firman & Pane, 2023)	Informal sector coordination; infrastructure scale (Santoso et al., 2023)
Curitiba, Brazil	BRT corridor integrated with land use; metro in São Paulo complements BRT	High mode share for public transport; TOD model (da Silva et al., 2021)	Scaling and modernisation across regions
Santiago, Chile	RED system with metro + BRT; centralized fare and route control	Fare integration; multimodal reach (Bowen, 2017)	Service reliability; operator performance (World Bank, 2016)
London, UK	TfL manages all modes; unified fare system with Oyster/contactless	Seamless transfers; strong policy alignment (Zhou & Currie, 2020)	Peak-hour congestion; capacity planning (Mulley & Nelson, 2023)

Each of these cities demonstrates a unique approach to implementing integrated public transport networks, with varying degrees of success. Jakarta and Curitiba emphasize multimodal connectivity and strategic land-use integration, while Santiago and London focus on fare unification and institutional coordination. Although all systems encountered implementation challenges, ranging from informal sector alignment to infrastructure strain, they provide valuable lessons for Tshwane. These insights underscore the importance of

policy coherence, phased roll-outs, and flexible planning in advancing integrated public transport in complex urban environments.

4. POLICY AND REGULATORY FRAMEWORKS

Effective traffic management depends on establishing structured systems that are well-designed, consistently implemented, and monitored. Robust governance frameworks are essential for enabling national and municipal authorities to standardise operations, enforce regulatory compliance, and develop interoperable infrastructure that meaningfully reduces congestion and enhances network efficiency. In the South African context, national policy efforts to support urban mobility reform have been guided by the National Land Transport Act (NLTA) and reinforced through strategic initiatives such as the Integrated Public Transport Network (IPTN) programme and the Public Transport Network Grant (PTNG) (Mashamaite, 2023; Mokoma & Venter, 2023). These instruments aim to promote modal integration, equity, and sustainability within city-scale transport planning. Substantial efforts have been made to introduce Bus Rapid Transit (BRT) systems and foster cooperation among different transport modes. However, implementation has faced persistent obstacles, including limited funding, service fragmentation, and difficulties integrating the informal minibus taxi sector, a dominant yet unregulated urban mobility component (Gumbo et al., 2022). These challenges mirror those seen in other global contexts, as discussed in the previous section, but are further complicated in South Africa by historical spatial inequalities and fragmented institutional mandates. Recognising these barriers, the government's Public Transport Strategy proposed a long-term approach to address systemic issues such as chronic traffic congestion, limited modal interoperability, and low user satisfaction. This strategy aligns with international best practices in sustainable urban transport and provides a structured roadmap for achieving integrated, user-centred, and environmentally responsible mobility solutions (Mphahlele, 2023; Risimati, 2021). The strategy's emphasis on transparent planning, stakeholder engagement, and developmental alignment represents a critical step toward overcoming past inefficiencies and reshaping the urban mobility landscape.

4.1 Development of IPTN and its Significance

Reliable and inclusive public transport is essential for building sustainable cities. It promotes economic growth, supports social equity, and helps mitigate environmental degradation. Among the various models applied globally, Bus Rapid Transit (BRT) systems have emerged as effective responses to complex urban mobility challenges, provided they are well-integrated with existing transport infrastructure (Mokoma & Venter, 2023; Gumbo et al., 2022). In this context, Integrated Public Transport Networks (IPTNs) offer a framework for unifying diverse transport modes under a cohesive, efficient, and user-oriented system. When implemented effectively, IPTNs enhance connectivity, increase accessibility, and reduce mobility-related inequalities, fostering more inclusive urban growth patterns (Mashamaite, 2023; Risimati, 2021). However, implementing and sustaining IPTNs presents both institutional and practical challenges. Stakeholder collaboration is often hampered by competing interests, particularly in contexts where informal transport sectors, such as the minibus taxi industry in South Africa are both dominant and decentralised (Mphahlele, 2023). Successful integration efforts thus require not only political commitment and clear strategic direction, but also sufficient administrative capacity at the municipal level. Balancing these complex interdependencies is crucial for urban planners to meet current and future transport needs. Adoption of cost-effective, phased implementation strategies, backed by robust long-term planning, is key to reducing congestion and mitigating its adverse effects on economic productivity and environmental health (Santoso et al., 2023; Mulley & Nelson, 2023).

