Center for
Healthy and Efficient Mobility
CHEM A USDOT University Transportation Center

Leveraging Artificial Intelligence in Sustainable Transportation Research: A Literature Review

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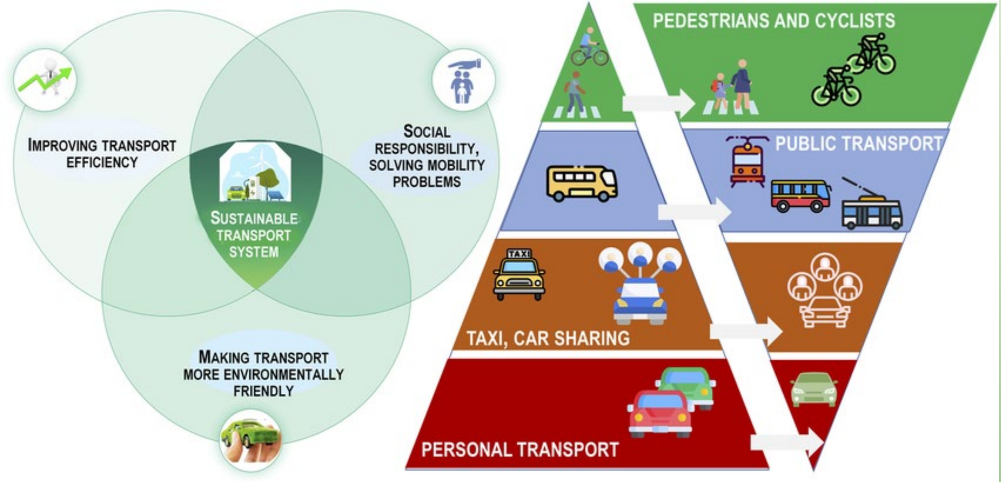
Outline

1. Background/ Research Question
2. Methods for Literature Review & Screening Process
3. Network Visualization
4. Key Findings: Cluster & Trend Analysis
5. AI Themes and Related Techniques in Sustainable Transportation Literature
6. Overlay Visualization
7. Implications
8. Factors to Consider / Limitations
9. Future Research
10. Questions

Background

What is sustainable transportation?



Research Question: "What patterns and applications of artificial intelligence emerge in sustainable transportation research between 2000 and 2020?"

Methods for Lit. Review & Screening Process

Identification

Records identified from TRID/TRB (n=1,177)

