AI for Public Transport Optimisation:

Enhancing Throughput, Efficiency, and Sustainability in Telangana

Futures Report

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A Futures Report by

ITS India Forum & OMI Foundation Trust

President's Message

Akhilesh Srivastava
President,
ITS India Forum

India's public transport systems are the lifeblood of urban life - moving millions daily, connecting citizens to opportunities, and driving the economy forward. Yet, in an era defined by data and digital transformation, efficiency alone is no longer enough. Our transport systems must become intelligent - capable of learning, anticipating, and adapting in real time.

This report, ***AI for Public Transport Optimisation: Enhancing Throughput, Efficiency, and Sustainability in Telangana***, charts a decisive path toward that future. It demonstrates how **Artificial Intelligence** can serve as the **invisible engine** that powers a more **efficient, reliable, and sustainable public transport system** - one that moves not just people, but possibilities.

Through its **AI Throughput Framework**, the report identifies five key domains where intelligence can unlock exponential gains: **optimising routes and schedules**, **predicting maintenance**, **elevating passenger experience**, **enabling data-driven decision-making**, and **advancing environmental sustainability**. Together, these represent not a technological upgrade, but a systemic transformation - from static operations to adaptive, self-improving mobility networks.

Telangana stands at the **forefront of this transformation**. With progressive digital policies, an early **state-level AI mission**, and the **proactive leadership** of **TGSRTC**, Telangana has laid the foundations for India's first AI-driven public transport ecosystem. The collaboration between **ITS India Forum** and **OMI Foundation** builds on this vision, offering a replicable national model that bridges technology and governance.

As India moves toward **Viksit Bharat 2047**, the challenge before us is clear - to move from automation to intelligence, from efficiency to resilience, and from service delivery to citizen experience. AI gives us the tools to achieve this shift. What we need now is *institutional readiness, ethical foresight, and sustained collaboration between government, industry, and academia.*

The next decade can define **India's leadership in intelligent public transport**. If implemented with purpose, the roadmap presented here will ensure that every kilometre travelled in Telangana is not just faster or cleaner - but smarter, safer, and more inclusive.

Foreword

Dr R.S.Sharma IAS (Retd.)
Former Chairman,
TRAI
Govt. of India

Public transport is a critical enabler of equitable, safe, and sustainable mobility. As India's cities expand and mobility patterns evolve, strengthening public transport systems remains essential for improving accessibility, passenger experience, and environmental outcomes. The rapid advancement of digital connectivity, 5G, and artificial intelligence (AI) now provides an unprecedented opportunity to modernise public mobility by transforming real-time data into actionable intelligence that enhances service delivery and citizen trust.

The report, ***AI for Public Transport Optimisation: Enhancing Throughput, Efficiency, and Sustainability in Telangana***, offers a timely and comprehensive assessment of how AI can augment public transport performance. By emphasising throughput as a core efficiency metric, it introduces a measurable and citizen-oriented lens to system optimisation. The AI Throughput Framework outlined in this report demonstrates a clear and scalable pathway for operational excellence.

Telangana's efforts underscore the value of strong digital foundations, interoperable systems, and responsible innovation. The report's focus on ethical AI, secure data governance, and institutional capacity strengthens public trust and aligns with India's broader vision for a safe, reliable, and future-ready digital ecosystem. As the nation accelerates 5G deployment, edge computing, and AI adoption, such initiatives are essential to building resilient and intelligent public service platforms.

The telecommunications ecosystem has a pivotal role in enabling this journey by ensuring ubiquitous connectivity, fostering innovation, and upholding principles of transparency, accountability, and consumer protection. This report exemplifies how technology, policy alignment, and institutional leadership can work together to deliver cleaner, more efficient, and citizen-centric mobility systems.

As we move toward a digitally-empowered and sustainable mobility future, I hope this work inspires wider adoption of responsible AI and trusted connectivity to serve every commuter with dignity, fairness, and reliability.

Foreword

Shri Giridhar Aramane, IAS (Retd.)
Former Secretary, Defence and Ministry of Road Transport and Highways.
Govt. of India

India's transportation ecosystem is entering a decisive phase of transformation, driven by the integration of advanced digital technologies, data-driven systems, and process innovation. Among these, Artificial Intelligence (AI) has emerged as a critical enabler for strengthening the efficiency, reliability, and sustainability of public transport services. For large public transport undertakings such as the Telangana State Road Transport Corporation (TGSRTC), the adoption of AI-based planning and operational tools represents a timely and forward-looking intervention to meet growing mobility demands with improved service delivery and enhanced citizen experience.

The report, ***AI for Public Transport Optimisation: Enhancing Throughput, Efficiency, and Sustainability in Telangana***, presents a structured and practical approach to mainstreaming AI in public transport operations. It outlines clear pathways for leveraging data and machine intelligence across key functions including predictive maintenance, network and route optimisation, fleet planning, energy management, and passenger engagement. The emphasis on throughput as a core performance indicator is noteworthy, linking operational efficiency with commuter convenience and service quality, and thereby reinforcing the user-centric principles of modern public transport planning.

Importantly, the report recognises the foundational role of institutional readiness, capacity enhancement, and ethical governance frameworks in enabling sustainable technology adoption. Telangana's experience demonstrates how public transport agencies can introduce innovation within legacy systems while ensuring accountability and equity. The effort also underscores the value of collaborative engagement between government, research institutions, and industry, a model aligned with the national vision for Intelligent Transport Systems and digital public infrastructure in mobility.

The framework presented herein will support ongoing efforts to strengthen India's public transport ecosystem and advance the objective of ensuring safe, efficient, inclusive, and environmentally responsible mobility for all.

Foreword

Shri Rohit Kumar Singh IAS (Retd.)
Former Secretary, Ministry of Consumer Affairs; and Member, National Consumer Dispute Redressal Commission
Govt. of India

Public transport is a vital public good, shaping daily lives, economic productivity, and social equity. As India strengthens its mobility systems, the integration of advanced digital technologies, particularly Artificial Intelligence (AI) represents a key enabler for improving efficiency, enhancing commuter experience, and safeguarding consumer interests. In a rapidly urbanising nation, reliable, safe, and accessible public transport is not only a mobility priority but also a fundamental service-quality expectation of citizens.

The report, ***AI for Public Transport Optimisation: Enhancing Throughput, Efficiency, and Sustainability in Telangana***, presents a thoughtful and structured framework for leveraging AI to improve operational performance across public transport systems. Its focus on throughput ensures that capacity is translated into timely, dependable, and passenger-focused services aligns well with national priorities of improving service delivery, consumer convenience, and overall travel experience.

Telangana's approach demonstrates how emerging technologies can be embedded into existing transport systems to enable predictive maintenance, route optimisation, efficient fleet deployment, emissions management, and commuter-centric service enhancements. This experience reinforces the importance of institutional preparedness, data governance, and responsible innovation to ensure solutions are scalable, accountable, and aligned with public interest.

Strengthening public transport requires collaboration between central and state agencies, industry, academia, and civil society. As India accelerates digital mobility initiatives, it is essential that technological progress translates into equitable access, road safety, transparent service standards, and improved citizen outcomes.

I commend the authors and partner institutions for this timely and forward-looking contribution. Initiatives such as this are instrumental in advancing India's commitment to building mobility systems that are efficient, sustainable, inclusive, and aligned with the rights and expectations of every commuter.

Foreword

Ambassador (Retd.) Gautam Bambawale
Managing Trustee,
OMI Foundation

Harish Abichandani
First Trustee,
OMI Foundation

Public transport is the most democratic of infrastructures. When it works well, it multiplies opportunity - linking people to jobs, education, and healthcare. When it falters, it compounds exclusion. This is why the OMI Foundation continues to focus on practical, people-centred pathways to make Indian mobility safer, smarter, and more inclusive.

AI for Public Transport Optimisation: Enhancing Throughput, Efficiency, and Sustainability in Telangana advances that mission with a clear message: intelligence - not just expansion - will define the next leap in public transport performance. Co-authored with the **ITS India Forum**, the report places **"throughput"** at the heart of **efficiency**, showing how **AI** can help **TGSRTC** move more passengers, more reliably, with the same fleet and workforce - while lowering costs and emissions.

Three ideas anchor this work:

a. **Institutional readiness over pilots:** Technology succeeds when organisations are prepared - with clear governance roles, ethics-by-design, secure data systems, and skilled staff.

b. **End-to-end intelligence:** From route optimisation to predictive maintenance, passenger feedback, and EV energy management, the **AI Throughput Framework** turns data into decisions that improve service.

c. **Equity and sustainability as first principles:** Optimising efficiency must translate into safer, more inclusive, and climate-aligned mobility for all.

We thank the **Government of Telangana, TGSRTC leadership**, and the **ITS India Forum** for their partnership and vision. Telangana's strong digital foundations and openness to innovation make it a **natural testbed for AI-driven mobility governance**.

We recommend this report to policymakers, transport officials, and civic leaders. Its roadmap is actionable and scalable - showing how AI can transform TGSRTC into an intelligent, adaptive system that sets new benchmarks for reliability, transparency, and public trust.

