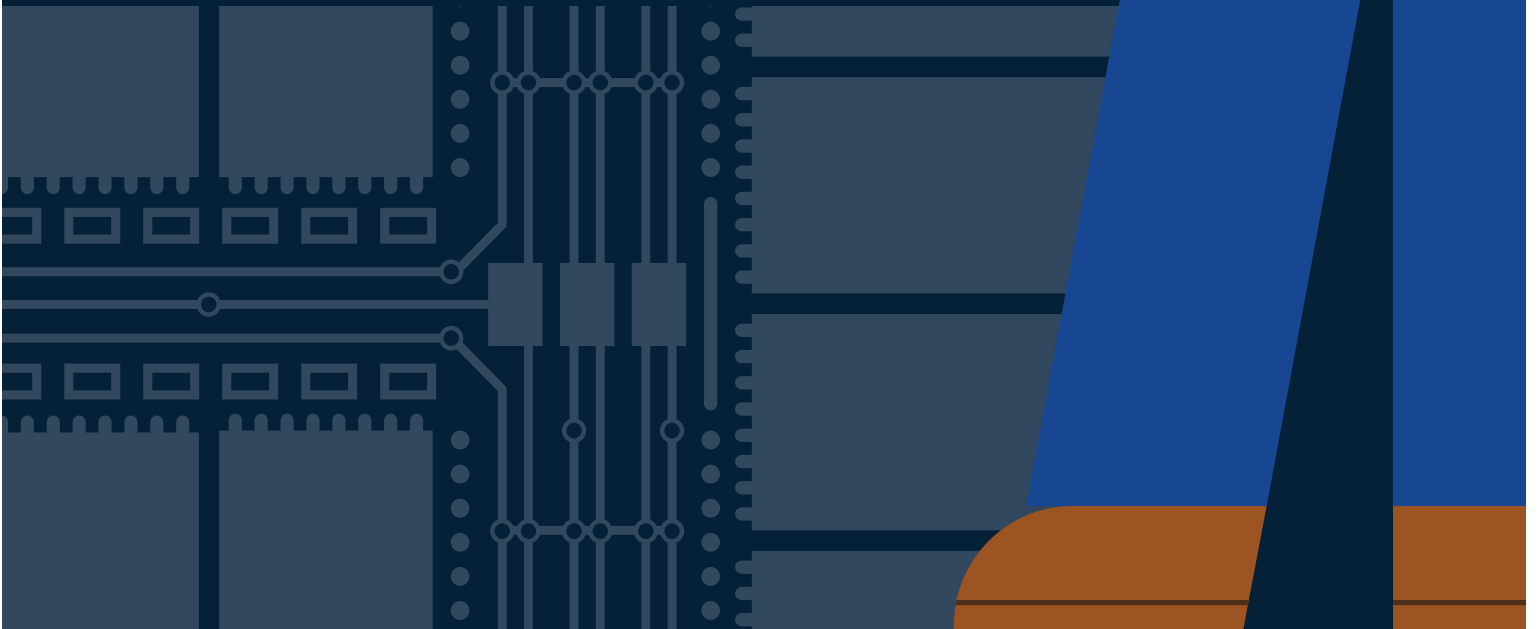




# Practical Applications of AI and Big Data

for Metropolitan Planning Organizations



# Practical Applications of AI and Big Data for Metropolitan Planning Organizations (MPOs)

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Authors: KiHong Kim | Amanda McDaniel | Kevin Kane | Jung Seo | Mengdi Li

Corresponding author: Amanda McDaniel

Initial versions of this paper were developed using ChatGPT Deep Research. A prompt, several subprompts, and an extensive literature review were first developed by SCAG staff and repeatedly queried, iterated, and edited. A final ChatGPT output consisted of roughly 100 pages, was used as a framework for this paper, and contributed some sections of text directly. Staff made substantial edits for content, tone, and organization, as well as rewrote numerous sections and added dozens of references which were generally underprovided by ChatGPT in order to ensure this white paper is a meaningful resource for regional planning practice.

# Table of Contents

<b>Executive Summary .....</b>	<b>iv</b>
<b>Introduction .....</b>	<b>1</b>
Glossary of Common Terms.....	1
<b>AI and Big Data in Regional Planning: State of the Practice .....</b>	<b>3</b>
AI Usage .....	3
Big Data Usage.....	3
<b>Applications in Transportation Planning and Operations .....</b>	<b>5</b>
Traffic and Mobility Analysis.....	5
Congestion Management and Traffic Operations.....	5
Safety Analysis and Vision Zero.....	6
Use Case: AI Techniques for Proactive Safety Planning.....	6
Infrastructure Management .....	6
Multimodal Transportation Planning .....	7
Use Case: Multimodal Planning with a Private-Sector Big Data Platform .....	7
<b>Geospatial Intelligence (GeoAI) in Planning .....</b>	<b>8</b>
Scope of GeoAI Applications.....	8
Data Sources for GeoAI.....	8
Advances in Mapping and Feature Extraction .....	9
Spatial Analytics and Predictions .....	9
Use Case: Urban Form and Design Insights.....	9
Challenges in GeoAI .....	9
<b>Digital Twins and AI-Driven Simulation .....</b>	<b>11</b>
Concept of Smart City Digital Twins.....	11
Scenario Planning and “What-If” Simulations.....	11
Use Case: Digital Twins for Congestion Management .....	11
Integration of Virtual Reality and Augmented Reality in Public Engagement.....	12
Use in Infrastructure and Asset Management .....	12
Challenges and Considerations .....	12
<b>Smart Governance and Public Engagement.....</b>	<b>13</b>
Data-Driven Decision Making .....	13
AI for Policy Analysis and Development .....	13
Public Participation and Engagement.....	14
Collaborative Platforms and PPGIS .....	14
Transparency and Accountability.....	14
Ethical and Equitable Use of Big Data.....	14

<b>AI Tools for Planning Practice: Natural Language Processing and Computer Vision .....</b>	<b>15</b>
NLP and Planning.....	15
CV Applications in Planning.....	16
<b>Challenges and Considerations in Implementing Artificial Intelligence and Big Data.....</b>	<b>19</b>
Data Quality and Availability.....	19
Technical Expertise and Workforce Readiness.....	19
Algorithmic Bias and Equity .....	19
Transparency and Explainability .....	20
Privacy and Data Governance.....	20
Integration with Existing Processes.....	20
Cost and Sustainability.....	20
<b>Strategies for Integrating Artificial Intelligence and Big Data in Metropolitan Planning</b>	
<b>Organizations.....</b>	<b>21</b>
Develop a Clear AI/Big Data Strategy and Vision.....	21
Invest in Digital Infrastructure and Data Governance.....	21
Build Workforce Capacity and Skills .....	21
Start with Pilot Projects and Scalable Wins.....	22
Develop Ethical Guidelines and Review Processes.....	22
Engage Stakeholders and Communicate Benefits .....	22
Collaborate and Share Knowledge.....	23
Update Policies and Plans to Incorporate AI/Big Data.....	23
<b>Conclusion .....</b>	<b>24</b>
References.....	25

# Executive Summary

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Metropolitan planning organizations (MPOs) are increasingly exploring artificial intelligence (AI) and big data to enhance regional planning and decision-making. The planning field is replete with new digital tools that promise greater efficiency in analyzing complex datasets, forecasting trends, and engaging the public. Recent research and surveys indicate that AI technologies such as natural language processing (NLP) are beginning to augment tasks traditionally done by planners. Likewise, big data (often accessed through third party platforms such as StreetLight Insight, INRIX, and Replica) is increasingly being used by planning agencies across multiple applications and modeling processes, offering a more granular and real-time understanding of urban systems.

AI can automate routine processes, analyze data at previously impractical scales, and generate predictive insights, which can allow for reduced workload, increased focus on strategic, human-centered aspects of the work, or the exploration of new areas. AI offers new upsides and new challenges, but it also builds on at least a decade of existing work to integrate big data and aspects of machine learning and modeling into regional planning practice.