Screening

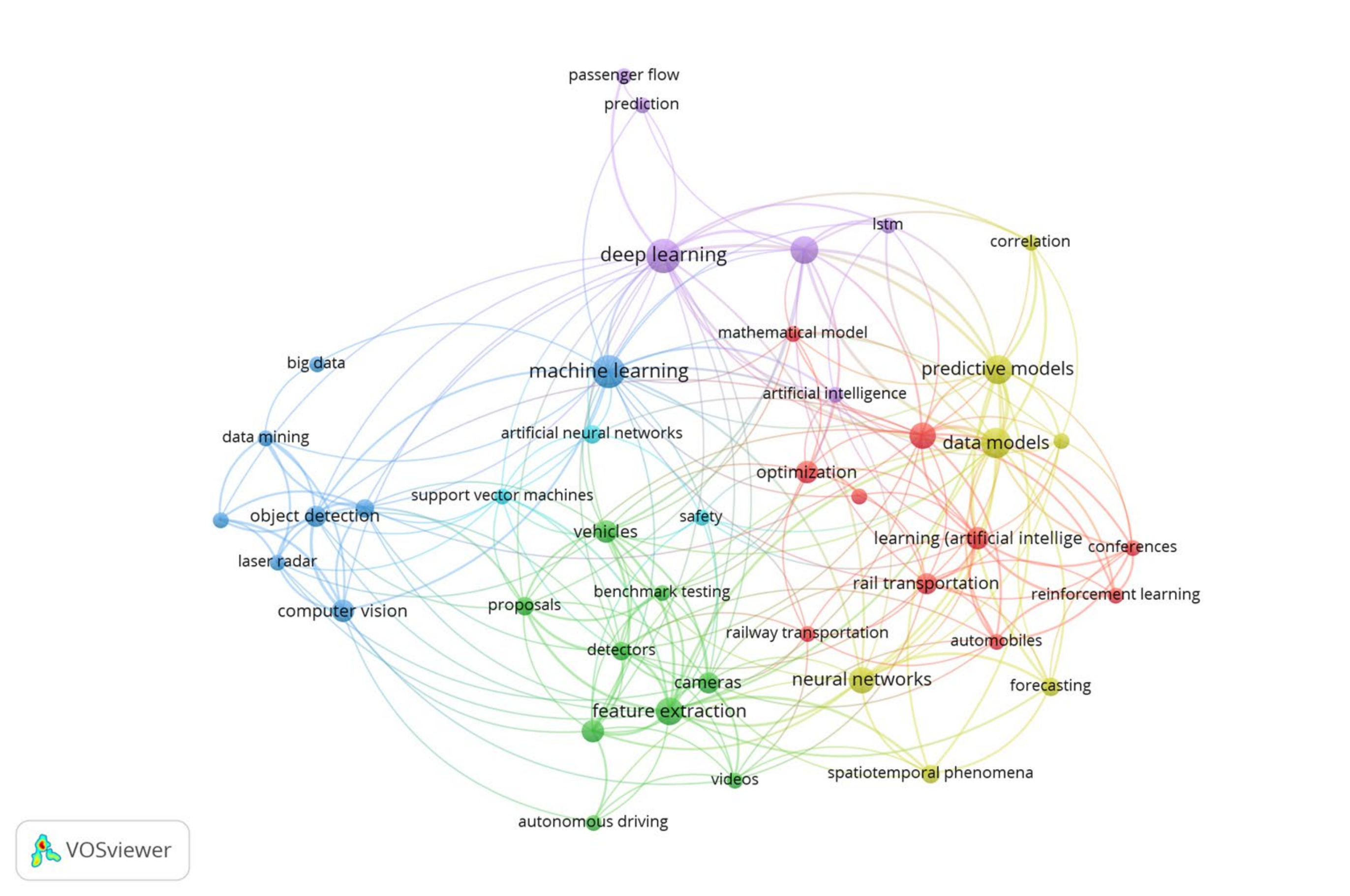
Abstracts screened (n=1,177)
Records excluded (n=34)

