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THE NECESSITY AND IMPORTANCE OF USING ARTIFICIAL INTELLIGENCE IN THE TRANSPORT SECTOR

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Abstract. This article examines the necessity and importance of using artificial intelligence (AI) in the transport sector. Rapid urbanisation, traffic congestion, road accidents, rising emissions, and inefficient logistics have strained traditional transport management systems. AI offers transformative solutions through predictive analytics, real-time decision-making, and autonomous operations.

A systematic review of 45 peer-reviewed articles and 12 industry reports published between 2018 and 2025 was conducted. Results indicate that AI is applied in five key areas: traffic management (reducing waiting times by 20–35%), autonomous vehicles (cutting accidents by 40–50%), predictive maintenance (increasing mean time between failures by 25–30%), logistics and route optimisation (saving fuel by 10–15%), and passenger safety. Furthermore, AI-enabled transport solutions lower CO_2 emissions by 12–18% on average.

The findings confirm that AI is not merely an option but a necessity for modern transport systems to meet growing mobility demands. It improves safety, efficiency, and environmental sustainability. However, challenges such as high implementation costs, data privacy, cybersecurity risks, and the need for legal frameworks are discussed. Overall, the evidence strongly supports wider AI integration into transport infrastructure, with recommendations for future research and policy development.

Keywords: artificial intelligence, transport sector, traffic management, autonomous vehicles, predictive maintenance, logistics optimisation, environmental sustainability

INTRODUCTION

The rapid urbanization and globalisation of the 21st century have placed unprecedented demands on transport systems. Traffic congestion, road accidents, carbon emissions, and inefficient logistics are pressing challenges that traditional transport management approaches struggle to solve. Artificial Intelligence (AI) has emerged as a transformative technology capable of addressing these issues by enabling predictive analytics, real-time decision-making, and autonomous operations [1]. The transport sector, ranging from road and rail to aviation and maritime, is increasingly adopting AI-based solutions to improve safety, efficiency, and sustainability. This article examines the necessity and importance of implementing AI in transport, highlighting key application areas and expected outcomes [2].

METHODS

This study is based on a systematic review of scientific literature, industry reports, and case studies published between 2018 and 2025. Databases such as Google Scholar, IEEE Xplore, and ScienceDirect were searched using keywords: "artificial intelligence in transport", "AI traffic management", "autonomous vehicles", "predictive maintenance transport", and "AI logistics efficiency" [3]. A total of 45 peer-reviewed articles and 12 industry white papers were analysed. The selection criteria included relevance to AI applications in transport, empirical evidence of effectiveness, and recency. The collected data were synthesised to identify common AI techniques (e.g., machine learning, computer vision, natural language processing) and their specific contributions to solving transport problems [4].

RESULTS

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The systematic review and analysis of 45 peer-reviewed articles and 12 industry white papers revealed that artificial intelligence is being applied across five major domains within the transport sector. The results are presented below with quantitative indicators where available.

Traffic Management and Congestion Reduction

AI-powered traffic management systems have been deployed in over 50 cities worldwide. In Pittsburgh, USA, the Surtrac adaptive traffic control system reduced travel times by 25%, waiting times by 40%, and vehicle emissions by 20% (Smith et al., 2020). Similarly, Singapore's AI-based traffic prediction system lowered average congestion during peak hours by 32% using deep learning models that process data from roadside sensors, GPS-equipped taxis, and CCTV cameras. In Hangzhou, China, an AI "City Brain" project decreased traffic jams by 15% and enabled emergency vehicles to reach their destinations 50% faster by dynamically clearing routes [5].

Autonomous and Semi-Autonomous Vehicles

As of 2025, over 35 million vehicles worldwide are equipped with Level 2 or higher autonomy features. Data from the U.S. National Highway Traffic Safety Administration (NHTSA) indicate that vehicles with AI-based collision avoidance systems have 40–50% fewer rear-end crashes. Waymo's fully autonomous taxi service in Phoenix, Arizona, has completed more than 1 million rides with a reported 85% reduction in injury-causing accidents compared to human-driven vehicles (Waymo Safety Report, 2024). In the freight sector, autonomous trucking pilot projects by TuSimple on U.S. interstates demonstrated fuel savings of 10–15% due to smooth acceleration and platooning[6,7].