5. DISCUSSION OF THE STUDY RESULTS AND FINDINGS

According to the 2019–2020 Gauteng Province Household Travel Survey (GP-HTS), approximately 2.2 million people travelled through the City of Tshwane (CoT) on a typical weekday. The majority of morning peak hour trips (42.9%) were work-related, while 11.4% were made for educational purposes. Travel mode data highlights a strong reliance on private vehicles, with 38% of all trips undertaken by car. Walking accounted for 36.8% of trips, indicating the continued importance of non-motorised transport, especially in peripheral and underserved areas. Among public transport options, minibus taxis dominated usage, accounting for 12.8% of trips, far surpassing buses (1.3%) and trains (0.4%). The city's high level of car dependency is attributed to several interlinked factors, including infrequent and unreliable public transport services, uncoordinated fare structures, long travel times, and, critically, a fragmented spatial layout that hinders effective system integration. These barriers reinforce modal inefficiencies and limit the uptake of more sustainable travel alternatives.

5.1 Characteristics of Public Transport Corridors Studied

The public transport corridors analysed in this study consist of key junctions located along major axial routes that span different regions of the City of Tshwane. These corridors serve as primary connectors between the central business district (CBD) and various surrounding townships and suburbs (see Table 2 below). All selected routes are classified as Class 3 roads, indicating their role in facilitating medium- to high-capacity urban traffic flow. Most of the corridors are signalised to manage traffic volumes during peak periods, and in several cases, operational control is supplemented by OUTsurance pointsmen, private traffic coordinators deployed to reduce congestion. A recurring challenge across multiple routes is the presence of informal traders and hawkers at intersections and junctions. While these activities contribute to local economies, they also obstruct vehicle movement and disrupt traffic flow, particularly during peak travel hours.

The table highlights Tshwane's most critical public transport corridors, reflecting significant variation in demand, modal usage, and service coverage. Corridors linking the CBD to high-density townships like Soshanguve and Mamelodi show the highest passenger volumes. Minibus taxis dominate across all corridors, with limited rail and bus usage in most areas. Despite the presence of multiple service providers, including BRT, Gautrain, and Metrorail, modal integration remains inconsistent, underscoring the need for better coordination and infrastructure investment in high-demand routes.

5.2 Tshwane Trip Making

According to the *National Household Travel Survey – Gauteng Province Report (2022)*, the majority of daily trips in Tshwane were made for work purposes (31.1%), with a similarly high proportion dedicated to education-related travel (30.7%). These figures reflect the strong influence of employment and schooling patterns on peak-hour mobility and underscore the importance of reliable public transport options during commuting hours.

5.3 Modal Split Shift

Between 2013 and 2020, the public transport mode share in Tshwane declined from 35.5% to 32.1%, while private car usage increased from 34.8% to 37.5%. During the same period, non-motorised transport (NMT) experienced a marginal decline from 29.8% to 29.6%. These trends highlight a gradual shift towards private vehicle reliance and a weakening

uptake of public and active transport modes, raising concerns about long-term sustainability and congestion.

Table 2: Characteristics of 17 key public transport corridors in Tshwane, including route length, estimated AM peak public transport demand, modal split, and current services

