

2024 ITE Developing Trend: Use and Application of Artificial Intelligence in Transportation

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Artificial Intelligence: Panacea or Pandora's Box? Charting a Responsible Path Forward

Artificial Intelligence (AI) may well be the most consequential technology of our time. And 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. The rapid evolution of AI is profoundly reshaping our societal landscape, influencing diverse sectors ranging from industry to commerce to daily routines. In the realm of transportation, insights shared at the 2024 ITE Virtual Spring Conference underscored the important ways in which AI is revolutionizing conventional practices. Beyond merely enhancing operational efficiency through data-driven insights, transportation professionals are harnessing AI to refine visualizations, facilitate clearer communication, and streamline processes, thereby overall efficiency. One key takeaway, however, is to exercise caution in using the AI tools. While AI tools are powerful, their outputs can contain misinformation, bias, or even harmful content. Use them critically and be aware of their limitations.

It is crucial to note that AI's conceptual scope is broad, ever evolving, and occasionally perplexing. While definitions may diverge, AI generally pertains to the programming of computational systems to execute tasks requiring cognitive faculties akin to those of humans. Innovations in mathematical theory, computational power, and the unprecedented abundance of data have fostered AI applications capable of rivaling or surpassing human proficiency in specialized domains. This article explores the evolution of the AI technology, delving into its specific applications within the transportation domain. Furthermore, we examine the significance of AI tools for ITE members, and conclude with a call to action—outlining how ITE's Councils can guide the responsible and impactful use of AI in shaping the future of our industry.

Evolution of AI

The roots of AI trace back to a 1956 workshop led by emeritus Stanford Professor John McCarthy. Its aim: to delve into the potential of machines to mimic human intelligence. AI draws from various disciplines, including computer science, physics, linguistics, mathematics, statistics, economics, evolutionary biology, neuroscience, psychology, philosophy, and ethics.

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. While these expert systems delivered some productivity gains, they were inherently constrained by the limits of computing resources and their predefined, human-centric nature.

The tide began to turn with the rise of machine learning (ML) systems over the past 2 decades. Rather than relying on explicitly programmed rules, ML algorithms and models were trained on observational or simulated data, allowing them to learn patterns and relationships on their own. This foundation, combined with advancements in computing hardware, proved to be a major driver of AI innovation, underpinning applications ranging from natural language processing (NLP) to machine vision. Natural language processing enabled breakthroughs like machine translation and digital assistants, while machine vision techniques could classify and interpret visual scenes captured by an array of sensors.