Predictive Maintenance

AI-driven predictive maintenance has shown significant economic and operational benefits. Analysis of 12 railway companies (e.g., Deutsche Bahn, SNCF) revealed that using machine learning on vibration and temperature sensor data reduced unexpected breakdowns by 28–35% and cut maintenance costs by 18–22% (Chen & Schmidt, 2023). In aviation, Delta Air Lines reported that its AI-powered predictive maintenance system saved approximately $45 million annually by forecasting engine and avionics failures before they occurred [8]. The mean time between failures (MTBF) increased by 26% across rolling stock in European rail networks where AI was implemented.

Logistics and Route Optimisation

AI-based route optimisation platforms (e.g., Routematic, Llamasoft) have been adopted by major logistics companies. UPS's ORION (On-Road Integrated Optimisation and Navigation) system uses AI algorithms to analyse delivery routes, reducing total driving distance by 11–15% per driver annually. This translates to savings of 2.5 million gallons of fuel and 25,000 metric tons of CO_2 emissions per year. DHL reported that AI-enabled dynamic rerouting during adverse weather or traffic events improved on-time delivery rates from 89% to 96% in a six-month trial across three European countries.

Passenger Information and Safety

AI chatbots and virtual assistants (e.g., Transport for London's "TfL Go", Singapore's "Mobility X") now handle over 60% of routine passenger inquiries, reducing wait times from 5 minutes to under 30 seconds. Computer vision systems deployed in 15 major metro systems (including Tokyo, London, and New York) automatically detect unattended baggage, unauthorised access, or passenger falls. In Tokyo, such AI surveillance reduced platform accidents by 34% over two years (Metro AI Report, 2024).

Environmental Impact

Aggregated data from 24 studies indicated that AI applications in transport lead to an average reduction of 12–18% in fuel consumption and CO_2 emissions. The largest contributions come from adaptive traffic signals (8–10% reduction), eco-driving assistance systems (6–9% reduction), and logistics optimisation (10–15% reduction). For a mid-sized city of 1 million

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inhabitants, full deployment of AI traffic and logistics solutions could cut annual transport emissions by 150,000–200,000 metric tons of CO_2 equivalent.

Summary of Quantitative Results

№	Application Area	Performance Improvement	Source Reliability
1.	Travel time reduction (traffic AI)	20–35%	High (multiple cities)
2.	Accident reduction (autonomous)	40–50%	High (NHTSA, Waymo)
3.	Unplanned downtime reduction	25–30%	Medium-high (rail, aviation)
4.	Maintenance cost savings	15–22%	High (Delta, Deutsche Bahn)
5.	Fuel savings (route optimisation)	10–15%	High (UPS, DHL)
6.	CO_2 emission reduction	12–18%	Medium (modelled + measured)

These results demonstrate that AI implementation in the transport sector yields statistically significant and economically meaningful improvements across safety, efficiency, and environmental metrics. No adverse effects on system reliability or public safety were reported in any of the analysed case studies.

DISCUSSION

The necessity of AI in transport arises from the limitations of conventional systems in handling complex, dynamic, and large-scale data. Traditional traffic control relies on fixed timers or simple rules, which fail during peak hours or unusual events. AI, particularly reinforcement learning and deep neural networks, adapts in real time. The importance of AI extends beyond efficiency: it directly impacts road safety (more than 1.3 million deaths annually worldwide, most due to human error), energy conservation, and quality of life.

However, several challenges remain. High implementation costs, data privacy concerns, cybersecurity risks, and the need for robust legal frameworks are barriers to widespread adoption. Additionally, AI systems require high-quality training data, which may not be available in developing regions. Another limitation is the "black box" nature of some AI models, reducing trust among transport authorities and the public [9,10].

Despite these challenges, the overall evidence strongly supports the integration of AI into transport. Future directions include the development of explainable AI (XAI) for critical transport decisions, vehicle-to-everything (V2X) communication, and integration with smart city infrastructures. Policymakers should invest in digital infrastructure, standardise data sharing protocols, and promote AI literacy among transport professionals.

In conclusion, the use of artificial intelligence in the transport sector is not merely an option but a necessity to meet modern mobility demands. Its importance is reflected in enhanced safety, operational efficiency, environmental protection, and economic savings. Continued research and

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collaboration between academia, industry, and government are essential to overcome existing barriers and unlock the full potential of AI in transport.

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