This white paper is intended as a resource document for MPOs and similar agencies to help demystify AI and big data, present different applications of AI and big data across different facets of regional planning, including transportation, geospatial analysis, and public engagement. It includes case studies and real-life examples and guidance on how to minimize common implementation challenges. Specifically, the white paper explores:

- **Transportation Planning & Operations:** real-time traffic analytics, multimodal forecasting, safety risk prediction, and predictive maintenance using AI and large mobility datasets.
- **Geospatial AI (GeoAI):** automated feature extraction from imagery, land use classification, urban growth prediction, and equity analyses using spatial data.
- **Digital Twins and Simulation:** integrated simulation environments for “what-if” scenario testing, infrastructure monitoring, and immersive public engagement through virtual and augmented reality.
- **Smart Governance & Public Engagement:** AI-enhanced policy analysis, natural language processing of public comments, and participatory GIS tools for transparent and inclusive planning.
- **NLP & Computer Vision (CV):** Text automation (e.g., ChatGPT and PlanGPT) and image/video processing for rapid document drafting, code compliance, asset mapping, and infrastructure inventory are two key underlying tasks which characterize much of the recent AI advancement.

The paper also outlines strategies for successful AI and big data integration, including:

- Establishing a clear vision and strategic goals.
- Investing in digital infrastructure and data governance.
- Building staff capacity through training and collaboration.
- Implementing scalable pilot projects that can demonstrate value.
- Embedding ethics, equity, transparency, and privacy into all phases of implementation.

Overall, the integration of AI and big data in regional planning can be a powerful enhancement to the MPO planner’s existing toolkit. By embracing these tools with a clear vision, strong ethics, and a commitment to capacity building, MPOs can be leaders in creating smarter, more responsive, and equitable governance.

# Introduction

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Metropolitan planning organizations (MPOs) are increasingly exploring artificial intelligence (AI) and big data to enhance regional planning and decision-making. The planning field is replete with new digital tools that promise greater efficiency in analyzing complex datasets, forecasting trends, and engaging the public. Recent research and surveys indicate that AI technologies such as natural language processing (NLP) are beginning to augment tasks traditionally done by planners. Likewise, big data (often accessed through third party platforms such as StreetLight Insight, INRIX, and Replica) is increasingly being used by planning agencies across multiple applications and modeling processes, offering a more granular and real-time understanding of urban systems.

AI can automate routine processes, analyze data at previously impractical scales, and generate predictive insights. This can allow for reduced workload, increased focus on strategic, human-centered aspects of the work, or the exploration of new areas. AI offers new upsides and new challenges, but it also builds on at least a decade of existing work to integrate big data and aspects of machine learning and modeling into regional planning practice.

As with any new and emerging technology, planners must contend with many challenges and considerations to AI and big data integration, such as data quality, bias, privacy, ethical issues, and workforce readiness. To realize the benefits of these technologies in an ethical way, MPOs will need to adopt thoughtful strategies for implementation, such as improved data governance, staff training, and establishing guidelines for use.

This white paper provides an overview of the practical applications of AI and big data for MPOs based on a literature review of relevant academic and professional sources. The paper begins with a brief overview of the state of the practice in terms of AI and big data adoption across MPOs, then details different AI and big data applications in major subject areas where MPOs work: transportation planning and geospatial analysis. The report goes on to highlight specific areas of opportunity for AI and big data adoption at MPOs (through digital twins, public engagement strategies, and smart governance), before highlighting AI tools for planning, which include NLP and computer vision tools. The paper then summarizes important challenges and considerations for AI and big data implementation before concluding with strategies MPOs can utilize to integrate AI and big data into their existing planning processes and work.

## Glossary of Common Terms

This glossary of common terms serves as a quick reference guide for technical terms mentioned throughout this report.

### Exhibit 1 Glossary of Common Terms

Term	Definition
Artificial Intelligence (AI)	Refers to technologies that enable machines to learn, analyze data, and make decisions with minimal human intervention. In regional planning, AI is used for tasks such as land use modeling, traffic prediction, environmental impact assessment, urban growth simulation, research, programming, and more. AI is an umbrella term for a large technological field, which includes subsets including computer visioning, machine learning, natural language processing, large language models, and more.
Big Data	Data is usually considered “big” if it is high-velocity, i.e., it is generated in real-time or near real-time as opposed to periodically through a survey or a census,

Term	Definition
	and if it is exhaustive, meaning it covers or attempts to cover everyone or everything involved, as opposed to reflecting a sample or an aggregation.
Big Data Platform	A big data platform is a comprehensive system that collects, stores, processes, and analyzes vast datasets (big data). It integrates various tools and technologies to handle data ingestion, storage, processing, analysis, and visualization. In planning, big data allows planners to monitor conditions in near real-time and make more informed, data-driven decisions.
Computer Visioning (CV)	A form of AI that enables computers to interpret and process visual data from images and videos to extract insights. It applies AI to visual data, enabling automated analysis of the physical environment through photos, satellite imagery, or live video feeds. CV can perform tasks including image classification, object detection, object tracing, and content-based image retrieval.
Digital Twin	A digital twin is a digital replica of a physical system that is continuously updated with data and can be used for simulation and analysis. A smart city digital twin is a living digital replica of a city that is continuously updated with real-time data and analytics on interactions between humans, infrastructure, and technology and offers a holistic view of the changes that take place in a city.
Geospatial Artificial Intelligence (GeoAI)	GeoAI refers to the integration of AI techniques with geographic information systems (GIS) and spatial data sciences. GeoAI leverages AI techniques such as machine learning, deep learning, and knowledge graph to process, analyze, and extract insights from GIS data.
Large Language Model (LLM)	LLMs are a subset of natural language processing that can generate human-like text, summarize documents, translate languages, and answer questions. Examples include Open AI’s GPT-4 (commonly referred to as ChatGPT) and Azure Open AI.
Machine Learning (ML)	ML refers to the use of computerized decision rules (algorithms) to automatically learn insights and recognize patterns from data, make decisions, and improve themselves through experience and data.
Natural Language Processing (NLP)	NLP is a subset of AI that uses ML to enable computers to understand and communicate with human language. NLP tools deal with text and language and are exemplified by LLMs like ChatGPT.
Smart Governance	Smart governance refers to leveraging data and technology to improve policymaking, service delivery, and public participation.

# AI and Big Data in Regional Planning: State of the Practice

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## AI Usage

The current state of AI adoption among MPOs is emergent but growing. A 2023 survey by the Association of Metropolitan Planning Organizations (AMPO) found that **roughly half of responding MPOs have some experience using AI tools** (AMPO, 2024). This aligns with SCAG internal research efforts, with a recent survey of internal SCAG planning staff showing **49 percent** have previously used or are currently using AI in their work. Notably, **medium-sized MPOs lead in adoption**, with about 61 percent reporting AI use (compared to 50 percent of large MPOs and 32 percent of small MPOs). This suggests that mid-sized agencies—often with moderate resources and flexibility—are experimenting with AI to compensate for limited resources.

The most common AI tools in use are **text generation applications** (e.g., OpenAI’s ChatGPT), reported by many MPOs, followed by **image generation tools** (such as Midjourney) and other specialized AI software (AMPO, 2024). In practice, MPOs are leveraging these tools for a variety of tasks including drafting planning documents and reports, assisting with data analysis, creating maps or graphics, and formulating scopes of work for projects. This again closely mirrors the internal SCAG survey, which found that AI is mostly used to **assist with business productivity tasks**. This shows how planners are already using AI to take on time-consuming and routine or repetitive sub-tasks within the planning workflow, allowing planners to work more efficiently.

MPOs also voice clear concerns and limitations regarding AI. According to the same AMPO survey, the top-cited concern (by 43 MPOs) is **doubt about AI’s ability to handle nuanced decision-making** and that it may miss context or subtleties that human planners would catch.

