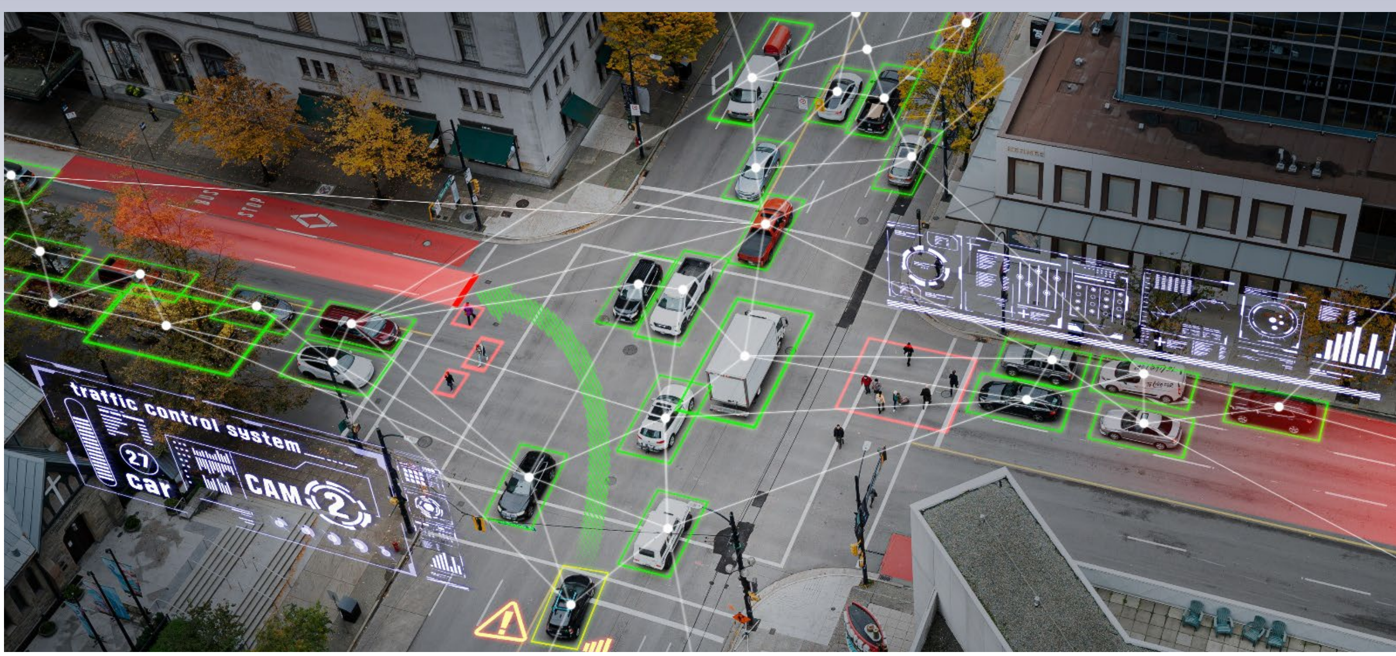
REPORT

Artificial Intelligence and Transportation in Canada

July 2026



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Abstract Artificial intelligence (AI) can elevate experiences, enhance productivity, and empower better decisions. It also comes with risks. There are promising AI applications in Canada's transportation sector, and transportation organizations are increasingly exploring AI-driven solutions to their challenges. However, many transportation practitioners face gaps in their understanding of AI. The aim of this discussion paper is to demystify AI, provide real-world examples of its use in transportation, and suggest ways that volunteer groups within the Transportation Association of Canada can contribute.	**Keywords** Economics and Administration • Artificial intelligence • Asset management • Cost benefit analysis • Data processing • Planning • Safety • Traffic control	
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L'intelligence artificielle (IA) peut améliorer l'expérience utilisateur, accroître la productivité et favoriser la prise de meilleures décisions. Elle comporte toutefois des risques. Il existe des applications prometteuses de l'IA dans le secteur des transports au Canada, et les organismes responsables des transports explorent de plus en plus des solutions basées sur l'IA pour relever leurs défis. Cependant, de nombreux professionnels des transports éprouvent des lacunes dans leur compréhension de l'IA et de ses possibilités. L'objectif de ce document de réflexion est de démystifier l'IA, de fournir des exemples concrets de son utilisation dans le domaine des transports et de suggérer des moyens par lesquels les bénévoles de l'Association des transports du Canada peuvent apporter leur contribution.</td><td>Mots clés
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Executive summary

Introduction

Artificial intelligence (AI) can elevate experiences, enhance productivity and empower better decisions. It also comes with risks.

There are promising AI applications in Canada's transportation sector, and transportation organizations are increasingly exploring AI-driven solutions to their challenges. However, many transportation practitioners face gaps in their understanding of AI.

The aim of this discussion paper is to demystify AI, provide real-world examples of its use in transportation, and suggest ways that volunteer groups within the Transportation Association of Canada (TAC) can contribute.

About artificial intelligence

Using machine learning methods and patterns found in training datasets, AI systems are trained to generate content, predictions, recommendations or decisions based on input data. They encompass a wide range of tools, from simple linear regression to highly complex artificial neural networks. They can perform some tasks better than humans, but cannot operate reliably outside the scope of the data they are trained on.

AI systems are categorized according to four dimensions: domain, objective, learning method, and technique for pattern recognition. Each dimension includes multiple types that offer insights into the system's capabilities, risks, biases and limitations.

Simpler AI systems have been in use for decades, but major recent advancements have resulted from the growth of "big data," declining computer processing costs, funding for research and development, and a proliferation of labelled data for training AI models. Those advancements have yielded emerging opportunities such as agentic AI, but have also made it harder to understand and interpret AI system logic.

Canada has not yet implemented a legislative or regulatory framework for AI, although it has developed a code of conduct and a guide for managing AI implementation.

Applying artificial intelligence: Use cases in transportation

Listed below are many of the ways that AI technologies are being applied in the road, highway and urban transportation segments of Canada's transportation sector.

Planning and design
Data collection
Modelling
Emergency planning
Geometric design

Traffic operations
Compliance and enforcement
Traffic control devices
Traffic management systems
Connected vehicle data use
Dynamic pricing systems

Construction and asset management
Project management
Public-private partnerships
Asset inspection and condition assessment
Predictive maintenance
Lifecycle cost planning
Digital twins
Salt use
Vegetation management

Safety and security
Road safety engineering
Incident prevention, detection, response and analysis
In-vehicle safety systems
Automated driving systems
Cybersecurity

Mobility services
Bike sharing and car sharing operations
Multimodal trip planning
Accessibility
Transit
Electric vehicle charging

Administration
Human resources management
Talent development
Research and content creation
Agentic AI

Artificial intelligence challenges and risks

One area of concern around the use of AI is bias, which refers to systematic errors or unfair tendencies in how a model evaluates information, makes predictions, or arrives at a decision. Bias can be introduced either through data or through the people developing and training the model. It is a subject of particular sensitivity when AI models guide decisions that affect people, and can be mitigated through measures that include careful selection of training data and screening of results, human oversight, transparent communication and ethical guidelines.

Another area of concern is personal privacy, which can be threatened by poor AI governance and use. Steps to mitigate privacy risks include the development of data governance frameworks, regulatory compliance, impact assessments, and education.

Organizations are vulnerable to unauthorized sharing of confidential intellectual property when employees use generative AI tools improperly. This risk is reduced by the acquisition and use of enterprise licenses (rather than public platforms) for generative AI, accompanied by guidance and training for staff.

AI can also pose security risks, particularly by its enabling of phishing or social hacking schemes that employ “deepfake” technology. Employee training, security protocols and an organizational culture of caution can help minimize this threat.

Finally, the impacts of AI systems on employees and their work are still evolving but may be dramatic in some cases. The potentially transformative impacts of AI in workplaces can be successfully managed by communicating about AI and related initiatives, focusing on AI’s ability to improve (rather than replace) human work, involving staff in decisions, reinforcing the need for human involvement in AI-driven processes, and offering upskilling opportunities.

Suggested actions for TAC councils and committees

TAC's councils and committees are run by dedicated volunteers. Those groups interested in the use of AI within their technical area of concern could create a working group as a forum for interested individuals to focus their efforts. In addition, committees could share case studies or technical documents related to AI systems, deliver learning events, conduct surveys to identify current practices and issues, and propose or undertake projects leading to presentations or published reports. Finally, they are also able to suggest ideas for AI-related webinars or training courses to be delivered by the TAC Secretariat.

Résumé

Introduction

L'intelligence artificielle (IA) peut améliorer l'expérience des usagers, accroître la productivité et favoriser la prise de meilleures décisions. Elle comporte toutefois certains risques.

