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Artificial Intelligence for Transit Asset Management

Adam Cohen

Background

Transit Asset Management (TAM) is the strategic and systematic practice of procuring, operating, inspecting, maintaining, rehabilitating, and replacing transit capital assets to manage their performance, risks, and costs over their life cycles, for the purpose of providing safe, cost-effective, and reliable public transportation. Federal law (49 CFR Part 625) requires all U.S. transit agencies to maintain a TAM plan that includes a capital asset inventory, condition assessments, investment prioritization, and a decision support tool. This tool may consist of an analytic process or methodology used to prioritize state of good repair investments based on asset condition and objective criteria, or to assess long-term financial needs for asset investments.

Artificial intelligence (AI) can strengthen these capabilities by helping transit agencies analyze large and complex datasets, detect patterns and anomalies, automate routine tasks, and support predictive decision-making. As a result, AI can help transit agencies:

- Predict asset failures before they occur;
- Optimize maintenance scheduling and workforce deployment;
- Improve inspection accuracy and frequency;
- Enhance lifecycle cost forecasting;
- Support real-time asset monitoring; and
- Improve operational reliability and customer service.

What Is AI in Transit Asset Management?

AI refers to computational systems capable of performing tasks typically requiring human intelligence, including learning, pattern recognition, reasoning, and decision support. AI technologies with potential applications to TAM include:

- Machine learning (ML) - algorithms that identify patterns in data and improve their predictions over time;
- Predictive analytics - tools that use historical and real-time data to forecast future conditions or events;
- Computer vision - AI systems that analyze images or video to detect objects, defects, or patterns;
- Natural language processing (NLP) - AI that reads, interprets, and generates human language, including maintenance reports and operational records;

- Generative AI - systems that can produce text, summaries, or recommendations based on large datasets;
- Digital twins - virtual replicas of physical assets used to simulate performance and test maintenance strategies; and
- Automated anomaly detection - systems that flag unusual patterns in data that may indicate an emerging problem.

For example, machine learning can identify trends and predict future conditions using historical and real-time data. Computer vision systems can analyze images and video collected from cameras, drones, or mobile devices to detect infrastructure defects or equipment issues. Generative AI can assist with maintenance documentation, reporting, troubleshooting, and knowledge management.

To date, AI applications in transit asset management have largely focused on targeted functions such as prediction, anomaly detection, automation, and decision support, rather than fully autonomous decision-making systems.

Historically, TAM has relied upon scheduled maintenance intervals and reactive repairs. AI-enabled asset management systems shift agencies toward predictive maintenance. This transition allows agencies to improve reliability while reducing unnecessary maintenance activities and minimizing unexpected failures.

AI Use Cases in Transit Asset Management

The table below summarizes five major categories of AI applications for TAM. The table describes what the technology does, how it is being applied at transit agencies today (or could be applied by transit agencies in the future), and the potential benefits for public transit. Hyperlinked sources are provided for each agency example.

Table 1. AI Applications in Transit Asset Management

Application	Description	Examples of Transit Applications	Potential Benefits
Predictive Maintenance	AI analyzes sensor data, maintenance histories, and operational patterns to predict asset failures before they occur.	MTA New York City Transit (Preteckt): Continuously analyzes vehicle sensor data to flag components approaching failure and dispatches crews based on predicted condition rather than schedules — yielding a 43% increase in maintenance productivity and 24% reduction in material costs.[1] Read more SBS Transit, Singapore (Stratio): Monitors brakes, electric systems, fluid levels, and air-conditioning across its fleet — covering over 200 vehicle parameters in real-time. Phase 1 (1,000 buses) yielded a 20% reduction in breakdowns; expanding to 3,000+ buses.[2] Read more Ravenna, Italy (EBSF_2 pilot): Sensors monitored engine oil condition as a leading failure indicator, reducing bus breakdowns by 8% during the pilot period.[3] Read more	Reduced downtime; fewer emergency repairs; extended asset life; improved reliability.
Automated Inspections	Computer vision, sensors, and automated imaging technologies support inspections of vehicles and infrastructure assets.	AC Transit, CA (Hayden AI): An AI image recognition system automatically scans camera footage to identify vehicles illegally using transit-only lanes, flagging violations in real-time. Citations increased from 22 to 787 over a comparable two-month period.[4] Read more While this application focuses on transit operations rather than asset management, it demonstrates the growing use of AI-enabled image recognition in public transportation. Similar computer vision technologies could be applied to transit asset management through automated vehicle inspections. For example, buses could drive over fixed cameras at maintenance facilities, where frame-by-frame AI analysis would detect cracks, fluid leaks, and worn components without requiring manual inspection of each vehicle.	Improved inspection frequency; enhanced worker safety; greater consistency; reduced labor requirements.