Nearly as many respondents (39 MPOs) fear that **AI tools could produce cookie-cutter or generic content** that lacks the tailored insight needed for complex planning issues. Similar concerns were voiced in the SCAG survey, with respondents worried that continued AI use will lead to a lack of creative thinking, comprehensive thinking, and a risk of everything becoming more generic.

Additional concerns include a **reduction in critical thinking** if staff become over-reliant on AI, **potential copyright issues** with AI-generated work, **ethical considerations**, and fears regarding **workforce implications**. These findings align with broader planning literature (O’Niel, 2016; Daniel, 2023), which cautions that AI outputs must be critically reviewed and not taken at face value. Planners recognize that AI can assist with routine tasks, but they remain wary of delegating professional judgment to algorithms without human oversight.

## Big Data Usage

Surveys and workshops also suggest that big data usage by MPOs is still developing, with **37 percent of respondents** in the internal SCAG survey having used big data tools.

Big data products are beginning to be used for mobility and travel analysis, but often in limited ways. In a recent workshop of over 50 MPO professionals, participants noted that while big data enhances analyses (for example, providing detailed travel behavior insights), its adoption is **typically confined to specific applications and pilot projects** (Ugurel et al., 2024). Reiterating this point, the internal SCAG survey showed that the highest barriers to more big data adoption included a **lack of technical expertise, high costs**, and **data quality concerns** that result in limited utility.

The extent of using big data often varies with an MPO's size and resources. Larger MPOs or those with robust technical teams are likely to be more able to integrate data from GPS traces, transit smart cards, or social media feeds into their models, whereas smaller MPOs may rely on traditional data due to budget or skill constraints. Larger MPOs might also have more resources to acquire licenses and use big data platforms. Planners in these discussions emphasized the need for **transparency and legitimacy** in big data. **Regulatory clarity** is also a factor; questions around data privacy, ownership, public records, and acceptable use can make MPOs hesitant to dive headlong into big data without clear guidelines.

# Applications in Transportation Planning and Operations

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Transportation planning is a core metropolitan planning organization (MPO) responsibility and is one of the domains most visibly transformed by artificial intelligence (AI) and big data. Planners have access to unprecedented volumes of mobility data and advanced analytical algorithms, enabling a more data-driven approach to managing congestion, improving safety, and planning infrastructure investments.

## Traffic and Mobility Analysis

Traditionally, transportation planning relies on manually collected data, such as travel surveys or traffic counts. Today, big data is augmenting or replacing these methods.

For instance, GPS signals from smartphones, connected vehicle telemetry, and other “internet of things” sensors generate continuous streams of information about travel behavior. Big data platforms can process this big data with contextual information like road networks and Census data in machine learning models to derive core transportation metrics, such as:

- Annual Average Daily Traffic.
- Vehicle miles traveled.
- Turning movement counts.
- Origin-destination flows.

By leveraging large sample sizes and continuous data feeds, MPOs and transportation agencies can obtain up-to-date traffic volume estimates on virtually any road segment without installing a sensor on every street (StreetLight Data, 2024). The benefit is a more responsive understanding of congestion and travel demand patterns. By detecting shifts in traffic flows or mode usage in near real time, plans and operations can be adapted accordingly and proactively.

## Congestion Management and Traffic Operations

AI techniques are increasingly applied to optimize traffic flow in metropolitan areas, for areas including congestion management, curb management, parking management, and traffic operations.

- **Congestion management:** machine learning algorithms can analyze traffic sensor data and travel times to predict congestion before it happens and adjust signal timings or suggest demand management strategies. For example, AI-driven predictive models can use weather, event, and historical traffic data to forecast peak congestion locations each day and allow traffic management centers to intervene proactively. Real-world applications like AI-driven traffic monitoring can help cities dynamically manage traffic incidents and congestion in ways that static timing plans cannot (Andrews et al., 2022).
- **Curb management:** on-demand deliveries, the rise of transportation network companies (TNCs), and the emergence of micromobility options has placed new demands on curbside space. AI and big data can support curb management and alleviate congestion. Las Vegas implemented a digital curb management pilot that uses video enabled kiosks to monitor how long cars are dwelling on a curb and alert drivers when they have spent too much time on a curb, which has helped to improve the flow of TNC pickup and drop-offs (Descant, 2021).
- **Parking management:** parking management strategies utilize real-time data, including real-time occupancy tracking and AI-driven license plate recognition. This allows for improved

- efficiency by dynamically adjusting signage to guide drivers to available parking and adjust supply based on demand (Braibanti, 2018).
- **Traffic operations:** AI can support traffic operations and enhance multimodal coordination, such as by predicting bus arrival times more accurately or dynamically routing vehicles, by simultaneously analyzing data across different transportation modes.

## Safety Analysis and Vision Zero

Improving traffic safety is a high priority for most MPOs, and AI coupled with big data is providing new tools to advance toward vision zero (eliminating traffic fatalities). Traditional safety analysis often uses historical crash data, which is reactive and limited. New data sources can be integrated into big data platforms or machine learning models to achieve more proactive safety analysis (Wang et al., 2025). Some examples include:

- High resolution video from traffic cameras.
- Connected vehicle data (hard braking, near-misses).
- LiDAR scans of roadway features.
- Crowdsourced hazard reports.

## Use Case: AI Techniques for Proactive Safety Planning

The city of Bellevue, Washington leveraged computer visioning (CV) to analyze video footage at intersections for near-miss events and risky behaviors (Wang et al., 2025). By using CV to flag where drivers frequently brake suddenly or where pedestrians are nearly hit, planners can pinpoint dangerous locations *before* accidents occur. AI models (ranging from deep learning neural networks to decision tree ensembles) have been applied to datasets to uncover contributing factors to crashes that traditional methods might miss. With such tools, MPOs can prioritize interventions based on forward-looking safety risk assessments, ultimately shifting from reactive to predictive safety planning through data-driven insights.

## Infrastructure Management

MPOs often coordinate with departments of transportation and local governments in transportation infrastructure asset management. Big data and AI techniques can also offer advantages in this area, including:

- **Predictive maintenance:** sensors on bridges, pavement, and transit vehicles can continuously stream condition data that AI algorithms can analyze to predict when maintenance is needed.
- **Drones and CV:** can inspect roads, bridges, and other infrastructure for cracks or defects.
- **Big data analytics:** can optimize maintenance schedules by considering weather, usage patterns, and material performance data.

As these approaches become more mature and widely adopted, they have the potential to extend the lifespan of infrastructure and allocate limited maintenance funds more efficiently (National Academies of Sciences, Engineering, and Medicine, 2024).

## Multimodal Transportation Planning

MPOs are tasked with planning balanced multimodal systems including transit, cycling, walking, micromobility, and other emerging modes. Big data platforms give planners the ability to analyze many modes at once, and AI can help integrate and analyze data across these modes (StreetLight Data, 2019). Some examples are summarized below.

- Transit agencies use AI-based algorithms to analyze farecard data or real-time vehicle locations to redesign bus routes for better coverage.
- Bike-share and e-scooter programs generate big data that can reveal popular routes and areas underserved by current infrastructure.
- AI models can also simulate mode shift scenarios—e.g., estimating how many drivers might switch to transit if a new light rail line opens, by learning from data on past projects or similar cities.

Additionally, machine learning is being used to improve travel demand forecasting models. Traditional four-step travel models are being enhanced with AI techniques (such as neural networks to predict trip generation or distribution), offering potentially more accurate or fine-grained forecasts that account for non-linear relationships in travel behavior (Lee, 2024). As computing tools become more accessible, more MPOs can leverage cloud-based AI analytics to strengthen their regional travel models.

### Use Case: Multimodal Planning with a Private-Sector Big Data Platform

The Sarasota/Manatee MPO developed a comprehensive and equitable Active Transportation Plan using the big data platform StreetLight Insight with the goal of better connecting bicycle and pedestrian facilities to transit and other destinations (StreetLight Data, 2019). The MPO used StreetLight origin-destination analyses, revealing top origin-destination pairs without conducting extensive manual surveys. The MPO was able to use this information to prioritize new bike routes, improve route directness, and enhance multimodal connectivity. The result was a stronger multimodal network that helped reduce congestion and promote more equitable transportation access.