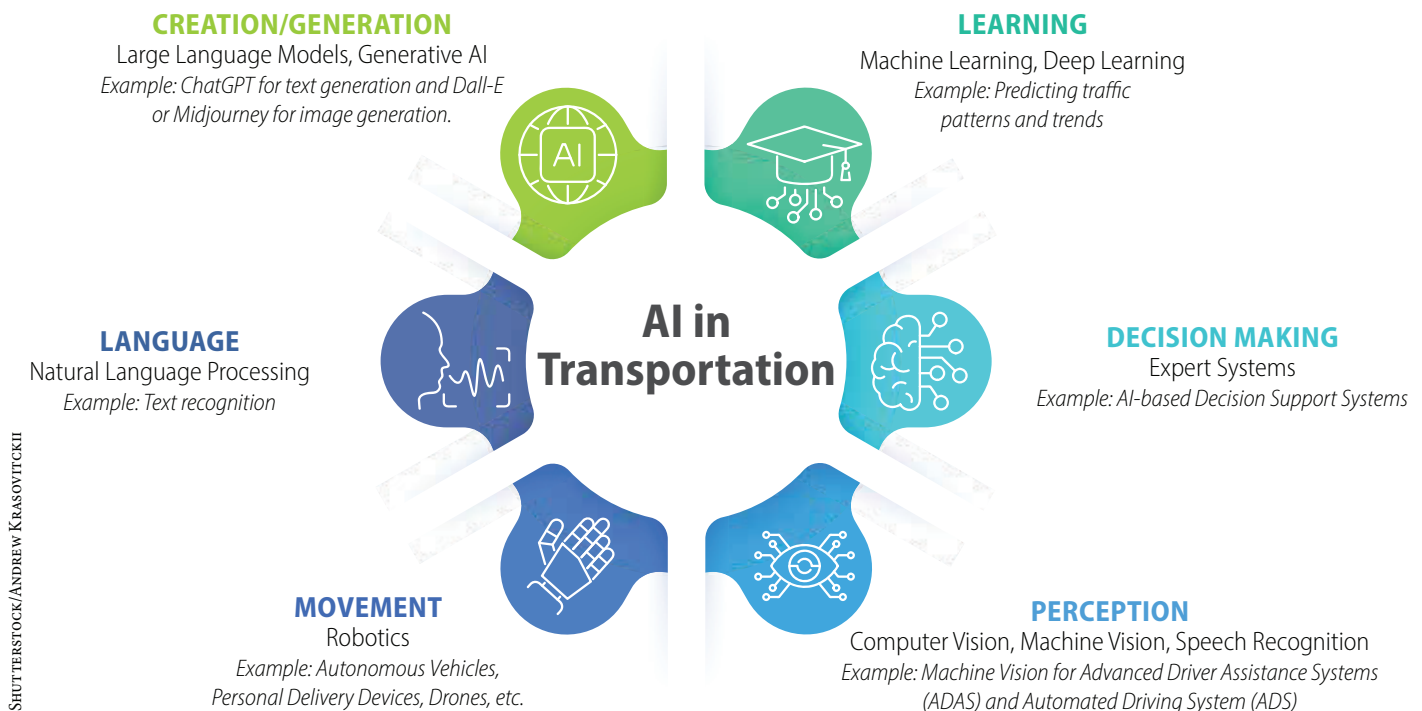


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However, the spotlight presently is on emerging Generative AI models, powered by Deep Learning on expansive datasets. These systems can now create entirely new content—from images and music to text—through the simple use of prompts, unlocking unprecedented creative potential.

AI in Transportation

The use of AI can be organized around six overarching categories in the context of transportation:



In 2023, there was a significant democratization of AI tools with the widespread availability of numerous generative models and engines. Notable tools include OpenAI's ChatGPT and DALL-E, Microsoft's Copilot, and Google's Gemini, among others. AI assistants are also being integrated into daily use applications such as Microsoft Office Suite and Adobe Acrobat, leading to efficiency improvements. These tools are rapidly becoming integral components of the daily toolkit for many transportation professionals, facilitating tasks ranging from routine administrative duties such as drafting meeting notes and developing responses, to more complex undertakings such as reviewing and summarizing legislative, regulatory and policy documents, and supporting the development of various transportation plans.

However, the application of AI in the transportation field is not totally new. For example, decision support systems (DSS) 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, and events, enabling proactive congestion mitigation strategies. The integration of AI into traffic engineering, Intelligent Transportation Systems (ITS), and smart mobility solutions are crucial for accommodating connected and autonomous vehicles, which rely on AI algorithms to navigate safely and efficiently through complex traffic scenarios.

* FHWA-HOP-19-052 Raising Awareness of Artificial Intelligence for Transportation Systems Management and Operations (Accessed April 9, 2024).

The ITE Council Leadership Team (CLT) publishes a yearly Developing Trends Report to identify up-and-coming challenges and solutions in transportation. This report, informed by ITE's Councils and Committees, focuses on advancements in planning, engineering, management, and operations. By highlighting these trends, the report aims to guide discussions among transportation professionals about adopting new solutions and rethinking existing practices. This year's report spotlights three member-prioritized trends: Artificial Intelligence, Transportation Workforce, and Transportation System Resilience, each getting a dedicated issue in the ITE Journal. The focus of this month's Developing Trend is on Artificial Intelligence.

