Пут и саобраћај
Journal of Road and Traffic Engineering
Journal homepage: www.putisaobracaj.rs

Artificial Intelligence on the Road or Road to Artificial Intelligence?

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ARTICLE INFO

DOI: 10.31075/PIS.71.02.05
Professional paper
Received: 12.04.2025.
Accepted: 20.05.2025.
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Keywords
Intelligent Transportation Systems (ITS)
Artificial Intelligence (AI)
Mobility

ABSTRACT

Artificial intelligence (AI) is last years the hottest buzzword, started from the world of information technologies and spreading across various areas of everyday activities where it can be applied. However, reality is that AI is with us for the longer time than we initially think of. In this paper we explain foundations and definitions of AI, followed by comparation of AI applied in transport, called Intelligent Transportation Systems (ITS). Main areas of state of the art AI-based technologies in road transport and traffic applications, already in use or ready to be used, are presented. At the same time, major obstacles for implementation of AI technologies which are on the horizon in those areas have been discussed.

1. Introduction

Artificial Intelligence (AI) has moved from the realm of theoretical inquiry to practical implementation across numerous sectors and transport is not avoided. As mobility systems grow in complexity and scale, AI offers unprecedented opportunities to manage traffic, maintain infrastructure, and design user-centric services. However, the adoption of AI also raises deep questions about governance, ethics, human-machine interaction, and public trust. This paper explores the dual evolution of AI within the road transport sector. It investigates whether AI is merely a tool for enhancing existing systems (artificial intelligence on the road), or the transport sector is emerging as a key domain that drives and shapes the future of AI itself (the road to artificial intelligence). Through technical, ethical, and policy lenses, we assess both current capabilities and the path for (advanced) intelligent mobility.

2. The foundations of Artificial Intelligence

Before analyzing the role of AI in the transport sector, it is essential to understand what AI is and how it has been conceptually framed throughout its development. AI does not refer to a single technology, but to a broad category of systems capable of performing tasks that typically require human intelligence. These systems vary significantly in structure and capability, and their design depends heavily on the context in which they are applied.

2.1. Definitions

Formally, the International Organization for Standardization defines Artificial Intelligence systems as “systems designed to, based on human-defined objectives, generate outputs such as content, predictions, recommendations, or decisions” [1]. These systems may use a variety of techniques and approaches to model data, knowledge, and processes, with differing levels of automation. Such a comprehensive definition arises from the need to encompass a wide range of systems that perform tasks typically associated with human cognitive activity, while also remaining applicable over time despite the rapid pace of technological progress. There are examples from reputable sources which have been changes in relatively short time period, as the one we mention in the next paragraph, justifying this approach.

Simplified and widely accepted description of AI as: “a system that uses computers to perform intellectual tasks that are usually attributed to humans”, being quoted in previous work of the authors on this subject [2], has been evolved in a less an a year in the online edition of the Encyclopedia Britannica into “the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings” [3].

2.2. Turing test

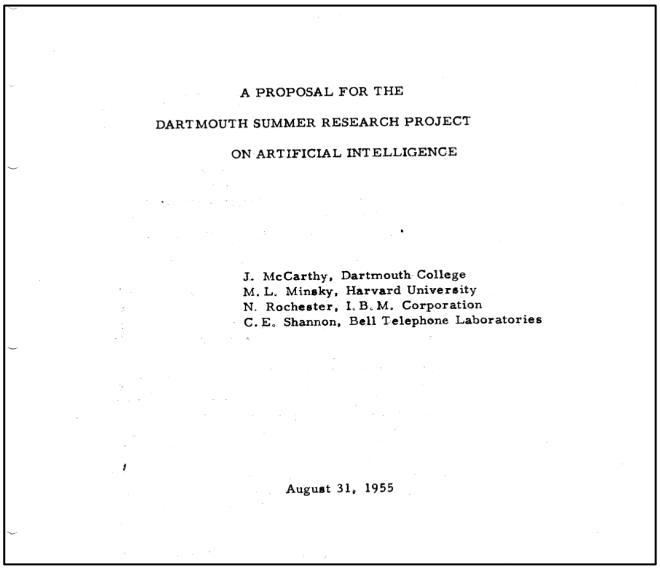
This simplified view, corresponding mainly to what is called today “weak” or “narrow” type of AI, reflects the foundational thinking of the man often considered as the father of modern computing and artificial intelligence - : British mathematician and scientist Alan Turing. Turing famously asked, “Can machines think?” and proposed a practical framework for this philosophical question in what he called the “Imitation Game” and now widely known as the Turing Test [4].

