MIT Mobility Initiative

Annual Report
2023 - 2024

Contents

Letter from the Executive Director's Desk

2023-2024 was a year of growth for the MIT Mobility Initiative (MMI). Conceived and founded by Prof. Jinhua Zhao in 2020, the MMI has grown into a global platform to accelerate a safe, clean and inclusive mobility system through our four pillars: research, education, entrepreneurship and engagement.

In the past year, the MMI team has improved our existing portfolio of activities:
- Expanded our research portfolio to include projects on a wider diversity of mobility topics, such as the equity implications of drone delivery systems led by Prof. Hamsa Balakrishnan
- Strengthened our relationships with an array of multinational corporations ranging from Microsoft to Schneider Electric to Denso
- Organized our third annual MMI Vision Day, our hyper-interactive flagship annual event, hosted by MMI member company Liberty Mutual Insurance
- Hosted the fourth year of our MMI Forum, our Friday on-line seminar open to the public that regularly attracts over 300 participants from around the world
- Taught the fourth year of Mobility Ventures, our graduate-level course at the intersection of entrepreneurship and transportation systems

The MMI team has also added new initiatives:
- Launched our MMI Senior Fellows program and welcomed our first cohort to campus in February to develop their research briefings
- Launched our MMI Visiting Scholars program and hosted a PhD student from Madrid as our first scholar
- Deepened our reputation outside the United States, through MMI-designed panels at the IAA Munich (the largest mobility-focused conference in the world), multiple events in Japan, and meetings with mobility leaders at the World Bank
- Convened over 20 workshops of our Transit Research Consortium, composed of senior executives from seven of the largest public transportation agencies in the United States
- Spoke and contributed to other MIT-organized activities, such as the ILP R&D conference, the ILP-Plastic Omnium Symposium in Paris, the MIT Energy Conference, and the MIT Sustainability Conference

These accomplishments were driven and achieved by the core MMI team (Jinhua Zhao, John Moavenzadeh and Bhuvan Atluri) with the support of faculty and researchers throughout the Institute. The success of the MMI relies on MIT's natural strength in systems thinking, entrepreneurship and our practical mens et manus relationship with industry. The MMI has collaborated with several organizations across the Institute, including ILP, MCSC, MITEI, Quest for Intelligence, Martin Trust Center, and of course DUSP and CEE on transportation education.

Our work matters because mobility matters. Mobility provides access: access to jobs, healthcare, food, childcare, education and the things we need to lead fulfilled lives. The benefits of mobility are tremendous: social cohesion and economic growth. However, the negative externalities are profound and contribute to some of the greatest challenges of our time: climate change, inequality and social justice, road and other mobility-related fatalities and injuries. The MMI contributes toward a collective redesign of a better mobility system for future generations.

Mission and Pillars

Our Mission
The MIT Mobility Initiative (MMI) is a global platform to accelerate a safe, clean and inclusive mobility system through research, education, entrepreneurship and engagement

Research		Catalyze cross-disciplinary research that provides insight to strategic challenges for industry and society
Education		Manage and enhance MIT's transportation degree programs and expand the executive education offering
Entrepreneurship		Leverage MIT's innovation ecosystem to spin off mobility tech startups and support existing startups
Engagement		Foster direct interaction with leaders from business and government on the "front lines" of the mobility revolution

Impact and Relevance of the Climate Project at MIT

The Climate Project at MIT is a bold response to the global threat posed by climate change. The goal is for MIT to become, within the next decade, one of the world's most prolific and collaborative sources of technological, behavioral, and policy solutions for the global climate challenge. The MIT Mobility Initiative seeks to actively support that goal.

Passenger and goods mobility accounts for about 16% of greenhouse gas emissions on a global basis – a significant contributor, but less than industry or buildings. However, the picture changes as we look toward wealthier countries. In the United States, transportation passed electricity generation as the largest source of carbon emission in 2017. As national economies gain wealth, people consume more mobility – particularly more air travel, the fastest growing contributor to climate change – but also package delivery, automotive mobility, and other transportation segments. The climate challenge cannot be overcome without a deep focus on the contribution from mobility.

Electrification is an important component of the solution for automotive mobility. The MMI has led the way with research on the broader system-level challenges of electrification by focusing on challenges such as the poor reliability of the public charging infrastructure or the geopolitical supply of critical minerals for EV batteries. Our research aligns with the MIT Climate Project's goal to not only advance the technology-related challenges but also the behavioral, policy and other dimensions. For example, we have invited leading venture capitalists and investment bankers in the mobility space to answer the question: where will the money come from to finance the electrification of mobility?

Ten Trends in Surface Mobility: 2023

MMI's short presentation on ten key trends in surface mobility reflecting on 2023. The focus is surface mobility and with the exception of trend 1, the trends are inherently US-biased.You can view the video presentation here and download the slides here.

	1. Geopolitical Bifurcation: China Races Ahead in Automotive
	2. Autonomous Backlash: AVs Drive into Headwinds
	3. Automotive Architecture: The Rise of Software Defined Vehicles
	4. Urban Micromobility: Two Steps Forward, One Step Back
	5. Capturing Externalities: Progress Toward Dynamic Pricing
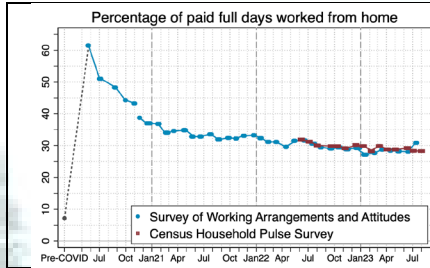
Percentage of paid full days worked from home	**6. Mobility Demand Patterns: Hybrid Is Here to Stay**
	7. EV Hesitation: Charging, Battery Supply, Cost
	8. Rising US Infrastructure Costs: Finding Bang for the Buck
	9. The End of the Froth: Capital Sloshes Out of Mobility Tech
	10. Future of Work: Rethinking the Social Contract

Mobility Vision Day 2023

Launched in 2021, the MMI Vision Day is a hyper interactive full-day invitation only event to showcase MMI research findings and discuss strategic shifts in all aspects of mobility with business and government leaders.

Nov 3, 2023, was the 3rd Vision Day and our largest event ever with more than 130 in-person senior leaders from industry, academia and government. All attendees had been carefully chosen to represent key perspectives and actively engage in an event with a clear purpose: to identify today's most pressing mobility challenges and develop a research agenda that can help move today's mobility system towards a future that is safe, clean, and inclusive. For 2023 we were hosted by our member Liberty Mutual at their headquarters in Boston.

The Mobility Vision Day 2023 was structured around participant discussions interspersed with expert panels. Attendees were encouraged to rotate tables throughout the day to engage with stakeholders from across the spectrum.

This year had the maximum number of Panel Discussions, Special Guest Keynotes, Roundtable Discussions and Research Briefings. Topics ranged from Transport Infrastructure, Mobility Trends of 2023, Public Transportation, China's Pivotal role in the Electrification journey, Electric Vehicle (EV) Battery Technology, Electric Vehicle Charging Infrastructure, Mobility Finance, Autonomous Mobility Safety and Building a Mobility Innovation Ecosystem. The detailed agenda can be seen below.