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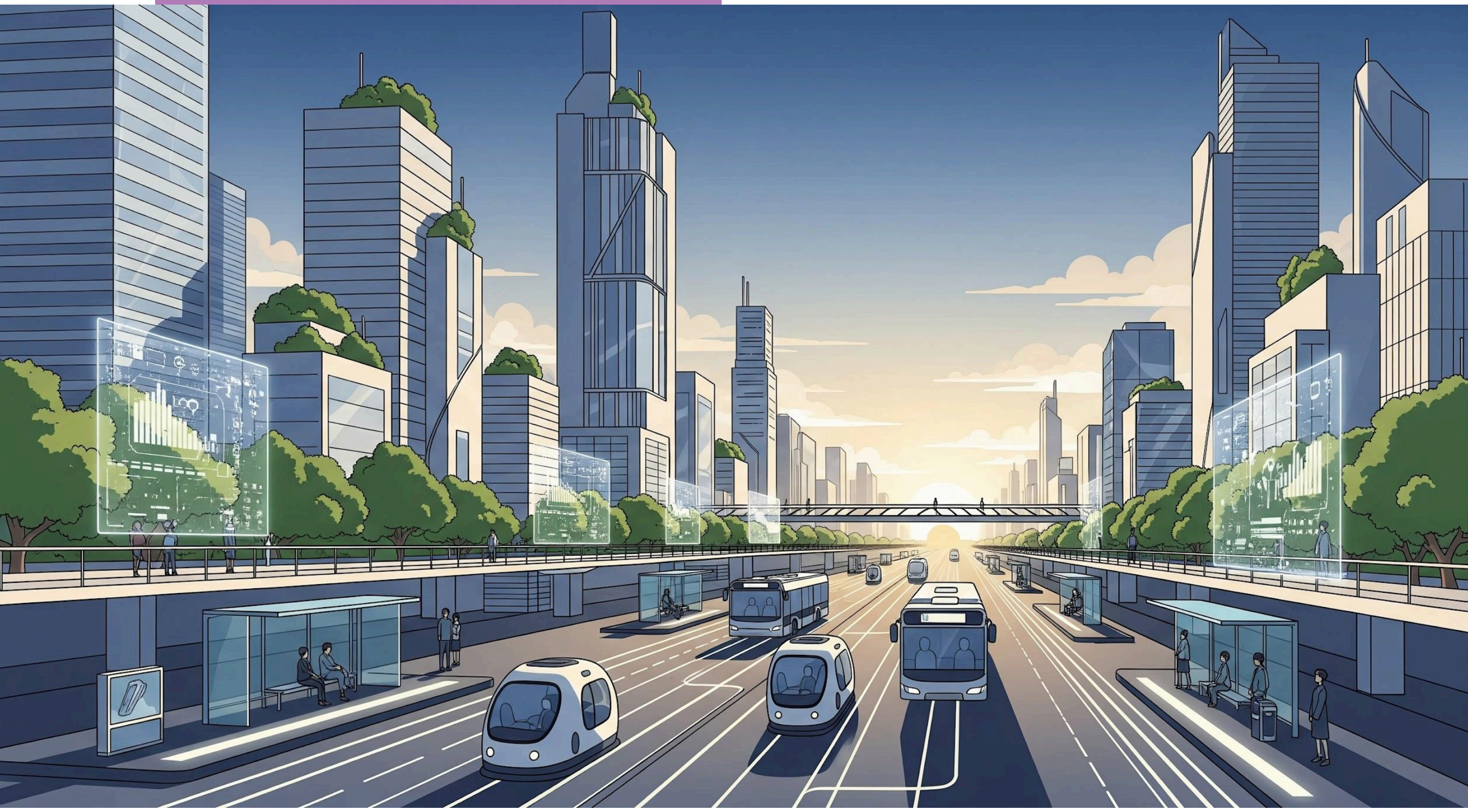



BIG BOSS
BIGGER & BETTER

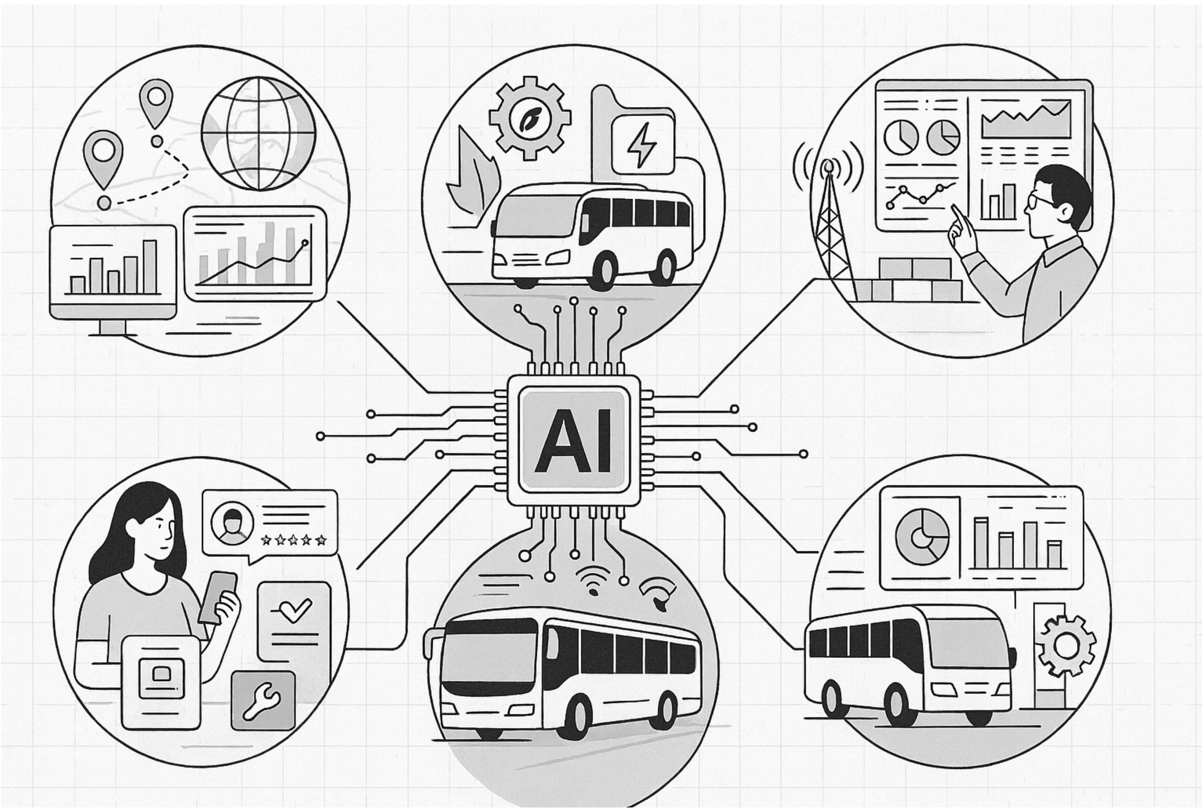
Executive Summary

The **Telangana State Road Transport Corporation (TGSRTC)** stands at a pivotal juncture to harness **Artificial Intelligence (AI)** for **transforming its public transport operations**. Building on the State's strong digital governance foundations, this report outlines a **comprehensive roadmap to integrate AI as a core enabler of efficiency, reliability, and sustainability in public transport**.

Public transport throughput, i.e., the rate at which a system converts available resources such as buses, drivers, and energy into effective passenger movement, is the **key performance indicator** for **service efficiency**. Improving throughput enables TGSRTC to move more passengers, more reliably, and with lower operational costs using the same fleet and workforce. **AI offers the analytical intelligence** to make this possible by shifting operations from **reactive to predictive**, and from **static to adaptive**.

The report introduces the **AI Throughput Framework**, comprising five interlinked domains that together enhance efficiency, reliability, and environmental performance, as follows.

Figure 1: AI Throughput Framework for Public Transport



Source: AI-generated image; Authors.

1. **AI for Route and Schedule Optimisation:** Uses predictive analytics, origin-destination mapping, and dynamic scheduling to align routes and frequencies with real-time demand.

2. **AI for Fleet and Asset Optimisation:** Employs IoT-based predictive maintenance and driver behaviour analytics to reduce downtime, lower maintenance costs, and enhance safety.
3. **AI for Passenger Experience Intelligence:** Integrates digital ticketing, mobile apps, and AI-enabled feedback systems to improve satisfaction, reduce leakage, and create responsive service delivery.
4. **AI for Institutional Decision-Making:** Deploys real-time dashboards across central, depot, and zonal levels for proactive, evidence-based management and operational transparency.
5. **AI for Environmental and Energy Management:** Enables emissions tracking, fuel and energy optimisation, and intelligent EV charging, advancing TGSRTC's sustainability and decarbonisation goals.

Collectively, these domains create an end-to-end throughput ecosystem, where continuous data from operations informs intelligent decisions that directly enhance service reliability and passenger experience.

To institutionalise this **transformation**, the report proposes **a structured pathway** encompassing:

1. **Institutional readiness** assessment, identifying capacity gaps across people, processes, data, technology, and governance.
2. **Governance and leadership** frameworks, including the establishment of roles such as Chief Data Officer, Data Protection Officer, and an AI Ethics Board.
3. **Capacity-building** programmes to develop digital literacy, AI governance, and cross-functional technical expertise among TGSRTC staff.
4. **A phased implementation strategy** of Scan, Pilot, Scale, and Sustain ensurring pragmatic, evidence-based adoption.
5. **Innovative financing and partnerships** through PPPs, multilateral funding, and climate-linked instruments to support sustainable AI deployment.

By **embedding AI across planning, operations, and management**, TGSRTC can evolve from a static operator to a dynamic, learning mobility system that is capable of anticipating disruptions, optimising resources, and delivering equitable, reliable, and climate-aligned mobility.

AI is not merely a technological upgrade for TGSRTC; it represents a strategic transformation towards an intelligent, sustainable, and citizen-centric public transport system for Telangana, the one that leads India's next generation of data-driven, inclusive, and green mobility governance.

1. AI in Public Transport: The Opportunity for Telangana

1.1. AI in Public Transport

Artificial Intelligence (AI) is rapidly transforming the global transport landscape, driving innovation across planning, operations, and service delivery. Governments and transport authorities are increasingly integrating AI systems to improve the safety, efficiency, and sustainability of mobility networks facing ageing infrastructure, rising costs, and growing urban demand (ITF, 2025). AI-enabled systems empower authorities to analyse complex data streams such as ticketing transactions, GPS traces, telematics, passenger feedback, etc. and generate actionable insights in three key policy domains: strategic planning and forecasting, operational optimisation, and citizen service delivery (PTV Group, n.d.).

In transport policymaking, AI provides the foundation for intelligent systems that can adapt and respond dynamically to changing conditions, while Machine Learning (ML) and Deep Learning (DL) techniques unlock deeper insights through pattern recognition and predictive modelling (Saki & Soori, 2025). AI supports scenario forecasting, spatial flow mapping, and infrastructure appraisal, enabling data-driven decisions that enhance network resilience. ML models help ministries simulate travel demand, test future scenarios, and prioritise investment in sustainable mobility corridors. At the operational level, transport authorities deploy AI for targeted maintenance, dynamic traffic control, and disruption management, optimising procurement, staffing, and enforcement. Similarly, AI-enhanced administrative systems streamline public-facing services such as licence renewal or fare payment, improving government responsiveness and transparency.