Corridor No.	Corridor Description	Approx. Corridor Length	2022 Estimated AM Peak Hour PT Pax (EMME)	2022 PT AM Peak Hour Modal Split (EMME)	Current PT Service/s
1	PTA CBD to Soshanguve / Mabopane	38km	20 180	MBT: 7300 PRASA: 6100 Bus: 5400 ARY: 1380	<ul style="list-style-type: none"> • Metrorail services • A Re Yeng from CBD to Wonderboom (Trunk) – Line 1A • PTOG Subsidised services • MBTs • TBS partly
2	PTA CBD to Mamelodi	30km	17 100	MBT: 6700 PRASA: 5000 Bus: 5400	<ul style="list-style-type: none"> • Metrorail services • PTOG Subsidised services • MBTs • TBS partly
3	PTA CBD to Atteridgeville / Lotus Garden	17km	15 100	MBT: 6500 PRASA: 3700 Bus: 4900	<ul style="list-style-type: none"> • Metrorail • PTOG Subsidised services • MBTs • TBS
4	PTA CBD to Ga-Rankuwa	38km	13 900	MBT: 6100 PRASA: 2700 Bus: 5100	<ul style="list-style-type: none"> • Metrorail services • PTOG Subsidised services • MBTs • TBS Partly
5	PTA CBD to KwaMhlanga (Moloto)	80km	12 690	MBT: 3840 Bus: 8850	<ul style="list-style-type: none"> • PTOG Subsidised services • MBTs
6	GA-Rankuwa / Soshanguve to Hammanskraal	47km	7 440	MBT: 3900 Bus: 3540	<ul style="list-style-type: none"> • PTOG Subsidised services • MBTs
7	PTA CBD to Hammanskraal	48km	6 700	MBT: 5200 Bus: 1500	<ul style="list-style-type: none"> • A Re Yeng to Wonderboom (Trunk) – Line 1A • A Re Reng Feeder / Distribution Services • PTOG Subsidised services • MBTs feeder services at Wonderboom • MBTs
8	PTA CBD to East Suburbs	20km	3 750	MBT: 1900 Bus: 600 ARY: 1070 Gautrain: 180	<ul style="list-style-type: none"> • A Re Yeng to Menlyn (Mix Traffic) • PTOG Subsidised services • TBS • MBTs
9	PTA CBD to Olievenhoutbosch	28km	2 700	MBT: 2100 Bus: 600	<ul style="list-style-type: none"> • PTOG Subsidised services • TBS • MBTs
10	PTA CBD to Centurion	15km	2370	MBT: 400 PRASA: 100 Bus: 1520 Gautrain: 350	<ul style="list-style-type: none"> • Gautrain services • Metrorail services • PTOG Subsidised services • TBS • MBTs
11	Wonderboom to Mamelodi	27km	2 300	MBT: 1700 Bus: 600	<ul style="list-style-type: none"> • PTOG Subsidised services • MBTs • TBS partly
12	Menlyn to Mamelodi	22km	2 200	MBT: 1700 Bus: 500	<ul style="list-style-type: none"> • PTOG Subsidised services • MBTs
13	Mamelodi to Centurion	30km	1 600	MBT: 1100 Bus: 500	<ul style="list-style-type: none"> • PTOG Subsidised services • MBTs
14	Atteridgeville / Lotus Garden to Centurion	26km	1 300	MBT: 1100 Bus: 200	<ul style="list-style-type: none"> • PTOG Subsidised services • MBTs
15	PTA CBD to Bronkhorstspuit	55km	1 000	MBT: 500 Bus: 500	<ul style="list-style-type: none"> • PTOG Subsidised services • MBTs
16	Bronkhorstspuit to Ekangala	20km	400	MBT: 400	<ul style="list-style-type: none"> • MBTs
17	Mamelodi to Cullinan	16km	300	MBT: 300	<ul style="list-style-type: none"> • MBTs

5.4 Tshwane Public Transport Corridor Routes

Tshwane's public transport system mainly runs along 17 main routes, as detailed in Table 2. Table 2 also shows the EMME model's peak-hour estimates of public transport demand, modal split and current services for each of the 17 main corridors. A thorough analysis of the identified corridors employed several ITPN Suite of Offerings Guidelines (2021) and the UITP Guide. This detailed analysis of the corridors considered mode type, overall length, important characteristics, functional capacity, average commercial speed, the total number of vehicles and minimum headways. Corridor priority depends on demand.

5.5 Tshwane Public Transport Route Selection Criterion

The study evaluated five alternative public transport network scenarios through a multi-criteria assessment (MCA) framework. Each alternative was tested and compared based on its performance, feasibility, and potential to improve mobility and integration across Tshwane.

Table 3: Depiction of 5 alternative public transport networks

Alternatives	Service Description
a) Alternative 1 (Business As Usual)	This is the standard we use to evaluate all the other options. It is assumed that public transport will continue operating as usual, handling only increases in future demand.
b) Alternative 2 (Original Full IPTN)	This considerably changed version comes from the original, thorough IPTN Network planned in the 2015 CIP.
c) Alternative 3 (Immediate Star Network)	This approach assumes the existence of public transport and it therefore depends on its availability. Services will continue. The anticipated A Re Yeng Bus Operation Company Agreement (BOCA 1) will be fully finalized and comprehensively implemented throughout 2023 and 2024.
d) Alternative 4 (Optimisation)	This alternative presupposes the continued operation of all existing public transport services, including a modernized but otherwise unchanged PRASA rail network, an unchanged Gautrain network, the full implementation of A Re Yeng BOCA1 and its phases and the rationalization of subsidized bus services to incorporate several MBT-based companies, with some MBTs providing complementary feeder and distribution services.
e) Proposed Alternative 5 (Restructured Network)	This scenario assumes continued public transportation services, including PRASA rail network upgrades and the addition of the Moloto rail corridor, while maintaining the Gautrain network and implementing some A Re Yeng phases (medium and low-end).

Restructured Network emerged as the preferred scenario based on the multi-criteria assessment. It demonstrated the strongest performance in terms of long-term sustainability, system integration, and service coverage. This option incorporates enhanced rail infrastructure, the addition of the Moloto rail corridor, and a combination of high-, medium-, and low-quality Bus Rapid Transit (BRT) lines, prioritising scalable, high-impact investments in public transport.