Ten Key Trends in Surface Mobility for 2023: Implications for Systems
- John Moavenzadeh, Executive Director, MIT Mobility Initiative
- Jinhua Zhao, Founder & Faculty Director, MIT Mobility Initiative

Special Guest Keynote: Rethinking Transportation Infrastructure
- Shailen Bhatt, Administrator, Federal Highway Administration

Rethinking Transport Infrastructure: Cost and Technology
- Chris Atkinson, Deputy Director for Technology, ARPA-I, USDOT
- Laura Chace, President and CEO, ITS America
- Jennifer Duthie, Head of Innovation, Cintra
- Erik Dietz, President & COO, Michelin Mobility Intelligence
- Shailen Bhatt, Administrator, Federal Highway Administration
- *Moderated by Victoria Sheehan, Executive Director, Transportation Research Board*

Future of Public Transportation
- Jonathan Rewers, Chief Strategy Officer, San Francisco MTA
- Marcel Porras, Deputy Chief Innovation Officer, LA Metro
- Jeremy Fine, Chief Financial Officer, Chicago Transit Authority
- Endre Angelvik, Executive Vice President of Radical Innovation, Ruter AS

- Carmen Cham, Global Practice Area Leader Mobility & Transportation, Gensler
- Daniel Ramot, Co-Founder and CEO, Via
- *Moderated by Jim Aloisi, Senior Lecturer, MIT*

Geopolitical Shifts: The Pivotal Role of China in Global Mobility
- Michael Dunne, Founder & CEO, Dunne Insights
- Christina Lampe-Onnerud, Founder & CEO, Cadenza Innovation
- Benjamin Qiu, Partner, Elliott Kwok Levine & Jaroslaw
- *Moderated by John Moavenzadeh, Executive Director, MIT Mobility Initiative*

EV Battery Technology
- Yet-Ming Chiang, Professor of Materials Science and Engineering, MIT
- Christina Lampe-Onnerud, Founder & CEO, Cadenza Innovation
- Mujeeb Ijaz, Founder & CEO, Our Next Energy (ONE)
- *Moderated by Martin Bazant, Professor of Chemical Engineering & Mathematics, MIT*

Electrification Infrastructure
- Alex Gruzen, CEO, WiTricity
- Kameale Terry, Founder and CEO, ChargerHelp!
- Katie Rowen, SVP, Chief Legal and Sustainability Officer, Vontier
-
- Tiya Gordon, Co-Founder and COO, itselectric
- Khaled Fakhuri, Senior Vice President, Schneider Electric
- Sejal Shah, Senior Advisor, USDOT Joint Office of Energy and Transportation
- *Moderated by Charlie Fine, Professor of Operations Management and Engineering Systems, MIT*

After the SPACs: What's Next for Mobility Finance?
- Bryce Kim, Head of Investment, Hyundai CRADLE SV
- Chris Thomas, Founder & Partner, Assembly Ventures
- Daniel Keh, Senior Managing Director, Mobility Investment Banking, Guggenheim Partners
- Saurabh Jain, Investment Director, Volvo Cars Tech Fund
- *Moderated by Laura Fox, Co-Founder and Managing Partner, Streetlife Ventures*

Moving Forward with Automated Vehicles

- Nick Grant, Liberty Mutual Mobility Solution Co-Lead, Liberty Mutual
- Raquel Urtasun, Founder and CEO, Waabi
- David Zipper, Visiting Fellow, Harvard Kennedy School
- Mark Rosekind, Administrator, National Highway Traffic Safety Administration, 2014-2016; Chief Safety Innovation Officer, Zoox, 2017-2022
- Chris Thomas, Founder & Partner, Assembly Venture
- *Moderated by Jinhua Zhao, Founder & Faculty Director, MIT Mobility Initiative*

Mobility Forum - Fall 2023 and Spring 2024

The MIT Mobility Forum hosted by Prof. Jinhua Zhao showcases transportation research, trends and mobility innovations across the globe. The Forum is hosted on Fridays between 12 - 1PM ET during the fall and spring terms, is fully online and open to the public. Audience Participation has grown over the years and the last 2 editions saw an average of 250 attendees join each session. Speakers present for the first half of the forum, followed by a moderated audience Q&A. The subscription to the MIT Mobility Initiative mailing list has organically grown to over 14,000. All the sessions are recorded, and the recordings and slides are uploaded and available at https://www.mmi.mit.edu/forum for the benefit of the community.

Fall 2023	Topics
Engineering Ecosystems with AI Sandy Pentland Professor of Media Arts and Sciences; Toshiba Professor; Media Lab Entrepreneurship Program Director	Machine Learning; Society & Equity
Funding US Transportation needs in an electric, post-gas tax world Jim Aloisi and Bhuvan Atluri Lecturer of Transportation Policy and Planning & Associate Director of Research, MMI	Policy; Decarbonization
Demand-Responsive Microtransit: Design and Operations Alexandre Jacquillat Associate Professor, Operations Research and Statistics, MIT Sloan	Control & Optimization

	MIT Mobility Initiative: Three Years On Jinhua Zhao & John Moavenzadeh Founder & Faculty Director - MMI and Executive Director - MMI	Community; Society & Equity
	Women Leaders in Transportation: Mobility Forum Sub-Series Co-Hosted by Prof. Jinhua Zhao and Hyun-A Park Laura Chace, Hyun-A Park, Victoria Sheehan and Polly Trottenberg President & CEO - ITS America, President - Spy Pond Partner & MIT Corporation Member, TRB Executive Director, US DOT Deputy Secretary	Society & Equity; Community
	Learning with Certificate Functions for Automotive Systems Chuchu Fan Wilson Assistant Professor of Aeronautics and Astronautics and PI of LIDS, MIT	Control & Optimization; Automation
	Cities, Mobility & Complexity in a Post-Pandemic World Eric Miller Professor, Department of Civil and Mineral Engineering, University of Toronto. Director, University of Toronto Transportation Research Institute	Cities & Pedestrians; Society & Equity

	## Geopolitical Shifts: The Pivotal Role of China in Global Mobility Michael Dunne, Christina Lampe-Onnerud, Benjamin Qiu Founder & CEO at Dunne Insights Founder & CEO at Cadenza Innovation ,Partner, Elliott Kwok Levine & Jaroslaw	Policy; Decarbonization
	## Fuel Cell Powered Vehicles – Opportunities and Challenges Harry Tuller Professor of Materials Science and Engineering	Decarbonization ; Policy
	## Pedal, Power, and Tensions: A Panel Discussion on Micromobility and Cities Jascha Franklin-Hodge, Mike Frumin, Dave Montague, Tony Ho Chief of Streets for City of Boston, Director of Product & Data Science at Lyft Transit/Bikes/Scooters, CEO at Metromobility, VP of Robotics & Business Development at Segway	Cities & Pedestrians; Policy
	## Dan and Eva Roos Best Dissertation Award and Presentations Baichuan Mo, Rounaq Basu & Karthik Gopalakrishnan	Community

		Investment & Finance
	Wheel and Deals: Institutional Investment in Mobility - Mobility Forum Sub-series Jeff Shen and Meghan Sharp Co-CIO of Active Equity and Co-Head of Systematic Active Equity, BlackRock & Global Head of Decarbonization Partners, BlackRock	

