August 1, 2024

Dr. Robert C. Hampshire
Principal Deputy Assistant Secretary for Research and Technology and Chief Science Officer
U.S. Department of Transportation
1200 New Jersey Avenue, SE
Washington, DC 20590

Subject: Comments on Request for Information: Opportunities and Challenges of Artificial Intelligence in Transportation (Docket No. DOT-OST-2024-0049)

Dear Dr. Hampshire,

ITE—A Community of Transportation Professionals is grateful for the opportunity to provide these important comments on the U.S. Department of Transportation's (USDOT) Advanced Research Projects Agency–Infrastructure (ARPA-I) Request for Information (RFI) on Opportunities and Challenges of Artificial Intelligence in Transportation published in the *Federal Register* on May 3, 2024.

Founded in 1930, ITE is an international membership association of transportation professionals who work to improve safety and mobility for all transportation system users and help build smart and livable communities. Through its products and services, ITE promotes professional development and career advancement for its members, supports and encourages education, identifies necessary research, develops technical resources including standards and recommended practices, develops public awareness programs, and serves as a conduit for the exchange of professional information. Through meetings, seminars, publications, and a network of more than 18,000 members working in 78 countries, ITE connects members to a world of ideas, people, and resources.

Artificial intelligence technologies are rapidly becoming essential tools that the transportation industry is using to reach our shared goals of reducing and eliminating the more than 41,000 traffic fatalities that occur on an annual basis and improving the efficiency, equity, and sustainability of our transportation network. ITE views ARPA-I and USDOT as important partners in shaping the development and use of AI transportation tools and technologies to achieve these shared goals.

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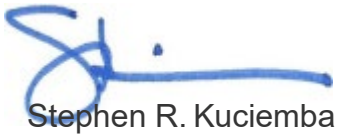
ITE applauds ARPA-I's efforts to identify potential opportunities and challenges associated with AI use in the transportation sector. Below, we have included responses to many of the questions outlined by ARPA-I in the RFI. We look forward to continuing to support the efforts of ARPA-I and USDOT to further guide the use and application of AI technologies in the transportation sector.

If you have any questions about these comments or recommendations, please contact Matthew Hardy, Ph.D., Deputy Executive Director and Chief Technical Officer, at (703) 868-7154 or mhardy@ite.org.

Sincerely,



Stephen R. Kuciemba
ITE Executive Director & CEO

Introduction

ITE has recently initiated three efforts addressing artificial intelligence (AI) in transportation, which have helped inform our response to this request for information (RFI). First, in January 2024, ITE identified AI in Transportation as one of three critical developing trends with emerging challenges and solutions related to transportation. The purpose of identifying these critical developing trends is to focus on how these areas can advance transportation planning, engineering, management, and operations. By highlighting these trends, ITE aims to guide discussions among our members and other transportation professionals about adopting new solutions and rethinking existing practices.

Second, the AI Developing Trends group published an article on the use and application of AI in transportation in the May 2024 edition of *ITE Journal*[1]. In it, we discuss how AI has been a topic of interest to the ITE membership for several f years. While the current focus is on generative AI models powered by deep learning on expansive datasets, AI has been applied in transportation in various forms for the past two decades. In the early days of AI, the field often revolved around expert systems—programs built on rules defined and coded by human experts within specific, limited domains. Although these expert systems delivered some productivity gains, they were inherently constrained by the limits of computing resources and their predefined, human-centric nature.

However, the tide began to turn with the rise of machine learning systems that use algorithms and models trained on observational or simulated data, allowing them to learn patterns and relationships independently, rather than relying on explicitly programmed rules. This foundation, combined with advancements in computing hardware, has driven AI innovation, underpinning applications ranging from natural language processing to machine vision. Natural language processing has enabled breakthroughs like machine translation and digital assistants, while machine vision techniques can classify and interpret visual scenes captured by an array of sensors.

Finally, ITE surveyed its members on the use and application of AI by transportation professionals at both public agencies and private companies. The purpose of the survey was to determine the significance and impact of AI tools on organizations and to inform ITE about the actions we can take to further support our members. The survey results are included in our response to the ARPA-I questions below, with a more complete summary to be published by ITE later this summer.

Current AI Applications in Transportation

The application of AI in the transportation field Is not entirely new. For example, decision support systems and expert (or rule-based) AI systems have been utilized by agencies for incident management and road weather management within their transportation/traffic management centers (TMCs). These systems enable TMC operators to swiftly choose responses to incidents or severe weather events. Furthermore, predictive traffic management, powered by AI, forecasts future traffic patterns by analyzing historical data, weather conditions,

[1] 2024 ITE Developing Trend: Use and Application of Artificial Intelligence in Transportation, ITE Journal, May 2024.

and events, enabling proactive congestion mitigation strategies. The integration of AI into traffic engineering, Intelligent Transportation Systems (ITS), and smart mobility solutions is crucial for accommodating connected and autonomous vehicles, which rely on AI algorithms to navigate safely and efficiently through complex traffic scenarios.