Eligibility

Relevance score filter applied:
-2000-2010: > or = 8
-2010-2020: = 9

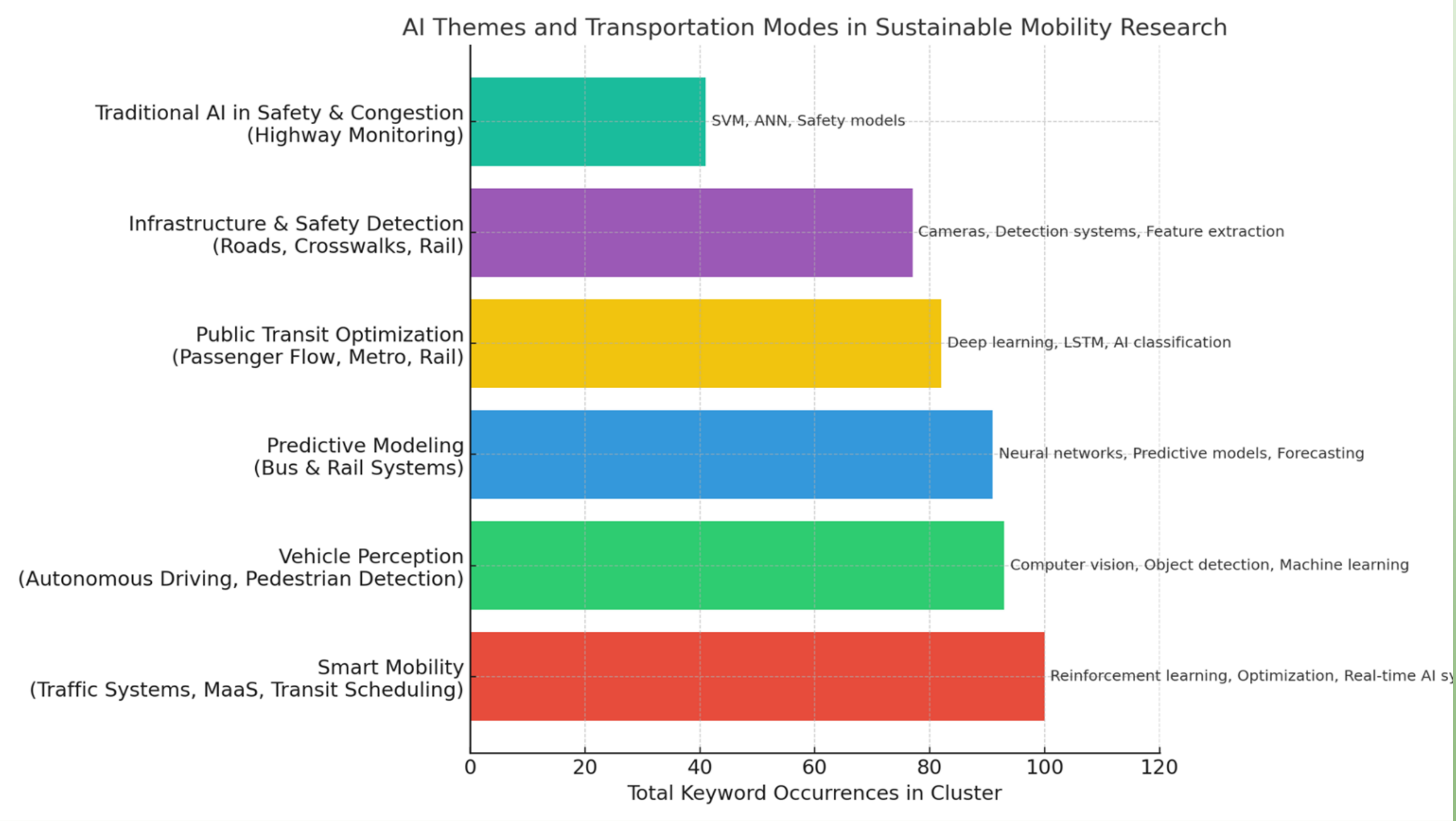
Studies included in synthesis (Zotero folder & VOSviewer)
(n=126)