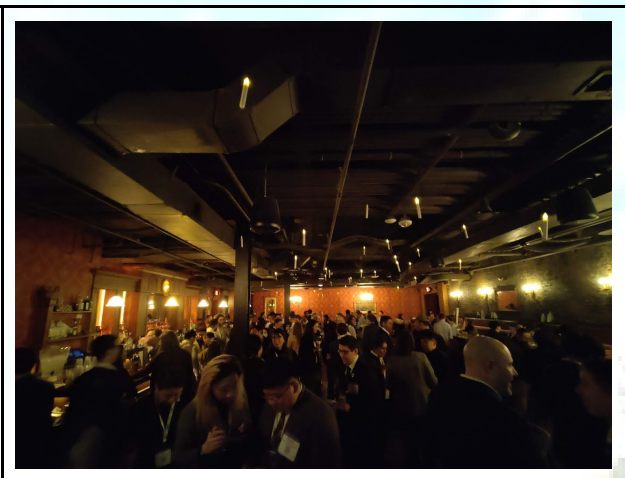| **Spring 2024**		**Topics**
	Car-sharing – Has it finally come of age? Alexandra Lougovoy, Anand Nandakumar, Andrés Ruiz, Justin Holmes CMO at Vulog, Founder & CEO at Halo.car, Executive Vice Chairman at Minits, Head of Marketing & Public Policy at Zipcar	Behavior; Society & Equity; Shared Mobility
	Retraining for the EV era Kianna Scott, Rajeev YSR, Sunil Nair SVP of Learning & Development at ChargerHelp!, Founder & CEO at EV Masterclass, VP of Zero Emissions & Fleet Technologies at New York MTA	Community, Future of Work; Decarbonization
	Fiscal Cliff of Public Transit Jeremy Fine, Jim Aloisi and Fred Salvucci Chief Financial Officer at Chicago Transit Authority, Lecturer of Transportation Policy and Planning at MIT, Senior Lecturer and Senior Research Associate at MIT	Public Transport; Future of Work

	The Many Costs of Sprawl Reid Ewing Distinguished Professor of City and Metropolitan Planning, The University of Utah	Cities & Pedestrians; Community; Society & Equity
	Risk within the Materials Supply Chain for Transportation Elsa A. Olivetti Associate Dean of Engineering, Jerry McAfee (1940) Professor in Engineering, Professor of Materials Science and Engineering, MIT	Supply Chain; Safety, Security & Resilience
	Perspectives on Highway Safety: Contemporary issues and the forthcoming age of autonomous vehicles Fred Mannering Executive Director, Center for Urban Transportation Research & Professor, Department of Civil and Environmental Engineering at the University of South Florida	Automation; Safety, Security & Resilience
	Co-Design of Complex Systems: From Autonomy to Future Mobility Gioele Zardini Incoming Assistant Professor, Department of Civil and Environmental Engineering, MIT. Postdoctoral Scholar, Department of Aeronautics and Astronautics, Stanford University	Automation; Control & Optimization

	Changing driver behavior to improve road safety Samuel Madden MIT College of Computing Distinguished Professor of Computing	Behavior; Safety, Security & Resilience
	The Insidious Problem of Selection Biases: How to Recognize Them, and What to do about Them Patricia L. Mokhtarian Clifford & William Greene, Jr. Professor, School of Civil and Environmental Engineering, Georgia Institute of Technology	Behavior; Community
	The Evolution of Urban Transportation Policy at the Federal Level Polly Trottenberg Deputy Secretary at the US Department of Transportation (USDOT)	Policy; Community
	Transit Tech: Payment and Benefits Innovation Ruth Miller, Avi Shavit, Lilly Shoup, Anson Stewart Senior Product Manager at Jawnt, Senior Director at the Office of Innovation at LA Metro, Managing Director at Rebel, Research Scientist/Deputy Director, MIT Transit Lab	Public Transport; Society & Equity

	## Rethinking AV Development with Foundation Models Marco Pavone Associate Professor, Aeronautics and Astronautics, Stanford University. Director, Autonomous Systems Laboratory and the Center for Automotive Research at Stanford	Automation; Control & Optimization
	## Autonomous Vehicles: How Safety Paves the Road to Success Nat Beuse Chief Safety Officer, Aurora	Automation; Safety, Security & Resilience
	## The Evolving Role of Venture Capital in Mobility: A Fireside Chat with Reilly Brennan Reilly Brennan Partner, Trucks Venture Capital	Investment & Finance; Community

Other Events

Aug 2023 MMI Members Meeting	Our Summer 2023 hybrid MMI Members Meeting was held on August 30th with 30 participants. The agenda can be seen here and the participant list can be found here.
Sep 2023 MMI & MIT Club of Boston Event on Public Transportation with over 50 participants, held at The Engine.	
Nov 2023 ILP Mobility Showcase. Jinhua Zhao and Bhuvan Atluri from the MMI presented the current challenges in mobility to an engaging audience at the ILP Research & Development Conference.	
Nov 2023 MMI Members Meeting	Our Winter 2023 in-person MMI Members Meeting was held on Nov 2nd with 30 participants. The agenda can be seen here and the participant list can be found here.
Nov 2023 Advisory Board Meeting	Our 2nd meeting for 2023 of the MMI Advisory Board was held on November 9th, 2023, with participation from 6 out of the 8 board members.

Jan 2024 MMI Transportation Research Board (TRB) Reception at Washington DC. An annual MMI tradition, the Jan 2024 reception during the TRB conference saw over 250 attendees.	
May 2024 MMI Members Meeting	Our Summer 2024 in-person MMI Members Meeting was held on May 2nd with 39 participants. The agenda can be seen here and the participant list can be found here.
May 2024 Advisory Board Meeting	Our 1st meeting for 2024 of the MMI Advisory Board was held on May 31st, 2024, with participation from all 8 board members.
May 2024 NHTSA (National Highway Traffic Safety Administration) Seminar Series 	MMI in participation with other MIT faculty conducted 3 seminars on current mobility & transportation topics for NHTSA staff in May 2024. Over 50 attendees were present at each of the virtual sessions. The seminars were well received and will be held again for different topics in the second half of 2024. The 3 sessions in May were 1. May 15 2024 – 10 to 11 AM ET – AI in Transportation – Prof. Jinhua Zhao 2. May 21 2024 – 10 to 11 AM ET – Pedestrian Mobility Safety Impact Assessment – Prof. Andres Sevtstuk 3. May 22 2024 – 10 to 11 AM ET – EV Batteries and Supply Chain – Prof. Elsa Olivetti

Mobility Ventures Fall 2023

Launched in Fall 2020 by the MMI this course is designed for students who aspire to shape the future of mobility. This graduate level course offering at MIT explores technological, behavioral, policy and systems-wide frameworks for innovation in transportation systems, complemented with case studies across the mobility spectrum, from autonomous vehicles to urban air mobility to last-mile sidewalk robots.