5.5.1 Comparative Justification for the Selection of the Restructured Network

To contextualize the selection of Tshwane’s Restructured Network (Alternative 5), the following table compares its key features with those of international best practices from Indonesia, Brazil, Chile, and the United Kingdom. The comparison focuses on sustainability, system integration, and service coverage, three core criteria used in the multi-criteria assessment (MCA).

Table 4: Comparison of the restructured network with International Integrated Public Transport Models

Aspect	Restructured Network (Tshwane)	International Best Practices
Sustainability	Rail upgrades, phased BRT investment, and focus on long-term scalability.	Curitiba (Brazil) and London (UK) linked transport planning with urban development for low-emission, high-efficiency transit systems.
Integration	Multimodal approach: PRASA, Gautrain, Moloto rail, A Re Yeng BRT, and MBT feeder services.	London’s TfL excels in institutional and fare integration; Jakarta and Santiago aligned bus and rail modes to varying degrees of success.
Service Coverage	Serves urban core and outlying areas (e.g., Hammanskraal, Bronkhorstspuit) through trunk and feeder networks.	Jakarta’s BRT and Curitiba’s corridor model ensure broad geographic reach; Santiago faced limitations in consistent service delivery to outer areas.

The comparative analysis reinforces the selection of Alternative 5 – the Restructured Network as the most appropriate public transport strategy for Tshwane. Like its global counterparts, the restructured network balances long-term sustainability goals with practical, phased investments in infrastructure. Its emphasis on rail modernization and flexible BRT configurations reflects lessons from Curitiba and Jakarta, while its focus on geographic reach echoes London’s inclusive service model. Moreover, its attempt to coordinate formal services with the informal minibus taxi sector addresses a uniquely South African challenge, positioning it as both ambitious and contextually grounded. Given its alignment with successful international principles and its responsiveness to local demands, Alternative 5 presents the strongest pathway to integrated, equitable, and efficient mobility in Tshwane.

6. RECOMMENDATIONS

The Integrated Public Transport Network (IPTN) strategy for the City of Tshwane outlines a three-tiered service model: a Primary Public Transport System, Secondary/Complementary Services, and Feeder & Distribution Services. These components collectively aim to improve public transport planning, infrastructure, and service delivery to enable smoother, more efficient mobility across the city. To effectively reduce congestion, it is recommended that Tshwane undertake targeted modifications to its road network, particularly at known bottlenecks along public transport corridors. Infrastructure upgrades should be aligned with

efforts to prioritise high-ridership routes and ensure service reliability. As Veryard and Perkins (2017) note, successful transport systems depend on strong infrastructure, service reliability, and user-focused planning. Similarly, Samuel et al. (2015) emphasize that systems that are efficient, accessible, and attractive to users play a critical role in encouraging public transport uptake. Figure 1 presents a set of mitigation and coping strategies designed to support the implementation of the IPTN in Tshwane, highlighting both short-term interventions and long-term planning approaches.