Il existe des applications prometteuses de l'IA dans le domaine des transports au Canada, et les organismes de transport explorent de plus en plus des solutions basées sur l'IA pour relever leurs défis. Cependant, de nombreux professionnels des transports éprouvent des lacunes dans leur compréhension de l'IA.

Ce document de réflexion a pour but de démystifier l'IA, de fournir des exemples concrets de son utilisation dans les transports et de suggérer des moyens par lesquels les équipes bénévoles au sein de l'Association des transports du Canada (ATC) peuvent y apporter leur contribution.

À propos de l'intelligence artificielle

À l'aide de méthodes d'apprentissage automatique et de modèles issus d'ensembles de données d'entraînement, les systèmes d'IA sont formés pour générer du contenu, des prévisions, des recommandations ou des décisions à partir de données recueillies. Les systèmes d'IA englobent un large éventail d'outils, allant de la simple régression linéaire à des réseaux neuronaux artificiels d'une grande complexité. Ils peuvent accomplir certaines tâches mieux que les humains, mais ne peuvent pas fonctionner de manière fiable en dehors du cadre des données sur lesquelles ils ont été formés.

Les systèmes d'IA sont classés selon quatre dimensions : le domaine, l'objectif, la méthode d'apprentissage et la technique de reconnaissance des modèles. Chaque dimension comprend plusieurs types qui permettent de mieux cerner les capacités, les risques, les biais et les limites du système.

Des systèmes d'IA plus simples sont utilisés depuis des décennies, mais les avancées majeures récentes résultent de l'essor des systèmes de mégadonnées, de la baisse des coûts du traitement informatique, du financement de la recherche et du développement, ainsi que de la prolifération des données étiquetées destinées à l'entraînement des modèles d'IA. Ces avancées ont donné naissance à de nouvelles possibilités, telles que l'IA agentique, mais ont également rendu plus difficile la compréhension et l'interprétation de la logique des systèmes d'IA.

Le Canada n'a pas encore mis en place de cadre juridique ou réglementaire pour l'IA, bien qu'il ait élaboré un code de conduite et un guide pour la gestion de la mise en œuvre de l'IA.

Application de l'intelligence artificielle : cas d'espèce dans les transports

Le lecteur trouvera ci-dessous un aperçu des nombreuses applications des technologies d'IA dans les secteurs des transports routiers, autoroutiers et urbains du domaine des transports au Canada.

Planification et conception
Collecte de données
Modélisation
Planification des mesures d'urgence
Conception géométrique

Gestion de la circulation
Conformité et application de la réglementation
Dispositifs de régulation de la circulation
Systèmes de gestion de la circulation
Utilisation des données des véhicules connectés
Systèmes de tarification dynamique

Gestion des travaux et des actifs
Gestion de projet
Partenariats public-privé
Inspection des actifs et évaluation de leur état
Entretien préventif et prédictif
Planification des coûts du cycle de vie
Jumeaux numériques
Utilisation des sels de voierie
Gestion de la végétation

Sécurité et sûreté
Ingénierie de la sécurité routière
Prévention, détection, intervention et analyse des incidents
Systèmes de sécurité embarqués
Systèmes de conduite automatisée
Cybersécurité

Services de mobilité
Exploitation des services de vélos en libre-service et d'autopartage
Planification des trajets multimodaux
Accessibilité
Transports en commun
Recharge des véhicules électriques

Administration
Gestion des ressources humaines
Développement des talents
Recherche et création de contenu
IA agentique

Défis et risques liés à l'intelligence artificielle

L'un des sujets de préoccupation liés à l'utilisation de l'IA est le biais, qui désigne les erreurs systématiques ou les tendances inéquitables dans la manière dont un modèle évalue les informations, formule des prévisions ou prend une décision. Le biais peut provenir soit des données, soit des personnes chargées de développer et d'entraîner le modèle. Il s'agit d'un sujet particulièrement sensible lorsque les modèles d'IA orientent des décisions qui ont une incidence directe sur les personnes, et il peut être atténué grâce à des mesures telles que la sélection rigoureuse des données d'entraînement et la vérification des résultats, la supervision humaine, une communication transparente et des lignes directrices guidées par l'éthique.

La protection de la vie privée constitue un autre sujet de préoccupation, qui peut être menacée par une gouvernance et une utilisation inadéquates de l'IA. Les mesures visant à atténuer les risques liés à la protection des renseignements personnels comprennent l'élaboration de cadres de gouvernance des données, le respect de la réglementation, les analyses d'impact et la formation.

Les organisations sont exposées au partage non autorisé de propriété intellectuelle confidentielle lorsque les employés utilisent de manière inappropriée des outils d'IA générative. Ce risque est réduit par l'acquisition et l'utilisation de licences d'entreprise (plutôt que de plateformes publiques) pour l'IA générative, accompagnées de conseils et de formations destinés au personnel.

L'IA peut également présenter des risques pour la sécurité, notamment en facilitant les tentatives d'hameçonnage ou de piratage social recourant à la technologie d'hypertrucage (deepfake). La formation des employés, les protocoles de sécurité et une culture d'entreprise axée sur la la prudence peuvent contribuer à réduire cette menace autant que possible.

Enfin, les répercussions des systèmes d'IA sur les employés et leur travail sont en pleine évolution, mais peuvent s'avérer considérables dans certains cas. Les effets potentiellement transformateurs de l'IA sur le lieu de travail peuvent être gérés avec succès en communiquant sur l'IA et les initiatives associées, en mettant l'accent sur la capacité de l'IA à améliorer (plutôt qu'à remplacer) le travail humain, en impliquant le personnel dans les décisions, en soulignant la nécessité d'une implication humaine dans les processus pilotés par l'IA et en proposant des possibilités de perfectionnement professionnel.

Suites à donner suggérées pour les conseils et comités de l'ATC

Les conseils et comités de l'ATC sont animés par des bénévoles dévoués. Les groupes intéressés par l'utilisation de l'IA dans leur domaine technique d'intérêt particulier pourraient créer des groupes de travail servant de forum permettant aux personnes intéressées de concentrer leurs efforts. En outre, les comités pourraient partager des études de cas ou des documents techniques liés aux systèmes d'IA, organiser des activités de formation, mener des enquêtes pour identifier les pratiques et les enjeux actuels, et proposer ou mener des projets débouchant sur des présentations ou des publications techniques. Enfin, ils peuvent également suggérer des idées de webinaires ou de formations liés à l'IA, qui seraient organisés par le secrétariat de l'ATC.

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1. Introduction

Artificial intelligence (AI) is now integrated into our daily lives. It can elevate our experiences, enhance our productivity, and empower better decisions. Though, as with any emerging technology, it also comes with risks.

In the road, highway, and urban transportation segments of Canada's transportation sector, there are promising applications of AI across fields as diverse as planning, operations, asset management, and human resources. Canadian transportation organizations are increasingly exploring AI-driven solutions that support real-time monitoring, predictive maintenance, and adaptive traffic control systems. These technologies help optimize resource allocation, make transportation networks more reliable, and proactively address issues before they become larger problems.

Many transportation stakeholders face gaps in their understanding of AI and its implications both for their organizations, and for themselves as practitioners. To bridge those gaps, the Transportation Association of Canada (TAC) commissioned this discussion paper to help its stakeholders understand AI's major opportunities while navigating its challenges, risks and uncertainties.

The primary way that transport practitioners will likely be involved with an AI system is in managing its operation – starting and ending its use, altering parameters of its operation, and monitoring and controlling access to its output. With that perspective, this paper speaks directly to practitioners through its subsequent chapters:

- **Chapter 2** defines AI in familiar terms, and provides a framework for understanding the various types of AI.
- **Chapter 3** describes the major areas of current AI application in transportation, and provides short case studies for many of them.
- **Chapter 4** outlines AI's major challenges and risks.
- **Chapter 5** offers suggestions for the members of TAC's volunteer councils and committees to support the effective and responsible use of AI in Canada's transportation sector.

2. About artificial intelligence

2.1 What is AI?

The roots of AI trace back to the 1950s, when Alan Turing asked “Can machines think?” and John McCarthy coined the term “artificial intelligence” to describe the ability of computers or other machines to exhibit or simulate intelligent re sponses. Today, the Organization for Economic Co-operation and Development defines an AI system as a “machine-based system that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments.”[1]

The main thing distinguishing AI systems from other computer systems is that AI models are not programmed. Rather, they are **trained** through a method called machine learning that finds patterns in training datasets, then uses those patterns to generate inferences. AI actually incorporates a wide range of tools, from simple linear regression to highly complex artificial neural networks.

Today’s AI systems are designed to help us complete specific tasks, and the most advanced AI systems perform those tasks better than humans can. However, a recent research paper concluded that even the most advanced generative AI systems of today “face a complete accuracy collapse beyond certain complexities,” and are unable to operate accurately outside their training data[2]**.**

What is intelligence?