Public transportation systems are among the most visible beneficiaries of this technological shift. AI innovations now underpin predictive maintenance, fleet scheduling, and real-time passenger information systems, helping operators anticipate disruptions rather than merely react to them. Through ML, predictive analytics, natural language processing (NLP) and real-time optimisation, AI can (Amplework, 2025):

- ➢ Forecast peaks and optimise fleet deployment dynamically, increasing throughput and reducing crowding.
- ➢ Detects faults before breakdowns through predictive maintenance, reducing downtime and maintenance costs.
- ➢ Tailor operations or user interactions via feedback loops, improving responsiveness and satisfaction.
- ➢ Plan operations that are low emission and more sustainable, for instance by scheduling electric bus charging or minimising unoccupied ‘deadhead’ movements.

AI represents a systemic shift as it can empower public transport agencies to anticipate, adapt, and learn. Cities worldwide have demonstrated measurable impacts from such integration. Singapore’s Land Transport Authority uses deep-learning to forecast passenger flows, resulting in 7-12% reduction in commuting delays during peak periods (Hanxiang &

Leong, 2025); New York's MTA has piloted AI-enabled predictive maintenance for public buses, aiming to reduce breakdowns and optimise repair schedules (Wallace, 2022); and Transport for London (TfL) employs ML to manage disruptions and enhance user journey planning through open data APIs (Cow-shed, 2024).

These advances mark a transition from isolated automation to systemic intelligence, positioning AI as a foundational capability for twenty-first-century mobility governance. Beyond efficiency, AI helps authorities plan cleaner transport systems, such as deploying electric vehicle (EV) charging infrastructure, optimising electric-bus performance, energy use, and route design to reduce emissions (Singh, 2025; Ibrahim et al., 2025).

The emerging global evidence is clear: transport agencies embracing AI deliver higher reliability, fiscal sustainability, and passenger satisfaction than their traditional counterparts. The integration of AI into public transport is therefore not merely a technological upgrade; it is an imperative for achieving sustainable, inclusive, and intelligent urban mobility.

1.2. The Opportunity for Telangana

Telangana is uniquely positioned to pioneer AI-driven transformation in public transport, underpinned by one of India's earliest state-level AI visions. The Telangana AI Framework (2020) emphasises responsible AI through ethical, inclusive, and public-sector-focused principles, framed under the slogan 'AI for Good and for All'. Through the Telangana AI Mission (T-AIM), the Government of Telangana, in collaboration with NASSCOM, will assist the state in accelerating the process of powering Telangana to be a leading Global Artificial Intelligence Innovation hub (ITE&C Dept., Government of Telangana, 2020).

Parallel initiatives such as the State EV and Energy Storage Policy, Digital Telangana, and the Telangana Data Exchange Framework, further demonstrate Telangana's whole-of-government commitment to digital governance, open data, and sustainability. Collectively, these efforts build a strong regulatory and infrastructural foundation needed for AI's large-scale application in public services.

In public transport, Telangana stands at the forefront of digital innovation, with the Telangana State Road Transport Corporation (TGSRTC) becoming the first Indian public transport agency to embed AI in operations (Telangana Today, 2025). In partnership with technology firms and innovative public sector collaborations, Telangana's approach covers automated demand-driven bus scheduling, real-time health monitoring of over 40,000 employees, and advanced operational tracking, each underpinned by AI and ML (The Hans India, 2025). These initiatives are underpinned by AI and ML, promising improved commuter experience and operational efficiency while establishing a national model for data-driven mobility governance.

The TGSRTC already operates on a strong digital base:

- ➢ GPS tracking in its buses to provide real-time location tracking via its own Gamyam app (Telangana State Road Transport Corporation, n.d.).

- ➢ E-ticketing and digital payments generate high-volume, time-stamped passenger data (Mohammed, 2024).
- ➢ Dynamic-pricing pilots with industry partners such as Sciative Solutions have tested adaptive fare models (Sciative, 2025).
- ➢ Depot-level Management Information Systems (MIS) support day-to-day scheduling and revenue oversight (Telangana State Road Transport Corporation, n.d.).

This digital foundation enables TGSRTC's strategic AI applications to tackle urban mobility challenges such as variable demand, route optimisation, and cost management through automated analytics and predictive modelling. The iRASTE project, for instance, has showcased a 33% reduction in accidents involving buses equipped with advanced driver-assistance systems (Government of Telangana, 2024), a substantial impact on fleet safety and overall service reliability.

Telangana's ambitions align seamlessly with national frameworks such as the IndiaAI Mission (2023), the Digital India Programme, etc., all emphasise AI for improved service delivery and inter-modal integration. Compliance with the Digital Personal Data Protection Act (2023) positions the state to deploy AI responsibly, balancing innovation with privacy and citizen trust.

With ongoing projects and policy support, Telangana also offers a fertile test bed for AI-powered mobility solutions and India's prime candidate for piloting a model AI-driven public transport system, aligned with broader decarbonisation and innovation goals. By scaling such programmes statewide, Telangana can demonstrate how data-led governance delivers tangible benefits in safety, sustainability, and service quality, paving the way for future-ready, intelligent public transport systems in India

2. AI for Improving Public Transport Throughput

2.1. Why Throughput Matters

Public transport throughput measures how efficiently a system converts its available resources, such as buses, depots, drivers, time, and energy, into the movement of passengers across a network. It reflects the flow capacity of the system, which is the rate at which mobility is produced per unit of fleet, infrastructure, and operational effort (Throughput Capacity, n.d.).

For a state-run bus corporation such as TGSRTC, improving throughput is critical to achieving both operational efficiency and passenger satisfaction. When throughput rises, it means that the same fleet and workforce are delivering more reliable service, moving more passengers per kilometre, and using energy more efficiently. Conversely, when throughput falls, buses spend longer in depots, routes overlap wastefully, or passengers experience longer dwell times.

High throughput, by contrast, means (Passenger Throughput, n.d.):

- More trips per bus per day,
- Better load balance and reduced idle running,
- Shorter passenger waiting and travel times,
- Fewer breakdowns and unplanned service disruptions.

AI provides the analytical and adaptive capabilities to systematically raise throughput. It allows TGSRTC to move from data collection to data intelligence, i.e., from recording what happened to predicting what will happen and optimising operations accordingly.

AI can directly improve throughput by:

- Forecasting passenger demand to optimise routes and schedules,
- Predicting maintenance needs to maximise fleet availability,
- Adjusting operations in real time to traffic and load patterns, and
- Streamlining passenger boarding and feedback systems to reduce delays.

In doing so, AI helps TGSRTC achieve more movement, reliability, and service quality with the same physical resources, making throughput the most actionable indicator of sustainable public transport performance.

2.2. The AI Throughput Framework

The AI Throughput Framework identifies five interlinked domains that together determine the efficiency, reliability, and sustainability of a public transport network. Each domain represents a strategic lever where AI can generate measurable improvements in throughput for TGSRTC.

1. **AI for Route and Schedule Optimisation:** Aligning routes, schedules, and fleet deployment with real-time and forecasted passenger demand.
2. **AI for Fleet and Asset Optimisation:** Ensuring continuous vehicle availability and reliability through predictive maintenance and intelligent resource management.

3. **AI for Passenger Experience Intelligence:** Accelerating passenger flow and closing the feedback loop between commuters and operations.
4. **AI for Institutional Decision-Making:** Embedding analytics and real-time dashboards for responsive, evidence-based management at every organisational level.
5. **AI for Environmental and Energy Management:** Monitoring emissions, optimising fuel and energy use, and enabling a data-driven transition to low- and zero-emission fleets.

Together, these domains create an end-to-end throughput system in which data flows seamlessly from the field to decision-makers, and decisions translate into immediate, adaptive operational actions. AI serves as the unifying intelligence layer - collecting, processing, and analysing operational and environmental data to enhance both the speed and quality of passenger movement.

Data → Intelligence → Decision → Throughput Improvement

By embedding AI across these five domains, TGSRTC can transform from a static operator into an adaptive, learning transport network that constantly self-optimises for efficiency and reliability.

3. Applying the AI Throughput Framework in TGSRTC

The sections below show how AI can be applied in each throughput domain to improve the overall efficiency and reliability of TGSRTC's network.

3.1. AI for Route and Schedule Optimisation

Public transport systems face the continuous challenge of balancing operational efficiency with passenger convenience. Static route planning often struggles to keep pace with changing travel patterns (Puri, 2025), leading to underutilised services in some areas and overcrowding in others. AI offers a way forward by enabling dynamic, data-driven service design. AI algorithms can analyse historical data, real-time traffic conditions, and passenger demand to create optimised schedules and routes for buses, trains, and other transit services (Vemuri et al., 2024). By adapting to live conditions, these systems minimise delays, reduce wait times, and improve overall service reliability (Nampalli & Adusupalli, 2024). transport agencies now have the means to make smarter, evidence-based decisions. For the TGSRTC, this presents a significant opportunity to adopt a holistic, analytics-driven approach for streamlining operations, reducing costs, and enhancing the overall passenger experience.

a. Origin-Destination (O-D) Analysis

Public Transport Origin-Destination matrices (PT OD) are essential for effective transit planning and route network design, providing foundational insights into actual travel demand and passenger flows (Zhao et al., 2024). Recent studies confirm that integrating AI into O-D analysis enables more accurate, dynamic, and predictive insights into mobility patterns than traditional static methods. ML algorithms improve the construction and interpretation of O-D matrices by capturing subtle temporal-spatial variations and forecasting future demand trends (Wang et al., 2022; Mohamed & Chen, 2025). ML algorithms can cluster trip data to identify hidden mobility patterns, uncover high-demand corridors, identify consistently underserved areas, and reveal emerging patterns such as peri-urban growth or new residential-employment linkages. Reinforcement learning models can also simulate the impact of different route or frequency adjustments on passenger travel times and operational costs, guiding evidence-based service redesign. By embedding AI-enhanced O-D analysis into its planning framework, TGSRTC can transition from static, backward-looking models to a predictive and adaptive decision-making paradigm. This may enable TGSRTC to proactively plan and pilot new services rather than reacting after overcrowding or service gaps appear. It will align service supply with evolving mobility demand while improving efficiency, accessibility, and passenger satisfaction.