The Turing Test is a thought experiment intended to evaluate whether a machine can behave in such a way that an observer, judging solely from its responses, cannot reliably determine whether the answers come from a human or a machine. With this definition in mind, and as Turing predicted, it did not take long for AI systems (particularly in their “weak” or “narrow” form where are designed to excel in specific, well-defined tasks) to find widespread application in various fields, including transport and traffic.

2.3. Artificial Intelligence – the name itself

Although being considered as the father of the AI, Turing did not gave this name to his “child” like parents do. That happened overseas in 1955, a year after his tragic death, and the nomenclator was John McCarthy, at that time Assistant Professor of Mathematics at Dartmouth, Hanover, New Hampshire, United States. McCarthy discussed the possibility of making a Turing machine behave intelligently, and the name used at that time “automata studies” had nothing to do with the reproduction of human intelligence he had in mind [5].

At the same time, he was working on proposal together with 3 more colleagues (Marvin Minsky from Harvard University, Nathaniel Rochester from IBM and Claude Shannon from Bell Laboratories) for summer research project, planned to be held in the summer of 1956 on Dartmough College. The term he picked - “Artificial Intelligence”, appeared for the first time in public in August 1955, when the request for funding of that project has been sent to the Rockefeller Foundation.



A PROPOSAL FOR THE
DARTMOUTH SUMMER RESEARCH PROJECT
ON ARTIFICIAL INTELLIGENCE

J. McCarthy, Dartmouth College
M. L. Minsky, Harvard University
N. Rochester, I. B. M. Corporation
C. E. Shannon, Bell Telephone Laboratories

August 31, 1955

Figure 1. A proposal for the AI summer research project

3. Intelligent Transportation Systems (ITS)

As artificial intelligence becomes increasingly integrated into various sectors, its convergence with the domain of transport is most visible through the latest development of Intelligent Transportation Systems (ITS), just like the term “intelligent” they are sharing. Intelligent Transportation Systems represent the interface where digital technologies and traditional systems, machines and infrastructure combine to form adaptive, efficient, and often predictive systems for moving people and/or goods.

3.1. Definitions

Intelligent Transportation Systems (ITS) is understood as the systems that apply the technologies of Electronics, Automatic Control, Computer, and Communications to the field of transport [6].

Hence, ITS are defined as the integration of information and communication technologies (ICT) into transport infrastructure and vehicles to improve safety, efficiency, and environmental sustainability. Unlike traditional transport systems, ITS rely on ICT technologies, particularly real-time data, connectivity, and automation to manage transport operations dynamically.

Key components include traffic management centers, vehicle-to-everything (V2X) communication, smart intersections, dynamic routing, passenger information and various payment / tolling systems, to name a few. As such, ITS serve as the technological foundation and ideal environment for AI-enabled functions explored in later chapters and even more.

3.2. Artificial Intelligence in transport vs Intelligent Transportation Systems

While ITS and AI in transport are closely linked, they are conceptually distinct. ITS represents the broader ecosystem of connected infrastructure and services, whereas AI refers to the computational systems that enable these services to learn, predict, and adapt. AI in transport enhances ITS by providing cognitive capabilities - such as forecasting congestion, detecting incidents, and managing fleet logistics. In this sense, AI can be viewed as the "intelligence" driving the responsiveness and adaptability of ITS. However, not all ITS rely on AI; some are rule-based or operate through human supervision. Conversely, AI's value in transport only materializes when it is embedded in the systemic context of ITS infrastructure. Therefore, the relationship is both complementary and evolutionary: ITS provides the operational framework, and AI brings the transformative potential that turns transport systems into intelligent, adaptive, and user-centric ecosystems.

4. Artificial Intelligence on the road

As being said, AI in essence presents computer systems which are performing tasks that typically require human involvement and intelligence. It is not a kind of magic which immediately solves all problems and, as any new technology, requires careful planning, design, implementation with human experts involvement and monitoring. Nevertheless, AI has become a foundational pillar in the transformation of modern transportation systems. Its deployment across various aspects of road transportation is leading to smarter cities, more efficient systems, and safer mobility experiences. This chapter explores the major applications of AI in transportation today, providing in-depth discussion, real-world examples, and critical evaluation of its implications.