# Geospatial Intelligence (GeoAI) in Planning

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A significant portion of planning work is inherently spatial—dealing with maps, land use distributions, environmental factors, and geographic relationships. Geospatial artificial intelligence (GeoAI) refers to the integration of AI techniques with geographic information systems (GIS) and spatial data sciences. GeoAI is not a single tool, but a collection of spatial problem-solving approaches enhanced by machine learning (ML) and big data. For metropolitan planning organizations (MPOs), GeoAI holds promise for richer mapping analytics, automated feature extraction from imagery, and better understanding of spatial patterns and trends in their regions.

## Scope of GeoAI Applications

GeoAI has applications across several topic areas relevant to regional planning (Song et al, 2023):

- **Buildings and infrastructure:** detecting buildings, roads, or utilities from satellite images or classifying urban structures.
- **Land use and land cover analysis:** automating the mapping of land use types, monitoring changes in development, or modeling urban growth patterns.
- **Natural environment and hazards:** such as predicting flood zones, assessing tree canopy and heat islands, or managing disaster response with AI-driven damage assessments.
- **Social and human activities:** analyzing human mobility and crowdsourced data (like social media or volunteered geographic information) to understand travel patterns, public sentiment by location, or equity in service provision.

## Data Sources for GeoAI

To power these applications, GeoAI draws on a wide variety of data sources, far beyond traditional GIS layers. There are seven types of geospatial data commonly used in GeoAI (Song et al, 2023):

- **In-situ data:** ground-collected measurements (e.g., traffic counts, sensor readings, field surveys).
- **Traditional geospatial datasets:** curated data like cadastral maps, land use databases, or census tracts.
- **Crowdsourced geospatial data (geospatial big data):** user-generated content such as OpenStreetMap contributions, Waze traffic reports, or geo-tagged social media posts.
- **Remote sensing imagery:** satellite and aerial images, which can range from high-resolution photos to multispectral or radar images.
- **Photogrammetry data:** detailed 3D spatial data derived from overlapping photographs (for example, using drones to map terrain or infrastructure).
- **LiDAR data:** laser scanning data that provides precise 3D point clouds of surfaces, useful for modeling topography or building heights.
- **Statistical data:** demographic or economic data tied to geographic units (like population by tract, employment density maps, etc.).

Combining these heterogeneous datasets is often where ML models can fuse data from multiple sources and uncover patterns not evident in any single layer or visible without extensive, iterative processing. For instance, predicting where urban sprawl will occur might involve a model that takes in satellite imagery (to

see current land cover), road network data, and real estate market statistics (see, e.g., Kane and York 2017). GeoAI methods can handle this complexity more adeptly than traditional GIS overlays.

## Advances in Mapping and Feature Extraction

One practical use of GeoAI for MPOs is automating the extraction of map features from imagery and sensor data, a task that traditionally required labor-intensive digitization. Modern CV algorithms can be trained to identify and classify objects in satellite or aerial images and are discussed in detail later in this report.

Deep learning models have been used to turn aerial imagery into updated land use maps and to map community assets like trees or sidewalks by processing street-level photos (Wasserman, 2025). A prominent example is the National Oceanic and Atmospheric Administration's (NOAA) work on land cover mapping: using AI to classify land cover from satellite data, NOAA produces granular land cover maps that planners can use to understand urbanization patterns, vegetation loss, or wetland changes (Wasserman, 2025). Similarly, some cities have employed AI-driven image analysis to assess tree canopy coverage and inventory infrastructure (Wasserman, 2025).

## Spatial Analytics and Predictions

Beyond mapping what exists, GeoAI can expand the ability to predict what might happen where. ML models have long been used to forecast urban growth patterns or land use changes by learning from historical data. Models can incorporate dozens of variables to simulate scenarios such as where development would likely concentrate due to a transit line extension.

ChatGPT-like generative models for urban planning could automate certain spatial planning tasks, for example ingesting complex datasets (e.g., geospatial, mobility, economic data) and suggesting optimized zoning or land-use configurations, effectively providing a computational second opinion for planners. While such approaches are still experimental, they hint at a future where planners might use AI to generate multiple spatial scenarios quickly, then use their expertise to evaluate which scenario aligns best with community goals.

## Use Case: Urban Form and Design Insights

Algorithmic methods have also been applied to analyze urban design characteristics at a granular level. In a study of pedestrian-scale urban archetypes, researchers combined planning domain knowledge with ML to classify patterns of urban form. By quantifying spatial characteristics (e.g., block size, intersection density, building arrangement) and feeding these into an algorithm, they could distinguish "modern" versus "traditional" neighborhood layouts and predict the presence of certain design features (Voulgaris et al. 2017). For MPOs concerned with urban design and livability, such analyses can inform where to focus pedestrian improvements or how new developments might affect walkability. It exemplifies how big data (in this case spatial complexity metrics across many cities) coupled with AI can yield insights into the built environment's impact on human experience.

## Challenges in GeoAI

While GeoAI offers powerful capabilities, it also presents unique challenges. Spatial data and models have to grapple with issues of scale, spatial autocorrelation, and heterogeneity in a way that typical AI (focused on non-spatial data) does not.

- Challenges **integrating unique geospatial features** (location context, topological relationships, etc.) directly into AI models, which were often designed for aspatial data. This is analogous to long-acknowledged representational challenges in spatial big data, wherein basic characteristics of physical or urban geography can highly affect an outcome measure,

e.g., that drive times are longer in a hillier sub-region or transit use is lower in a poorer one (Kane and Kim 2020). Ongoing research is developing more spatially explicit AI models that inherently understand distance and geography.

- GeoAI applications often face limitations related to **data quality** and **availability**. In many cases, spatial datasets may be outdated, inconsistently formatted, or lack sufficient metadata.
- GeoAI workflows can be **computationally demanding**, especially when processing high-resolution imagery or large-scale geospatial data, requiring hardware resources such as GPUs that may be beyond the reach of smaller organizations.
- **Reproducibility concerns**, specifically, differences in coordinate reference systems, data resolution, or processing steps can make it hard to reproduce GeoAI studies. A best practice could be to standardize workflows and improve transparency in model development to ensure that results can be replicated across different environments (Li et al, 2024).
- **Data biases** can emerge. For example, if training data for an AI mapping model mostly comes from one region, it might not perform well in another with different urban forms.

These cautionary points underscore that building a strong foundation of data management and validation is essential when MPOs deploy GeoAI for critical planning decisions.

# Digital Twins and AI-Driven Simulation

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One of the most promising developments intersecting urban planning and technology is the emergence of digital twins for cities and regions. A **digital twin** is a digital replica of a physical system that is continuously updated with data and can be used for simulation and analysis. For metropolitan planning organizations (MPOs), digital twins represent a powerful way to integrate diverse data streams (transportation, land use, environmental, socio-economic) into a unified model that supports scenario testing and real-time decision-making.

## Concept of Smart City Digital Twins

A digital twin for a city or region functions as a living model of the urban environment (Mohammadi and Taylor, 2020). It ingests real-time data about human activities (e.g., traffic flows, transit ridership, foot traffic), infrastructure status (e.g., road conditions, energy grid performance, water usage), and environmental conditions, creating a dynamically updating mirror of the city. This holistic integration overcomes the problem of siloed data systems; instead of separately analyzing traffic data, land use maps, and sensor readings, a digital twin brings these together so planners can see interdependencies more easily. For example, an MPO using a digital twin could observe how a road closure (transportation data) is affecting local business activity (economic data) and air quality (environmental data) in real time, all within one interactive platform.