Imagine two different computer systems that recommend travel modes to users based on weather conditions and the length of their trip. They operate as follows:

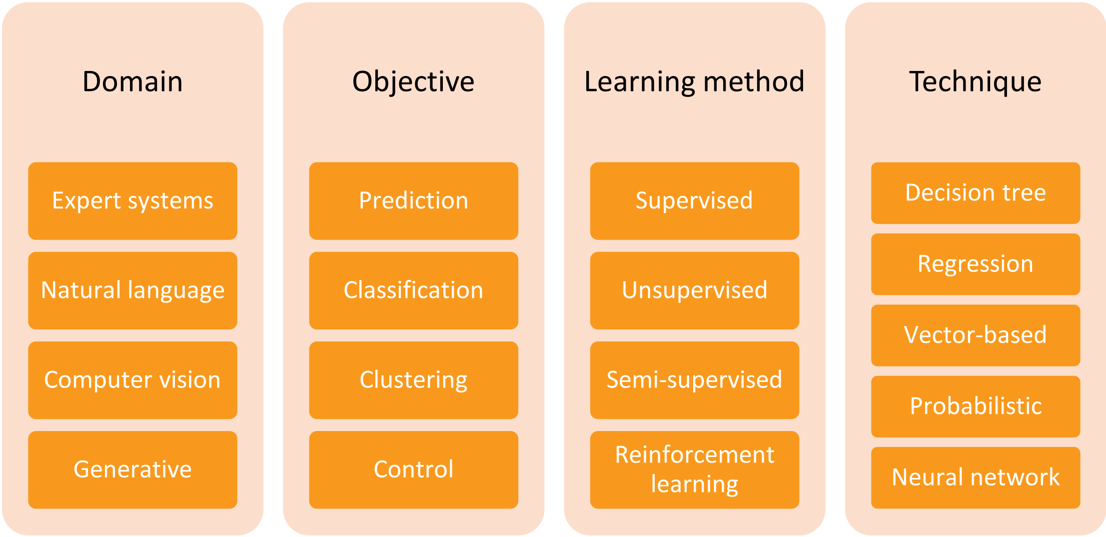
- System A follows pre-programmed rules (e.g. if the weather is sunny and the trip is less than one kilometre, then it recommends walking).
- System B uses a dataset of actual user choices for different weather conditions and trip lengths to train a model that predicts the probability of which mode is best for any given distance and weather.

System B is intelligent, and System A is not.

2.2 Classifying AI systems

Different tasks require different kinds of AI systems, and we categorize those systems according to their context, purpose and underlying approach. This framework for categorizing AI systems uses four key **dimensions** (domain, objective, learning method, and technique for pattern recognition) as shown in Figure 2.1 and discussed further below. We describe an AI system using its **type** within each dimension (e.g. “an expert system for prediction based on a decision tree using supervised learning”). These four dimensions also give insight into an AI system’s capabilities, risks, biases, and limitations.

Figure 2-1: Dimensions and types of AI systems



(Source: Mott MacDonald, 2025. Framework for Understanding AI)

2.2.1 Domain

An AI system's domain describes the task it is designed to help with:

- **Expert systems** support decision making by working with structured data. They can include linear regression tools, social media content recommendation engines, and rules-based systems in automated vehicles.
- **Natural language processing and computer vision systems** interpret information from unstructured data (e.g. text, sounds, images, videos). A common example of natural language processing is next-word prediction on smartphones, and a common example of computer vision is identifying an object in a photograph.
- **Generative AI systems** create unstructured or structured data from user prompts. Generative AI systems like ChatGPT are a main driver behind the surging interest in AI.

2.2.2 Objective

There are four common objectives of AI systems, each with diverse use cases:

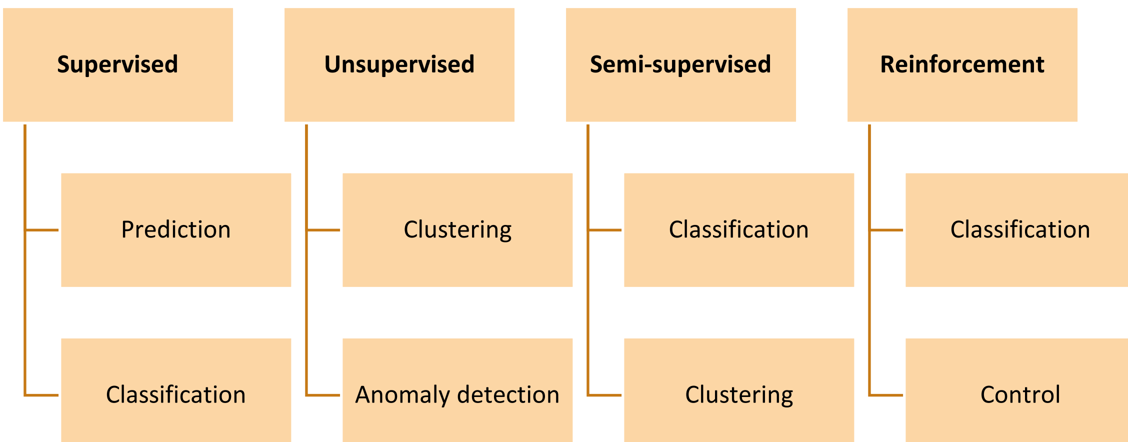
- **Prediction** could apply to traffic or weather forecasting.
- **Classification** could involve identifying cars using computer vision, or tagging outliers in web traffic as part of cybersecurity monitoring.
- **Clustering** could involve customer segmentation or asset categorization.
- **Control** could refer to automated vehicle driving decisions or updates to adaptive signal timings.

2.2.3 Learning method

AI models are trained using one of four main machine-learning methods. Each method has different risks and limitations, and is selected according to the solution objective (see Figure 2.2) and available data:

- **Supervised learning** involves training an AI model using a labelled dataset, which can be extremely resource intensive to produce.
- **Unsupervised learning** involves training an AI model using an unlabelled (and thus less resource-intensive) dataset.
- **Semi-supervised learning** combines both supervised and unsupervised learning, using a small amount of labelled data alongside a substantial amount of unlabelled data.
- **Reinforcement learning** involves training an AI model through interactions with an environment. The model learns to make decisions by receiving rewards or penalties based on its actions, and optimizes its inferences over time. Examples are game-playing AI systems that are trained by playing a game many times; each time the system obtains a higher score, the pattern used to achieve that score is reinforced.

Figure 2-2: AI model learning methods and their typical objectives



An illustrative comparison of learning methods

A computer vision model that can identify cars and trucks inside images could be trained in three ways:

- A supervised model would be trained using a series of images pre-labelled as either ‘car’ or ‘truck’.
- An unsupervised model would use images of cars and trucks to train a model that can assign images of cars and trucks to one of two clusters, but neither cluster is labelled ‘cars’ or ‘trucks’.
- A semi-supervised model would use the supervised learning result to label one cluster of images as ‘cars’ and the other as ‘trucks.

2.2.4 Technique

Technique refers to the approach to pattern recognition (i.e. machine learning algorithm) used to train an AI model (see Table 2.1). There are dozens of techniques because specialized approaches are needed to optimize results for different objectives, constraints and data types. The most common techniques are decision trees, regressions, vector-based, probabilistic models and neural networks.

Techniques dictate an AI system's transparency, explainability, and interpretability. Simple techniques (e.g. regressions, decision trees, and probabilistic models) are highly transparent and useful when explainability is important (see Table 2.1). However, even these approaches can grow complex as datasets grow and as objectives or constraints become more complicated. Multinomial regression and random forest decision trees are examples of technique sub-types that are much less transparent than their relatively simple parents.

Many of the complex tools that have created excitement around AI and launched it into daily life are deep learning AI systems; examples include natural language processing, computer vision, and generative AI. Deep learning is a sub-type of neural networks which, as their name suggests, mimic the way the brain works. Deep learning systems layer together multiple neural networks, which makes them even less transparent and explainable (see Table 2.2).