4.1. Traffic management and urban mobility

AI is revolutionizing how cities manage traffic and urban mobility. Intelligent traffic systems use real-time data from sensors, cameras and connected vehicles to dynamically adjust traffic signals, reducing congestion and improving traffic flow. AI algorithms can predict traffic patterns, allowing city planners to proactively manage transportation networks and respond to changing conditions. AI-driven adaptive signal control (**Smart Traffic Signals**) is one of the most widely implemented use cases, where traffic light patterns are optimized in real time to minimize congestion. In developed countries, such systems have been deployed in multiple urban centers, using machine learning (ML) algorithms that continuously learn and refine signal timing strategies based on evolving traffic patterns. An exemplary case of AI application in traffic management is the SCATS (Sydney Coordinated Adaptive Traffic System) developed in Australia. Originally an in-house tool designed for local traffic optimization, it has evolved into a commercially available system used worldwide. SCATS exemplifies how locally initiated AI systems can scale to deliver global impact, providing real-time signal coordination and dynamic response capabilities to shifting traffic volumes [7]. AI models trained on historical and real-time data can forecast congestion and suggest alternate routing (**Traffic Flow Prediction**). For example, Google Maps integrates AI to optimize route recommendations, helping drivers avoid heavy traffic zones. In Thessaloniki ThSMLL (Thessaloniki Smart Mobility Living Lab) was established. It is one of Europe's largest Living Labs. The entire city of Thessaloniki is a platform for testing technological and innovative solutions for mobility. Through this program AI is used for prediction, knowledge extraction and value generation [8].

Route	Average Speed
Ringroad	77 km/h
Via Egnatia	36 km/h
Via Nikis	38 km/h

Figure 2. Current traffic and typical traffic forecast
Source: https://flyover.imet.gr/

Beyond traffic lights, AI facilitates the integration of multiple transport modes within **Mobility-as-a-Service (MaaS)** platforms, enabling seamless trip planning and real-time multimodal routing. The AI supports the personalization of travel recommendations, dynamic pricing, and service coordination across buses, trams, metro systems, and even shared micromobility services such as e-scooters and e-bikes. AI systems enable these platforms to adjust to disruptions, demand fluctuations, and individual user preferences, thereby enhancing user satisfaction and promoting public transport adoption. In addition, the integration of GPS-based Automatic Vehicle Location (AVL) systems and Internet of Things (IoT) devices is crucial for real-time tracking, operational planning, and remote diagnostics within both public transport and freight operations. These technologies underpin modern ITS infrastructure and enhance the responsiveness of AI algorithms in urban mobility environments. AI also plays a critical role in **cooperative traffic management environments**, where interconnected stakeholders - municipalities, road operators, and private service providers leverage shared data ecosystems to achieve coordinated interventions. The emergence of Cooperative Intelligent Transport Systems (C-ITS), supported by AI, exemplifies this. These systems facilitate dynamic lane management, priority routing for emergency vehicles, and coordinated incident responses, often using a hybrid communication mix of short-range ITS-G5 and cellular networks.

In the broader European context, AI supports the **integration of urban mobility** into the framework of sustainable urban mobility plans (SUMPs). Cities are encouraged to adopt AI-based tools that assist in data collection, performance analysis, and forecasting, aligning mobility strategies with climate targets and public health objectives. For instance, AI is instrumental in managing dynamic reallocation of street space in favor of active mobility modes such as walking and cycling, particularly in response to real-time congestion levels and air quality data. In summary, AI is not just automating urban traffic management - it is transforming it into a responsive, intelligent, and user-centric ecosystem. From adaptive signal control and multimodal integration to predictive maintenance and cooperative traffic strategies, AI technologies are enabling cities to transition towards a more connected, efficient, and resilient mobility future. As these systems mature, ensuring inclusive access, data governance, and alignment with public policy goals will be key to unlocking their full potential in urban mobility.