## Scenario Planning and “What-If” Simulations

MPOs have been utilizing scenario planning models (SPMs) for decades. SCAG’s SPM is a web-based data management, land use planning, and modeling tool developed by customizing the open-source version of UrbanFootprint (UFv1.5). SCAG’s SPM enables the creation and organization of local and regional data, plans and policies, facilitates scenario creation and editing, and estimates a wide range of potential benefits resulting from alternative transportation and land use strategies. SCAG’s SPM also provides a comparison of the Forecasted Regional Development Pattern for the Connect SoCal Regional Transportation Plan/Sustainable Communities Strategy versus an alternative that assumes no growth policy intervention will take place, which allows the SPM to measure and quantify the benefits resulting from Connect SoCal’s land use strategies.

Digital twins present new opportunities to run simulations of various scenarios to observe potential outcomes before making real-world decisions. Planners can pose “*what if*” questions within the digital twins, such as: *What if we add a new bus rapid transit line along Corridor X? What traffic, land use, and emission impacts might result?* Because the digital twin contains interconnected models of transportation, land use, and environment, it can forecast how a change in one domain propagates through others. This allows testing interventions in a risk-free virtual setting: by leveraging historical and real-time data, the twin can simulate future conditions under different assumptions. This capability greatly enhances urban resilience and strategic planning.

## Use Case: Digital Twins for Congestion Management

MPOs can evaluate the effects of policies (like congestion pricing, zoning changes, or telecommuting incentives) and refine them based on simulated performance. For example, Chattanooga, Tennessee, built a digital twin that helps anticipate and alleviate traffic congestion (Solomon, 2021). This allowed Chattanooga planners to pinpoint congestion hotspots during the midday period, a time when they do

not historically collect manual counts. The digital twin allowed the city to run signal timing simulations during the midday period, showing an up to 30 percent improvement in traffic flow in identified corridors. The iterative learning from simulation results helps optimize policies for desired outcomes in sustainability, mobility, or economic development. Digital twins can turn planning into a more evidence-driven, adaptive process where data continuously informs decision cycles.

## Integration of Virtual Reality and Augmented Reality in Public Engagement

Digital twins can also support immersive visualization and public participation. With advanced integrations, a digital twin model can be experienced in **virtual reality (VR)** or **augmented reality (AR)** formats, allowing both planners and the public to virtually “walk through” planned changes or future scenarios. Coupling a digital twin with AR/VR and crowdsensing tools (crowdsourcing from mobile devices) enables a more participatory and immersive approach to planning (Mohammadi and Taylor, 2020). For example, community members at a public workshop can view 3D renderings in context using a VR headset and a digital twin, which can elicit more informed feedback.

Digital twins can also incorporate **two-way data flows with the public and stakeholders**, where the public can provide location-specific inputs which are fed into the digital twin. By actively involving stakeholders, MPOs can use digital twins not just for top-down analysis but as a platform for collaborative planning that enhances trust and transparency.

## Use in Infrastructure and Asset Management

Digital twins can help support predictive infrastructure and asset management in a variety of ways (National Academy of Sciences, Engineers, and Medicine, 2024).

- **Continuous condition tracking:** digital twins can continuously track the status and condition of highways, bridges, and transit assets via embedded sensors and inspection data.
- **Anomaly detection:** AI algorithms can detect anomalies or degradation (like a pattern of bridge vibrations that suggest a need for maintenance) and alert engineers.
- **Simulated maintenance activities:** digital twins can simulate maintenance activities to assess impacts.

## Challenges and Considerations

Despite their potential, digital twins present barriers to implementation, including:

- Significant investment in **data infrastructure** and integrating streams of information from multiple sources and agencies.
- **Model accuracy and validation:** maintaining accuracy requires constant calibration and scrutiny.
- **Privacy:** information about citizens (even if anonymized) must be managed under strict privacy guidelines to prevent the misuse of private information.

Digital twins represent a convergence of big data, AI, and immersive technology for planning. By creating comprehensive, interactive models of regional systems, they empower MPOs to perform even deeper evidence-based scenario planning and foster collaborative governance. As this technology matures, it has the potential to become a powerful tool in the planning toolkit, complementing traditional analytical methods with dynamic simulation and engagement tools.

# Smart Governance and Public Engagement

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The infusion of artificial intelligence (AI) and big data into planning also shows promise for governance and how planners engage with the public. Smart governance refers to leveraging data and technology to improve policymaking, service delivery, and public participation. AI and big data can improve how decisions are made and how the public is involved in the planning process for metropolitan planning organizations (MPOs) by being able to quickly analyze thousands of public comments, predict the impact of different policy decisions, and encourage a more participatory planning process.

## Data-Driven Decision Making

Integrating big data analytics into an MPO's existing planning process can improve the efficiency and accuracy of policy decisions and ultimately help create more responsive public services (Hossin et al, 2023).

For example, an MPO can improve transportation systems by using real-time traffic data to dynamically adjust congestion management strategies or make more data and evidence-driven decisions by using big data to analyze housing, jobs, and commuting patterns simultaneously to design policies to address jobs-housing balance issues.

Ensuring MPOs have the right infrastructure and framework in place prior to implementing data-driven governance practices is key. Major challenges associated with integrating big data into governance contexts include:

- Technological constraints (legacy systems that cannot handle big data well).
- Difficulties integrating data from disparate sources.
- Ethical concerns regarding data privacy and surveillance.

## AI for Policy Analysis and Development

AI tools can help policymakers sort through the complexity of urban issues by identifying patterns and simulating outcomes. For instance, natural language processing (NLP) can analyze thousands of public comments on a major plan to identify key themes or sentiment.

For example, the Metropolitan Transportation Commission (MTC) is exploring how to automate their public comment analysis process using a combination of Python code and large language models (LLMs) (CALCOG, 2025). While MTC's existing manual process for analyzing public comments is resource intensive and time consuming, they found that LLMs can support engagement analysis work by quickly and efficiently grouping similar public feedback and producing outputs that are nondeterministic and easily interpretable. MTC has used this automated process in three engagement efforts in the past year.

Machine learning (ML) models can also be used to predict the impact of different policy choices. For example, an MPO can use a ML model to assess the impact of a new transit subsidy across different neighborhoods, or which intersections should be prioritized for safety improvements.

As AI becomes more widely adopted at MPOs, planners can increasingly act as **informed consumers** of AI outputs, using them to guide decisions while ensuring they align with agency goals and local knowledge (Sanchez, 2023). Planners should interrogate AI recommendations for bias or blind spots and

be aware of biases inherent in any historical data used to train the model. AI-augmented governance and policymaking require strong professional judgement and ethical oversight from planners.

## Public Participation and Engagement

MPOs conduct extensive public outreach as part of developing plans, and AI and big data are opening new channels for public engagement, including public-facing AI tools and NLP for analyzing public feedback.

Virtual chatbots that can answer questions about planning projects by pulling information from plan documents are an example of public-facing AI tools. For example, a prototype city planning chatbot was developed for the city and county of Denver, which was trained on publicly available documents to answer questions about city planning and zoning regulations. Though not officially endorsed by Denver, the chatbot serves as a proof-of-concept that aims to improve public access to information, thereby increasing transparency and civic engagement (Steins, 2023).

Another aspect is analyzing public input. With social media and online engagement platforms, planners face an overwhelming volume of feedback. As discussed in the previous section, LLMs can be used to summarize opinions or flag common concerns or sentiments across thousands of comments.

## Collaborative Platforms and PPGIS

Public participation GIS (PPGIS) is a participatory approach to spatial planning, involving the public in mapping and spatial decision processes. AI can bolster PPGIS by processing heavy data analytics in the background while presenting easily understandable insights to the public.

AI models can foster a human-centered approach to smart cities by placing human and public engagement at the center of the planning process (Mortaheb and Jankowski, 2023). For example, an AI model could evaluate dozens of scenarios for a new transit line and produce interactive interfaces for each scenario. Participants can tweak inputs, and the model can update scenario outcomes in real time.

GIS tools including PPGIS, real-time GIS, and geodesign frameworks are crucial for ensuring this approach remains inclusive and collaborative. AI models should be built to show comprehensive feedback, including negative outcomes such as increased emissions or community displacement.