b. Rationalisation of Low-Ridership Routes

One of the most persistent inefficiencies in public transport systems arises from the continued operation of routes with consistently low ridership. AI offers powerful tools to address this challenge through the automated identification, analysis, and rationalisation of underperforming services. By applying ML algorithms to large-scale datasets of spanning ticket sales, passenger occupancy, GPS traces, and temporal demand fluctuations, AI systems can generate predictive models of route viability (Zhao et al., 2024). These models not only detect persistently low-performing routes but also flag patterns of declining ridership, enabling early intervention. Beyond simple identification, AI can simulate alternative route structures and service scenarios. For instance, optimisation algorithms can test whether merging two low-demand routes, restructuring stop sequences, or introducing demand-responsive feeder services would improve efficiency without compromising accessibility. Therefore, real-time fleet management systems use this data to dynamically adjust vehicle deployment, ensuring adequate capacity during peak hours while avoiding underuse during off-peak times (Zheng et al., 2022). NLP of passenger feedback, when integrated with ridership data, can further refine these recommendations by highlighting qualitative factors influencing route performance (Michael, 2023). Once rationalisation decisions are made, AI-driven resource allocation systems can automatically reassign freed capacity, such as buses, fuel, and manpower, to high-demand or underserved corridors, which is guided by real-time demand forecasts. This ensures that service supply dynamically adapts to actual mobility needs that may improve both operational sustainability and passenger satisfaction. Through AI-enabled rationalisation, TGSRTC can move towards a more adaptive, data-driven service model where route networks are continuously optimised, inefficiencies are minimised, and resources are deployed where they deliver the greatest value.

Global Example: AI-Powered Occupancy Monitoring in Sofia (EIT Urban Mobility, 2025)

In Sofia, the Urban Mobility Center has partnered with technology provider Theoremus to apply AI in monitoring bus occupancy levels. The system utilizes real-time images from existing onboard cameras and classifies passenger loads into five distinct categories. By doing so, it eliminates reliance on traditional boarding and alighting counts, which are often error-prone, accumulate inaccuracies over time, and typically require additional hardware investments. The solution is both efficient and cost-effective: the AI model was trained on a dataset of just 50,000 images and designed to remain relatively lightweight, ensuring ease of deployment at scale. This approach demonstrates how transit agencies can leverage existing infrastructure with AI to improve passenger visibility, enhance service planning, and minimize costs.

c. Clustering, Heat Maps, and Route Redundancy Analysis

AI-powered visualisation and spatial analytics tools, such as clustering and heat maps, enable TGSRTC to better understand network efficiency. By analysing GPS traces, boarding data, and passenger flow patterns, AI can identify overlapping routes, service gaps, and areas of underutilization. In dense urban zones, multiple routes often operate in parallel with only minor variations, leading to resource duplication and suboptimal fleet deployment. Clustering algorithms can group routes with high geographic and demand overlap, while heat maps reveal zones of concentrated or underserved demand. This can allow TGSRTC to restructure redundant services, streamline operations, and expand coverage into underserved areas, improving both efficiency and accessibility

d. Dynamic Scheduling Through AI-Driven Demand Patterns

Passenger travel behaviour is not static. It varies significantly by time of day, weekends versus weekdays, seasons, weather conditions, and special events. Static scheduling models fail to reflect this variability, often resulting in overcrowding at peaks and underutilization during off-peak hours. AI enables real-time, tactical adjustments to service schedules by analysing data such as historical ridership, time of day, and weather conditions. These models provide insights into peak demand periods and underutilised routes (Tang et al., 2021). For example, predictive algorithms can anticipate spikes in demand during office commute hours or festival seasons and recommend frequency increases, while during low-demand hours, services can be rationalised to avoid running near-empty buses. Dynamic scheduling ensures operational adaptability by making day-to-day service delivery responsive, efficient, and cost-effective. For TGSRTC, this approach translates into shorter passenger wait times, reduced empty runs, lower fuel consumption, and more reliable services that continuously adapt to real-world demand.

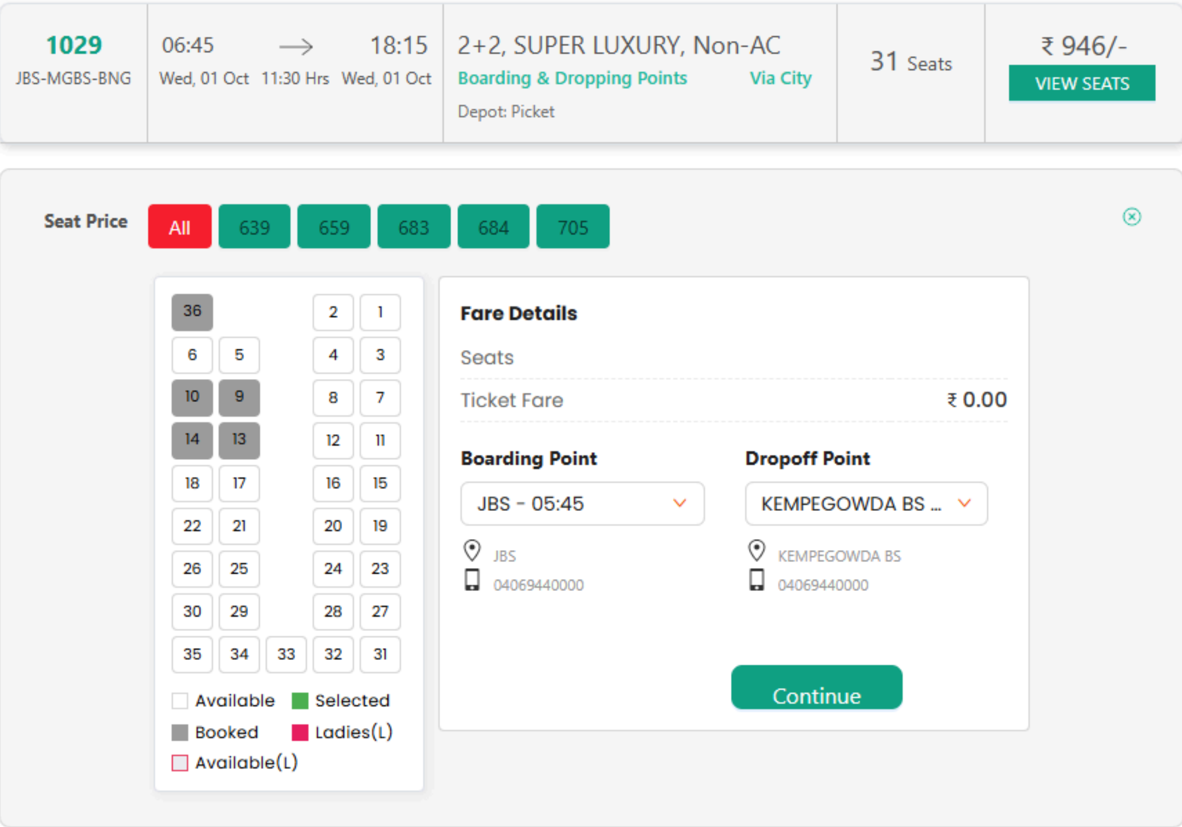
Global Example: AI-Powered Train Deployment and Crowd Management at Hong Kong MTR (Chen, 2025)

In Hong Kong, the MTR Corporation has begun integrating AI-powered systems to enhance train deployment and crowd management across its extensive rail network. Using predictive models built on historical ridership data, government mobility surveys, and event-specific datasets, the system can forecast passenger flows, station-level loads, and directional travel patterns with high accuracy. The AI tools were first deployed in July 2024 and have already demonstrated their value in managing crowds after large events such as concerts and sports matches. By anticipating post-event surges, the system enables MTR to adjust train frequencies, deploy additional capacity, and implement targeted crowd-diversion strategies. This not only helps maintain service reliability but also improves passenger safety and reduces congestion during peak surges. By embedding AI into its daily operations and special-event planning, Hong Kong's MTR illustrates how predictive analytics and intelligent crowd management can transform traditional transport systems into adaptive, passenger-responsive networks.

e. Dynamic Pricing on Competitive Routes

On routes where TGSRTC competes with rail, metro, or private buses, pricing strategies play a critical role in attracting and retaining passengers. While dynamic pricing has already been piloted in partnership with Sciative Solutions, AI can expand and refine this approach. By analysing real-time occupancy levels, historical ticketing data, and competitor pricing, AI models can recommend fare adjustments that balance demand with revenue (Transport Advancement, n.d.). Lower fares during non-peak hours can help improve seat utilisation, while competitive rates during high-demand periods ensure better revenue per kilometre. ML further allows continuous calibration by learning from passenger responses that can enable TGSRTC to offer fares that are both market-responsive and operationally sustainable. In this way, AI-driven dynamic pricing not only improves load factors but can also strengthen TGSRTC's competitiveness in a multimodal transport ecosystem.

Figure 2: AI for Route and Schedule Optimisation: Dynamic Pricing on Competitive Routes in TGSRTC



Source: TGSRTC; Authors

f. Integration of Multi-Modal Transport Hubs

Seamless connectivity across modes is central to a modern public transport ecosystem. By leveraging AI-driven O-D analysis and passenger flow modelling, TGSRTC can pinpoint key locations where integration with rail, metro, and feeder bus services is most critical. Intermodal transfer synchronisation is required to ensure that connecting services adjust their schedules in real-time to prevent missed transfers (Eze, 2025). Predictive analytics can help determine passenger transfer volumes, peak interchange periods, and optimal scheduling alignments between modes. This enables infrastructure and route planning to ensure efficient interchanges at multimodal hubs. This will help in reducing waiting times, minimising travel fatigue, and improving the overall journey experience. AI-supported integration not only strengthens system efficiency but can also enhances the competitiveness of public transport against private vehicles.