4.2. Autonomous vehicles and micromobility

Perhaps the most visible application of AI in transport is in the **development of autonomous vehicles (AVs)**. In the context of road transport, AI enables automation ranging from driver assistance to full autonomy, while also supporting a growing ecosystem of micromobility solutions, including e-scooters, e-bikes, and cargo bikes. AV technologies, especially at higher SAE levels of automation (Levels 4 and 5), depend on AI for environmental perception, decision-making, and motion planning. These vehicles integrate computer vision, LiDAR (Light Detection And Ranging), radar sensors, and deep learning algorithms to interpret their surroundings, predict the behavior of other road users, and make real-time navigation decisions. Tesla's Full Self-Driving (FSD) Beta exemplifies the application of AI in AVs. The FSD system learns from billions of miles driven by Tesla vehicles, continuously refining its performance through over-the-air updates. In the region Rimac is integrating advanced AI technologies into its upcoming autonomous taxi service, Verne, set to launch in Zagreb by 2026. The Verne robotaxi will utilize Mobileye's self-driving software, combining cameras, radar, and lidar sensors to achieve full autonomy without the need for a steering wheel, pedals, or even a windshield. This AI-driven system enables the vehicle to navigate urban environments safely and efficiently. One of the examples is also, the **automated valet parking platforms** such as the EAVP system that apply AI-based Internet of Things (AIoT) systems to manage space utilization, reduce vehicle idling, and improve customer experience in complex urban settings.

In the realm of micromobility, the growth of AI-enabled shared mobility services is notable. AI supports dynamic fleet management, predictive maintenance, and demand forecasting. Moreover, it plays a crucial role in ensuring the safe integration of these lightweight vehicles into urban traffic systems. AI can help cities assess crash risks, design appropriate infrastructure, and implement traffic regulations that account for the interactions between micromobility devices and pedestrians or other vulnerable road users. Particular emphasis has been placed on evaluating the risks associated with micromobility vehicles. Micromobility modes such as e-scooters and e-bikes, whether privately owned or shared, have become increasingly common, yet they bring new challenges, especially when it comes to interactions with heavier, faster road users. AI can support the development of solutions such as Vehicle-to-Everything (V2X) communication systems that **help prevent collisions** by warning drivers and micromobility users of impending risks. Projects supported under Horizon Europe foresee AI being used to assess actual and perceived safety risks, evaluate road infrastructure conditions, and support the regulatory frameworks for new mobility modes. This includes potential contributions to a future European type-approval system for micromobility vehicles based on safety standards supported by AI-based performance metrics. By enabling automation and safety intelligence, AI is not only advancing the capabilities of vehicles but is also shaping the legal and operational frameworks necessary for their deployment across European and global cities.

4.3. Intelligent infrastructure and safety

AI is instrumental in transforming traditional road infrastructure into intelligent, responsive systems capable of real-time analysis, predictive maintenance, and automated decision-making. The integration of AI with infrastructure enhances road safety, operational efficiency, and resilience. Computer vision and machine learning are now commonly used for infrastructure inspection. As demonstrated in the EyeVi platform deployed in Oslo, AI analyzes video data to **detect surface defects** such as cracks and potholes on urban roads, reducing reliance on manual inspection and enabling more frequent and cost-effective maintenance planning. Moreover, predictive maintenance powered by AI enables road authorities to **anticipate failures before they occur**. These systems use historical and real-time data to predict wear and degradation, helping prioritize repairs and schedule interventions at optimal times. The result is not only cost savings but also improved safety through the reduction of infrastructure-related incidents [7]. Similar system is already implemented in Serbia. The LIAISON software is Linear Assets Infrastructure Software Observatory Node used by PE "Roads of Serbia". Using drone data, data from the vehicles and cutting-edge technology software capture every detail of the infrastructure. AI efficiency combined with expert validation refines data to the purest form so that further maintenance activities can be performed to optimize costs, eliminate risks and increase road safety [2].

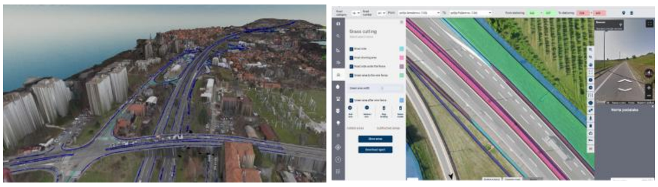


Figure 3. LIAISON software

Source: Courtesy of software developer

AI also supports traffic safety through **intelligent surveillance and incident detection**. In Lima, Peru, Valerann's Lanternn system applies AI analytics to video and sensor data for rapid identification of incidents such as stopped vehicles or road debris. This enables road operators to react swiftly, reducing secondary crashes and improving emergency response times [7]. Beyond individual technologies, AI plays a systemic role in coordinated safety strategies. The C-Roads initiative, for instance, showcases how cross-border cooperation in Europe is implementing Cooperative Intelligent Transport Systems (C-ITS). These systems use a hybrid communication model - ITS-G5 and cellular networks - to disseminate real-time messages such as hazardous location warnings, weather updates, and road work alerts. The C-Roads X-Test events validate these systems and ensure interoperability, illustrating how AI-enhanced C-ITS is becoming embedded in national and regional road networks. Complementing C-ITS, smart tachographs are emerging as a core element of digital enforcement. These devices, integrated into ITS environments, record and transmit data on driving time, vehicle movement, and driver identity in real time, enabling authorities to conduct remote compliance checks and enhancing road safety. [9]