## Transparency and Accountability

A recurring theme with AI in governance is the need for **algorithmic transparency**. If an MPO uses an AI model to help rank project priorities or to guide funding allocations, its methodology must be transparent and explainable. Black-box algorithms that affect public decisions can undermine trust if left unexplained. Part of smart governance involves establishing explainable AI methods and clear documentation of data sources and assumptions.

One component of ethical AI use is transparency, and planners have called for ethical guidelines for public sector AI use that involves testing outcomes for disparate impacts, maintaining privacy protections, and involving humans in all decision making.

## Ethical and Equitable Use of Big Data

Ensuring ethical and equitable use of big data requires addressing **data privacy concerns** and **algorithmic bias**. Smart governance frameworks stress the importance of proper data handling, including anonymization, data security, and consent. Algorithmic bias can also reinforce inequities, so it is important for planners to know how to identify and correct these issues. Equipping planners with sufficient technical literacy in how AI and big data analytics work can help to ensure equitable and ethical use.

# AI Tools for Planning Practice: Natural Language Processing and Computer Vision

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Natural Language Processing (NLP) and computer vision (CV) are two areas of artificial intelligence (AI) that have gained prominence in the planning realm due to their versatility and potential applicability. This section explores in greater detail how these areas can be utilized by metropolitan planning organizations (MPOs).

## NLP and Planning

### TEXT GENERATION

NLP tools deal with text and language, aiding in tasks from document drafting to interpreting regulatory codes. NLP tools are exemplified by large language models (LLMs) like Open AI's GPT-4 (commonly referred to as ChatGPT). LLMs are a subset of NLPs that can generate human-like text, summarize documents, translate languages, and answer questions.

Survey data shows that the most commonly used AI tool among MPO staff are text generators like ChatGPT, and that planners are using them to assist with business productivity tasks including report writing assistance, parsing public comments, and generating lines of code.

### INFORMATION RETRIEVAL

NLP can also assist in information retrieval. MPOs maintain vast document libraries that are often in PDF format and not always easily searchable or cross-referenced, and members of the public might not know which document contains the information they are looking for. Closed-loop or domain-specific LLMs trained only on an agency's documents can be used to answer technical questions or retrieve specific information. For example, the Western Riverside Council of Governments developed a closed-loop LLM for staff to use to help draft briefs and staff reports and find data quickly (CALCOG, 2025). The tool works in the same way as ChatGPT, where staff can ask questions and the LLM will produce responses that provide citations to the source documents.

Researchers at the Chinese Academy of Urban Planning have also developed PlanGPT, the first LLM designed specifically for urban planners (Zhu et al, 2024). Compared to open-source LLMs, PlanGPT improves the precision of information extraction from urban planning texts. It incorporates a retrieval system that taps into local planning databases and uses fine-tuning to understand planning jargon and the structure of planning documents. In tests, PlanGPT could draft text for planning documents, evaluate planning proposals for compliance and feasibility, and act as a virtual planning assistant answering questions based on city regulations. Another component, PlanAgent, was designed to review and audit documents using a combination of vector database search and reasoning, effectively performing a first-pass compliance check or consistency review across planning documents.

The development of these domain-specific LLMs suggests that MPO use of AI will continue to evolve beyond individual planners using open-source LLMs for business productivity assistance.

## INTERPRETATION

NLP can also serve an interpretation role, translating raw data analysis into a narrative report. This concept of bridging technical data and human-friendly explanations can help to democratize data, enabling members of the public to glean insights and understand complicated analyses without technical expertise. AI models can be used to develop narrative outputs to accompany visualizations and make big data findings more relatable.

One paper explored how AI, with models like ChatGPT, can interpret and make accessible complex GIS and remote sensing data. The idea is that an NLP interface could allow a planner (or even a layperson) to ask questions in the form of phrases or sentences which are decomposed into categorizable pieces, assessed, and responded to. For instance, “Describe the trends in satellite-observed night-time light intensity in our metro area over the last 10 years” could be answered by an AI that translates the raw data analysis into a narrative report (Daniel, 2023).

## CHALLENGES AND CONSIDERATIONS

There are a number of important considerations that planners and MPOs should understand when using NLP tools and LLMs, including accuracy, biases, and data readiness.

- LLMs **do not truly understand facts**. They predict plausible text based on patterns. A **hallucination** refers to when an LLM produces incorrect or fabricated information with a confident tone. Planners must critically review any AI-generated content, and these tools should be used as a starting point for drafting or analysis and not the final word. Specifically, open-source LLMs show problematic knowledge cutoffs and generalization issues, so verification against source documents is essential (Daniel, 2023).
- NLP models reflect the **biases** in their training data. If certain communities were underrepresented in historical planning documents, an LLM built on those documents may mirror that bias. There have been instances where AI text generators produce outputs that inadvertently favor more affluent or majority groups if prompts are not carefully constructed. This is why transparency about AI use and checking the model with **diverse** sources is important (O’Neil, 2016).
- As mentioned earlier, planning documents and ordinances (especially older documents) are not always in machine-readable formats. If a city’s zoning code is only available as a scanned PDF, NLP tools cannot easily parse it. Prioritizing **data readiness** and digitizing and structuring such information properly is a prerequisite for utilizing NLP tools for planning (Daniel, 2023).

In summary, NLP tools and LLMs are poised to become helpful co-pilots in planning work, through accelerating writing tasks, summarizing complex inputs, and making information more accessible. Planners will need to develop guidelines for their use (for instance, when is it appropriate to use AI in drafting a public document? How should AI be attributed and how should accuracy be ensured?) and cultivate internal expertise to fine-tune these models on local data safely. With those guardrails, NLP can boost productivity, leaving planners to innovate in other areas requiring human cognition or resulting in labor cost savings.

## CV Applications in Planning

CV applies AI to visual data, enabling automated analysis of the physical environment through photos, satellite imagery, or live video feeds.

## AUTOMATED IMAGERY ANALYSIS

As discussed in the GeoAI section, CV is now being used in planning to process aerial or satellite imagery, automating tasks that once took interns or technicians hours of manual digitization. Deep learning models are able to recognize patterns in images. As noted earlier, the National Oceanic and Atmospheric Administration's land cover maps and urban tree canopy assessments have been enhanced by AI classification of imagery. Another example, which predates the more recent use of the term AI, analyzed Google StreetView images of parked cars to approximate neighborhood socioeconomic characteristics found in the American Community Survey (Geburu et al. 2017).

More recently, various startups and research projects have built CV models to identify:

- The presence of sidewalk and crosswalk for mapping pedestrian infrastructure.
- Roof types for modeling solar panel potential or stormwater runoff.
- Neighborhood conditions such as presence of litter, graffiti, and broken windows.

For MPOs, updated land use or infrastructure inventories derived from imagery can improve model inputs, ultimately improving the decision-making process.

## MONITORING TRANSPORTATION SYSTEMS

CV is also advancing how planners monitor transportation in real time. Many cities have networks of traffic cameras which can be digitized and classified by AI. Pedestrian and vehicle counts can be generated by CV algorithms, turning video frames into numerical counts of crossing pedestrians or turning vehicles without an analyst manually clicking a counter. This provides continuous data on intersection usage, speeds, and even near-miss incidents (Wang et al, 2025).

In public transit, CV could monitor passenger crowding by analyzing CCTV to help transit agencies adjust service on the fly. CV can also detect incidents, such as identifying a stopped vehicle on a freeway from camera feeds and alerting an emergency response.

CV is also being used by transit agencies for automated bus lane enforcement. As part of its Bus Lane Enforcement program (Los Angeles County Metropolitan Transportation Authority, n.d.), the Los Angeles County Metropolitan Transportation Authority has installed front-facing cameras on select buses that use AI to detect vehicles that are parked in bus lanes and bus stops. When a parking violation is detected, an evidence package is created containing a short video of the violation, a photograph of the license plate of the offending vehicle, and the time and location where the incident occurred. The camera system documents the violation, sends it to the Los Angeles Department of Transportation for traffic officer review.

For an MPO concerned with regional congestion management, these AI-driven capabilities can mean more timely and detailed data to feed into management systems.