Students interact with a series of guest lecturers from CEOs and other business and government executives who are actively reshaping the future of mobility. Interdisciplinary teams of students collaborate to deliver business plans for proposed mobility-focused startups with an emphasis on primary market research. The course has steadily grown in popularity and class size for Fall 2023 consisted of 26 Students from MIT Sloan, DUSP, MIT Engineering, Harvard Kennedy School & Harvard GSD.
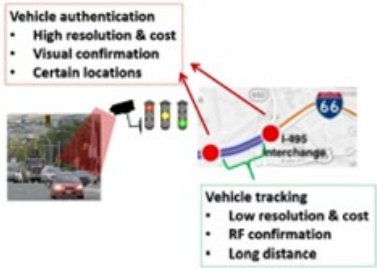
Guest Speakers over the years include:
Dean Kamen, Founder & CEO, DEKA Research
R.J Scaringe, CEO, Rivian Automotive
Karl Iagnemma, President & CEO, Motional
Kameale C. Terry, Co-Founder & CEO, ChargerHelp!
John De Souza, co-Founder & President, Ample Inc.
Tiffany Chu, Chief of Staff, City of Boston
Tiya Gordon, Co-Founder & COO, itselectric
Billy Thalheimer, Co-Founder & CEO, Regent Craft
Mujeeb Ijaz, Founder & CEO, Our Next Energy (ONE)**Kyle Vogt,** Co-Founder & CEO, Cruise
Alex Wallar, Co-Founder & CTO, The Routing Company
Kei Onishi, CEO & MD, Yamaha Motor Ventures
Libby Wayman, Partner, Breakthrough Energy Ventures
Chetan Maini, Founder & CEO, Sun Mobility
Jody Kelman, Head of Autonomous, Lyft
Reilly Brennan, Founder & Partner, Trucks Venture Capital

MMI Research Projects

New Projects Launched and their Core Research Questions

	Autonomous Mobility Computing Energy Sertac Karaman Vivienne Sze	1. How much energy would be required to power the compute of autonomous vehicles in the future? 2. How fast is the efficiency of computing increasing, versus the computing requirements for AVs? 3. What is the optimal distribution of AV computing among vehicle, edge, and cloud?
	EV Charging Urban Optimization Alex Jacquillat Daniel Freund	1. Where to locate public electric vehicle chargers in an urban setting? 2. How many and what type (power) of chargers should be used in which locations? 3. How to optimize charging infrastructure for access, utilization, equity, etc.?
	Carbon Footprint of Commuting vs WFH vs W3P Bhuvan Atluri Gensler	1. What are the current trends in work location (both day of week and longer term) in the US? 2. What is the CO_2 impact of working from home versus working at the office? 3. What are possible levers or policies to minimize growth in CO_2 emissions driven by work location options?

	Hi-Lo Resolution in Transportation Sensing Sanjay Sarma Dajiang Suo Stephen Ho	1. How can we optimally deploy high- and low-resolution sensors to achieve a balance between enhancing transportation security and reducing congestion via improved traffic management at a low cost? 2. What are the trade-offs between cost, security and detection performance when employing these sensors for tasks such as vehicle authentication, identification, object tracking in traffic monitoring?
	Enabling Equitable Access to AAM Service Hamsa Balakrishnan	1. How do we ensure that certain communities are not disproportionately impacted by the adverse effects of Advanced Aerial Mobility (AAM) operations and also ensure equitable access to the benefits of AAM services? 2. How do we ensure equitable airspace access to a range of fleet operators who might vary in scale of operations, business models, and missions?
	Road Data Convergence: Building Platform Efficiencies Jinhua Zhao Jim Aloisi Andre Ferreira Schweizer	1. What business models will enable multiple stakeholders in road usage to collaborate on the collection and use of road usage data while safeguarding privacy concerns? 2. What are the models for road pricing, coherent frameworks and how receptive are drivers to these?

MMI Automotive Strategy & Technology Consortium (MAST)

Background: The automotive industry is undergoing a transformative shift with the increasing focus on electrification and the growing significance of software in vehicles. As the industry evolves, Tier-1 suppliers in particular, responsible for providing critical components and systems to automakers, face unprecedented challenges and opportunities. Tier-1 suppliers and OEMs urgently need to understand how these challenges and opportunities can and should be addressed over the next decade.

The mission of the MIT Mobility Initiative (MMI) Automotive Strategy & Technology Consortium (MAST Consortium) is to provide a resource for strategy and technology executives at automotive-related companies (OEMs, Tier-1s, related ecosystem) to explore future scenarios and technology trajectories of the global automotive industry, particularly related to software-defined vehicles, autonomous and ADAS mobility, electrification and new energy vehicles, and new form factor vehicles and their associated infrastructure systems.

The MAST Consortium will bring together automotive stakeholders and facilitate knowledge and insight sharing among them. Members will greatly benefit from sharing their views and listening to external viewpoints in a confidential setting. The presentations, while facilitated and driven by MMI, will also include many sessions delivered by Tier-1s, innovative startups, policymakers and automotive OEMs.

MMI announced the consortium in March 2024, with the first session scheduled for Fall 2024. Automotive manufacturers and Tier 1- suppliers - both existing and new members - will be part of the inaugural session. The MMI will convene members of the MAST Consortium community four times per year, a combination of virtual and in-person, to exchange best practices and to offer insights on targeted subjects as selected by all participants. Presenters will include a mix of MIT/MMI faculty and researchers and executives/researchers from participating companies.

MIT researchers will deliver short, direct insight briefings on an array of topics selected to advance strategic cross-company objectives. Topics will be selected by Consortium members and MMI. Employing a mixed-methods approach, utilizing surveys, interviews, and case studies to gather insights from Tier-1 suppliers, industry experts, and key stakeholders. Data will be from secondary research for insight briefings while primary data will be generated for primary research projects. Participation in the form of data sharing, insights, sharing of tools, pilot implementation from MMI Tier-1 Consortium members is highly encouraged.

Closed Projects and their Key Findings

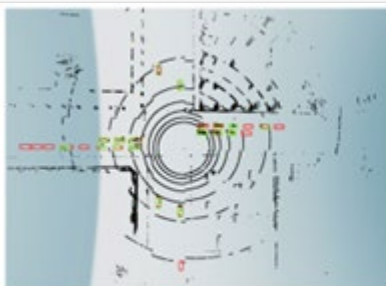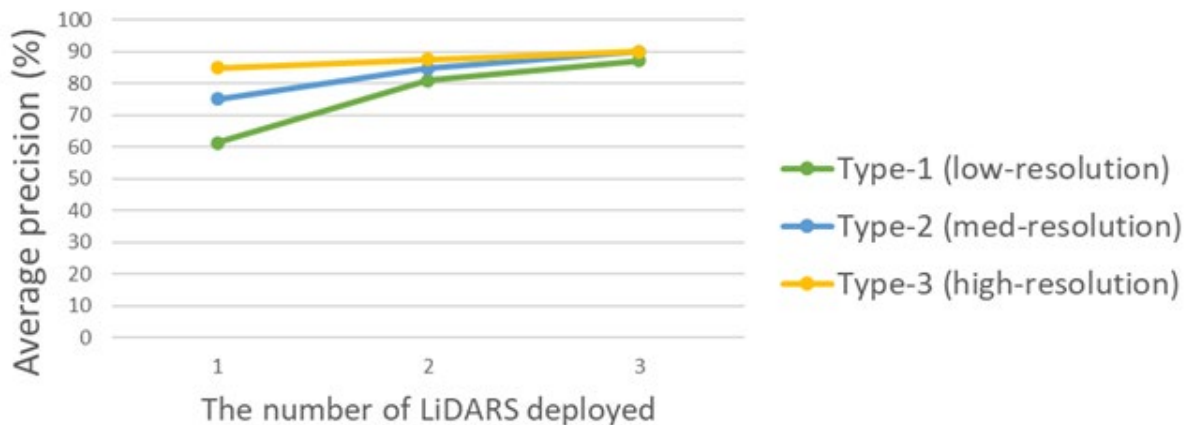| **Collective Sensing as an Enabler for Cyber-resilient Connected Mobility**
Sanjay Sarma
Dajiang Suo