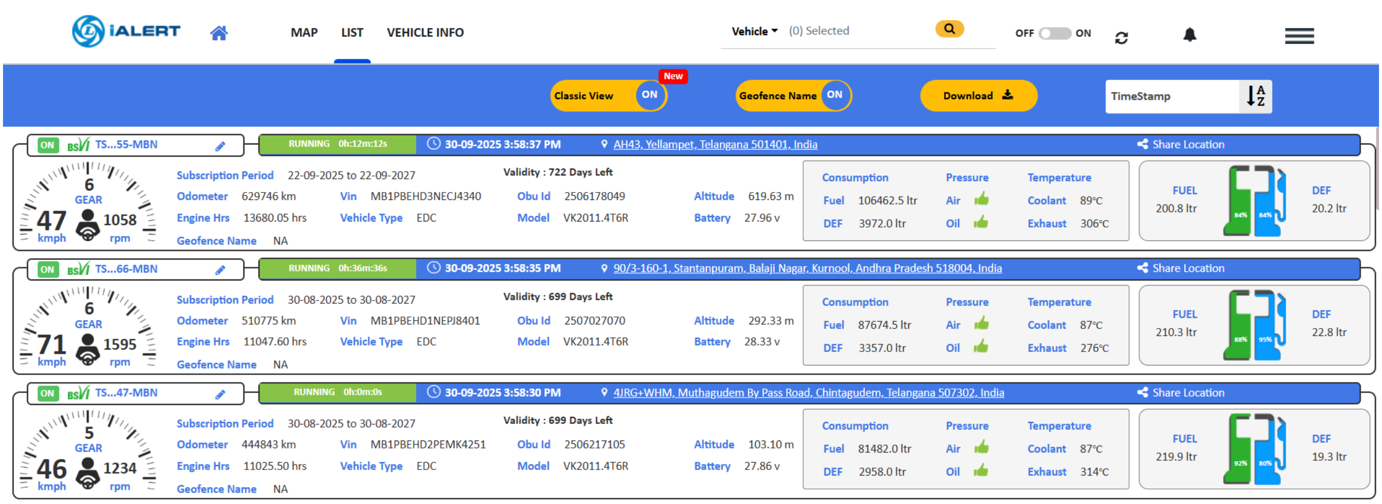
3.2. AI for Fleet and Asset Optimisation

Beyond optimising routes and schedules, the efficiency of a public transport system also depends on the reliability and availability of its fleet. Buses that break down frequently, operate below peak efficiency, or follow rigid maintenance schedules not only disrupt services but also increase operational costs. AI offers powerful tools to shift fleet management from reactive to proactive models. By leveraging IoT, telematics, and real-time diagnostics, AI enables intelligent fleet monitoring, predictive maintenance, and optimised asset utilisation. These applications ensure that vehicles remain roadworthy, downtime is minimised, and operational resources are used more effectively to strengthen both service reliability and passenger trust in TGSRTC.

a. Real-Time Vehicle Health Monitoring Through ML and IoT Sensors

Predictive maintenance systems, powered by ML and IoT, monitor the health of fleet vehicles and predict potential failures before they occur (Shah, 2024). Equipping buses with IoT sensors enables continuous collection of data on critical vehicle parameters such as engine performance, tyre pressure, and other key metrics (Syed, 2024). These data streams are transmitted in real time to a central Command and Control Center (CCC), where AI-enabled analytics can detect deviations from normal operating thresholds. By flagging anomalies early, maintenance teams can address emerging issues before they escalate into costly breakdowns or service disruptions. This proactive monitoring reduces on-road failures, enhances passenger safety, and improves overall fleet availability, which can allow TGSRTC to maximise service reliability while minimising downtime.

Figure 3: AI for Fleet and Asset Optimisation: Real-Time Vehicle Health Monitoring Through ML and IoT Sensors in TGSRTC



Source: TGSRTC; Authors

b. Predictive Maintenance Using Historical Service Data

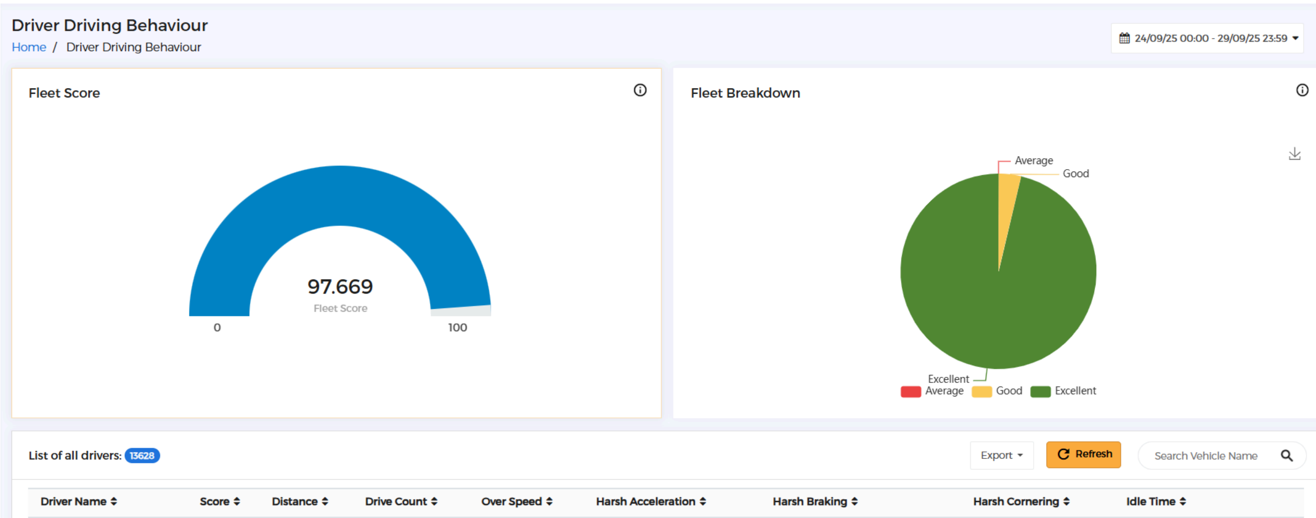
Research indicates that predictive maintenance powered by AI can lower maintenance costs by up to 30% and reduce unplanned downtime by as much as 45% (Cogent infotech, 2025). For instance, Deutsche Bahn has implemented an AI-driven system to reduce maintenance costs by about 25% and avoid delay-causing failures (Best Practice AI, n.d.). AI-driven predictive maintenance can enable TGSRTC to anticipate failures before they occur by analysing historical service logs, component replacement records, and operational data. ML models can identify recurring patterns, such as the average lifespan of brake pads under varying driving conditions or subtle precursors of engine malfunction. This approach shifts the maintenance regime from reactive or time-based schedules to a condition-based model (The American Public Transportation Association (APTA), 2025). AI-powered systems can generate real-time alerts when critical components approach failure thresholds, notifying both the Command and Control Center (CCC) and depot engineers. By forecasting failures, TGSRTC can minimise unscheduled downtime, optimise spare parts inventory, and maximise fleet availability to ensure smoother operations and reduced costs while enhancing passenger safety and reliability.

Global Example: AI-Driven Predictive Maintenance at Singapore's SBS Transit (Stratio, 2024)

In Singapore, the city's leading bus operator, SBS Transit, introduced an AI-enabled predictive maintenance program covering 1,000 buses in its initial rollout. The system delivered tangible results, reducing bus breakdowns by nearly 20% and improving service reliability. Encouraged by the impact, the program is now scaling to over 3,000 buses, amounting to approximately 62% of SBS Transit's fleet. This centralised AI platform ingests data from more than 200 vehicle parameters, offering real-time visibility into the health condition of brakes, electric systems, fluid levels, battery packs and more.

c. Driver Behaviour Analytics for Safety and Efficiency

Figure 4: AI for Fleet and Asset Optimisation: Driver Behaviour Analytics for Safety and Efficiency in TGSRTC



Source: TGSRTC; Authors

Driver behaviour plays a critical role in vehicle health, fuel and energy costs, and passenger safety. Using AI-driven analytics, TGSRTC can track indicators such as harsh braking, rapid acceleration, excessive idling, and overspeeding. ML models can identify high-risk patterns and correlate them with fuel consumption, wear and tear, and accident likelihood (Stratio, 2023). These insights can inform targeted driver training programs and performance-based incentives, fostering safer and more efficient driving practices. Over time, behaviour optimisation lowers maintenance costs, improves fuel economy, reduces accident risks, and enhances the overall passenger experience.

Global Example: AI-Enabled Driver Behavior Optimization in Morocco (UITP, 2025)

Alsa Morocco, which operates bus services across four major cities with a workforce of more than 3,000 drivers, has implemented an AI-driven program to promote efficient and safe driving practices. The system integrates on-vehicle telemetry data with external factors such as traffic conditions, passenger loads, and weather information. Using ML clustering algorithms, it identifies driving styles adapted to different operational contexts distinguishing, for example, between peak and off-peak conditions or between varying route profiles. To ensure assessments were both fair and effective, the programme employed multiple techniques: gamification features with incentives and recognition for good performance, identification of risk zones and recurring unsafe behaviors, and targeted training sessions tailored to specific issues. The outcomes were significant: fuel savings of 4-12% and a 15-40% reduction in alerts related to improper vehicle use. These improvements translated directly into safer, more comfortable passenger journeys and better vehicle health, underscoring the value of AI in combining operational efficiency with enhanced safety standards.