## URBAN DESIGN AND STREETScape ANALYSIS

On a finer scale, CV tools can help planners **evaluate urban design elements**. For example, using Google Street View images, CV has been applied to assess sidewalk quality and streetscape features block by block in cities. One project used CV to compute a pedestrian friendliness score of streets by detecting elements like trees, building facades, windows, and pedestrians themselves in images, correlating those with human perceptions of safety or comfort (Wasserman, 2025).

Planners have also used CV for **design review** by using AI models to visualize proposed changes, such as how a street would look with the addition of a bike lane or parklet. As discussed in the section on "Digital Twins and AI-Driven Simulation," AR can let planners and the public hold up a smartphone at a site and

see a 3D model of a planned building in place. These applications merge CV with visualization to support more informed urban design discussions.

## ASSET MANAGEMENT

MPOs and their partner transportation agencies must manage thousands of assets. CV is proving useful in asset management by analyzing imagery from roadway cameras or dedicated survey vehicles to identify assets and their conditions. For example, a CV system can scan through roadway video and automatically log the GPS coordinates of every traffic sign, including its type and condition using object recognition. This creates or updates asset inventories much faster than manual field surveys.

Some state departments of transportation have vans equipped with cameras and AI to drive the road network and produce an updated asset database in hours. Similarly, CV can detect pavement cracks or potholes from images, aiding maintenance planning. By incorporating these data, MPOs can better coordinate regional maintenance priorities and advocate for resources based on objective, up-to-date infrastructure condition data.

## LIMITATIONS AND ETHICAL ISSUES IN CV

Despite the potential of CV, planners should be aware of its limitations, including **accuracy**, **privacy**, and **bias**.

- CV models might **misidentify objects**, especially in suboptimal conditions such as poor lighting, bad weather, or atypical object appearances. If a building footprint extraction AI model is assumed to be 95 percent accurate, the agency must be comfortable with a 5 percent error rate, or undertake post-processing, especially for critical uses like hazard mitigation maps. Over-reliance on automated CV outputs without verification can lead to errors in maps or analysis. Combining AI with a human review process may be a desirable workflow, with AI identifying features and humans double-checking a sample for quality control.
- There are also significant **privacy and surveillance concerns** with using CV or live video involving people. Planners should adhere to ethical standards that any use of surveillance data for planning is transparent to the public and solely for public interest purposes like safety or service improvement and undertake efforts to anonymize individuals and discard footage when it is no longer needed.
- As mentioned in other areas of AI and big data, there is also a risk of **bias** in CV algorithms. If the training data for a CV model is insufficiently diverse, the model might perform better in some environments than others. For instance, a CV algorithm trained mostly on suburban North American street scenes might struggle to identify features in dense urban Asian cities or vice versa. Bias can also reflect in what is detected: a model might undercount people based on visually observable characteristics or miss cyclists if they are rare in the training data.

These issues warrant careful evaluation of CV tools, ideally with local calibration, before deployment in planning analyses that could impact resource allocation or policy.

# Challenges and Considerations in Implementing Artificial Intelligence and Big Data

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While the potential benefits of artificial intelligence (AI) and big data are substantial, there are also substantial challenges and important considerations for implementation, many of which have already been discussed in earlier sections of this report. These challenges include data-related issues, technical expertise, bias and equity, transparency, privacy concerns, integration with existing processes, and cost.

## Data Quality and Availability

As discussed in both sections on challenges for Geospatial AI and natural language processing, AI tools are only as good as the data they learn from. A common issue identified is that planning departments often still rely on analog or non-digitized information, making it hard to leverage with AI. For metropolitan planning organizations (MPOs) data modernization, including data infrastructure needs, is a prerequisite for successful AI integration, which can also involve new software needs, interagency sharing agreements, and dedicated staff or resources for data upkeep (National Academies of Sciences, Engineering, and Medicine, 2024).

## Technical Expertise and Workforce Readiness

The introduction of AI tools and big data analytics may mean that MPOs need to upskill their workforce or hire staff with data analysis proficiency and AI knowledge. As these emerging technologies continue to evolve, it could be beneficial for MPOs to equip all planning staff with at least basic levels of AI and big data literacy. Workshops, webinars, and hands-on projects can demystify AI and big data platforms for staff by teaching how models work, what their outputs mean, and how to critically evaluate them. Planners who augment their skillsets to critically evaluate and interpret AI results, set the right questions for AI to answer, and integrate insights into holistic decisions might be better positioned for long-term workforce readiness.

## Algorithmic Bias and Equity

One of the most prominent and critical concerns with AI systems is algorithmic bias and associated equity concerns, which have been discussed at length in previous sections, including sections on NLP and computer vision (CV as well as “Smart Governance and Public Engagement.” Bias can enter the AI pipeline at many stages: in the training data, in the model design, or in how the results are applied. For example, a predictive policing algorithm famously ended up disproportionately targeting minority neighborhoods because it was trained on historically biased crime data (O’Neil, 2016).

Strategies for MPOs to minimize potential bias include:

- Ensuring that data training the model include diverse representation of different communities and conditions.
- Bias testing by checking outputs for any system differences correlated with sensitive variables.
- Explicitly incorporating equity goals into algorithms.

## Transparency and Explainability

A recurring theme seen throughout this report is the need for algorithmic transparency. AI algorithms can be “black boxes” where even the developers might not fully understand how inputs are being transformed into outputs. MPOs should favor AI tools that offer interpretable results or use techniques and be able to fully explain the methodology and rationale that led to a decision or output.

Documentation is also crucial: agencies should document how an AI model was trained, what data was used, its known limitations, and how it has been validated. Such transparency builds trust, and in cases where the AI might be wrong, it allows for constructive critique and improvement of the system.

## Privacy and Data Governance

As discussed previously in the section on CV, ensuring privacy and ethical standards for using personal or sensitive information is important. Many big data mobility datasets require data agreements and adherence to ethical practices about not re-identifying individuals or exposing potentially private information.

Another consideration when handling large data streams and AI systems is cybersecurity. MPOs should establish clear policies on data use, sharing, and protection. MPOs can also consider aligning policies with other efforts, such as the House Committee on Energy and Commerce Privacy Working Group which formed in early 2025 (U.S House Committee on Energy and Commerce, 2025) with the intention of creating a comprehensive national data privacy standard.

## Integration with Existing Processes

MPOs operate under various regulatory frameworks and established processes for plan and project development. Introducing AI and big data analytics raises the question of how they fit into these processes. Planners will need to integrate new analytics in a way that complements rather than confuses decision-making, such as by running AI analyses in parallel with traditional methods to build confidence. For now, MPOs should use AI as an enhancement and insight-generator but continue to cross-check with established methods and independent professional judgment.

## Cost and Sustainability

While some tools are accessible (such as open-source and free versions), AI systems and big data platforms are typically expensive. Ongoing data subscription costs, hiring skilled personnel or consultants, and ongoing maintenance can further strain MPO budgets.

To offset these costs, MPOs can explore multiple strategies, including pilot projects, to demonstrate value before upscaling, partnerships with other public agencies or academic institutions for research opportunities, and policy and legislation that can impact AI and big data procurement (such as Assembly Bill 744 in California). MPOs should also incorporate recurring costs (such as ongoing maintenance and upgrades) into initial investment budgets.

# Strategies for Integrating Artificial Intelligence and Big Data in Metropolitan Planning Organizations

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Given the myriad opportunities and challenges presented with artificial intelligence (AI) and big data adoption, metropolitan planning organizations (MPOs) should be thoughtful and intentional about how these technologies are integrated. Below are some strategies MPOs can employ to adopt these technologies in an ethical and effective way.

## Develop a Clear AI/Big Data Strategy and Vision

Developing a clear strategy and vision for how and why AI and big data will be used as a first step is extremely important to align staff and stakeholder expectations, provide a basis for evaluating progress, and ensure the effort is purpose-driven.