Final Report
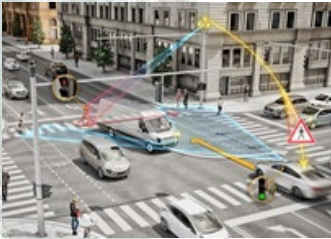
 | 1. Redundancies in low-resolution sensors result in higher performance improvement than high-resolution ones.

2. Multifactor identification systems, such as vehicle flashing headlight patterns or vehicle QR codes read by infrastructure-based sensors, offer a robust strategy against cyber hacking

3. The effectiveness of infrastructure-assisted security mitigations also depends on vehicle movement and geometric design of roads. |

The performance improvement by adding LiDARs

- Type-1 (low-resolution)
- Type-2 (med-resolution)
- Type-3 (high-resolution)

Average precision (%) vs. The number of LiDARS deployed
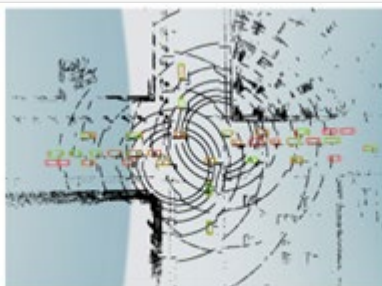
(a) The number of LiDARs=1   (b) The number of LiDARs=2   (c) The number of LiDARs=4

Replacing Declining Gas Tax Revenue with EV Adoption

Jim Aloisi
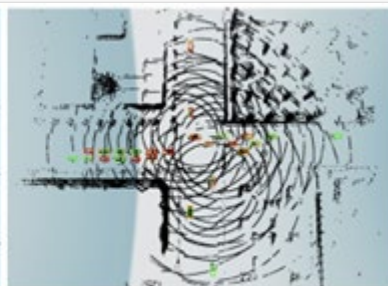Jinhua Zhao
Bhuvan Atluri
Yunhan Zheng
Seamus Joyce-Johnson

Final Report

1. EVs shift the externalities calculation: CO_2 decreases, but road wear and safety impacts due to extra weight may increase.

2. The decline of the gas tax has shown the danger of relying heavily on a single revenue source; a more resilient transportation funding system must draw from multiple sources to account for future technology and policy shifts.

3. A promising variety of proven revenue sources are available to policy makers looking to replace this tax.

	Ease of administration	Potential for evasion	Stability over time	Fairness
Gas tax	Easy	Low	Low	Medium
Flat fees	Easy	Low	High	Low
Parking pricing	Easy	Medium	Medium	Medium
VMT charge	Medium	Medium	High	High
Road pricing	Medium	Low	Medium	Medium
Charging tax	Hard	High	High	Medium

Gas Tax : $ Billions
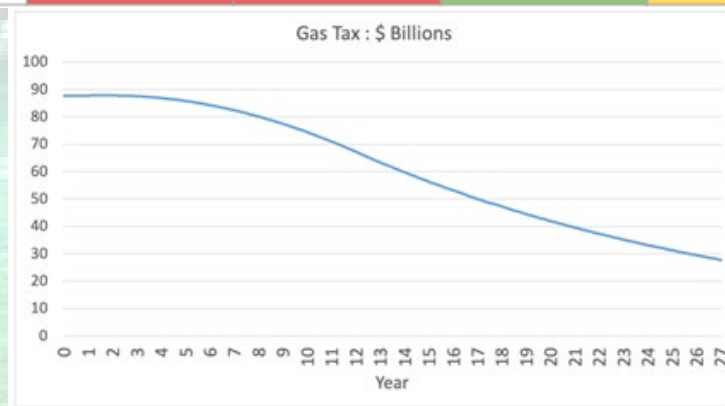
Safety as a Performance Metric in Autonomous Mobility

Cathy Wu
Ao Qu
Final Report

Surrogate Safety Measure

1. This investigation exposes several challenging limitations regarding open-access data, notably limited access to detailed driving data, potentially resulting in a disparity between actual and simulated driver behavior.

2. Using naturalistic driving data, with precise vehicle trajectories can help solve this.

Relative Error by County
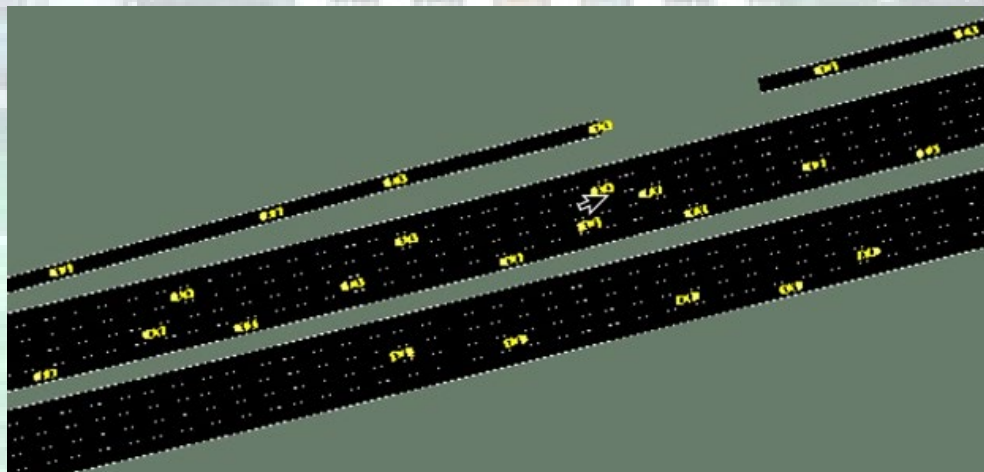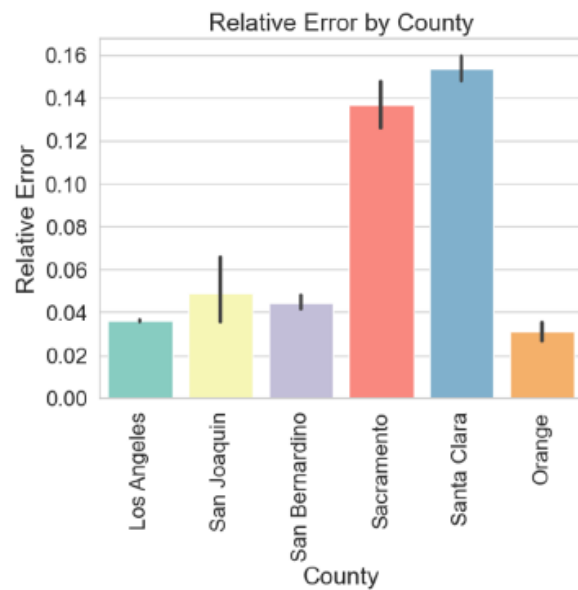
Simulation of the Reconstructed Traffic

MMI Transit Research Consortium (TRC) - The Impact of Remote Work on Travel

Nick Caros

Final Report

1. Approximately one third of all remote work hours are now taking place outside of the home, at public spaces (e.g. cafés, libraries), coworking spaces and friend and family members' homes (FFH).