Table 2-1: Simple machine learning techniques

Technique	Why it's interpretable	Use cases
Linear regression	Coefficients directly show the impact of each feature on the outcome.	Forecasting, pricing models
Logistic regression	Output probabilities and feature weights are easy to interpret.	Accident risk prediction, ridership prediction
Decision trees	Tree structure can be visualized and followed step-by-step.	Mode choice, diagnostics
Naive Bayes	Probabilistic but simple; assumptions make it easy to trace decisions.	Text classification, spam filtering

Table 2-2: Complex machine learning techniques

Technique	Why it's hard to interpret	Use cases
Random forest	Combines many decision trees, making the overall logic hard to trace.	Fraud detection, predictive maintenance
Gradient boosting	Sequentially builds trees to correct errors, resulting in complex interactions.	Forecasting, accident risk prediction
Support vector machines	Uses high-dimensional transformations that are not easily visualized.	Image classification, bioinformatics

Technique	Why it's hard to interpret	Use cases
Neural networks	Layers of weights and activations make it difficult to explain decisions.	Image and speech recognition
Ensemble methods	Combine multiple models, increasing predictive power but reducing transparency.	Recommendation systems, risk modeling

2.3 AI's trajectory

2.3.1 Where we are

As discussed in Section 2.2, some simpler AI systems have been used since the early days of computing. However, in the last decade AI has evolved far beyond its statistical roots to involve increasingly sophisticated and integrated technologies, and it is now easily accessible through our computers and phones. These recent AI advancements have been propelled by four key factors:

- Massive information digitization and data collection ('big data') resulting from digital tools and platforms
- The steadily decreasing cost of computer processing
- Vast funding for research and development into machine learning techniques
- The proliferation of labelled data that can be used to train AI models

One important challenge facing researchers today is the desire to make complex AI systems more transparent and less like 'black boxes'. It has become increasingly difficult to understand and interpret the internal logic of AI systems, which require specialized tools to explain their outputs.

One of today's emerging, transformational opportunities is agentic AI. AI agents are generative AI systems that can not only create content (e.g. text, images, music, code) but can also initiate and execute tasks. Organizations are already experimenting with the adoption of AI agents, with large consulting firms reporting the deployment of thousands of agents to automate their internal operations[3].

An example of agentic AI

An executive asks her AI agent to 'deal with my inbox'. The agent first identifies emails that can be deleted and those that need a response, and asks the executive to confirm each choice; the agent then drafts required responses for the executive to review and send. For any response requiring the organization of a meeting, the agent will execute a series of tasks that could include sending multiple emails, polling participant availability, checking participant food restrictions, making restaurant reservations, and sending meeting invitations.

2.3.2 Looking ahead

AI systems that exist today are known as artificial narrow intelligence (ANI) systems; due to their speed and capacity, they often perform a single task at least as well as humans can. The race is on to develop more advanced artificial general intelligence (AGI) systems that would match humans in performing many different tasks, and eventually to develop artificial super intelligence (ASI) systems that exceed human creativity and problem-solving abilities. Experts have widely varying opinions on when AGI systems might be brought about, with forecasts ranging from short-term to centuries away. This polarization reflects technical uncertainties as well as differing philosophical and ethical perspectives.

2.4 Canada's legal and regulatory landscape

To support international trust and interoperability in AI systems, Canada is beginning to develop a regulatory framework for AI that aligns with international standards including those from the European Union, United Kingdom and United States.

In June 2022, the Government of Canada tabled the Artificial Intelligence and Data Act (AIDA) as part of Bill C-27, the Digital Charter Implementation Act. However, in early 2025 Bill-27 was removed from the Order Paper by prorogation of Parliament, and the timeline for any further federal AI legislation in Canada remains unclear. As proposed, AIDA would have:

- Regulated the design, development, availability, management and use of high-impact AI systems to ensure safety, transparency and accountability
- Required an assessment of deployed AI systems that could impact the rights or well-being of Canadians
- Applied to public and private entities

In the absence of a legal framework, the Government of Canada has introduced a *Voluntary Code of Conduct for Advanced Generative AI Systems*[4], accompanied by an *Implementation Guide for Managers of AI Systems*[5]. The Code recommends ways for organizations and managers to ensure that AI systems are operated safely and responsibly, and helps organizations adopt responsible AI practices and manage AI systems effectively throughout their lifecycle.

3. Applying artificial intelligence: Use cases in transportation

There are many established and emerging use cases for AI technologies in the road, highway, and urban transportation segments of Canada's transportation sector – in other words, within the range of activities undertaken by TAC's member organizations. This chapter discusses representative applications in the following subject areas, and cites a number of examples in each:

- Planning and design
- Construction and asset management
- Mobility services
- Traffic operations
- Safety and security
- Administration

3.1 Planning and design

3.1.1 Data collection

Traditionally, traffic counts and other data used in the planning process have been collected using human effort, temporary tube counters, or loop detectors embedded in roads. While these methods each capture a limited range of data, camera-based computer vision provides highly complete and detailed counts in real time. Different computer vision AI models can be applied to the same footage to count active mode users, motor vehicle classes, vehicle occupancy, and conflicts between road users.

Computer vision can also be used to analyze satellite or aerial imagery, and to provide data on parking space usage, land uses or other geospatial information that interests planners.

3.1.2 Forecasting, modelling and simulation

Regression models are a relatively simple form of AI and have been used for decades to forecast demographics, travel demand, mode choice and travel times. While software used for modelling is continuously updated with more advanced AI, planners prefer to avoid "black box" models with low transparency and explainability.

The scientific community uses AI models extensively for weather and climate predictions. Governments and academic institutions are building simulation models powered by AI to predict the impact on communities of future floods and other major climate events, and to improve mitigation and emergency response measures.

The ability of linear assets like roads and transit lines to provide service is determined by their most at-risk segments. AI systems help identify risks based on topology, flora and climate patterns, and help predict failure based on condition, mitigation and severity. In complex networks, AI systems can be used to help assess impact and criticality which, combined with likelihood of failure, inform decisions about infrastructure resiliency investments.

Interactive tools for planning and operations – York University[6]

Interactive-OR is a web-based platform that combines operations research models with AI and machine learning to support transportation planning and operations. It enables real-time scenario analysis for transit networks, electrification planning and last-mile logistics, using predictive analytics and text-based data streams data to optimize routes, schedules and resource allocation.

Resiliency planning – City of Calgary[7]

AI for the Resilient City is a data-visualization and scenario planning tool to measure, understand and visualize impacts of climate change such as extreme temperatures and the urban heat island effect. The tool uses satellite imagery and local data on weather, infrastructure and demographics. City staff use the tool to develop climate risk profiles for each community in Calgary, and to help planners make evidence-based decisions related to climate risk reduction.

3.1.3 Emergency planning

AI can be used in emergency and evacuation planning to identify high-risk areas and populations, and to propose effective evacuation strategies. It can also be used to simulate emergency scenarios and evaluate response tactics.

Simulation of wildland-urban interface fire evacuation – U.S. National Fire Protection Association[8]

The WUI-NITY project is developing a platform for simulating evacuation scenarios related to fires at the wildland-urban interface. The tool is built on a 3D game engine, and simulates wildfire spread as well as human and traffic behaviour during community evacuations.

3.1.4 Geometric design

Major engineering design software companies are introducing AI assistants to accelerate routine tasks such as report generation, giving engineers more time to focus on the design itself. AI systems can help select an optimum route that reflects key decision-making criteria including environmental impacts, cut and fill balances, road safety and cost.

Generative design for linear infrastructure[9]

Using constraints defined by engineers including property limits, geotechnical constraints, and environmentally or socially sensitive areas, commercially available road design software can quickly generate multiple alignment alternatives and allow engineers to explore creative options they may not have considered on their own.

3.2 Construction and asset management

3.2.1 Project management

AI tools are becoming increasingly common in project management software, where they can predict the future state of a project and help identify cost, schedule and resourcing risks. Project managers can tweak their running rate of spending and progress to achieve their objectives.

In the field, more complex AI systems are used to compare actual construction progress against detailed project plans. For long linear infrastructure, this can be accomplished through AI-enabled post processing of aerial imagery captured using drones.

Construction project scheduling – City of Edmonton[10]

Edmonton is using a platform to help contractors generate and evaluate multiple project schedules. The system uses AI to simulate various sequencing scenarios, and allows the comparison of options based on factors such as efficiency, cost, and risk from winter weather and other challenges.

3.2.2 Public-private partnerships

Public-private partnership (PPP) frameworks are sometimes used to deliver major highway and rapid transit infrastructure. AI systems can help address typical PPP challenges such as limited resources and complex data management, and they can help streamline operations, enhance decision making, and foster greater public confidence[11]. By harnessing data-driven analytics, AI can enable real-time monitoring of project performance, predict cost overruns, anticipate maintenance needs, reduce delays and mitigate fraud. Additionally, AI-powered tools like natural language processing and automated auditing simplify contract oversight, identify potential risks, and ensure compliance. Combined with deep learning models, these systems can detect patterns and correlations that traditional methods often miss, enabling more accurate risk profiling.

Explainable AI techniques can build transparency and trust in these AI-driven assessments by explaining how risk scores are derived and allowing stakeholders to understand the rationale behind recommendations. This approach not only improves decision making but also supports fair and efficient risk allocation between public and private partners, ultimately leading to better governance and project outcomes[12].