Within the transportation context, ITE has organized the use and application of AI tools into the following six overarching categories:

Table 1 AI Tool Classification

Category	Application	Example	Currently Used
Learning	Machine Learning, Deep Learning	Predicting Traffic Patterns and Trends	38%
Decision Making	Expert Systems	AI-based Decision Support System	13%
Perception	Computer Vision, Machine Vision, Speech Recognition	Machine Vision for Advanced Driver Assistance Systems, Automated Driving Systems	24%
Movement	Robotics	Personal Delivery Devices, Drones	9%
Language	Natural Language Procession	Text Recognition	46%
Creation/Generation	Large Language Models(LLMs), Generative AI	ChatGPT, Gemini, Dall-E, Midjourney	82%

The last column in the table above indicates the percentage of respondents who are actively using the category of AI tools based upon the ITE survey. In a follow-up question, respondents provided the following details on how they are currently using AI tools:

- **Content Creation**
  - Drafting emails, summarizing reports, and other daily tasks.
  - Assisting in report writing and editing.
  - Generating starter text and summarizing large amounts of data.
  - Converting speech to text in Word documents.

    - Generating sample text for proposals and reports and creating stock images for presentations.
- **Data Analysis**
    - Integrating with existing statistical and interpretable models to enhance data processing and inference extraction.
    - Leveraging ArcGIS machine learning libraries for various tasks.
    - Extracting and summarizing data sets and large volumes of text, as well as extracting topical knowledge.
    - Analyzing crash data, identifying causes, and predicting crashes.
    - Evaluating travel behavior characteristics.
- **Document Review and Content Analysis**
    - Helping staff prepare responses to community correspondence.
    - Using the AI assistant feature within Adobe Acrobat Reader to review and summarize PDF content.
    - Analyzing content during reviews to speed up processes.
    - Automating the reconciliation between invoices and work authorizations.
- **Specialized Applications in Transportation**
    - Predicting red light running.
    - Using detection devices for traffic mobility.
    - Predict mechanical failure and conducting soil testing.
    - Overlaying on existing CCTV cameras and using tools like Miovision 360 for traffic analysis.
    - Detecting objects in vehicles in networks, identifying near misses, and predicting roadway vehicle counts.
- **Coding and Model Development**
    - Planners using AI to generate R/Python scripts for data analysis.
    - Using LLMs to help write and debug code, impute bad/missing data from traffic signal detectors, and predict traffic volumes.
    - Generating code for automation and data analysis.

AI Opportunities in Transportation

ITE and its members understand and appreciate the potential that AI tools have in supporting the transportation industry by improving safety, increasing system efficiency, and boosting productivity. Given the six categories of AI tools identified in Table 1 above and how current AI tools are being used, ITE members were asked which areas of transportation they see as having the greatest opportunities for applying AI technologies in the future. Shown below in Table 2 are the rankings for 17 different transportation application areas, including the traditional project life cycle (planning through operations) and specialized applications such as vehicle safety systems and knowledge management.

Table 2 Opportunities of AI in Transportation

Transportation Application Area	Response
Traffic Signal Optimization	62%
Traffic Modeling and Simulation	61%
Connected and Autonomous Vehicles	61%
Transportation Systems Management and Operations	57%
Vehicle Safety Systems (collision avoidance, vision systems, etc.)	54%
Planning	51%
Asset Management	48%
Knowledge Management	45%
Smart Cities	43%
Design	38%
Supply Chain and Logistics Optimization	32%
Infrastructure Safety	25%
Transportation Resilience	22%
Maintenance	20%
Equity Analysis	19%
Construction	13%
Environmental Sustainability	12%

The top five application areas are consistent with current and historic use of AI tools. Traffic engineers have been applying machine learning and deep learning algorithms to optimize networks of traffic signals for over a decade[2]. Traffic modeling and simulation have also utilized machine learning and expert systems to improve and develop better macro-, meso-, and micro-simulation models. Additionally, vehicle manufacturers have been using machine learning, machine vision, computer vision, and other sensor technologies to enable connected and automated vehicles as well as develop and deploy in-vehicle automated safety systems. What is even more compelling is the potential ITE member see in the use of AI tools across the traditional project life cycle (planning, design, construction, operations, and asset management) and in other areas such as smart cities and knowledge management.

The results highlight the application areas that ITE members see as having the most potential. We will continue to work with our members through our AI Developing Trends group to better understand which types of AI applications will be applied to various transportation areas and to what extent. For example, the use of AI to enhance transportation resilience will likely include

[2] *The AI Toolbox for Transportation Professionals: Understanding Data, Predicting Problems, and Enhancing Safety*, 2024 ITE Spring Virtual Conference. Available at http://www.ite.org.

aspects of AI perception tools (detecting rockfall in mountainous areas), which will inform decision-making systems. These systems will then assess next steps, leading to improved learning for transportation simulation models to predict the flow and movement of vehicles on the transportation network.