2. Employer's business premises (EBP) account for just 44% of worked hours and about half of all commuting trips.

3. Commutes to "third places" (non-work, non-home locations) are shorter, less likely to occur during peak periods, and more likely to use sustainable travel modes than commutes to an employer's primary workplace

TRC Members - New York, Chicago, San Francisco, Seattle, Los Angeles, Washington DC and Boston
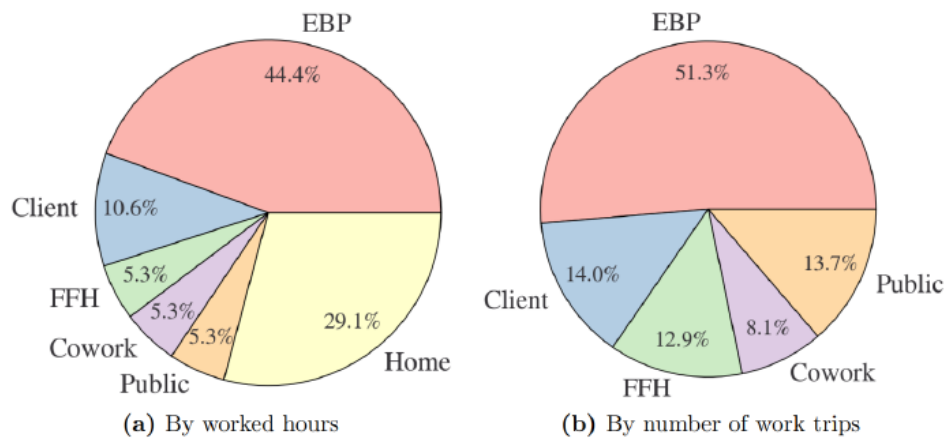
(a): Nov 2021 - Jun 2022, N = 27,364; (b): Nov 2022 - Jan 2023, N = 13,091.

(a) By worked hours

(b) By number of work trips

(b) Commute mode (excluding driving)
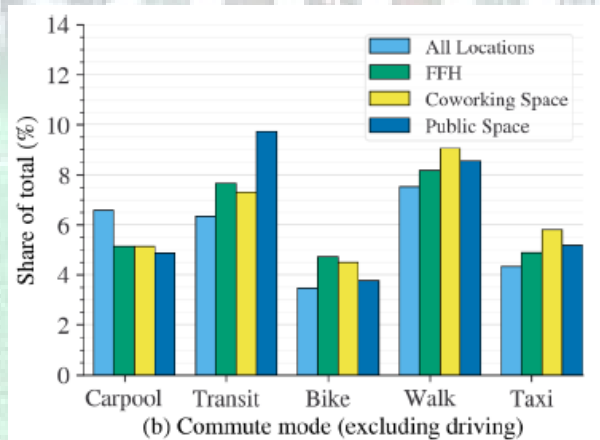
TRC Workshop 2023-24

| Workshop Topic	Date
Optimizing Bus Service Delivery in The Age of Workforce Delivery Challenges	20th Mar 2023
MMI Members Meeting - TRC Workshop on Implications of Remote Work for Public Transit Agencies	27th Apr 2023
Overnight Track Maintenance - Optimization Workshop	8th May 2023
CFO-Level Transit Research Consortium Meeting	26th May 2023
Emerging Travel Patterns of Remote Workers	12th Jun 2023
Brainstorming Workshop With SFMTA	13th Jun 2023
Zero Emission Brainstorming Workshop with King County Metro	21st Jun 2023
Gensler - Public Transit Experience and Global Survey Presentation	12th Jul 2023
CFO-Level Transit Research Consortium Meeting	14th Jul 2023
E-Bus Workshop	16th Oct 2023
CFO-Level Transit Research Consortium Meeting	17th Oct 2023
Headway Management App Pilot Presentation	29th Jan 2024
CFO-Level Transit Research Consortium Meeting	2nd Feb 2023
Ruter (Oslo) E-Bus Presentation	4th Mar 2024
NY MTA Fare Evasion - MIT Workshop	26th Mar 2024
Humatics Workshop - Innovations in Transit	29th Apr 2024
Rider Sentiment: MIT Research Presentation	17th Jun 2024

MMI Community

MMI Senior Fellows

The MIT Mobility Initiative announced its inaugural cohort of MMI Senior Fellows for 2024. The MMI Senior Fellows program enables a select group of accomplished individuals with unique insights and professional experience to:

1.) Engage with and contribute to the Mobility Initiative and the broader MIT community during the course of this year

2.) Produce a research briefing that addresses a timely and important research question aligned with our mission to accelerate safe, clean, and inclusive mobility.

Laura Fox

Laura speaks on mobility, city, and climate topics globally, and is on 'Transportation Power 100' and 'Top Women in Mobility' lists. She is the Co-Founder and Managing Partner of Streetlife Ventures, a seed-stage venture fund investing in urban climate solutions to transform sectors including mobility, buildings, energy, waste, and water.

Previously, Laura was the General Manager of Citi Bike at Lyft and built it into a $100M ARR business and one of the country's largest transportation systems, led diligence on urban climate tech companies at Sidewalk Labs, launched new mobility products with Boston Consulting Group's digital ventures team, and advised Bloomberg Philanthropies on their urban investment strategy.

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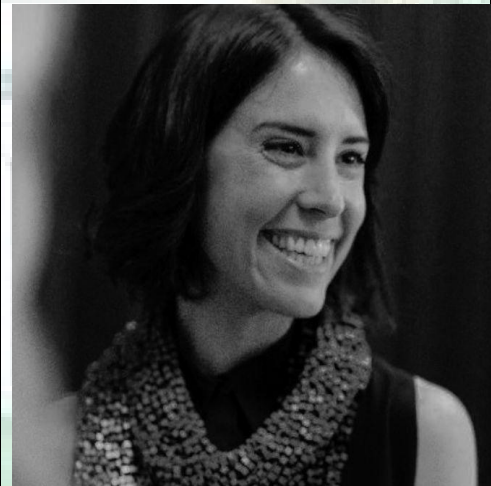
Alex Mitchell

Alex Mitchell is a seasoned investor at the intersection of cleantech and mobility. He currently serves as a Senior Advisor at Los Angeles Cleantech Incubator and authors the Su$tainable Mobility newsletter. While Alex was SVP at Los Angeles Cleantech Incubator (LACI) he oversaw startup recruiting, incubation programs and was responsible for venture capital investments. Alex raised and deployed the LACI Cleantech Debt Fund, a first-of-its kind lending solution for cleantech startups that was the subject of a Stanford GSB case study.