3.2.3 Asset inspection and condition assessment

Vehicle- and drone-mounted cameras, computer vision and AI tools are increasingly used to collect location and condition data about pavements, bridges, culverts, tunnels and other road infrastructure assets. Repeated camera inspections of the same route can capture the degradation of assets over time and provide the basis for detailed degradation models.

AI-powered robots are being used to improve safety, efficiency and precision in labour-intensive tasks or hazardous locations (e.g. stormwater culverts, which are often dangerous due to crumbling concrete, submerged obstacles, and toxic gases).

Other efficient, scalable uses of AI include machine learning models that analyze bridge vibration and strain data, and foundation models that use aerial imagery to evaluate pavement distress and inventory roadside infrastructure.

Road maintenance operations – City of Windsor[13]

The City of Windsor has improved road maintenance operations using vehicle-mounted smartphone cameras and an AI-based application to automatically detect potholes and other road surface issues with no manual input. The city has reported productivity improvements, faster completion of seasonal patching, and a 90% reduction in pothole-related claims by drivers.

Structural health monitoring – Samuel de Champlain Bridge, Montréal[14]

The Samuel de Champlain Bridge is designed for a service life of 125 years, and is equipped with a comprehensive structural health monitoring system to support ongoing inspection and maintenance. The system includes 255 sensors that measure factors such as corrosion, temperature, strain, displacement, vibration, tilt, GPS position, weather and visibility. The sensors are connected to 26 data acquisition units and generate continuous real-time data that is managed using advanced analytics and AI tools. A custom software platform is used by the operations team to monitor sensor outputs and issue alerts when readings fall outside expected ranges.

Remotely operated vehicles – City of Toronto[15]

Contractors can use remotely operated vehicles and pipe crawlers to monitor the integrity of stormwater and sewer networks, access hard-to-reach areas, avoid disturbing settled sediment, and minimize the cost of hiring professional divers. The City of Toronto recently used a remotely operated vehicle to inspect a 100-year-old submerged sewer pipe, saving time and money and keeping divers out of hazardous waters.

3.2.4 Predictive maintenance

There has been considerable research into the use of AI models to predict the degradation of transportation assets[16]. AI systems can help predict when assets should be maintained, rather than relying on schedules. Predictive maintenance can improve service and safety by identifying and addressing issues that may arise before they would normally be expected, and can also reduce costs by avoiding maintenance that is not actually required.

Rather than using historical data to predict maintenance needs, an advanced predictive maintenance system uses live data captured continually by sensors. An AI system trained on situation, maintenance activity and outcome information then identifies any changes in the asset's condition that warrant further analysis or correction. For a given situation, the AI system will prescribe a corrective action through which past maintenance activities achieved the desired outcome.

Bus predictive maintenance – Saskatoon Transit[17]

Saskatoon Transit's maintenance team is working with a technology company to use AI for predictive maintenance that stays ahead of mechanical issues and prevents bus breakdowns. The technology reads existing bus sensors, analyzes millions of data points, and identifies issues before they lead to service interruptions. After a four-month pilot test, Saskatoon Transit found that the system could reduce labour hours by half while also saving money on parts.

3.2.5 Lifecycle cost planning

Historical information on asset lifecycle costs is often located in unstructured formats (e.g. project cost sheets or purchase orders) rather than in structured databases. AI systems can extract unstructured data from PDF files or images, and use it to train models that predict future lifecycle costs for different asset classes.

3.2.6 Digital twins

A digital twin is a virtual representation of an asset or system that continuously integrates real-world data reflecting the current state of its physical counterpart. Possible types of digital twins include asset condition models, travel demand models, and traffic management simulation engines. Many digital twin use cases involve predicting future states, and they increasingly use AI for calibration, control, and anomaly detection tasks; however, examples of transportation applications are limited because they need to be transparent and explainable.

Municipalities can create digital twins of streets using AI systems that analyze data from vehicle-mounted cameras and LiDAR sensors to detect, classify and label streetside assets. Continuously updating dynamic digital twins of street environments can improve asset management by efficiently detecting anomalies.

Digital twin – City of Ottawa[18]

Ottawa is developing a city-scale digital twin that integrates LiDAR scans, point clouds, zoning bylaws, and utility networks in a single three-dimensional model. The O-Twin Viewer platform manages terabytes of data collected daily via mobile mapping. About 7,000 km of roads are being mapped with 360-degree images and LiDAR, while underground utilities and storm sewers are digitized to create a link between above- and below-ground assets. Beyond visualization, the digital twin functions as a decision-making tool: generative AI models allow planners to simulate neighbourhood development scenarios by applying potential zoning and density rules to a virtual, three-dimensional environment.

3.2.7 Salt use

In an operational context, AI models are being used to predict winter conditions and limit the amount of salt that enters the environment through snow and ice control operations.

Maintenance decision support system – City of Vaughan[19]

In 2018, Vaughan became the first Canadian city to deploy an AI-based maintenance decision support system. Using data from road weather sensors and forecasts, the system predicts temperature, moisture and salinity to recommend optimal salting strategies. Updated four times daily, these recommendations integrate with Vaughan's patrol software for real-time decisions. Over three recent winters the city reduced salt usage by 30% and saved about $400,000 annually due to better salt management.

3.2.8 Vegetation management

Vehicle-mounted cameras can collect data about vegetation along rural roads, using computer vision to identify invasive species and dangerous conditions. Helmet- or pole-mounted cameras can be used to collect information about tree species and diameters around work sites before construction, for input into environmental impact assessments.

Tree species detection using computer vision – North Vancouver[20]

Using a wearable camera rig, workers captured high-resolution video and 360-degree images of trails in North Vancouver for three-dimensional reconstruction and virtual tours. They used the data to map trail widths and train a computer vision model to accurately identify tree species from bark images. The project showed that photogrammetry and AI can effectively provide low-cost environmental mapping for infrastructure planning.

3.3 Mobility services

3.3.1 Shared mobility

Car sharing providers in Canadian cities can use AI to make their operations (e.g. regular vehicle maintenance) more efficient, and to identify new service locations and markets[21]. AI systems are also used to identify engaging customer incentives, create marketing materials, and improve customer service[22].

Bike sharing operators use AI systems to predict where bikes will be needed, and highlight areas where there are too few or too many. They can also suggest actions to efficiently rebalance bikes based on where they need to be picked up or dropped off, the street network layout, the capacity of rebalancing vehicles, and other factors.

Rebalancing tool – Bike Share Toronto[23]

Bike Share Toronto uses an AI rebalancing tool that applies historical data patterns and daily changes in ridership patterns to ensure that "hotspot" locations always have available bikes and docking spaces. The tool led to a 68% improvement in bike and docking availability.

3.3.2 Multimodal trip planning

AI-powered trip planning tools (e.g. Google Maps) allow people to efficiently plan and adapt multimodal journeys, combining up-to-date travel information across multiple modes of transportation (e.g. transit, taxi, cycling, and walking) into a single trip. These tools apply multiple AI systems (travel time prediction models, neural networks for understanding inter-system connectivity, and optimization models) to help travelers make informed choices about route options and schedules in a complex environment. In addition, they can optimize single-mode trips according to user preferences for fuel-efficient driving routes, transit routes with minimal transfers, protected bicycle lanes, or signalized pedestrian crossings.

Safe walking routes to school – City of Vancouver

In 2021, Vancouver ran a pilot project at four local schools that offered a web-based interactive map and routing tool to help parents and students find the safest walking routes to school. The route-finding algorithm considered safety features such as crossing types, vehicle speeds and sidewalk availability.

3.3.3 Accessibility

AI technologies can improve confidence, safety, and accessibility for people with sight loss or other mobility challenges, particularly in crowded or complex environments. Smart wheelchairs can navigate, avoid obstacles and respond to voice, or gesture commands, while AI-equipped canes can detect hazards and provide audible navigation cues.

Accessible navigation – TransLink[24]

TransLink is piloting a tool to help customers with sight loss better navigate the transit system. Customers can download an app to scan specially coded decals at three transit locations. The App uses computer vision algorithms to detect and interpret codes, then gives audible instructions to guide customers to bus stops or pick-up points. The App can also identify nearby amenities such as elevators, and provide real-time information alerts.

3.3.4 Public transit

Transit operators are embracing AI systems in several ways:

- In customer communications and marketing, AI helps identify customer personas and tailoring content.
- In operations, AI helps optimize bus routes and plan contingency routes during irregular operations.
- Inside transit vehicles, computer vision helps identify unsafe behaviour of passengers and drivers.
- Outside of vehicles, computer vision helps automate enforcement by reading the license plates of vehicles that are illegally parked or driving in bus lanes.