Network Visualization

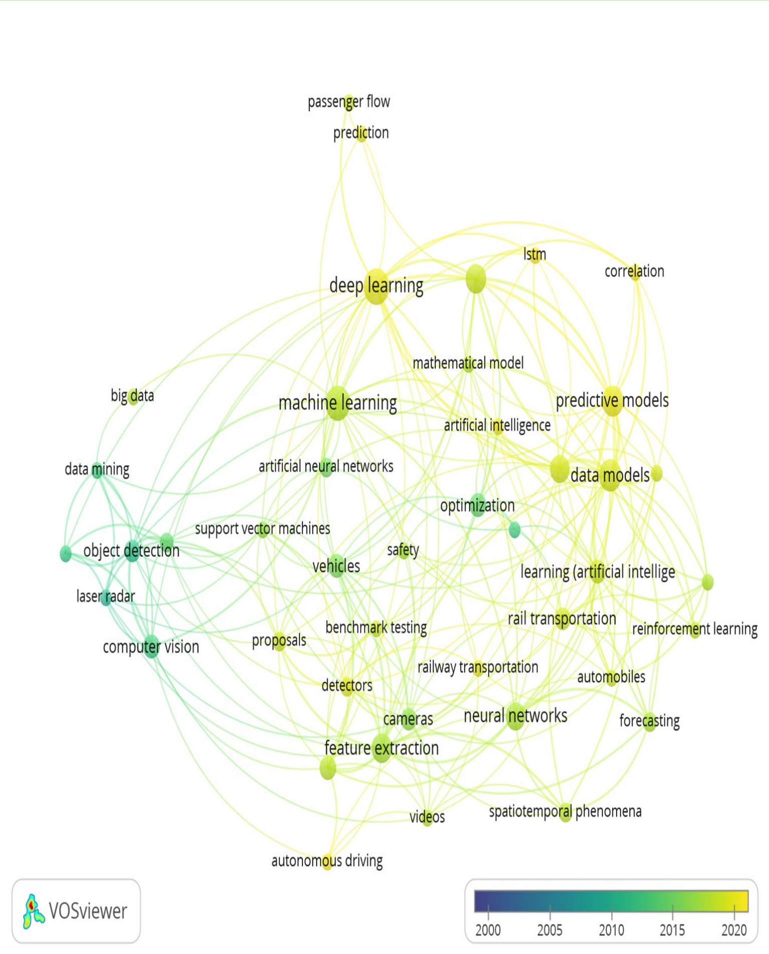


Cluster & Trend Analysis

Cluster Color	Theme / Application Area	Total Occurrences	Application Goal	AI Techniques
Red 🔴	Smart Mobility & Real-Time Systems	100	Dynamic decision-making in **traffic systems**, **public transit**, and **Mobility-as-a-Service (MaaS)**	Reinforcement learning, Optimization, Real-time systems
Green 🟢	Vehicle Perception & Computer Vision	93	**Autonomous vehicle** perception, **cyclist/pedestrian** detection, **shared road** monitoring	Computer vision, Object detection, Deep learning, ML
Blue 🔵	Modeling & Prediction	91	Travel time prediction in **bus systems**, **demand-responsive transit**, emissions modeling	Neural networks, Predictive models, Forecasting
Yellow 🟡	Public Transit & Sustainability	82	Passenger flow modeling, **rail and metro** scheduling, **public transit** optimization	Deep learning, Artificial intelligence, LSTM
Purple 🟣	Infrastructure Monitoring & Detection Systems	77	**Rail safety**, **pedestrian alert systems**, **road infrastructure** evaluation	Cameras, Feature extraction, Detection systems
Light Blue 🔷	Traditional AI Tools & Safety Applications	41	**Crash classification** on **highways**, congestion detection in **urban road networks**	SVM, ANN, Support vector machines, Safety


AI Themes and Transportation Modes in Sustainable Mobility Research
Traditional AI in Safety & Congestion (Highway Monitoring)
SVM, ANN, Safety models
Infrastructure & Safety Detection (Roads, Crosswalks, Rail)
Cameras, Detection systems, Feature extraction
Public Transit Optimization (Passenger Flow, Metro, Rail)
Deep learning, LSTM, AI classification
Predictive Modeling (Bus & Rail Systems)
Neural networks, Predictive models, Forecasting
Vehicle Perception (Autonomous Driving, Pedestrian Detection)
Computer vision, Object detection, Machine learning
Smart Mobility (Traffic Systems, MaaS, Transit Scheduling)
Reinforcement learning, Optimization, Real-time AI sy
0
20
40
60
80
100
120
Total Keyword Occurrences in Cluster

Overlay Visualization



Time Period	Dominant Techniques	Application Focus	Interpretation
2000-2010	SVM, Object Detection, Computer Vision	**Vehicle perception systems**, traffic cameras, imaging	Building "sight" — making **traffic systems and onboard sensors perceive pedestrians, cyclists, and road signs**
2010-2015	ML, ANN, Feature Extraction	**Traffic flow analysis**, road safety, incident detection	Understanding **transportation network patterns** — intersections, congestion zones, and safety risks
2016-2020	Deep Learning, LSTM, Reinforcement Learning	**Public transit optimization**, MaaS, smart traffic control	Acting intelligently — enabling **real-time adjustments** to **bus/rail scheduling**, ride-sharing, and urban mobility

Implications

AI in Transportation Is Becoming More Adaptive and Intelligent

Transit systems now adapt in real time, optimizing routes and managing services like e-scooters based on demand.

Shift from Infrastructure to Intelligence

AI has evolved from perception (detecting events) to decision-making—enabling cities to plan, predict, and respond autonomously.