4.4. Payments, tolling and congestion charging

AI technologies are increasingly applied in automating payments and optimizing tolling systems and congestion charging schemes. The aim is to streamline revenue collection, reduce operational overhead, and improve user convenience while supporting broader policy objectives such as demand management and pollution reduction. Automated Number Plate Recognition (ANPR) systems, enhanced with AI, are a well-established **tool used for toll collection, congestion zone enforcement, and violation detection**. These systems use optical character recognition to read vehicle license plates in real time and are widely deployed across Europe and North America. AI improves these systems by increasing the accuracy of detection, reducing errors in billing, and supporting scalable deployment across multiple zones. For instance, ANPR technologies powered by AI are central to low-emission zones in several European cities, where vehicles are automatically identified and charged based on their emissions category. This enables differentiated charging models that promote cleaner vehicles and reduce air pollution.

AI also supports **dynamic pricing schemes**, adjusting toll rates in real time based on congestion levels, time of day, or vehicle type. These systems analyze real-time traffic data to implement pricing strategies that balance traffic loads across a network, thus mitigating peak-hour congestion and improving travel time reliability. While these systems are commonly used in developed countries, other countries are beginning to explore AI-powered tolling and payment systems, albeit with more limited infrastructure. With the right enabling infrastructure, AI-based tolling systems offer an opportunity to expand cost recovery mechanisms and road usage pricing models in regions where traditional toll booths may be infeasible or cost-prohibitive. The broader vision for AI in tolling aligns with mobility-as-a-service (MaaS) integration, where AI consolidates trip data and payments across multiple transport modes and service providers into a single user interface. Such systems enhance customer experience and open new avenues for intelligent demand and revenue management.

5. Road to Artificial Intelligence

As Artificial Intelligence systems become more deeply integrated into transport infrastructure and mobility services, the journey toward widespread adoption must be guided by more than technological advancement alone.

5.1. Data privacy and security

The protection of data privacy and the assurance of cybersecurity emerge as foundational challenges. AI systems in mobility environments collect vast amounts of data, including personal information such as vehicle location, travel patterns, and behavioral insights derived from user interactions. Ensuring that this data is handled ethically and securely is essential for building public trust and legal compliance. Concerns over data privacy and cybersecurity are particularly prominent in high-income countries, where advanced digital infrastructures make AI deployment widespread but also expose systems to increased risks. Even in these technologically advanced environments, gaps in governance and the absence of consistent standards pose threats to the integrity of AI-driven mobility systems. AI systems rely on large datasets for training and real-time decision-making, often involving sensitive or personally identifiable information. This creates a dual challenge: protecting individuals' data from misuse and ensuring the systems themselves are resilient to attacks. For instance, smart tachographs in commercial vehicles collect continuous streams of sensitive driver data, necessitating robust encryption, secure communication protocols, and clear data ownership policies. Data breaches or manipulations could lead to unsafe outcomes in real-time traffic systems, misinformed decisions by AVs, or even malicious control of infrastructure.

Legislative frameworks such as the General Data Protection Regulation (GDPR) in the EU provide a basis for regulating data usage. However, implementation at the local level often varies, and AI-specific nuances—such as algorithmic inference and data minimization—require new approaches. The ERTICO White Paper [10] highlights the importance of aligning AI deployment with these regulatory frameworks, particularly in high-risk environments such as traffic control centers. In Low- and Middle-Income Countries, the primary concern lies in the absence of comprehensive data governance frameworks. As these countries begin to adopt AI, they must invest in foundational cybersecurity policies, privacy standards, and capacity building. Fostering international cooperation and leveraging global frameworks such as GDPR can be a path forward for these regions. A critical milestone in the governance of artificial intelligence in Europe is the adoption of the EU AI Act [11] - the world's first comprehensive legal framework for AI. Adopted by the European Parliament in 2024, the Act introduces a risk-based approach to AI regulation, categorizing systems from minimal to unacceptable risk. High-risk applications, such as those used in critical infrastructure or transport systems, are subject to strict requirements for transparency, data governance, human oversight, and cybersecurity. This legislation is expected to significantly influence how AI is developed, deployed, and monitored in Intelligent Transportation Systems across the EU, ensuring that innovation is aligned with European values of safety, accountability, and fundamental rights.