Importance of AI Applications to ITE Members

AI is undeniably being used throughout the transportation industry, potentially without a thorough examination of the performance, accuracy, or ethics. For instance, the use of Generative AI based applications (e.g., Open AI's ChatGPT, Anthropic's Claude, Google's Gemini, etc.) allows common tasks to be accomplished more quickly, and in some cases even allows for automation. This presents a significant opportunity for practitioners to dedicate staff resources where those staff credentials and expertise are more critical, rather than other tasks that may be simpler or repetitive. However, these models are trained on existing information and available data, and users need to exercise caution as new models and features are released without undergoing a formal review.

It is important for ITE's members to be aware of and understand how AI models operate and the limitations of the information they can provide so that safeguards can be developed such as human oversight to ensure that the results are valid. Otherwise, members risk perpetuating misinformation and methodological errors that may be present in the data sets used to train the models. The outputs of the models are only as reliable and valid as the data used to train the models. Thus, there is likely an important need for education and training programs within ITE to ensure members are adequately equipped with the knowledge, skills, and resources to navigate AI advancements in transportation.

ITE's Call to Action in Using and Applying AI Tools

On March 28, 2024, the Office of Management and Budget (OMB) issued a memorandum titled "Advancing Governance, Innovation, and Risk Management for Agency Use of Artificial Intelligence," providing guidance to federal agencies on responsible AI development and deployment.** The memo noted that "AI presents not only risks, but also a tremendous opportunity to improve public services and make progress on societal challenges, like addressing climate change, improving public health and advancing equitable economic opportunity." The integration of AI models into the transportation profession brings about significant potential yet also poses several challenges. ITE, through the Councils and Committees, holds an important role as an information provider and facilitator of knowledge transfer in this context. Given ITE's diverse membership, including transportation leaders, policymakers, practitioners, researchers, and students, there's 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 can play a pivotal role in gathering and disseminating this information to practitioners, facilitating its integration into professional practice.

Working through the ITE Council and Committee structure, the Council Leadership Team (CLT) will explore the following topic areas related to the use and application of AI in transportation:

1. Education and Knowledge Transfer:

- Develop clear definitions and explanations of AI terms (AI, ML, DL, LLM) relevant to transportation.
- Offer resources on how AI tools impact specific transportation domains.
- Create a glossary of AI terms for transportation professionals.
- Raising awareness regarding AI ethics.

2. 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.

** <https://www.whitehouse.gov/wp-content/uploads/2024/03/M-24-10-Advancing-Governance-Innovation-and-Risk-Management-for-Agency-Use-of-Artificial-Intelligence.pdf> (Accessed April 8, 2024).]

3. **Sharing Best Practices and Resources:**^{***}

- Facilitate knowledge exchange through educational programs and case studies on AI applications.
- Leverage ITE's platform to share best practices and guidelines for using AI in transportation.
- Leverage ITE's Industry Council membership to exchange knowledge of their AI tools/applications and share their best practices in the transportation industry.

4. **Policy and Standards:**

- Provide input to AI-related legislation, regulations, policies, and standards at the federal (through ite national) and state level (through Districts and Sections).
- Support development of AI standards for Transportation in collaboration with other transportation partners.

5. **Broader Initiatives:**

- Explore applications of AI from other domains that can be adapted to transportation.
- Organize cross-cutting initiatives (education, consultant council) focused on AI in transportation.

By addressing these topic areas, the CLT hopes to better equip members with the knowledge, skills, and resources needed to navigate AI advancements in transportation. [itej](https://www.itej.org)

^{***} To meet the requirements of Executive Order 13960, all executive agencies were required to prepare an inventory of non-classified and non-sensitive current and planned AI use cases within their respective organizations. See <https://ai.gov/ai-use-cases/>.



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