Transit lane violations – Toronto Transit Commission (TTC)

The TTC has awarded a pilot contract for a system that uses video capture and automated ticketing to catch motorists who fail to stop for streetcars when the passenger doors are open[25,26]. The system captures relevant information on suspected violations in real time, uploads evidence to a cloud-based server, confirms the evidence using AI-driven video analytics, and generates citations through integrated ticketing software.

3.3.5 Electric vehicle charging

AI systems can help identify optimal locations for public electric vehicle charging stations, using machine learning and optimization models to score potential sites based on geospatial data and energy network information. AI is also embedded in the energy management applications of electric vehicles themselves, to optimize both charging speed and battery life. In the future, AI systems are expected to help manage two-way electricity flow between the electricity grid and plugged-in electric vehicles based on grid capacity, energy prices, and the preferences of vehicle owners.

EV Everywhere – Hydro Ottawa[27]

A pilot initiative of Hydro Ottawa, EV Everywhere uses AI and real-time data to explore ways to improve electric vehicle charging. Through a mobile app, users can monitor their charging patterns and manage charging sessions, including pausing and resuming as needed. The App can also suggest optimal charging times based on grid conditions such as low electricity demand or the availability of renewable energy. To support grid efficiency, the program may temporarily pause electric vehicle charging during predicted periods of high electricity usage.

3.4 Traffic operations

3.4.1 Compliance and enforcement

AI systems can improve safety and help manage congestion by supporting traffic enforcement activities. Speed cameras and red-light cameras that use computer vision for license plate recognition are common tools for identifying and charging violators; speed cameras are particularly useful in constrained locations such as highway work zones. Parking enforcement on streets and in off-street parking lots makes use of vehicle-mounted cameras and computer vision technology.

Computer vision is also being used to identify risks on construction sites. AI models can identify unsafe behaviours such as the incorrect use of personal protective equipment, and also can flag unauthorized entry and dangerous driving.

Parking enforcement – Calgary Parking Authority[28]

The authority is implementing parking enforcement tools that incorporate AI-driven license plate recognition. These tools enable real-time scanning of license plates, rapid validation of parking status, and access to relevant vehicle information.

Mobile photo radar – Quebec[29]

Photo radar devices have been used to protect workers and improve road safety on major work sites including the Louis-Hippolyte-La Fontaine Tunnel in Montréal.

Distracted driving enforcement[30]

A commercial product applies computer vision to remotely detect and capture evidence of law-breaking driver behaviour such as illegal mobile phone use, seatbelt non-compliance and speeding, and is equipped with automatic number plate recognition.

3.4.2 Traffic control devices

Smart traffic control devices can use AI systems to collect and process real-time video or radar feeds, creating a rich dataset to support more complex and holistic decision making.

Advanced systems can adapt signal timing patterns to better serve approaching traffic, which is particularly helpful when signals are far apart. An AI-based model that receives information on traffic speeds and volumes from upstream signals can predict the pattern of arriving traffic and suggest adjusted signal timings.

In variable speed limit and adaptive ramp metering solutions, predictive AI models help anticipate traffic conditions and enable proactive control strategies. For instance, they use predicted traffic volumes and speeds to optimize ramp metering signal timing in real time, thereby improving safety and reducing delay.

Network performance – Town of Milton, ON[31]

Milton deployed AI-enabled hardware and software at two critical intersections to generate actionable insights. Computer vision validated sensor-based queuing and congestion observations, providing a clear picture of network performance and enabling engineers to identify operational issues, reduce congestion and enhance safety.

3.4.3 Traffic management systems

Real-time traffic monitoring systems equipped with AI can reduce the time needed to respond to incidents by automatically detecting collisions or irregular operations, flagging them to transportation or emergency staff, and helping with triage[32].

Looking toward predictive applications, artificial neural networks can effectively generate decision-making insights in environments where information comes from multiple sources. These AI techniques are being used for short-duration traffic volume predictions in real time, and future advancements could support the prediction of congestion or incidents.

Traffic Management Centre – City of Calgary[33]

Calgary uses drones and virtual reality technology to support real-time traffic monitoring. Drones help staff to assess crowd movements, observe traffic flow, and determine when and where traffic control may be needed. Traffic Management Centre operators are also testing virtual reality headsets to monitor congestion at intersections and make real-time adjustments to traffic signals.

Urban traffic control system – University of Toronto[34]

A cutting-edge AI-based urban traffic control system developed by the University of Toronto leverages camera data, reinforcement learning and transformer networks to enable real-time traffic signal control that improves traffic flow at complex intersections and reduces average vehicle delay by 30%.

3.4.4 Connected vehicle data use

As connected vehicle technologies become more widely adopted, AI systems will play a critical role in supporting communications to, from, and among vehicles, and in enhancing the safety and awareness of all road users. These systems will classify and prioritize data from different message types (e.g. vehicle-to-vehicle, vehicle-to-infrastructure, vehicle-to-pedestrian) and will detect any outliers to identify malicious data and keep road users safe. Real-time data sent from connected vehicles will allow AI-driven traffic management systems to assess traffic patterns, predict congestion, and enable dynamic traffic signal control.

3.4.5 Dynamic pricing systems

Parking fees and road tolls are usually static, but occasionally increase during pre-defined peak periods. In contrast, dynamic pricing can more effectively support objectives such as protecting desired levels of service or ensuring equitable cost distribution. AI systems could permit agencies to use dynamic pricing on individual facilities or across entire systems, setting prices in real time as demands change.

3.5 Safety and security

3.5.1 Road safety engineering

Road safety engineering is a data-intensive discipline that can take advantage of the power of AI systems. Experts have long used relatively simple AI systems and safety data, and now they can use more complex datasets. New forms of data are also becoming available thanks to computer vision, which is now used to analyze pedestrian movements at intersections and mid-block locations; by taking a wider look at pedestrians' origins and destinations, planners and designers can identify upgrades and mitigation strategies. Generative AI models can also categorize incident reports and look for patterns across them and other datasets, with the resulting data and insights used to adjust planning and design assumptions.

Roadway safety improvements – Bellingham, Washington State[35]

Staff analyzed recorded traffic video using computer vision and AI algorithms to evaluate bike lane safety by detecting ear miss' events, assessing collision risks, and informing design changes. The work resulted in data-driven adjustments to high-risk intersections with improved pedestrian safety and a 33% increase in bike ridership.

3.5.2 Incident prevention, detection, response and analysis

AI systems that analyze data from road sensors and roadside video cameras can identify an elevated risk of traffic incidents and automatically warn drivers using variable message signs. The same variable message signs can be used to influence driver behaviour and prevent free-flow conditions from collapsing into congestion, which can lead to emergency braking.

AI systems that anticipate pedestrian movements are being developed to help regulate crossing signals and alert drivers to potentially dangerous pedestrian behaviours[36].

AI models are also leveraging computer vision, machine learning, and simulation to improve collision reconstruction and safety analysis.

3.5.3 In-vehicle safety systems

Computer vision AI systems can monitor unsafe conditions in vehicles, alerting the driver when they exhibit signs of fatigue or unsafe behaviours such as texting or distracted driving. Video feeds from inside and outside buses or trains can be used to identify unsafe passenger conduct, physical hazards, or operational anomalies, and to notify management or emergency personnel.

3.5.4 Automated driving systems

Highly automated vehicles rely on AI systems for critical functions such as perception, mapping, planning and control. Several companies are developing autonomous vehicles that use AI and machine learning to process data feeds from LiDAR, radar and camera sensors, enabling the vehicle to interpret its surroundings, anticipate actions by other road users, and make driving decisions in real time. In the future, cooperative automated driving environments would rely on AI to avoid conflicts between road users and to maintain safe distances between vehicles.

Delivery robots – City of Toronto[37]

The City and its partners conducted a 2025 pilot project that used driverless, three-wheeled automated vehicles to deliver small packages. For safety, the vehicles were limited to a maximum speed of 32 km/h, travelled only on roads with a posted limit of 40 km/h or less, and were not allowed to turn left at intersections.

3.5.5 Cybersecurity

Any compromise of a city's mobility system can have serious implications for public safety, traffic flow, and emergency response capability. As transportation networks evolve into highly interconnected ecosystems featuring sensors, smart cameras, edge devices and cloud-based platforms, their cybersecurity landscape is becoming more complex and critical. AI is increasingly being deployed to predict cyber threats, detect anomalies and automate responses. For example, machine learning models can monitor network traffic and system behaviour to identify unusual patterns that could indicate cyber intrusions or system failures. Predictive analytics can also forecast potential vulnerabilities or attack vectors based on historical data and real-time inputs. Canadian technology firms have pioneered AI-powered threat detection systems that can identify and neutralize potential breaches before they occur[38].