5.2. Ethical concerns

The rise of Artificial Intelligence in the mobility and road infrastructure sectors introduces a spectrum of ethical concerns that must be addressed to ensure fair, transparent, and accountable deployment. These issues range from algorithmic bias and discrimination to the lack of transparency in automated decision-making processes. A fundamental ethical concern is the opacity of AI systems—often referred to as the "black box" problem—where decision-making logic is not easily understandable by end users or even developers. This lack of transparency can be particularly problematic in high-stakes applications such as traffic incident detection or autonomous driving systems, where the rationale behind an AI decision could have safety or legal implications. There is a need for transparency, particularly in high-risk AI systems regulated under the EU AI Act, such as those used in critical infrastructure like traffic control. Another issue is bias in AI algorithms, which can lead to unequal treatment of different user groups. For instance, data used to train AI models may reflect historical inequalities or underrepresent certain demographics, resulting in systems that perform worse for minority populations or non-urban environments. These concerns are especially critical when AI influences policing traffic violations, allocating infrastructure investments, or managing micromobility networks. Ethical governance of AI technologies is still underdeveloped globally. There is a growing call for regulatory frameworks that ensure ethical considerations are embedded from the outset of AI development and deployment. This includes the creation of standards for algorithmic accountability and the incorporation of ethical audits in public procurement processes. Importantly, ethical AI must also consider the societal impacts of automation. As decisions increasingly shift from humans to machines, questions of responsibility, redress mechanisms, and moral agency must be resolved. These challenges demand a multi-stakeholder approach, involving not only engineers and regulators but also ethicists, civil society, and affected communities.

5.3. Workforce impacts

The automation of tasks traditionally performed by humans raises both opportunities for efficiency gains and concerns about job displacement and skill mismatches. Resistance to AI implementation is often linked to workforce concerns, particularly fears of job loss and the erosion of professional roles in road authorities and operations centers. In many road sector organizations, there is apprehension among staff that AI systems will replace rather than assist human expertise, especially in areas such as traffic monitoring, incident detection, and maintenance planning. However, the narrative is not solely one of loss. AI can augment human capabilities by taking over repetitive or data-intensive tasks, allowing professionals to focus on strategic decision-making and system oversight. This shift requires investment in upskilling and reskilling programs to equip workers with the competencies needed to work alongside AI systems. The ERTICO White Paper calls for targeted policy measures to manage the workforce transition, such as continuous training, integration of AI ethics in engineering curricula, and public-private initiatives that promote technological adaptability in transport agencies. These efforts are particularly critical in public sector organizations, which are often slower to adapt and less agile in human resource reform. Workforce impacts also vary between high-income (HIC) and low- and middle-income countries (LMIC). In HICs, the focus is on refining existing roles and fostering digital literacy among public transport and infrastructure staff. In LMICs, however, the challenge lies in building foundational technical capacity to even begin engaging meaningfully with AI tools. For both contexts, AI must be framed not as a replacement but as a collaborative partner in achieving better transport outcomes.

5.4. Infrastructure requirements

The integration of Artificial Intelligence into the road and mobility sectors is not only a software challenge but also an infrastructural one. Effective AI deployment requires an extensive foundation of digital, physical, and operational infrastructure.

One of the primary requirements is high-quality data collection infrastructure. This includes the widespread deployment of sensors, cameras, connected traffic signals, and other Internet of Things (IoT) devices capable of delivering real-time information. The performance of AI systems depends on the volume, variety, and veracity of data they can access. Gaps in data infrastructure lead to suboptimal decision-making and hinder the benefits of predictive analytics and automation.