3.3. AI for Passenger Experience

As passenger expectations evolve and digital adoption accelerates, public transport systems must look beyond operational efficiency to focus on the end-to-end journey experience. For TGSRTC, digital transformation offers a dual opportunity: streamlining revenue systems while strengthening passenger trust and satisfaction. AI-enabled smart ticketing solutions simplify fare collection, improve transparency, and generate valuable demand data, while structured integration of passenger feedback provides actionable insights for continuous service enhancement. Together, these tools form the foundation of a responsive, passenger-centric transport system that is both financially sustainable and socially inclusive.

a. Promotion of Mobile App-Based and QR-Code Ticketing

Mobile app-based and QR-code ticketing systems go beyond replacing paper tickets. They generate continuous, high-frequency passenger data that AI can process for real-time operational insights. By integrating QR-code scanners in buses, TGSRTC can create a live digital stream of ridership patterns. AI algorithms analyse this data to predict demand surges, optimise bus frequencies, and dynamically adjust fleet deployment. Additionally, AI detects anomalies in ticketing data to identify potential fraud or revenue leakage (Awaait, 2020), improving financial accountability. Thus, mobile and QR-code ticketing are not only convenience tools but foundational enablers of an AI-driven ecosystem where passenger data informs operational optimization and revenue protection.

Figure 5: AI for Passenger Experience: Promotion of Mobile App-Based and QR-Code Ticketing in TGSRTC

Source: TGSRTC; Authors

b. Integration of Conductor Handheld Devices with Live Inventory and Route Data

Upgrading conductor handheld devices to AI-enabled interfaces transforms them from ticketing tools into real-time data nodes. Synced with the central ticketing and operations system, these devices give conductors live visibility into seat inventory, stage-wise occupancy, and passenger load on routes. AI analyses this continuous data stream to forecast near-term demand on specific segments, supporting conductors and depot managers in making informed adjustments on the ground. Predictive load analysis helps conductors manage ticket issuance efficiently, while anomaly detection flags potential fraud or operational irregularities. Beyond immediate revenue protection, aggregated data feeds AI-driven systems for dynamic scheduling, demand forecasting, and fleet optimisation.

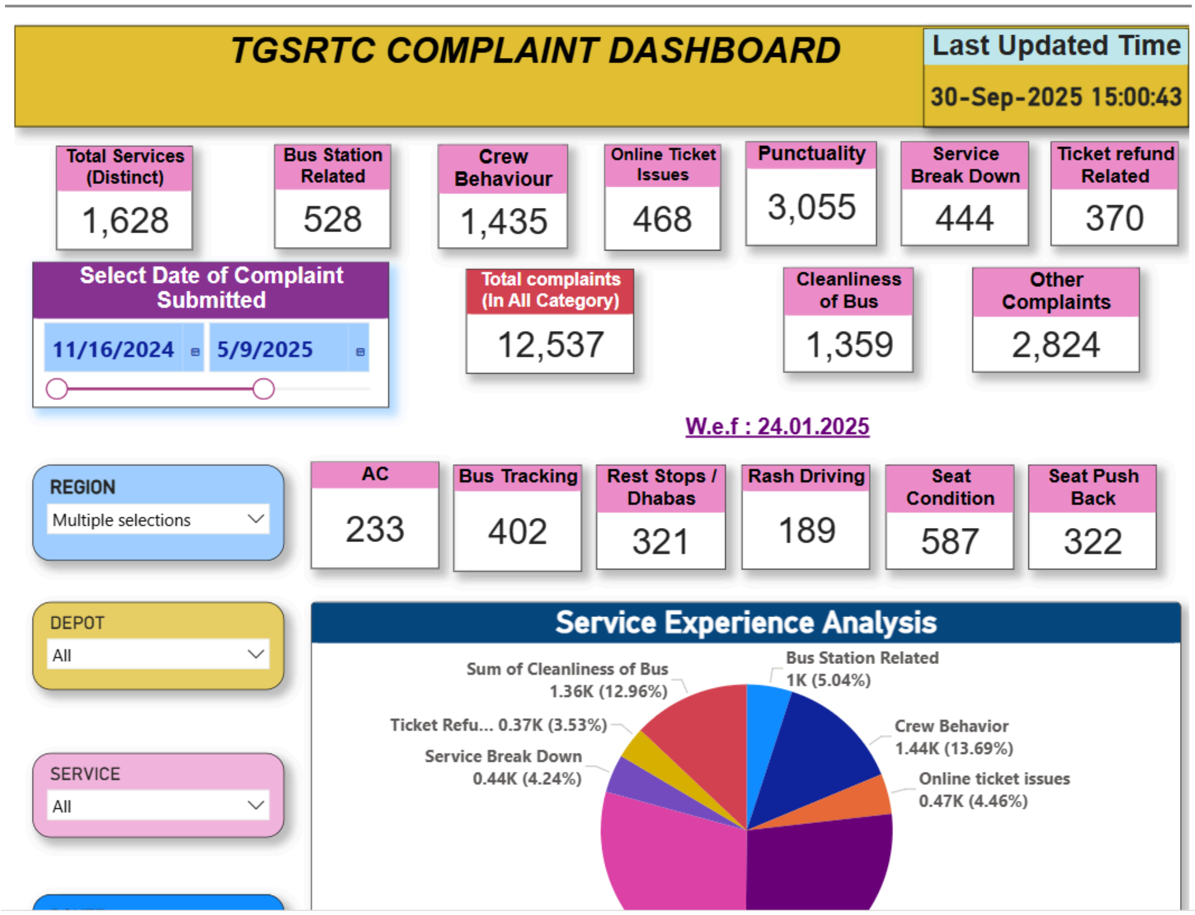
c. Real-Time Passenger Feedback Collection, Integration and Prioritisation

Passenger feedback provides critical intelligence on service quality, complementing operational performance metrics. By offering multiple digital channels such as SMS, mobile apps, website forms, and QR-linked portals, TGSRTC can capture real-time insights on punctuality, cleanliness, staff behaviour, and comfort. Linking feedback to specific trip IDs ensures that inputs are actionable at the route and service level, enhancing accountability. AI can elevate this process by applying NLP and sentiment analysis to unstructured feedback, automatically classifying comments into service themes and identifying patterns that may not be evident in manual reviews (Michael, 2023). ML models can further cluster satisfaction levels by route, time of day, or passenger type, enabling targeted interventions. Repeated complaints on specific routes or vehicles can be escalated automatically, ensuring that issues are not overlooked and are resolved promptly. In this way, AI ensures that this feedback loop is systematically analysed and translated into service improvements. Over time, such intelligence transforms feedback collection from a passive reporting tool into a proactive driver of continuous service enhancement.

d. Passenger Feedback Intelligence Dashboards

For feedback to drive meaningful change, it must be systematically integrated into performance monitoring. By embedding aggregated passenger feedback into monthly dashboards, depot managers and operations executives gain actionable insights alongside operational metrics. AI-driven visualisation tools can highlight trends such as a rise in cleanliness complaints on specific routes and generate route- or conductor-level performance scores. ML can also track resolution times and flag recurring or unresolved issues for escalation. By moving beyond static reporting, AI-driven dashboards transform feedback into an actionable performance metric to ensure service quality is continuously monitored, benchmarked, and improved as part of TGSRTC's operational review cycle.

Figure 6: AI for Passenger Experience: Passenger Feedback Intelligence Dashboards in TGSRTC

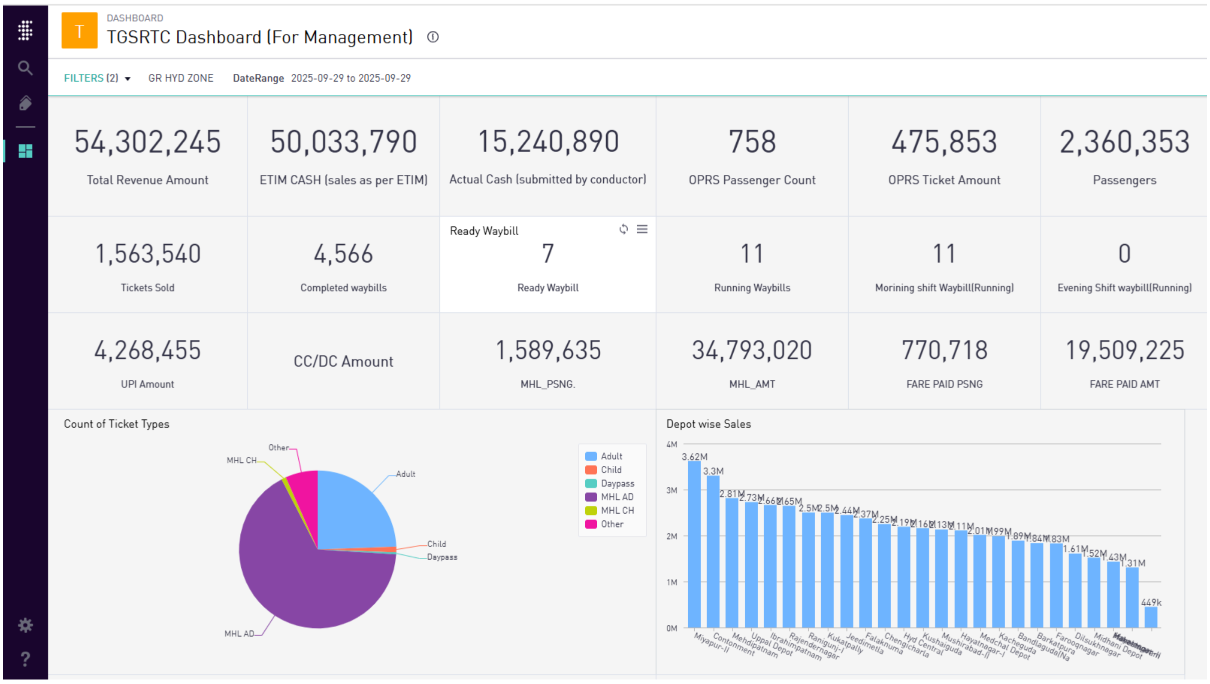


Source: TGSRTC; Authors

3.4. AI for Institutional Decision-Making

In a large-scale and complex public transport network such as TGSRTC, real-time operational visibility is essential for timely interventions, efficient resource use, and sustained performance improvement. AI can transform conventional monitoring into predictive and prescriptive decision support. By integrating live feeds from GPS, ticketing, IoT sensors, and passenger feedback into an AI-enabled dashboard ecosystem, decision-makers at every level can access actionable intelligence rather than static, post-facto reports. ML models can detect anomalies, forecast disruptions, and recommend corrective actions, while visualisation tools present trends in a form that supports rapid decision-making. This creates a proactive, data-driven culture across the organisation, where decisions are informed by real-time intelligence and system-wide coordination rather than fragmented reporting.