3.6 Administration

3.6.1 Human resources management

AI tools can benefit an organization's hiring process in several ways. AI platforms can be used to develop marketing strategies that attract the attention of target audiences, to create engaging job postings with less effort, and to assess postings for inclusive language. When a job posting attracts hundreds of applications, AI tools that process natural language can save considerable staff time by quickly screening submissions for key words and experiences. Generative AI platforms can also suggest interview questions that suit the job description and a candidate's application.

It should be noted that concerns exist around the use of AI tools for human resource tasks such as these. Systemic bias may be unintentionally built into generative AI tools that create or analyze text, and hiring teams should assess AI systems to ensure they comply with relevant data protection laws and do not store or share personally identifiable information without consent. To address these concerns, many third-party AI solutions integrate robust privacy safeguards and offer data encryption, access controls and compliance with Canada's *Personal Information Protection and Electronic Documents Act*; proprietary AI systems offer even greater control over data handling and security.

AI-based skills assessment platform – Treasury Board of Canada[39]

The Treasury Board of Canada Secretariat's HR Directorate uses an AI-powered platform to assess candidate interviews and provide data-driven insights that support objective, informed staffing decisions. The tool applies natural language processing and machine learning to analyze video or text responses, with the intention of reducing bias and improving efficiency.

3.6.2 Talent development

AI tools have many possible uses in education and training:

- Generative AI platforms can summarize existing reports and presentations to create engaging practical examples for use in courses.

- AI-powered training tools can replicate high-pressure environments for staff to practice decision making, communication and coordination in lifelike conditions.
- Natural language AI systems can analyze mentor and mentee applications and suggest pairings based on individuals' experience and expectations. Mentoring program participants can then use generative AI tools to build an overall plan for their engagement and come up with specific questions or discussion topics.

3.6.3 Research and content creation

Office technology providers are embedding AI into writing and email applications, document management systems, and data analysis tools. For research tasks, natural language AI systems excel at locating relevant information in a knowledge base; to enrich the search, they can interpret and extrapolate intention. Generative AI systems can then compile and summarize content from multiple sources, creating a succinct response. Organizations are refining such systems to return responses derived from internal data sources with a trusted information hierarchy and an awareness of internal naming conventions.

Generative AI is having a transformational impact on content creation, whether for emails, meeting minutes, reports, or presentations. It is perhaps most valuable in overcoming writer's block, reviewing drafts and condensing text. At its core, generative AI is a prediction model and can return incorrect information; care in reviewing and applying its output is required.

3.6.4 Agentic AI

Agentic AI uses a combination of AI systems to complete a specific task. To fulfil a user's natural language request, an AI agent may ask for any clarifications and then compile and automatically undertake a list of required actions. Agentic AI is still an emerging application in the transportation sector, but use cases could include running transportation planning models, responding to operational irregularities, completing a safety audit, or purchasing winter maintenance materials. Agentic AI is used in chatbot agents that converse naturally with clients and filter incoming calls and emails so that staff only receive pressing or complex queries.

The deployment of agentic AI for specific uses may be constrained by organizational policies, government regulations, or industry licensing board guidance. Factors like these must be carefully considered when AI agents perform regulated tasks or interact with sensitive data.

Managing customer queries – Enfield, UK[40]

Enfield Council successfully deployed an agentic AI chatbot to answer resident queries, check licenses, and process permit applications. The system achieved an impressive 98% accuracy in understanding user intent, allowing it to efficiently handle time-consuming routine requests and leaving staff to handle complex problems that require human intelligence.

4. Artificial intelligence challenges and risks

Any emerging technology involves challenges and risks, and AI is no different. The following sections explore concerns around bias, privacy, intellectual property, and security, as well as fears related to workforce impacts and other changes.

4.1 Bias

In the context of AI, bias refers to systematic errors or unfair tendencies in how a model evaluates information, makes predictions, or arrives at a decision. When unsupervised learning is used to train an AI model, bias can be introduced through data; when supervised or semi-supervised learning is used, bias can be introduced either through data or through the people developing and training the model. To remove bias, a model can be either retrained or combined with models trained on different datasets, with varied parameters, or by different groups of people. The latter technique helps reduce the influence of any single biased model, and can create more balanced and reliable outcomes.

Bias is an especially sensitive topic when AI models guide decisions that affect people. Biases that stem from non-representative data reflecting historical prejudices will build in those prejudices and cause incorrect inferences, often without the user's knowledge. Ultimately, they can lead to inequitable decisions, increased costs, and a lack of public trust. In transportation, bias in AI can affect many important activities including transit route planning, traffic predictions, safety interventions, and maintenance schedules.

In 2022, the U.S. National Institute of Standards and Technology released a framework for managing and identifying harmful bias in AI[41]. Measures that model creators can take to minimize bias include:

- Use high-quality training data that is diverse and reflects the environment in which the system is deployed.
- Refine AI outputs after prediction through post-processing techniques, and apply thresholding practices to set appropriate cut-off values for accepting or rejecting results.
- Regularly audit AI systems to identify biases and correct them through supervised learning with data from the model's environment, and labelling of datasets by skilled workers.

Measures that model users can take to minimize bias include:

- Incorporate human oversight into decision-making processes, allowing experts to assess, validate, and intervene where necessary to ensure responsible and unbiased AI outcomes.
- Maintain transparent communication about the data and processes behind AI decisions.
- Train employees to understand and recognize biases in AI outputs.
- Develop and enforce ethical guidelines for AI usage to protect against discriminatory practices.

An example of biased data

A bridge manager wants to use AI to plan predictive maintenance. She finds a free, open-source AI model that uses weather conditions and vehicle volumes, and runs the model using local climate and traffic projections. However, the model outputs predict a much longer asset life than expected; a more detailed look at the AI model reveals that it was trained using biased data from a location with warmer weather and smaller vehicles.

4.2 Privacy

Canadian transportation systems collect vast amounts of data on passenger movements, preferences, and financial transactions. Agencies and vendors are incentivized to gather this data and use AI to leverage it for planning and operations. These efforts can improve service for customers, but weak anonymization or poor governance can threaten their privacy.

Personal privacy concerns also arise with AI-enabled facial recognition and other computer vision models that are implemented without proper governance. The *Personal Information Protection and Electronic Documents Act* (PIPEDA) is Canada's federal privacy legislation that regulates how organizations collect, use, and disclose personal information during commercial activities; violations are subject to legal action and fines.

Measures that can help transportation agencies minimize risks to personal privacy include:

- Prioritizing robust data governance frameworks.
- Limiting data collection to only what is strictly necessary, and ensuring compliance with PIPEDA and provincial privacy regimes (including public-sector freedom of information/privacy laws, and legislation covering the private sector in Alberta, British Columbia, and Quebec).
- Conducting regular privacy impact assessments to evaluate risks associated with AI systems and implement appropriate corrective measures.
- Educating staff about the importance of data protection and responsible AI usage.

4.3 Intellectual property rights

Many organizations in the transportation sector own highly sensitive operational data, such as passenger travel patterns, freight volumes, and infrastructure condition reports. A major risk to those organizations is the unauthorized sharing of their intellectual property (as well as sensitive or secure information) through employees' use of generative AI tools like OpenAI's ChatGPT and Microsoft's Copilot. Employees who use public AI platforms to summarize reports or generate content may inadvertently share proprietary or sensitive data that could be retained for future model training and thereby exposed to external parties.

Mitigation measures for transportation organizations include:

- Purchasing enterprise licenses for generative AI tools that offer enhanced security and privacy features compared to free or public platforms.
- Developing clear policies for the use of generative AI tools in the workplace.

- Training employees to be aware of what constitutes sensitive information, and to recognize when sharing content could expose proprietary data or violate copyright laws.

4.4 Security

In the same way that generative AI systems can help employees do their jobs better, they also make criminals more effective. Transportation systems are part of Canada's critical infrastructure, and are prime targets for AI-enabled cyberattacks. AI poses particular security risks related to phishing and social hacking schemes, including those using video or audio communications (known as 'deepfakes') that look and sound like people they are impersonating. Advanced deepfakes can be used to converse with an unsuspecting person in real time, tricking them into divulging sensitive information or acting against their better judgement.

Mitigating measures for transportation organizations include:

- Training employees to recognize sophisticated social engineering attempts and to stay vigilant against emerging scams.
- Promoting a culture of caution where employees feel comfortable verifying unusual requests and discussing suspicious encounters.
- Updating security protocols to enhance identity verification, multi-factor authentication, and rapid incident response procedures.

An example of security risk

Fraudsters used deepfake technology to pose as a corporate executive in a video conference call, and tricked a finance worker into sending them millions of dollars. The worker attended a virtual meeting with what he thought were several other staff members, but turned out to be real-time deepfakes created using AI[42].