Application	Description	Examples of Transit Applications	Potential Benefits
Proactive Interventions	AI systems can automatically trigger work orders, alerts, and parts orders when sensor thresholds are breached or predictive models flag elevated failure probability.	Penske Transportation Solutions (Hitachi Proactive Diagnostics): Monitors vehicle telemetry and auto-generates prioritized repair instructions before a vehicle enters the shop, routing parts to the right bay in advance. This prevented 90,000+ breakdowns in a single year and reduced average repair time by 15 minutes across a 440,000-vehicle fleet.[6] Read more NLP-driven work order automation: AI models trained on agency maintenance records and operator defect reports could potentially draft work orders, assign fault codes, and recommend repair actions.[5]	Faster response times; reduced administrative burden; prevention of cascading failures; improved parts availability.
Real-Time Asset Monitoring & Continuous Condition Monitoring	Continuous monitoring of asset condition via sensors and connected systems, building longitudinal health profiles over time.	Copenhagen Metro, Denmark (Hitachi Rail HMAX): AI-fed sensors on M3/M4 trains will be deployed to monitor vibrations, vehicle subsystems, bogie and wheelset health, and track condition, enabling condition-based maintenance.[5] Read more	Improved situational awareness; faster response times; improved lifecycle management; data-driven capital planning.
Dynamic Decision Support	AI synthesizes condition scores, cost data, ridership exposure, and remaining useful life estimates to prioritize maintenance actions and capital investments.	Federal Transit Administration (2024 TAM Roundtable): Used an NLP model to simultaneously process 600+ agency National Transit Database (NTD) narrative reports, automatically identifying recurring themes — bus procurement delays, cost escalation, capital backlogs — that would have taken analysts weeks to surface manually.[7] Read more AI-assisted capital prioritization: Agencies could leverage AI to ingest fleet condition scores, asset age, ridership exposure, and replacement costs. AI could generate a ranked replacement list with cost-benefit rationale for TAM plan target-setting and FTA grant applications.[8]	Better resource allocation; improved capital planning; increased defensibility of investment decisions.

Table footnotes: [1] Preteckt / NYCT UITP Award (2023) [2] Stratio Automotive / SBS Transit (2024) [3] ITS Deployment Evaluation, USDOT (2022) [4] AC Transit press release (2024) [5] ITS JPO Executive Briefing (2022/2025) [6] Penske / GovInfoSecurity (2024) [7] FTA 2024 TAM Roundtable Summary Report [8] Cohen (2024)

Challenges and Risks

While AI presents opportunities for improving transit asset management, implementation can also introduce a range of technical, organizational, financial, operational, and governance challenges. Public transit agencies should carefully evaluate these risks to ensure that AI is deployed appropriately (ITS JPO, 2025). Each of these issues is discussed below.

Data Quality and Integration

AI depends heavily on large volumes of accurate, consistent, and interoperable data. However, many transit agencies continue to operate with fragmented asset inventories, siloed data systems, inconsistent condition assessments, and legacy information technology platforms. These limitations can reduce the effectiveness and reliability of AI-enabled predictive analytics and decision support systems (ITS JPO, 2025). Industry discussions surrounding AI-enabled maintenance systems consistently emphasize that poor data quality remains one of the greatest barriers to successful implementation. Many agencies also face challenges integrating data across maintenance, operations, procurement, planning, and finance functions. Without strong data governance and interoperability standards, AI may generate incomplete or inaccurate recommendations (ITS JPO, 2025).

Organizational and Workforce Barriers

The successful deployment of AI requires organizational readiness, workforce engagement, and technical expertise (ITS JPO, 2025). Transit agencies may encounter institutional resistance to change, particularly when AI alters existing asset management processes and decision-making workflows. Public transit agencies may also face:

- Workforce concerns regarding automation and its impacts on labor;
- Difficulty recruiting staff with technical AI and data science expertise;
- Limited institutional expertise in AI literacy, cybersecurity, and AI governance.

As public transit adopts electrified fleets and connected infrastructure, agencies will require new technical competencies related to data analytics and AI-assisted decision making (ITS JPO, 2025). The APTA Primer (2026) identifies staff capacity and training as one of its four agency readiness dimensions, and recommends that workforce development precede technology deployment.

Financial and Procurement Constraints

Although AI may reduce long-term lifecycle costs, implementation often requires substantial upfront investments in sensors, cloud infrastructure, software, enterprise asset management systems, and workforce training. Many transit agencies already face significant capital funding constraints and deferred maintenance backlogs. FTA estimated the national transit state-of-good-repair (SGR) backlog at approximately $101 billion in 2018, with more recent estimates exceeding $140 billion (FTA & Volpe National Transportation Systems Center, 2025).