Figure 7: AI for Institutional Decision-Making in TGSRTC



Source: TGSRTC; Authors

a. Central Command Dashboard with Real-Time Aggregated Data

A central command dashboard should function as the nerve center of TGSRTC's operations, integrating and visualising live data streams from multiple subsystems. Inputs may include:

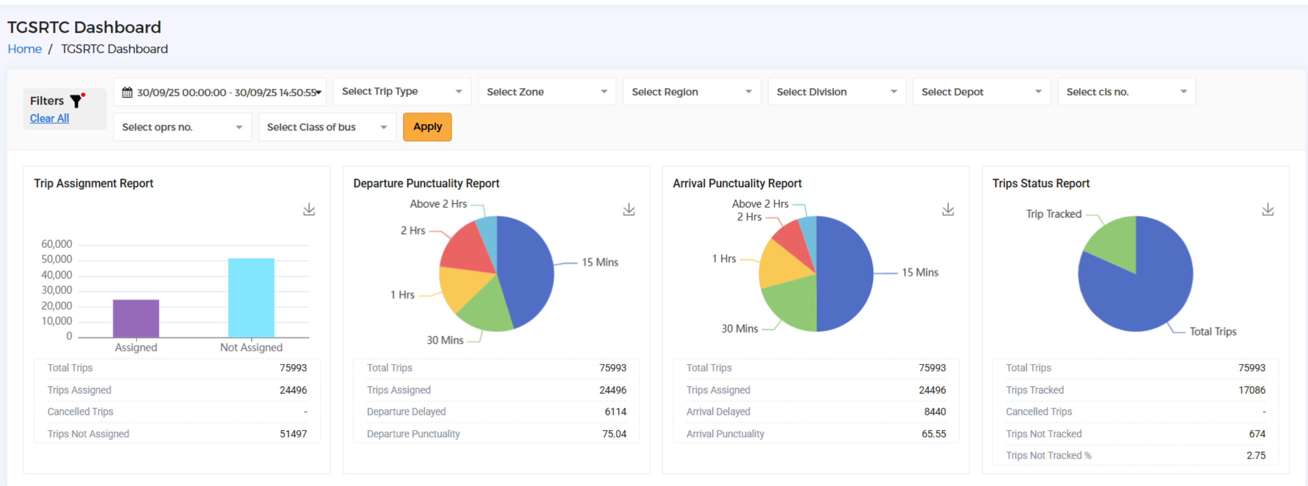
- ➢ Vehicle GPS data (current location, speed, route deviations)
- ➢ Ticketing system (real-time revenue, occupancy, ticket types)
- ➢ Schedule adherence (delays, early departures, missed trips)
- ➢ Driver behaviour analytics (idling, overspeeding, harsh braking)

AI-enabled analytics can process this data to detect anomalies, predict disruptions, and recommend interventions in real time. For instance, predictive alerts may flag potential congestion hotspots or identify underperforming routes before they impact service quality. By consolidating diverse datasets into a unified interface, the dashboard empowers executives and control room operators to monitor state-wide operations at a glance, coordinate responses during peak hours or special events, and shift from reactive reporting to proactive, intelligence-led decision-making.

b. Depot-Level Dashboards with Operational Performance Metrics

At the depot level, AI-powered dashboards can provide managers with granular visibility into day-to-day operations. Key Performance Indicators (KPIs) such as fuel efficiency (KMPL), vehicle utilisation rates, scheduled versus unscheduled maintenance hours, and daily trip completions versus missed trips can be continuously monitored in real time. ML models can benchmark these metrics across depots, automatically highlighting outliers and identifying systemic inefficiencies. Predictive analytics can further support proactive planning by either flagging vehicles likely to miss trips due to maintenance issues or estimating the impact of driver behaviour on fuel economy. These dashboards also strengthen accountability by linking performance data to staff and asset records, enabling targeted crew counselling, periodic reviews, and performance-based incentives. By embedding AI into depot-level decision-making, TGSRTC can foster a culture of continuous improvement, where localised insights directly contribute to system-wide efficiency.

Figure 8: AI for Institutional Decision-Making: Depot-Level Dashboards with Operational Performance Metrics in TGSRTC



Source: TGSRTC; Authors

c. Regional and Zonal Dashboards for Strategic Planning

For zonal and regional managers, dashboards must provide a strategic, aggregated view of operations that extends beyond daily monitoring. AI-enabled analytics can consolidate and interpret performance data to support higher-level planning and resource allocation. Key features may include:

- ➢ Route-wise profitability analysis (earnings per kilometre, long-term occupancy trends, and cost-revenue ratios)
- ➢ Region-wise comparison of manpower utilisation (drivers and conductors deployed per vehicle, benchmarked against peers)
- ➢ Seasonal demand mapping (forecasting passenger surges and planning additional services in advance)

ML models can detect persistent patterns of inefficiency, such as zones with recurrent breakdowns, consistently low revenue recovery, or chronic manpower shortages. By flagging these systemic issues, the dashboards equip senior managers with the intelligence needed to deploy corrective measures proactively and align zonal performance with corporate goals.

To maximise usability and responsiveness, certain features should be embedded across all dashboard levels. Intuitive visualisation tools, such as colour-coded KPIs (red for critical, yellow for warnings, green for normal performance), allow even non-technical users to identify problem areas at a glance, reducing decision fatigue and enabling quicker interventions. Similarly, integration with incident management systems ensures that dashboards evolve from passive monitoring tools into active problem-solving platforms. This includes logging on-road incidents, escalating them to relevant teams in real time, and tracking resolution status. Embedding these features across central, depot, and regional dashboards ensures that intelligence is not only visible but also actionable to close the loop between monitoring and response.

3.5. AI for Environmental and Energy Management

Sustainability is now core to public transport resilience, with emission reduction, optimized fuel and energy use, and electric vehicle (EV) integration essential to achieving climate goals at state and national levels. AI-driven tools for emissions monitoring and real-time fuel and energy optimisation enable transit agencies to actively reduce their carbon footprint while enhancing operational cost-efficiency (World Economic Forum, 2025). ML can also simulate future scenarios such as shifting fleet composition, route optimisation, etc. In this dimension, AI acts as both a monitoring and planning engine, ensuring that operational efficiency and environmental stewardship advance hand-in-hand, positioning TGSRTC as a leader in green public transport transformation.

a. AI-Based Emissions Monitoring and Reporting

By integrating IoT sensors with AI analytics, real-time emissions such as CO_2, NOx, and particulate matter from its fleet can be measured (Intangles, 2025). ML models can then track trends, benchmark emissions across depots and vehicle types, and flag high-polluting assets for corrective maintenance or replacement. This can create a data-backed foundation for compliance with national and state-level emission reduction goals.

b. Fuel and Energy Optimisation through AI

AI can analyse driving behaviour, route profiles, and traffic conditions to identify fuel inefficiencies and recommend corrective measures. Fleet management systems equipped with AI algorithms can recommend eco-friendly driving behaviours, such as maintaining optimal speeds and reducing rapid acceleration, which significantly lower fuel usage and emissions (Ma et al., 2024). For diesel and CNG buses, this may include optimising speed profiles or reducing idling, while for EVs, AI can balance charging cycles with demand forecasts to reduce energy costs and grid strain. This can ensure greener operations while lowering operating expenses for TGSRTC.

Global Example: AI-Optimised Smart Charging in Spain (Bia, n.d.)

At its Alcorcón depot, Arriva Spain operates a fleet of 16 battery electric buses (e-buses). With the transition to electric mobility came new challenges: increased power demand, higher variable energy costs, and the risk of accelerated battery degradation. To address these, the operator adopted Bia's AI-enabled Smart Charging solution, designed to optimise charging schedules while maintaining fleet uptime. The platform leverages historical charger telemetry data and fleet management information to predict charging needs and dynamically adjust charging cycles. This allows buses to be charged preferentially during periods of lower electricity tariffs, while keeping charging speeds slower where possible to protect battery health. Importantly, the optimisation does not compromise operational schedules or departure times. The results have been striking: electricity costs reduced by 25% and the average maximum state of charge per vehicle lowered by 24%, thereby prolonging battery life.

c. AI for Deployment of EV Charging Infrastructure and Battery Health Management

The transition to electric vehicles is a critical step toward reducing transportation-related emissions (Orsoletta et al., 2022). AI technologies support this transition by predicting charging demand and optimising the placement of EV charging stations (Yi et al., 2021). ML models analyse data on traffic patterns, population density, and electricity grid capacity to determine optimal locations for charging stations, ensuring accessibility and grid stability (Ahmad et al., 2022). As TGSRTC transitions to electric mobility, AI-driven systems can facilitate a smoother adoption of EVs while minimising the strain on energy infrastructure. AI can also help in monitoring battery health, charging cycles, and degradation patterns. Predictive models help schedule charging during off-peak grid hours, extend battery life, and prevent range anxiety by forecasting energy requirements based on route and passenger demand. This maximises EV fleet uptime and sustainability outcomes.