Challenges of AI in Transportation

ITE and its members recognize the many challenges of using and applying AI tools in the transportation sector. Survey respondents expressed a range of perspectives on AI, from fully supportive ("AI will become much more important in the analysis and decision-making process for almost everything.") to deeply skeptical ("AI is a threat to what makes us human."). While some acknowledge AI's potential to impact all areas of work and improve productivity, many express significant skepticism about its current reliability and practicality. Respondents raised concerns about AI threatening human understanding, being implemented without sufficient caution, and potentially introducing significant bias. Additionally, many believe that AI might not address core issues in transportation, such as the need for proper data analysis and addressing purposeful bad behavior in driving related to automated vehicle applications. Comments emphasized the importance of further academic studies, validation, and guidelines for privacy and security before widespread AI adoption.

In the ITE survey, members were asked what they saw as the biggest challenges they personally faced when using AI tools and the greatest challenges in applying AI tools in the transportation sector. The results are as follows[3]:

Table 3 Personal Challenges in Using AI

Personal Challenges	Response
Ethical Concerns	54%
Lack of Expertise	51%
Security Concerns	40%
Cost	29%
Lack of Data	28%
Other (please specify)	26%
Unsure	3%

Table 4 Industry Challenges in Using AI

Industry Challenges	Response
Safety/Liability Concerns	62.50%
Building public trust and acceptance	56.25%
Privacy Issues	51.56%
Fairness and Bias	46.88%
Workforce Impacts	34.38%
Cost and Infrastructure Requirements	26.56%
Funding	23.44%
Other (please specify)	15.63%

The responses highlight a range of concerns and considerations related to the use and application of AI in the transportation sector. Ethical concerns and the safety of using AI systems and the subsequent liability of using the and of AI systems should something go wrong emerged as prominent themes. Many ITE members emphasized the need for human oversight to ensure that AI-generated outcomes are accurate, contextually appropriate, and

[3] Results do not sum to 100% because respondents were able to select multiple challenges.

unbiased. They also expressed concern about AI's inability to fully grasp the complexities of transportation, including socio-economic factors and planning intricacies, which are crucial in building public trust and acceptance of these tools.

Other aspects of the personal and industry challenges in using AI include the following:

- **Training and Expertise**. ITE members point out the significant training gap in both AI and data literacy, stressing the need for professionals to understand AI tools beyond just the basics. They fear that over-reliance on AI could undermine professional judgment and lead to a perceived lack of need for licensed engineers. Ensuring that AI applications are properly vetted, with adequate data quality and validation processes, is seen as essential.
- **Ethical Considerations and Liability**. ITE members are concerned about the potential misuse of AI, ownership of data, and liability issues arising from AI-generated products. The ethical implications of AI, particularly in terms of ensuring unbiased and accurate outcomes, were also noted. The concept of AI "hallucination," where AI generates incorrect or misleading information, is identified as a significant issue and further supports the need for human oversight.
- **Resistance to AI Adoption**. Many ITE members noted the diversity of people and employees and their willingness and ability to use new technologies. The challenge of acceptance is compounded by regulatory hurdles and the need for higher-trained personnel to use AI effectively.

Other Considerations in the Development of AI for Transportation

The integration of AI models and tools into the transportation profession brings about significant potential yet also poses several challenges. USDOT, in partnership with organizations like ITE, plays a crucial role in providing information and facilitating the exchange of knowledge. There is a need to share guidelines, best practices, and case studies among transportation professionals to further support informed decision-making and effective utilization of AI tools. ITE looks forward to partnering with USDOT and its modal administrations in gathering and disseminating information to practitioners in the following topic areas related to the use and application of AI in transportation:

- **Developing Resources and Exchanging Knowledge**:
  - Develop clear definitions and explanations of AI terms relevant to transportation.
  - Offer resources on how AI tools impact specific transportation domains.
  - Create a glossary of AI terms for transportation professionals.
  - Raise awareness regarding AI ethics.
- **Evaluating and Validating AI Tools**:
  - Partner with other organizations to develop a framework for assessing AI product performance in transportation.
  - Establish performance criteria for AI applications in transportation.
  - Identify "deployment-ready" AI tools for practical applications.

- **Sharing Best Practices and Resources**:
    - Facilitate knowledge exchange through educational programs and case studies on AI applications.
- **Policy and Standards:**
    - Provide input to AI-related legislation, regulations, policies, and standards.
    - Support development of AI standards for transportation in collaboration with other transportation partners.
- **Broader Initiatives**:
    - Explore applications of AI from other domains that can be adapted to transportation.
    - Organize cross-cutting initiatives focused on AI in transportation.

Conclusion

AI may well be one of the most consequential technologies of our time. As this technology continues to advance, the transportation industry stands to gain substantial benefits from leveraging AI to innovate, augment, and optimize every facet of the industry, including education, research, planning, design, operations, and maintenance. One key takeaway, however, is to exercise caution in using the AI tools. Although AI tools are powerful, their outputs can contain misinformation, bias, or even harmful content. We must use and assess them critically, being aware of their limitations.