Specifically, MPOs can develop internal strategic plans or roadmaps identifying priority areas where the tools will be applied, highlight specific pilot projects or use cases to demonstrate value, and set clear goals for which progress can be assessed (National Academies of Sciences, Engineering, and Medicine, 2024). The strategy should be comprehensive in nature, incorporating the other implementation strategies listed here (e.g., data governance and infrastructure upgrades, workforce and training investments, identification of pilot projects and scalable wins, ethical guidelines, public and stakeholder communication plan, etc.).

## Invest in Digital Infrastructure and Data Governance

As emphasized earlier, having the right data in the right format is foundational. MPOs should invest in improved data infrastructure, including hardware (e.g., servers, cloud services), software (e.g., databases, data integration platforms, business intelligence tools), and data (e.g., new datasets, new sensor networks) prior to AI and big data adoption.

Robust data governance policies are also needed, including data quality standards, metadata documentation, sharing protocols, and privacy safeguards. Some MPOs create a data governance committee to oversee these aspects. By instituting standards (like common geospatial data schemas or API access to data), MPOs ensure that both internal AI projects and external partners can reliably access and use the data.

## Build Workforce Capacity and Skills

As technical expertise and workforce readiness have already been identified as challenges, MPOs will need to provide training opportunities for existing staff to gain literacy in AI and big data platforms. Not all staff need to become experts, but as mentioned throughout this white paper, basic literacy is required to understand and critically evaluate AI outputs, which is a skill all staff should acquire. MPOs can explore webinars, courses, peer learning opportunities, or hiring or contracting specialists. Creating interdisciplinary teams of planners, modelers, and IT staff can ensure that multiple perspectives are integrated.

## Start with Pilot Projects and Scalable Wins

Rather than deploying AI across all operations at once, it is more realistic to choose a specific, manageable problem where AI or big data could clearly add value, such as the MTC public comment automation process presented earlier. The pilot project should also include well-defined objectives and measures of success to help familiarize staff, increase public trust, and mitigate pitfalls.

## Develop Ethical Guidelines and Review Processes

Given the potential risks discussed, MPOs should proactively establish ethical guidelines for AI use. These guidelines can cover principles such as:

- **Accountability:** a designated person or committee reviews AI applications for fairness and appropriateness.
- **Transparency:** the agency will disclose when and how AI is used in analyses or decision support, both internally and in public-facing contexts.
- **Equity:** AI tools should be tested for biased outcomes; if biases are found, adjustments or different approaches will be used. For example, SCAG's Generative AI Acceptable Use Policy states that employees must use GenAI pursuant to SCAG's Ethics Policy and Personnel Rules (SCAG, 2024).
- **Privacy:** commit to protecting individual privacy by adhering to data anonymization standards and not using AI in ways that could invade privacy (like real-time facial recognition in public spaces, unless legally and publicly justified).
- **Human Oversight:** make clear that AI outputs are advisory and that human planners will make final judgments, especially on value-laden decisions.

Planners should also consider the ethical guideline considerations put forth by the American Planning Association (APA) Technology Division and APA Ethics Committee, which translate the principles of the American Institute of Certified Planners Code of Ethics into practical guidance for using generative AI in planning (APA Technology Division and APA Ethics Committee, 2024). The guide presents four important considerations for the ethical use of AI in planning, many of which have already been touched on in this report:

- Be sensitive to the bias and limitation of AI.
- Systematically check outputs, disclose use whenever practicable, and communicate capabilities and limitations.
- Be proactive in educating yourself about emergent technologies and AI systems.
- Do not disclose sensitive information regarding constituents or organizations using platforms that are not authorized within an organization.

Having such a framework in place provides guidance to staff and reassurance to the public. A review board or ethics committee, made up of a subcommittee of the agency, a staff working group, and including community representatives, could evaluate new AI initiatives.

## Engage Stakeholders and Communicate Benefits

Maintaining transparency helps MPOs to retain public trust and accountability. Stakeholder engagement around AI and big data is important and should center around demystifying the technologies and building public trust.

By addressing these openly and proactively (perhaps in an emerging technologies task force or working group), MPOs can refine their approach and ensure it aligns with regional values. Communicating success

stories is important too: if an AI-based model helped secure a grant or a big data analysis led to fixing a notorious traffic issue, informing the public and elected officials will further build trust.

## **Collaborate and Share Knowledge**

The success of regional planning relies on collaboration and sharing knowledge across agencies and partners, and this can be extended to AI and big data adoption.

The Association of Metropolitan Planning Organizations survey and report itself is an example of knowledge sharing across MPOs about AI practices. MPOs can pool resources for training sessions, jointly fund data acquisition, or share code or AI models for analyses. Academic partnerships, staying up to date on industry knowledge, and attending forums and conferences can help ensure MPOs stay up to date on technological advances. MPOs can also explore establishing or joining working groups where members across multiple agencies come together on a regular basis to discuss and coordinate adoption and present use cases.

## **Update Policies and Plans to Incorporate AI/Big Data**

As AI and big data become part of the planning process, they should also be reflected in the MPO's formal plans and policies. This could mean updating the regional transportation plan to acknowledge the role of emerging mobility data in performance monitoring or including objectives about improving data-driven decision-making across an MPO's operations more broadly. MPOs should also stay up to date on state or federal agencies' AI and big data use so MPOs can be aligned with these guidelines. Internally, MPOs can also revise data retention and public record policies considering the influx of digital data to prevent later legal ambiguities.

By pursuing these strategies, MPOs can integrate AI and big data in a way that is strategic, responsible, and sustainable, with the ultimate goal of utilizing these tools to create better plans grounded in evidence, data-based decisions, and reflect community input.

# Conclusion

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This report aims to provide a comprehensive overview of artificial intelligence (AI) and big data applications that metropolitan planning organizations MPOs can consider implementing to support more informed, data-driven decision-making and policymaking. AI offers new upsides and new challenges, but it also builds on at least a decade of existing work to integrate big data and aspects of machine learning and modeling into regional planning practice. The report looked at many different areas of AI and big data tools, technologies, and applications already being applied in the planning field and across different subject areas that MPOs work in. The report highlights use cases and real-life examples, as well as challenges and considerations for adoption.

Thoughtful and careful adoption strategies are key for integrating and scaling AI and big data ethically and sustainably. Top challenges and considerations include data quality and availability, technical expertise and workforce readiness, algorithmic bias and equity, transparency and explainability, privacy and data governance, integration with existing processes, and cost and sustainability. Based on the literature review, there are several strategies that MPOs can take to integrate AI and big data practices successfully.

An Association of Metropolitan Planning Organizations survey and SCAG internal survey show that planners are already using AI tools like large language models for minor business productivity subtasks, and it is likely that adoption will only continue to increase as these technologies continue to evolve and mature. Thus, it is important that MPOs equip their staff with the technical skills and knowledge necessary to critically understand and engage with AI and big data tools to make sure they are being used appropriately and ethically.

In implementing AI and big data solutions, MPOs should remember that success is not just measured by technical performance, but by public trust and tangible improvements on the ground. Maintaining transparency, inclusion, and accountability throughout the process is paramount. MPOs should proactively engage communities in conversation about how data is used, be open about successes and setbacks, and ensure equitable benefits from technological advancements.

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## MAIN OFFICE

### LOS ANGELES COUNTY

900 Wilshire Blvd., Ste. 1700  
Los Angeles, CA 90017  
Tel: (213) 236-1800  
[www.scag.ca.gov](http://www.scag.ca.gov)

## REGIONAL OFFICES

### IMPERIAL COUNTY

1503 N. Imperial Ave., Ste. 104  
El Centro, CA 92243  
Tel: (213) 236-1967

### INLAND EMPIRE

3403 10th St., Ste. 805  
Riverside, CA 92501  
Tel: (951) 784-1513

### ORANGE COUNTY

OCTA Building  
600 S. Main St., Ste. 1108  
Orange, CA 92868  
Tel: (213) 630-1599

### VENTURA COUNTY

4001 Mission Oaks Blvd., Ste. L  
Camarillo, CA 93012  
Tel: (213) 236-1960