Table 1: Summary of AI for Improving Public Transport Throughput Framework

Dimension	Strategic Focus	Key AI Applications	Outcomes
AI for Route and Schedule Optimisation	Aligning routes, schedules, and fleet deployment with real-time and forecasted demand	O-D analysis, dynamic scheduling, dynamic pricing, route clustering and redundancy analysis, multimodal hub integration	Higher route efficiency, reduced congestion, and better alignment of supply with demand
AI for Fleet and Asset Optimisation	Ensuring vehicle availability and reliability through predictive maintenance and monitoring	Real-time health monitoring, predictive maintenance, driver behaviour analytics, digital inspections, automated scheduling	Lower breakdowns, reduced downtime, optimised maintenance costs, improved reliability
AI for Passenger Experience Intelligence	Streamlining ticketing, accelerating passenger flow, and integrating feedback intelligence	Mobile/ QR ticketing with AI analytics, handheld device integration, AI-enabled feedback management, and dashboard-linked feedback	Faster boarding, reduced leakage, higher passenger satisfaction, stronger accountability
AI for Decision-Making	Embedding analytics and dashboards for real-time, evidence-based decision-making	Central, depot, and zonal dashboards, anomaly detection, KPI benchmarking, and incident management integration	Proactive interventions, faster responses, improved planning, culture of data-driven management
AI for Sustainability and Environmental Impact	Reducing emissions, optimising energy, and enabling transition to low/zero-emission fleets	AI-driven emissions monitoring, fuel/energy optimisation, EV battery health and charging management, and sustainability scenario modelling	Lower carbon footprint, regulatory compliance, reduced costs, greener and resilient operations

4. TGSRTC Readiness: Institutional Strengthening and Implementation

The transition toward an AI-enabled public transport ecosystem requires more than the deployment of new technologies. For TGSRTC, the challenge is not only to introduce AI into operations but to embed it within the organisation's governance structures, workforce capabilities, and financing models. Successful integration depends on institutional readiness-how well the corporation can adapt its decision-making culture, organisational design, and operational processes to leverage the transformative potential of artificial intelligence. This chapter outlines the pathways through which TGSRTC can strengthen its institutional foundations and ensure that AI adoption is both sustainable and scalable.

4.1. Assessing Institutional Readiness for AI Integration

Institutional readiness refers to the extent to which TGSRTC possesses the human, technical, and organisational capacity to absorb and scale AI innovations. A maturity assessment framework can be deployed across five key pillars: people, processes, data, technology, and governance (Stirling et al., n.d.; Department of Transport, Government of UK, 2025).

- ➢ **People:** Staff across all levels, from drivers and conductors to depot managers and senior executives, require varying degrees of AI literacy. The extent of current familiarity with digital systems, openness to change, and capacity for learning directly shape the adoption curve.
- ➢ **Processes:** Standard operating procedures (SOPs) for data intake, model deployment, monitoring, and incident response must be codified to reduce reliance on ad-hoc practices.
- ➢ **Data:** The quality, coverage, and interoperability of data systems form the backbone of AI integration. Without reliable data streams, predictive and prescriptive models cannot function effectively.
- ➢ **Technology:** Robust cloud infrastructure, secure integration platforms, and continuous integration/continuous deployment (CI/CD) pipelines for analytics are essential.
- ➢ **Governance:** Policies relating to data protection, ethical AI, and accountability mechanisms provide the safeguards necessary for trust and legitimacy.

By benchmarking each of these dimensions on a maturity scale, TGSRTC can identify capability gaps and prioritise interventions, ensuring that AI adoption is grounded in institutional capacity rather than technological aspiration alone.

4.2. Governance Model and Roles within TGSRTC

A clear governance framework is critical for embedding AI into day-to-day decision-making. TGSRTC must move from viewing AI as a vendor-provided solution to treating it as an institutional capability. This requires defining new roles and reconfiguring responsibilities.

At the apex, a Steering Committee comprising senior leadership and government representatives should provide strategic direction, budget approvals, and oversight of risk management. Within the organisation, an AI and Data Program Management Office should be established to coordinate implementation, manage vendors, and track performance.

Specialised roles are essential: a Chief Data Officer (CDO) to steward the data strategy, enforce standards, and ensure interoperability; a Chief Information Security Officer (CISO) to oversee cybersecurity and incident response; and a Data Protection Officer (DPO) to ensure compliance with the Digital Personal Data Protection Act (2023). Model ownership should be distributed across functional domains, such as ticketing, fleet, and scheduling, so that domain experts are accountable for the performance and ethical deployment of AI systems. Finally, an Ethics Board with representation from academia and civil society can strengthen transparency and legitimacy by reviewing new deployments and conducting annual audits.

4.3. Data Infrastructure and Capacity-Building for AI

Effectively implementing AI within TGSRTC requires a robust and scalable data infrastructure capable of managing large volumes of diverse data generated across its operations. This infrastructure must include secure and interoperable data lakes or cloud platforms, enabling seamless access and processing of data. Advanced data management tools are necessary to clean, harmonise, and enrich data from multiple sources, ensuring AI models receive high-quality inputs. Establishing reliable data pipelines that connect operational technologies (OT) with AI algorithms is critical; this may involve upgrading legacy IT systems and adopting edge computing to perform initial AI processing directly on vehicles for faster response (Cogent infotech, 2025). Additionally, robust cybersecurity measures must be implemented to protect sensitive transit data and ensure system integrity throughout AI integration.

The effective adoption of AI within transport authorities demands targeted upskilling across technical, operational, and governance domains. At its core, staff must develop strong digital literacy, including proficiency in data analytics, ML, cloud computing, and cybersecurity (Ministry of Electronics and Information Technology, 2024). Transport professionals need the ability to interpret AI-generated insights, steward data-driven decision-making, and oversee digital platforms for operations, maintenance, and service delivery (ITF, 2025a; ITF, 2025b; Smith, 2025).

Domain specialists including planners, engineers, and managers, will require additional training to understand AI system deployment, algorithmic bias, risk management, and ethical oversight, ensuring safe, transparent, and responsible integration of AI into public transport. Developing these cross-disciplinary capabilities can involve upskilling existing employees through structured training programs, launching AI apprenticeship schemes, and recruiting new talent with AI and digital expertise. Collaboration with universities, industry partners, and research institutions is recommended to keep pace with evolving best practices (Innovate UK, 2025). Certification modules and micro-credentials can help staff build competencies progressively, while creating a culture of continuous learning across the corporation.

4.4. Phased Implementation Strategy

Introducing AI into a complex system such as TGSRTC must follow a phased, iterative approach. TGSRTC can adopt a 'Scan > Pilot > Scale> Sustain' approach (Department for Science, Innovation & Technology, 2025) in embedding the use of AI.

- **Scan Phase:** Investing in building a deep and continually updated understanding of AI capabilities mapped to their highest impact challenges and opportunities in public transport.
- **Pilot Phase:** Small-scale pilots such as predictive maintenance in one depot or dynamic scheduling on a single corridor that will allow the organisation to test models, refine data processes, and generate quick wins. Importantly, baseline data must be collected in advance to measure improvements in efficiency, cost, and service quality.
- **Scale Phase:** Once validated, solutions should be expanded to multiple depots or zones. This stage involves integrating data pipelines, codifying standard operating procedures, and strengthening vendor management.
- **Sustain Phase:** At maturity, AI should be embedded into business-as-usual operations, with monitoring systems in place for drift detection, annual model recertification, and continuous improvement cycles. Budgetary allocations must shift from one-off pilots to recurring operational expenditure, ensuring long-term sustainability.

This phased strategy ensures that AI adoption is pragmatic, evidence-based, and resilient to early setbacks.

4.5. Financing and Partnerships

AI integration requires upfront investment in data infrastructure, analytics platforms, and capacity building. TGSRTC should explore a combination of financing models:

- **Public-Private Partnerships (PPPs):** Vendors may be engaged under outcome-linked contracts, with payments tied to measurable improvements such as fuel savings or reduced breakdowns.
- **Multilateral Development Banks (MDBs):** Institutions such as the World Bank and the Asian Development Bank increasingly fund digital and green mobility projects. AI systems that reduce emissions or enhance efficiency can qualify for climate-linked financing.
- **Innovation Grants:** Partnerships with startups and universities, supported by state innovation funds or national programs, can stimulate experimentation and reduce costs.
- **Green Bonds and Climate Finance:** Given the sustainability benefits of AI, TGSRTC can explore tapping into climate finance mechanisms to fund EV-intelligent charging systems or emissions monitoring platforms.

By diversifying financing sources, TGSRTC can reduce dependence on annual budgetary allocations and secure long-term support for AI-driven transformation.

4.6. Monitoring, Evaluation, and Continuous Learning

To prevent AI from becoming a 'black box,' TGSRTC can embed a culture of monitoring and evaluation. This involves defining clear Key Performance Indicators (KPIs) for throughput, passenger experience, sustainability, and AI quality.

- **Throughput KPIs** may include passenger throughput per bus-km, average wait times, and missed trips.
- **Passenger Experience KPIs** may track boarding times, revenue leakage, complaint resolution speed, and sentiment scores.
- **Sustainability KPIs** should measure emissions per passenger-km, fleet fuel efficiency, and EV battery health.
- **AI Quality KPIs** must monitor model accuracy, bias, drift, and explainability.

Regular reporting cycles, for example-monthly reviews for operational improvements, quarterly learning sprints for innovation, and independent annual audits, will ensure accountability.

AI offers TGSRTC a powerful pathway to enhance efficiency, reliability, sustainability, and passenger trust. By embedding AI across routes and schedules, fleet and asset management, passenger experience, decision-making, and sustainability, the corporation can evolve from a static operator into a dynamic, learning system. Realising this vision will require strong governance, ethical safeguards, institutional readiness, and sustained investment. If pursued with care and commitment, AI can enable TGSRTC to deliver not only higher throughput but also more inclusive, resilient, and environmentally responsible public transport for the people of Telangana.

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Credits

About ITS India Forum

The **ITS India Forum** is a leading not-for-profit think tank dedicated to advancing Intelligent Transportation Systems (ITS) in India. ITS India Forum promotes safety, affordability, and inclusivity in transportation in alignment with the Viksit Bharat Vision 2047. The Forum serves as a collaborative platform for industry professionals, government agencies, and academic institutions working together to shape the future of transportation in the country.

About OMI Foundation Trust

OMI Foundation Trust is a new-age policy research and social innovation think tank operating at the intersection of mobility innovation, governance, and public good. Mobility is a cornerstone of inclusive growth providing the necessary medium and opportunities for every citizen to unlock their true potential. OMI Foundation endeavours to play a small but impactful role in ushering meaningful change as cities move towards sustainable, resilient, and equitable mobility systems, which meet the needs of not just today or tomorrow, but the day after.

OMI Foundation houses four interconnected centres that conduct cutting-edge evidence-based policy research on all things mobility:

1) The Centre for Technology Transitions is dedicated to transforming India's innovation ecosystem through a systems approach. It aims to position India as a global leader in ethical, inclusive, and sustainable technological innovation.

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