Public-sector procurement processes may also create implementation challenges. Agencies may face difficulties evaluating rapidly evolving AI technologies, avoiding vendor lock-in, ensuring interoperability, and establishing data ownership rights. A specific procurement risk identified by ITS America (2023) is dataset shift: as real-world conditions change over time, an AI system trained on historical data gradually moves outside its training distribution, causing its predictions to become less accurate. In public-sector procurement, where systems are often purchased as one-time deliverables, this means AI performance may silently degrade unless contracts explicitly require ongoing model monitoring and retraining. When contracting with AI vendors, transit agencies should require that contracts spell out how the system's performance will be measured, who can review the data behind it, what happens when the AI's training data becomes outdated, and how and when the system will be updated (ITS America, 2023).

Cybersecurity and Operational Risks

AI-enabled transit asset management increases connectivity between vehicles, infrastructure, sensors, operational systems, and cloud-based platforms. While this connectivity improves monitoring capability, it also expands potential cybersecurity vulnerabilities (Zheng et al., 2020; Department of Homeland Security, 2024; CISA & ASD ACSC, 2025). Public transit agencies will need to address risks associated with:

- Unauthorized system access;
- Ransomware attacks targeting operational or maintenance systems;
- Data manipulation that corrupts AI model outputs;
- Communications disruptions affecting real-time asset monitoring; and
- Cascading failures in AI monitoring systems during service-critical periods.

These concerns will be increasingly important as transit agencies deploy connected infrastructure and electrified fleets that rely heavily on real-time digital systems.

Ethical, Legal, and Governance Considerations

AI systems may produce biased outputs if they rely on incomplete or historically biased datasets, potentially leading to discriminatory practices such as prioritizing services for some users or communities over others (Cohen, 2024; ITS America, 2023). For public transit agencies, this concern extends to AI-assisted decisions about maintenance prioritization and capital investment, where biased data could inadvertently disadvantage underserved communities — raising potential Title VI compliance concerns (Federal Transit Administration, 2012). Agencies should ensure appropriate human oversight, transparency, and accountability when deploying AI-enabled decision support systems, and should not rely solely on AI outputs when making decisions with civil rights implications (Tabassi, 2023).

Several studies emphasize that trust and human oversight are essential, and that AI should support — not replace — professional expertise and transit agency decision making (ITS America, 2023). Additionally, Cohen (2024) identifies unresolved liability questions: when an AI-assisted decision contributes to a safety incident, existing tort frameworks may not clearly assign responsibility between the agency, the vendor, and the AI model developer. Agencies should seek legal guidance on AI liability exposure before deployment.

Strategic Considerations for Public Transit Agencies

The following six strategic considerations are drawn from federal resources, industry associations, academic research, and peer agency experiences to help public transit agencies approach the adoption of AI-enabled asset management effectively and responsibly.

1. Establish Data Readiness Before Technology Investment

Data quality and infrastructure readiness are prerequisites for effective AI deployment, not afterthoughts (ITS JPO, 2025; FTA & Volpe National Transportation Systems Center, 2025). Before evaluating any AI product, agencies should conduct an assessment of their data infrastructure — including telematics connectivity, maintenance record digitization, and the ability to integrate data across computerized maintenance management systems, computer-aided dispatch / automated vehicle location, NTD, fuel/charge, and financial systems. Agencies with fragmented or inaccessible data may not realize the benefits of AI and risk wasting resources on procurement.

2. Develop AI Governance and Equity Policy Before Procurement

Industry guidance and federal governance frameworks recommend that agencies establish an AI governance framework before any vendor engagement (APTA, 2026; Tabassi, 2023). For public transit agencies, this framework should address:

- Accountability structures identifying who is responsible for AI-assisted decisions;
- Equity monitoring protocols to detect whether AI outputs disadvantage underserved communities — particularly for applications involving service allocation, maintenance prioritization, or enforcement;
- Title VI impact assessment requirements for any AI application that influences resource distribution (FTA 2012);
- Data privacy standards governing the collection, storage, and use of passenger and operational data; and
- Transparency requirements ensuring that AI recommendations can be audited and explained to decision-makers and the public.

Establishing governance before procurement protects the agency legally, builds public trust, and ensures that AI is deployed consistently with the agency's civil rights obligations and values.

