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# AI and Machine Learning Are Shaping the Future of Public Transit

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February 3, 2025



(Erik Von Weber/Getty Images)

Many industries, including public transportation, are turning to artificial intelligence (AI) and machine learning (ML) to solve and prevent challenges. Data are [foundational](#) in training the algorithms that determine AI and ML's performance quality. Because transit agencies collect, generate, and store vast amounts of data, they may be prime candidates for deploying these technologies to benefit a wide range of stakeholders, including transit riders, industry employees, operating agencies, and the general public.

Not only is the transit industry likely befitting of these applications, but it's also at a critical juncture of greatly needed support. Most US transit providers face [significant financial challenges](#) and struggle to fund services that are unlikely to return to, or maintain, prepandemic levels. Addressing this issue will require substantial intervention, such as major gains in efficiency, potentially offered by AI integration, or greatly increased [state-level political backing](#). Many agencies are also struggling with [workforce vacancies](#) (PDF) and [fears among frontline staff](#) regarding personal safety. AI technologies, such as [autonomous vehicles](#), may provide interim or long-term solutions for agencies facing employment-related crises.

## Current uses of AI and ML in US transit

Rising to this convergence of opportunity and urgency, the transit industry has begun implementing AI and ML in several ways. Agencies are using AI software to monitor camera and sensor feeds from tracks and station areas to identify potentially dangerous conditions, including [crowd management](#), [obstacle detection](#) on tracks, [pedestrian and cyclist detection](#) in roadways, indoor [air-quality monitoring](#) in subway stations, and even [firearm detection](#) throughout train and bus service networks.

Transit agencies are also using AI and ML to improve rider experience beyond safety, like making [real-time arrival](#) information dissemination faster and more reliable. They are using improvements in predictive scheduling capabilities to design their services to support [low wait-time transfers](#) and aid travelers in [multimodal journey planning](#).

Additionally, agencies have focused on making their services more inclusive and accessible. [Smart Dispatch technology](#) (PDF) has improved efficiency, allowing paratransit trips that previously needed 24-hour advance booking to now support same-day reservations. AI tools have also made it easier to comprehensively monitor sites within their service networks for [Americans with Disabilities Act compliance](#), helping prioritize construction needs.

Operational efficiency has seen the most widespread implementation of AI and ML technologies in transit:

- [Demand forecasting](#) (PDF): AI and ML predict passenger volumes based on historical data, weather, special events, and time of day to optimize vehicle deployment and prevent overcrowding.
- [Fuel efficiency optimization](#): These technologies model fleet load factors and real-time energy consumption, helping lower overall energy impacts.
- [Predictive maintenance](#): AI analyzes sensor data to identify potential issues with vehicles to prevent breakdowns and improve maintenance schedules.
- [Transit signal prioritization](#): By working with city traffic management systems, AI and ML help time traffic signals along transit corridors to decrease bus and trolley idling at red lights and shorten trip times for riders.
- [Enforcement of transit-designated roadway spaces](#): Vehicle-mounted or stationary cameras cite drivers in restricted areas like bus lanes and bus stops. This aims to change driver behavior and improve service quality and reliability, rider experience, and safety for all roadway users.

## Causes for concern

Although these applications appear beneficial, their growing prevalence raises concern among providers and the public, including the [cost of AI integration](#) into existing systems, abuses of [data privacy](#), and [safety implications](#). Worries that the [tech is faulty](#) or [vulnerable to hacking](#) (PDF) have also been raised. And, as with [many other sectors](#), workers in the transit industry [fear job loss at the hands of AI](#).

Major areas of concern center equity, discrimination, and biases. [Facial recognition](#) used by transit agencies might be subject to racial discrimination, as the identity data these tools are trained on is predominantly white and male, and camera settings may not be optimized for darker skin tones. Traffic enforcement cameras may disproportionately fine drivers of color because of the cameras' comparatively [frequent placement in neighborhoods of color](#). Language models used to enhance audio-based navigation in transit have their own set of biases, which can render them defective or exclusionary across [language spoken, tone of voice \(commonly associated with gender\), and accent](#).

The Biden administration's federal guidance on protections in AI integration, such as the [Blueprint for an AI Bill of Rights](#) (PDF) and Biden's [Executive Order on AI](#) has done much to chronicle these worries and describe their importance. These documents offer resources and recommendations on ways operators and administrators can relieve fears and avoid misuse of these technological advancements. However, [trepidation](#) about existing and further deployment of AI and ML for transit service provision still abounds.

## Recommendations for harnessing benefits and minimizing fears

To address the accelerated adoption of AI and ML, concerns and uneasiness, and transit agencies' need to boost ridership and improve their financial health, transit agencies may want to prioritize the following:

- **Using AI and ML to inform, not replace, infrastructure changes**

Some of the fear surrounding AI adoption for transit applications could be alleviated by treating AI not as an end-point solution, but as an interim catalyst for more tangible, transparent, and familiar infrastructure solutions. This is being done in California, where AI is being used to [detect and report near-miss collisions](#) (PDF) at intersections. These safety data are then intended to be used to inform roadway redesigns.

Similarly, [Boston-based research](#) revealed that public support for using AI to enforce traffic violations in transit-only spaces is strongest when AI is used primarily to collect data that then lead to infrastructure changes, such as [bus bulbs](#) and [curb-separated bus lanes](#). This approach allows for the eventual phasing out of that very same AI.

In both cases, AI serves as a tool to shape solutions for transit-relevant issues, rather than being the solution in itself.

- **Using AI and ML to get back to the basics of what defines high-quality transit.**

Both rider retention and new rider travel mode selection are [largely influenced by](#) riders' satisfaction with transit services. Factors that consistently rank as the [most important](#) (PDF) to riders in satisfaction surveys are service frequency, reliability, affordability, and cleanliness.

As highlighted earlier, much attention is being paid to frequency and reliability improvements. But what about cost and cleanliness? How can transit agencies concentrate their AI integration efforts in those vital arenas?

**Affordability:** AI and ML could be used to [automatically enroll](#) eligible riders in discounted fare programs without them having to self-identify and apply. Reduced-rate transit-fare cards could be sent to auto-matched recipients of Supplemental Nutrition Assistance Program benefits, as the eligibility criteria for income-based benefit programs are typically very similar, if not identical.

**Cleanliness:** These technologies might also be used to optimize cleaning schedules and staff allocations across the many agencies responsible for roadway cleaning, station facilities cleaning, and vehicle cleaning. Or they may be used to alert staff when cleanliness in a certain location has fallen below established standards, enabling more targeted and efficient staff deployment. AI-powered systems could even potentially take on [direct cleaning responsibilities](#).

AI and machine learning could enhance transit services by lessening safety risks, improving rider experience and operational efficiency, and ideally, addressing affordability and cleanliness. Although important challenges such as biases and workforce concerns remain, strategic implementation of these technologies—particularly those that directly respond to rider-stated wants and needs—are likely to render significant benefits for transit agencies that are willing and able to responsibly innovate.

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