Previously, Alex worked at Peugeot (now Stellantis) as the VP of Corporate Strategy, where he focused on vehicle autonomy and electrification. His previous work experience includes McKinsey, Toyota, and the World Economic Forum (WEF). Alex holds a BA from Stanford University and an MBA from The Wharton School. A lifelong car enthusiast, Alex is one of the rare but growing number of Los Angeles residents who are car free by choice.

Mary Skelton Roberts

Mary Skelton Roberts is a board member at the Massachusetts Bay Transportation Authority (MBTA) and brings extensive experience with transportation policy to advance climate solutions and foster thriving communities. She is currently Chief Executive Officer at Philanthropy Massachusetts. Skelton Roberts previously served as Senior Vice President at the Energy Foundation where she oversaw the strategic implementation of a $140 million grant making budgets aimed at reducing carbon emissions throughout the United States.

Prior to that, she spent over a decade as Co-director of Climate at the Barr Foundation, based in Boston, where she developed strategies focused on transportation, climate resilience, and land-use, all critical levers for reducing emissions and protecting

those most vulnerable to the impacts of climate change. Mary earned her B.A. from the University of Southern California, and her master's degree from Massachusetts Institute of Technology. She holds mediation and facilitation accreditations from Harvard Law School's Program on Negotiation and from the Center for Dispute Resolution in London, England. She is a native Spanish speaker with roots in Cuba.

David Zipper

David Zipper examines the interplay between transportation policy, technology, and society. A Contributing Writer at Vox & Bloomberg CityLab, David's writing has been published in outlets including The Washington Post, The Atlantic, Slate, and Vox. His articles focus on topics including road safety, climate change, the uses of transportation data, and the future of American public transit.

David was previously the Managing Director for Smart Cities and Mobility at 1776, a global entrepreneurial hub with over 1,300 member startups. Earlier in his career he served as the Director of Business Development and Strategy under two mayors in Washington DC, where he led support for the region's first startup incubators and guided the city's response to the emergence of ride hail. Before moving to Washington, David served as Executive Director of NYC Business Solutions in New York City under Mayor Bloomberg.

David holds an MBA with Highest Honors from Harvard Business School, an M. Phil in Land Economy (Urban Planning) from Cambridge University, and a BA with High Honors from Swarthmore College. He has been selected as a Truman Scholar, a Gates Scholar, and a Baker Scholar.

MMI Visiting Students

MMI launched a formal program for hosting Visiting PhD students from across the world for a term at MIT. All visiting students are provided with an MIT ID, and work with the MMI directors, MIT Transit Lab faculty & students and others across MIT on projects that contribute to MMI's mission of creating a safe, clean and inclusive transportation system.

For Fall 2023 we hosted Tulio Silveria Santos a PhD Researcher from the Transport Research Center (TRANSyT) at Universidad Politécnica de Madrid.

Tulio Silveira-Santos is a Ph.D. researcher at the Universidad Politécnica de Madrid (UPM) in Spain, specializing in Transportation Engineering. His research interests include Transportation Systems, Transportation Modeling and Planning, Transportation Systems Simulation, GIS, and Data Science. His Ph.D. thesis focuses on applying Data Science and Machine Learning in Transportation Engineering, specifically using machine learning models to analyze data and make predictions that can inform the decision-making processes of organizations, stakeholders, and policymakers. His research is particularly focused on promoting the effective and sustainable use of active modes and shared mobility services. During his time at MMI he contributed significantly to the Carbon Impact of Commuting project helping with commute trip data, modes, length, for 9 cities across the U.S.

Governing Board

Anantha P. Chandrakasan, Dean of the MIT School of Engineering	
Cynthia Barnhart, Provost, MIT	
Dan Huttenlocher, Dean of the MIT Schwarzman College of Computing	
David Schmittlein, Dean of the MIT Sloan School of Management	

Hashim Sarkis, **Deaon the MIT School of Architecture and Planning**	
Sanjay Sarma, **Professor of Mechanical Engineering, MIT**	

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Michigan Central

Karl Iagnemma,
President & Chief Executive Officer,
Motional

Mary Chan,
Managing Partner,
VectoIQ

Executive Team

Founder & Faculty Director - Prof. Jinhua Zhao	
Executive Director - John Moavenzadeh	
Associate Director of Research - Bhuvan Atluri	

Faculty Members

Jim Aloisi
Lecturer of Transportation Policy and Planning

Research Interests:
Urban Transportation, Equity, Public Realm Design, Public Transportation Funding and Service Delivery

Saurabh Amin
Robert N. Noyce Career Development Associate Professor

Research Interests:
Control of Infrastructure Networks, Security of Cyber-Physical Systems, Applied Game Theory and Information Economics

John Attanucci
Lecturer, Research Associate and Manager of the MIT Transit Research Program

Research Interests:
Transportation Planning, Transit Management and Operations, Transit Information and Decision Support Systems

Dimitris Bertsimas
Professor of Management and Operations Research, Associate Dean of Business Analytics

Research Interests:
Optimization, Stochastic Systems, Machine Learning, Robust Optimization, Transportation and Finance

Eran Ben-Joseph
Professor of Landscape Architecture and Urban Planning

Research Interests:
Environmental Planning and Management, Healthy Communities and Active Living, Transportation and Mobility, Urban Design

Hamsa Balakrishnan
Professor of Aeronautics and Astronautics

Research Interests:
Design, Analysis, and Implementation of Control and Optimization Algorithms for Large-Scale Cyber-Physical Infrastructures

Hari Balakrishnan
Fujitsu Chair Professor in the EECS Department

Research Interests:
Networking, Data Management, Sensing, Mobile and Sensor Computing, Wireless Networks, Overlay and P2P Networks

Steven Barrett
Director, Laboratory for Aviation and the Environment

Research Interests:
Climate Impacts of Aviation, Aircraft Emissions, Biofuels, Electric Aircraft Design, Low Emission and Noise Aircraft Propulsion

Moshe Ben-Akiva
Edmund K. Turner Professor in Civil Engineering

Research Interests:
Transportation Systems Analysis, Intelligent Transportation Systems, Demand Modeling, Econometrics

George Barbastathis
Professor of Mechanical Engineering

Research Interests:
Information Optics, Digital Holography, Subwavelength Optical Engineering

Cynthia Barnhart
Provost, MIT

Research Interests:
Large-scale optimization, Airlines operations, Transportation operations, planning, and control

Chris Caplice
Executive Director, MIT Center for Transportation & Logistics

Research Interests:
Freight Transportation, Supply Chain

Joseph F. Coughlin

Director, MIT AgeLab

Research Interests:
Consumer Behavior, Behavioral Science, Global Demographics

Luca Carlone

Leonardo Career Development Associate Professor, Department of Aeronautics and Astronautics

Research Interests:
Robotics, Autonomous Vehicles, Perception and Vision

Olivier de Weck

Professor of Aeronautics and Astronautics and Engineering Systems

Research Interests:
Aerospace Systems, Engineering Systems, Technology Development, Multidisciplinary Design Optimization

Fábio Duarte

Principal Research Scientist and Lecturer of Transportation Policy and Planning

Research Interests:
Urban Technologies, Transportation and Planning, Social Construction of Technologies