3. Require Contractual Protections Against Model Degradation and Vendor Lock-In

ITS America (2023) specifically warns that AI systems purchased as one-time deliverables will degrade over time as real-world conditions diverge from training data. Agencies should require that AI contracts include:

- Defined performance benchmarks with regular reporting obligations;
- The right to audit AI model outputs and training datasets;
- Vendor obligations to monitor, disclose, and address dataset obsolescence;
- Retraining schedules with agency approval rights over model updates;
- Data portability and interoperability standards to prevent vendor lock-in; and
- Clear data ownership provisions establishing that operational data generated by the agency belongs to the agency.

4. Adopt a Phased, Pilot-First Implementation Approach

Both the ITS JPO (2025) and the APTA Primer (2026) recommend a phased approach to AI deployment. Beginning with a defined sub-fleet pilot — with measurable performance targets, a limited time horizon, and clear evaluation criteria — allows agencies to build internal evidence, develop staff expertise, and identify implementation challenges before committing to fleet-wide deployment.

A well-designed pilot should define baseline metrics (breakdown rate, mean time between failures, maintenance cost per vehicle, inspection hours), set measurable improvement targets, include an equity assessment, and establish a clear decision gate for whether and how to expand. International examples — including SBS Transit's phased rollout from 1,000 to more than 3,000 buses following demonstrated results — exemplify this approach.

5. Align AI Investment with Federal TAM Cycles

AI-derived condition assessments, predictive metrics, and capital prioritization can directly improve the quality and defensibility of NTD reporting, TAM planning, and SGR investments (ARPA-I, 2024). Transit agencies that connect their AI deployments to TAM plan updates, NTD submissions, and capital planning may be better positioned to justify investments and demonstrate outcomes.

6. Leverage Federal and Industry Technical Assistance

Several federal and industry resources are available to support agencies before allocating agency resources to AI-enabled TAM:

- FTA TAM Technical Assistance Program — provides direct support for TAM plan development, condition assessment, and decision support tools;

- USDOT ITS JPO Deployment Evaluation Database — documents real-world AI/ITS deployments with performance data, at itskrs.its.dot.gov;
- APTA AI Primer and four Guidance Briefs (May 2026) — the most current transit-specific guidance, covering tool needs, governance, agency readiness, and implementation;
- California Transit Association (CTA) — peer network for California agencies, including those with active AI deployments; and
- APTA peer exchange program — connects agencies with peers who have implemented specific technologies.

Key Resources and Recommended Reading

Document / Resource	Publisher / Date	URL / Access
Artificial Intelligence and Machine Learning in Public Transit: A Primer	APTA / EBP / Foursquare ITP (May 2026)	apta.com/news-research/policy-research/artificial-intelligence-and-machine-learning-in-public-transit/
ITS for Transit Asset Management — Executive Briefing	USDOT ITS JPO (2022, updated Dec. 2025)	itskrs.its.dot.gov/briefings/executive-briefing/its-transit-asset-management
The Role of Artificial Intelligence in Transportation (MTI Project 2430)	Mineta Transportation Institute / SJSU, Adam Cohen (Nov. 2024)	transweb.sjsu.edu/sites/default/files/2430-Cohen-Artificial-Intelligence-Transportation-Use-Cases.pdf
The Impact of AI on Transportation and Mobility	ITS America & Cambridge Consultants (2023)	itsa.org/advocacy-material/the-impact-of-ai-on-transportation-and-mobility/
AI and Machine Learning for Transportation — Executive Briefing	USDOT ITS JPO (2022)	itskrs.its.dot.gov/briefings/executive-briefing/artificial-intelligence-and-machine-learning-transportation
2024 TAM Roundtable Summary Report	Federal Transit Administration (Sept. 2024)	transit.dot.gov/TAM/SGRroundtables/2024-TAM-Roundtable
Transit Asset Management Guide	Federal Transit Administration (2016)	transit.dot.gov/TAM
The Rate of Transit Bus Breakdowns Declined by 8 Percent After Installing a Predictive Maintenance System Which Monitored and Communicated Engine Data.	ITS Deployment Evaluation / USDOT (2022)	itskrs.its.dot.gov/2022-b01703
Artificial Intelligence: Transforming Public Sector Transit Services	Cogent Infotech (2025)	cogentinfo.com/resources/artificial-intelligence-transforming-public-sector-transit-services

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About the Author

Adam Cohen is a senior researcher in innovative and emerging mobility. He has two decades of experience as a researcher with the Mineta Transportation Institute of San Jose State University and the Transportation Sustainability Research Center at the University of California, Berkeley.

About MTI

The Mineta Transportation Institute (MTI) is a university transportation center located within the Lucas Graduate School of Business at San José State University. MTI supports the advancement of safe, efficient, and innovative surface transportation through research, education, workforce development, and technology transfer.