Urban Systems Can Now Be Coordinated Across Modes

LSTM and predictive models support integrated Mobility-as-a-Service (MaaS) by connecting buses, trains, and shared vehicles.

AI Is Being Aligned with Sustainability Goals

AI applications focus on emissions reduction, energy efficiency, and safety, supporting global sustainability goals.

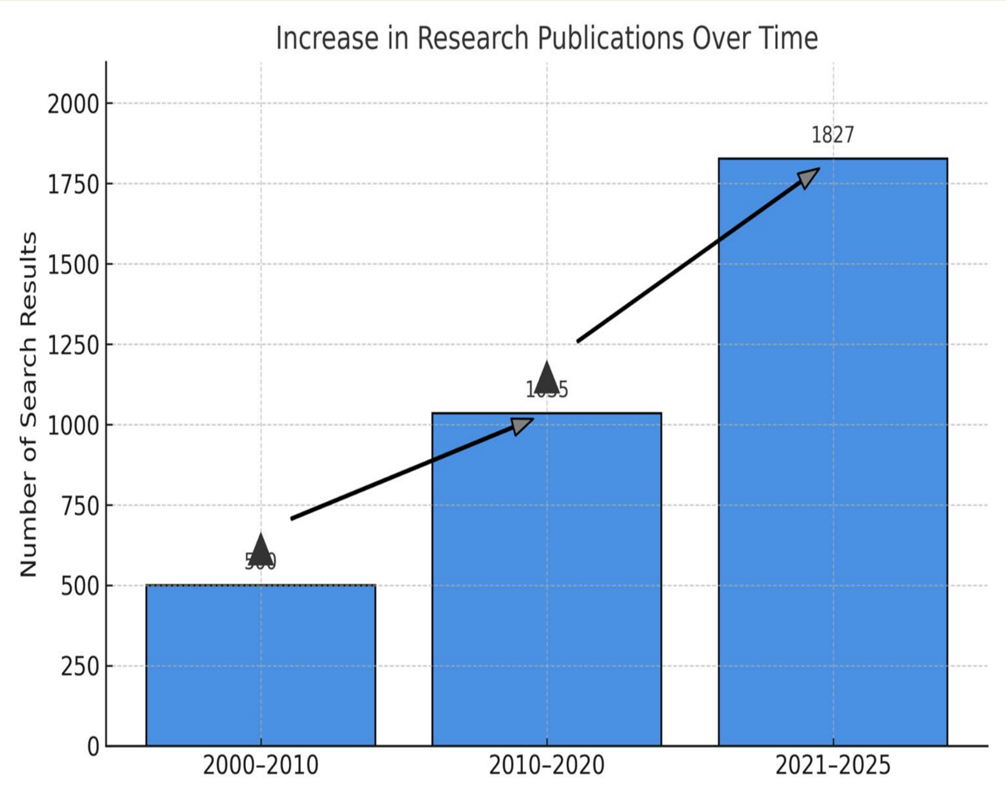
Risk of Unequal Adoption and Legacy Systems

Limited data, funding, and infrastructure may prevent some cities from adopting advanced AI tools, potentially widening transportation inequalities.

Factors to Consider/ Limitations

- Abstract-only screening may overinclude surface-level studies
- Keyword bias could miss relevant papers with different terminology
- Post-2020 trends (e.g., generative AI) are not included
- Bibliometric tools rely on co-occurrence, not context
- Lack of geographic/regional filtering may affect generalizability
- No evaluation of AI model effectiveness or sustainability outcomes

Future Research



*Consider that post 2020 research was not analyzed.

- Evaluate AI’s real-world impact on sustainability outcomes
- Explore emerging AI tools like LLMs and edge AI
- Localize models for diverse geographies and infrastructure
- Prioritize equity, accessibility, and governance in smart mobility
- Encourage interdisciplinary teams (engineering + policy + planning)
- Support deployment, not just theoretical models

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Questions

Thank you!

I would like to give a special thanks to

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Linkedln

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