Daniel Freund

Assistant Professor of Operations Management

Research Interests:
Analytics, Combinatorial Optimization, Management Science, Operations Management, Sharing Economy

Robert Freund

Theresa Seley Professor in Management Science at the Sloan School of Management at MIT

Research Interests:
Continuous Optimization, Computational Complexity, Convexity, Computational Science, Mathematical Systems

Charlie Fine

Chrysler Leaders for Global Operations Professor of Management

Research Interests:
Operations Strategy, Supply Chain Management, Value Chain Roadmapping, Outsourcing Dynamics

Joseph Ferreira

Professor of Urban Studies & Planning

Research Interests:
Transportation and Mobility, Urban Information, Technology, and Media and Analytics

Jarrod Goentzel

Director, MIT Humanitarian Supply Chain Lab and Principal Research Scientist, MIT Center for Transportation & Logistics

Research Interests:
Supply Chain Management, Operations Management, Distribution Network Design, Emergency Management, International Development, Public Policy

Stephen Graves

Abraham J. Siegel Professor of Management and Professor of Operations Management

Research Interests:
Design and Planning of Manufacturing Systems and Supply Chains, Supply-Chain Optimization

Bill Green

Hoyt C. Hottel Professor in Chemical Engineering

Research Interests:
Fuel Chemistry, Evaluation of Alternative Fuels & Engines

Song Han

Assistant Professor at MIT's EECS

Research Interests:
TinyML, enable deep learning on mobile devices, efficient algorithms and hardware for computation-intensive AI applications

Patrick Jaillet

Dugald C. Jackson Professor in EECS, Co-Director of the Operations Research Center

Research Interests:
Online Optimization and Learning, Machine Learning, Decision Making Under Uncertainty

Ali Jadbabaie

JR East Professor of Engineering

Research Interests:
Network Science, Decision Theory, Cooperative Control Of Multi-Agent Systems, Optimal Control, Motion Coordination

Alexandre Jacquillat

Assistant Professor, Operations Research and Statistics

Research Interests:
Stochastic optimization, data-driven decision-making, analytics, vehicle routing, transportation scheduling

Jason Jackson

Ford Career Development Assistant Professor of Political Economy

Research Interests:
Community Development, Economic Development, Law and Policy, Machine Learning, Transportation and Mobility

Chris Knittel

George P. Shultz Professor of Applied Economics

Research Interests:
Economics, Finance and Accounting

Sertac Karaman

Associate Professor of Aeronautics and Astronautics

Research Interests:
Robotics, Autonomous Vehicles, Foundations of Mobility

John Leonard

Samuel C. Collins Professor of Mechanical and Ocean Engineering

Research Interests:
AI & Machine Learning, Graphics & Vision, Robotics, Big Data and Transportation

Kent Larson

Principal Research Scientist

Research Interests:
Advanced Simulation and Augmented Reality for Urban Design, Mobility-on-Demand Systems

Thomas Magnanti

Institute Professor & Professor of Operations Research

Research Interests:
Operations Research and Statistics, Management Science

David Mindell

Dibner Professor of the History of Engineering and Manufacturing, Professor of Aeronautics and Astronautics

Research Interests:
Autonomy in Human Environments; Precision Navigation; Ultra-Wideband for Urban Transit

Amedeo Odoni

T. Wilson Chair Professor Emeritus of Aeronautics and Astronautics

Research Interests:
Operations Research, Stochastic Systems, Air Transportation, Urban Services

Georgia Perakis

William F. Pounds Professor of Management, EMBA Faculty Director, Operations Research Center Co-Director

Research Interests:
Operations Management, Management Science, Pricing, Revenue Management, Supply Chains, Machine Learning, Optimization

Nick Roy

Professor of Aeronautics and Astronautics

Research Interests:
Robotics, Machine Learning, Autonomous Systems, Planning and Reasoning, Human-Computer Interaction, Micro Air Vehicles

Daniela Rus

Andrew (1956) and Erna Viterbi Professor of Electrical Engineering and Computer Science

Research Interests:
Robotics, Artificial Intelligence, and Data Science

Carlo Ratti

Professor of Urban Technologies and Planning, SENSEable City Lab Director

Research Interests:
Education, Transportation and Mobility, Urban Information, Technology, and Media and Analytics

Elisabeth Reynolds

Lecturer, MIT Department of Urban Studies and Planning

Research Interests:
National and Regional Systems of Innovation, Competitiveness, Manufacturing Ecosystems

David Simchi-Levi

Professor of Civil and Environmental Engineering

Research Interests:
Supply Chain Management, Operations Management, Operations Research, Business Analytics, Artificial Intelligence

Andres Sevtsuk

Charles and Ann Spaulding Career Development Associate Professor of Urban Science and Planning

Research Interests:
Spatial Analysis, Walkability, Public Transport, Business Location Patterns, Urban Design

Tobias Salz

Castle Krob Career Development Assistant Professor of Economics

Research Interests:
Industrial Organization, Applied Econometrics, Applied Microeconomics

Yossi Sheffi

Director of the MIT Center for Transportation & Logistics

Research Interests:
Systems Optimization, Risk Analysis, Supply Chain Management

Paolo Santi

Principal Research Scientist at MIT Senseable City Lab

Research Interests:
Modeling and analysis of complex systems

Anson Stewart

Research Scientist

Research Interests:
Spatial Analysis, Urban Transportation, Public Transportation

Fred Salvucci

Senior Lecturer and Senior Research Associate

Research Interests:
Infrastructure, Urban Transportation, Public Transportation, Institutional Development in Decision-Making.

Jessika Trancik

Professor of Data, Systems, and Society

Research Interests:
Infrastructure and decarbonization, Low-carbon transport, Vehicle electrification, Storage Technologies, Environmental Analysis, Energy Technologies

Cathy Wu
Gilbert W. Winslow (1937) Career Development Assistant Professor

Research Interests:
Machine Learning, Control Theory, Multi-agent Systems, Implications of AI & Automation

Sarah Williams
Associate Professor of Technology and Urban Planning

Research Interests:
Semi-formal Transportation, Urban Information, Technology, Media Design, Data Action, Urban Design, Data Visualization and Privacy

Matthias Winkenbach
Director of the MIT Megacity Logistics Lab; Director of the MIT CAVE Lab

Research Interests:
Multi-tier Distribution Network Design, Urban Logistics, Last-Mile Delivery, Urban Freight Policy, Data Analytics and Visualization

Jinhua Zhao
Professor of Cities and Transportation, Founder and Faculty Director, MIT Mobility Initiative

Research Interests:
Urban Transportation, Travel Behavior, Public Transit, Automated and Shared Mobility, Machine Learning

Chris Zegras
Professor of Transportation and Urban Planning

Research Interests:
Environmental Planning and Management, Healthy Communities and Active Living, Transportation and Mobility, Urban Economics

Siqi Zheng
Samuel Tak Lee Professor, CRE, DUSP and SA+P

Research Interests:
Urban and Environmental Economics and Policy; Environmental Sustainability

Authors

Bhuvan Atluri, Associate Director of Research, MIT Mobility Initiative
John Moavenzadeh, Executive Director, MIT Mobility Initiative
Jinhua Zhao, Founder and Faculty Director, MIT Mobility Initiative