4.5 Managing change

Managing change is one of the most significant challenges to organizations as they adopt AI technologies. Employees often worry that AI will render their roles obsolete and lead to job losses, a fear that can lead to resistance to change, lower morale, and reduced productivity. However, it is inevitable that AI adoption will change the skills required by the workforce as activities move from physical to virtual spaces, and as human skills are replaced by sensors, cameras, and software. Employees also must learn to not use AI outputs blindly, adopting a critical eye and understanding the constraints of AI models. A lack of employee participation and upskilling can make an organization's best efforts at transformation less effective, and can even risk an employee revolt.

Several strategies can help mitigate these concerns:

- Communicating about the benefits of AI and its impacts on what employees do and how they do it.
- Sharing updates on AI initiatives and soliciting feedback to empower employees and encourage a culture of continuous learning.

- Positioning AI as a tool to streamline mundane tasks and enable effectiveness (i.e. doing more with existing resources) rather than just efficiency (i.e. doing the same with less).
- Engaging employees in discussions and decisions, so that changes are made with them rather than to them.
- Offering opportunities for employees to acquire new skills and transition into new roles.
- Slowing the pace of change so employees have an opportunity to adapt.
- Reinforcing the need for human oversight and judgment, and establishing guidelines for when and how employees should intervene in AI-driven processes.

5. Suggested actions for TAC councils and committees

To support TAC's member organizations in their pursuit of responsible and effective use of AI, this chapter includes suggestions for the consideration of TAC's councils and committees[43]. Volunteers in those groups regularly exchange their knowledge and experiences, and develop and deliver initiatives that benefit TAC members through conference sessions, volunteer projects, and pooled-fund projects. These activities complement the paid training courses and free national webinars delivered through the learning program of TAC's Secretariat.

TAC's volunteer-led Technology Council is likely to play a key role in overseeing and coordinating AI-related activities of other councils. It maintains an interdisciplinary focus on emerging transportation technologies, and in 2025 it created a working group to guide its efforts around AI topics.

The following sections suggest possible actions by TAC councils and committees in three areas:

- Focusing efforts through working groups
- Sharing knowledge internally and externally
- Supporting the professional development of practitioners

5.1 Creation of working groups

The work of TAC councils and committees is often most effective when conducted by a small group of interested and enthusiastic volunteers. Working groups tend to be relatively informal, nimble in participation, and shorter-lived than the committees they report to. As a result of their typical focus on a single subject and/or deliverable, they often attract participation from volunteer experts who work for TAC member organizations but are not members of the parent committee or council.

Suggested actions for TAC councils and committees

- Consider establishing working groups that can gather interested and enthusiastic volunteers to focus on priority AI-related subjects or deliverables.
- Invite designated representatives of TAC's peer member organizations (e.g. ITS Canada, ITE Canada, etc.) to contribute to working groups with the goal of aligning efforts, leveraging shared resources, and reducing duplication of effort.

5.2 Knowledge sharing

Knowledge sharing is a principal purpose of TAC councils and committees. Because of AI's rapid evolution and wide range of implementation maturity in Canadian transportation organizations, information exchange is critical to accelerate learning and avoid duplication of effort. By drawing on the collective experience of TAC members, volunteers can facilitate the dissemination of lessons learned, beneficial practices, and implementation insights. Doing so fosters collaboration and enables more strategic and cost-effective investments; learning from existing initiatives allows organizations to better target efforts, avoid common pitfalls, and build on proven successes.

5.2.1 Internal

Councils and committees often concentrate on sharing information among their own members. Doing so benefits volunteers and their organizations, and can inform work planning by the council or committee.

Suggested actions for councils and committees

- Use TAC's Volunteer Centre to share case studies, technical documentation, and implementation guides related to the use of AI systems in their areas of technical interest; this allows volunteers to monitor progress, identify gaps, and prioritize potential initiatives in response.
- Use online lunch-and-learn events and presentations at council or committee meetings to highlight AI innovations or experiences of particular interest from government agencies, businesses, and academics.
- With help from the TAC Secretariat, conduct surveys of TAC member organizations and other stakeholders to gather information on current practices and identify shared challenges and opportunities.

5.2.2 External

Councils and committees also support information sharing with and among TAC member organizations.

Suggested actions for councils and committees

- Organize and deliver presentation sessions, panel discussions, or workshops on AI-related topics at TAC's annual conference.
- Undertake volunteer projects to explore AI issues of concern, possibly leading to presentations, volunteer project reports, TAC emerging practice briefings, or TAC technical guidance.
- Propose pooled-fund projects (e.g. research reports, syntheses of practice, or national technical guidelines) that TAC member organizations would be invited to support with financial contributions and staff expertise.

5.3 Professional development

Successful adoption of AI in Canada's transportation sector will require a significant shift in workforce capabilities. To become AI ready, TAC member organizations must help practitioners improve their skills.

TAC's learning program offers free national webinars and paid training courses that benefit individual practitioners and their organizations. Councils and committees have the opportunity to shape the learning program by identifying needs and proposing topics for TAC courses and webinars. These activities, which are likely to focus on foundational aspects of AI adoption, can complement the internal staff development programs of individual organizations.

Suggested actions for councils and committees

- Through discussions, surveys, or volunteer projects, identify subject areas where TAC's learning program could help address shared gaps in practitioner knowledge related to AI, and communicate those priorities to the TAC Secretariat.

6. Glossary

Term	Definition / Description
Agentic AI	AI systems that act autonomously to achieve specific goals, often proactively interacting with their environments (including other agents) and responding to changes; agents are often built with memory capabilities so their actions are improved by past results
Artificial intelligence (AI)	A computer-based system that generates outputs using evidence from training data
Artificial general intelligence (AGI)	A hypothetical form of AI that would understand, learn and apply intelligence across a wide range of tasks at a human-like level
Artificial narrow intelligence (ANI)	AI systems designed to perform a specific task or a limited set of tasks with high efficiency, such as recognizing faces or translating languages
Artificial neural network (ANN)	A computational model inspired by the human brain, composed of interconnected nodes (neurons), that processes information and learns patterns from data
Artificial super intelligence (ASI)	A hypothetical form of AI that would surpass human intelligence and capabilities in all aspects, including creativity, problem solving and emotional intelligence
Black box models	AI models whose internal workings are not easily interpretable, even though their outputs can be observed
Classification model	A model that assigns data into predefined categories or classes
Computer vision	A field of AI that enables computers to interpret and understand visual information such as images and videos
Decision tree	A model that makes decisions by splitting data into branches based on feature values, leading to a prediction or classification
Deep learning	A subset of machine learning that uses multi-layered neural networks to learn representations and extract features from large volumes of data
Deepfake	Synthetic media created using AI that convincingly mimics real people in images, video or audio
Digital twin	A dynamic virtual representation of a physical asset, system or process that integrates real-world data for monitoring and/or simulation
Ensemble methods	Techniques that combine predictions from multiple models to improve overall performance
Foundation models	Large AI models trained on broad data that can be adapted for specific tasks
Generative AI	AI models that can create new content, such as text, images, music or code, by learning patterns from existing data
Gradient boosting	An ensemble technique that builds models sequentially, with each new model correcting errors from previous ones

Term	Definition / Description
LiDAR (light detection and ranging)	A remote sensing technology that uses lasers to measure distances to nearby objects
Linear regression	A simple regression method that models the relationship between a dependent variable and one or more independent variables using a straight line
Logistic regression	A statistical model used for binary classification tasks, predicting the probability of a categorical outcome
Machine learning	An application of AI that allows systems to learn from data and improve their performance over time without being explicitly programmed
Multinomial regression	A regression technique used to predict outcomes with more than two categories
Naive Bayes	A classification algorithm based on Bayes' theorem, assuming independence between features
Natural language processing	A branch of AI that enables computers to understand, interpret and generate human language
Neural networks	Computational models inspired by biological brains, consisting of layers of interconnected nodes for processing data
Prediction model	An AI model designed to forecast outcomes (numeric or categorical) based on input data
Probabilistic models	Mathematical models that use probability theory to make predictions or infer patterns from data
Random forest decision trees	An ensemble of decision trees, where outputs from multiple trees are combined to improve accuracy and reduce overfitting
Regression	A statistical technique used to predict numeric values based on input variables
Reinforcement learning	A type of machine learning where agents learn to make decisions by receiving rewards or penalties based on their actions
Semi-supervised learning	A machine learning approach that uses both labelled and unlabelled data to train models
Supervised learning	A machine learning technique where models are trained on labelled datasets to predict outcomes for new, unseen data
Support vector machines	Supervised learning models that classify data by finding the optimal boundary (hyperplane) between groups of data
Unsupervised learning	A machine learning method that finds patterns and relationships in data without labelled outcomes

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