Additionally, reliable communication networks are crucial. AI-enabled services such as C-ITS rely on hybrid communication architectures. The C-Roads initiative exemplifies this requirement through its emphasis on message interoperability and secure, real-time transmission of safety-critical information across national borders. Urban infrastructure must also evolve to accommodate AI systems in real-world contexts. This includes not only the placement of sensors and devices but also the modification of physical road layouts, integration with intelligent traffic management systems, and investment in cloud-based platforms for data processing and storage. These upgrades are often capital-intensive and require long-term planning, cross-sectoral coordination, and political commitment. In some countries, limited access to reliable electricity, weak broadband penetration, and poor road conditions inhibit the deployment of AI technologies. There is a need for international assistance and capacity-building programs to help underdeveloped regions leapfrog into intelligent infrastructure with the right support mechanisms in place. Ultimately, AI's promise in transport depends on building an enabling infrastructure that is scalable, interoperable, and resilient to future technological developments.

5.5. Prioritizing people

In the rush to implement Artificial Intelligence in transport, it is critical that human needs remain at the center of design and deployment strategies. AI should not only serve technological ambitions but also enhance quality of life, equity, accessibility, and safety for all users. AI must be inclusive, supporting diverse road users including pedestrians, cyclists, persons with disabilities, and vulnerable populations. There is a need for AI systems to accommodate the unique risks and requirements of non-motorized and micro-mobility users, especially in urban environments. This involves designing infrastructure, regulations, and services that reflect the growing complexity of interactions between different modes of transport. Furthermore, the success of AI integration depends on public trust. Systems perceived as opaque, unfair, or invasive risk rejection by users and pushback from civic institutions.

To address this, authorities must ensure transparent communication, provide avenues for public feedback, and incorporate social sciences into AI development processes. These measures help align AI systems with community values and democratic expectations. AI also provides an opportunity to actively engage communities in shaping mobility futures. Participatory approaches that include end-users in the design and testing of AI solutions can lead to more accepted, functional, and adaptive technologies. This is particularly relevant in the implementation of dynamic pricing, route planning tools, or micromobility integration, where local behaviors and preferences significantly influence system effectiveness. In summary, prioritizing people means embedding fairness, accessibility, and participation into the heart of AI systems in mobility. This ensures that technological progress is not achieved at the cost of social cohesion, but rather in service of a more inclusive and human-centric transport landscape. A study from Bloemfontein, South Africa, underscores that ICT-based transport solutions can unintentionally exclude users in low-income settings if they rely solely on high-tech platforms. Despite widespread smartphone ownership, most users communicated via calls and SMS, while public transport providers lacked a digital presence. This highlights the need for AI-enabled transport systems to consider accessibility, digital literacy, and affordability - especially in developing regions - by integrating low-barrier technologies and inclusive design from the outset [12].

6. Conclusion

The question posed at the outset of this paper - “Artificial Intelligence on the Road or Road to Artificial Intelligence?” - now finds a deeper resonance. The evolution of AI, as traced from its philosophical and technical foundations to its pragmatic role in modern mobility systems, reveals a dynamic interplay between technology and society. Beginning with foundational definitions that describe AI as a system capable of performing tasks traditionally reserved for human cognition, and revisiting Alan Turing’s seminal vision of machine intelligence measured by indistinguishability in behavior, we observe that AI has not only entered the realm of transportation - it is actively reshaping it.

As demonstrated in this paper, Artificial Intelligence is no longer an experimental concept confined to research labs but a maturing component of Intelligent Transportation Systems (ITS):

- in traffic management, AI enables real-time optimization and multimodal integration, supporting the emergence of Mobility-as-a-Service (MaaS) platforms;
- in infrastructure management, it powers predictive maintenance, asset monitoring, and incident response, enhancing operational efficiency and safety;
- the integration of AI with autonomous vehicles and micromobility is forging new mobility ecosystems that demand adaptive regulation, ethical oversight, and inclusive design.

Yet, as our path to artificial intelligence progresses, the technology must confront fundamental human concerns. The chapters underscore the importance of addressing data privacy and cybersecurity, developing ethical governance, preparing the workforce for new roles, and building the infrastructural backbone required for scalable AI deployment. Moreover, the road to AI must prioritize people - ensuring that innovations serve the diverse needs of all users and reinforce societal cohesion rather than fragment it.

Ultimately, AI is not just being implemented on the road; the road itself has become a proving ground for AI. It is a space where abstract theories meet concrete challenges, and where the design of algorithms has real-world implications for equity, safety, and sustainability. The way forward demands a balance between innovation and responsibility - a collaborative journey where engineers, policymakers, urban planners, and citizens jointly create a transport future not only efficient and smarter but also more humane.

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