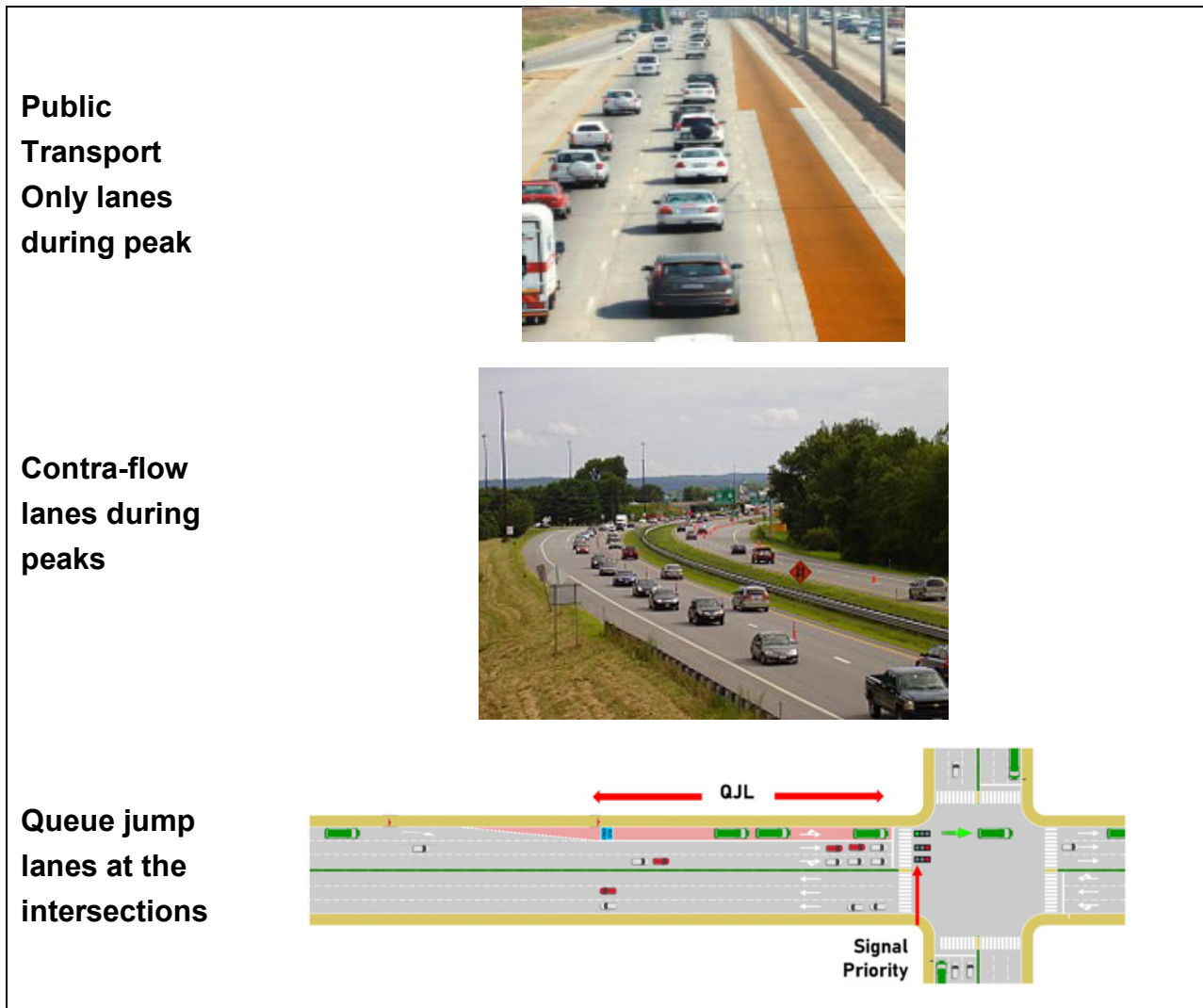


Figure 1: Mitigation and coping strategies for CoT IPTN

Achieving effective modal integration in public transport systems is complex but essential for long-term success. The City Modal Integration Report (CoT, 2022) highlights the need for a multidimensional approach that includes transparent fare structures, reliable infrastructure, and travel demand management tools. A unified fare and ticketing system, enhanced travel planning tools, and a better understanding of passenger profiles can reduce modal competition, strengthen infrastructure efficiency, and lower operational costs. Accessible, real-time information systems are also vital, enabling commuters to plan trips more effectively and confidently. City planners are actively pursuing improvements in modal connectivity, guided by the Comprehensive Integrated Transport Plan (CITP). The CITP outlines a strategic framework for aligning various modes, including buses, minibus taxis, rail, and non-motorised transport into a coherent and integrated system. Successful implementation of these plans depends on strong stakeholder collaboration. This includes coordination between internal city entities (e.g., the transport division, roads authority, and

TMPD) and external partners such as the Department of Transport, provincial government, taxi associations, political representatives, and commuter forums. Public participation is encouraged through structured consultations with community members, councillors, and subject matter experts. Such inclusive engagement strengthens accountability and ensures that integration strategies are both user-informed and contextually grounded.

7. CONCLUSIONS

This paper presented a comprehensive overview of integrated public transport planning in the City of Tshwane, identifying seventeen key public transport corridors and proposing practical solutions to alleviate congestion and improve connectivity. The Integrated Public Transport Network (IPTN) was positioned as a critical planning tool that should be embedded within broader metropolitan strategies, including Integrated Development Plans (IDPs), Regional Spatial Development Frameworks (RSDFs), Metropolitan Spatial Development Frameworks (MSDFs), and Comprehensive Integrated Transport Plans (CITPs). To remain responsive to the city's evolving needs, the IPTN should be reviewed and updated annually in alignment with the CITP review cycle. A well-connected system, linking buses, trains, and minibus taxis, supported by enabling infrastructure has the potential to transform Tshwane's urban mobility landscape. Integration will require coordinated operations, unified information systems, synchronised schedules, and interoperable payment mechanisms to enable seamless travel across all modes. Smart cards and contactless mobile ticketing can enhance user experience and operational efficiency. Ultimately, the success of the IPTN will depend on sustained investment, collaborative stakeholder engagement, and institutional capacity. If these foundations are established, Tshwane's IPTN can create a more inclusive, accessible, and sustainable public transport future.

8. REFERENCES

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