



BOSTON REGION METROPOLITAN PLANNING ORGANIZATION

Stephanie Pollack, MassDOT Secretary and CEO and MPO Chair
Karl H. Quackenbush, Executive Director, MPO Staff

MEMORANDUM

DATE January 19, 2017
TO Boston Region Metropolitan Planning Organization
FROM Karl H. Quackenbush, Executive Director
RE Work Program for Planning for Connected and Autonomous Vehicles

Action Required

Review and approval

Proposed Motion

That the Boston Region Metropolitan Planning Organization (MPO), upon the recommendation of the Massachusetts Department of Transportation (MassDOT), vote to approve the work program for Planning for Connected and Autonomous Vehicles presented in this memorandum

Project Identification

Unified Planning Work Program Classification

Boston Region MPO Planning Studies and Technical Analyses

CTPS Project Number

13277

Client

Boston Region MPO

CTPS Project Supervisors

Principal: Scott Peterson

Manager: Bruce Kaplan

Funding

MPO Planning Contract #95411 and MPO §5303 Contract #98873

Impact on MPO Work

This is MPO work and will be carried out in conformance with the priorities established by the MPO.

Background

Autonomous and connected vehicle (AV/CV) technology has the potential to dramatically change transportation patterns across the Boston region, as well as the nation. These vehicles—sometimes referred to as driverless vehicles or self-driving cars—rely on onboard sensor and imaging technologies—such as radar, Lidar, global positioning systems, ultrasound, cameras, and Bluetooth—to interpret the environment surrounding the vehicle and communicate with nearby vehicles in order to navigate through obstacles without human intervention.

Equipping passenger, freight, and transit vehicles with this technology could have far-reaching consequences for safety, energy consumption, air quality, congestion, travel times, equity, and accessibility, depending on how and when the technology is adopted. Understanding the range of possible impacts will require adapting and rethinking the tools and assumptions we use to conduct transportation planning for this region.

Over the past few months, two local studies on autonomous vehicles have begun. On September 13, 2016, the City of Boston announced a partnership with the World Economic Forum in a program testing autonomous vehicles on city streets. In addition to on-street testing, this project hopes to produce associated policy recommendations to advance some of the goals identified in the city's Go Boston 2030 transportation planning initiative.¹ On October 20, 2016, Governor Baker signed Executive Order 572, creating a special working group on autonomous vehicles, known as the AV Working Group. This group is charged with consulting with industry experts, collaborating with government on proposed legislation, and supporting Memorandum of Understanding agreements between companies that propose to test self-driving vehicles in Massachusetts and MassDOT or other affected state agencies or municipalities.²

At the federal level, the US Department of Transportation (USDOT), through the National Highway Traffic Safety Administration (NHTSA), proposed the Federal Automated Vehicles Policy in September 2016. This policy identifies different levels of vehicle automation according to the SAE International definitions:

- Level 0: A human driver is in complete and sole control of all vehicle functions.

¹ <https://www.boston.gov/news/mayor-walsh-announces-autonomous-vehicle-initiative>

² <http://www.mass.gov/governor/press-office/press-releases/fy2017/exec-order-signed-on-automated-driving-technologies.html>

- Level 1: An automated system on the vehicle can sometimes assist the human driver in conducting some parts of the driving task.
- Level 2: An automated system on the vehicle can actually conduct some parts of the driving task, while the human continues to monitor the driving environment and performs the rest of the driving task.
- Level 3: An automated system can both actually conduct some parts of the driving task and monitor the driving environment in some instances, but the human driver must be ready to take back control when the automated system requests.
- Level 4: An automated system can conduct the driving task and monitor the driving environment, and the human need not take back control, but the automated system can operate only in certain environments and under certain conditions.
- Level 5: The automated system can perform all driving tasks, under all conditions that a human driver could perform them.³

While the adoption of fully autonomous vehicles may not be realized for decades, the MPO needs to begin to understand the transportation planning consequences of AV/CV technologies because the MPO, through the Long-Range Transportation Plan (LRTP), makes investment decisions on infrastructure projects that will be implemented over the next twenty-five years. The imminent studies and policies discussed above underscore the pressing need to comprehend and prepare for the potential implementation of these new technologies.

Objectives

The objectives of this project are to review existing literature and practices concerning AV/CV technology, and answer the following questions:

1. What factors will influence a person's decision to utilize AV/CV technology?
2. What are the range of possible impacts that AV/CV technology may be expected to cause to transportation demand, travel patterns, development patterns, and housing location choice in the Boston region?
3. How can the MPO incorporate AV/CV technology into our modeling tools?
4. How could AV/CV technology be incorporated into LRTP scenario planning?
5. What types of infrastructure and programs will be needed to support AV/CV technology, and how could the MPO allocate funding to support them?

³ <https://www.transportation.gov/sites/dot.gov/files/docs/AV%20policy%20guidance%20PDF.pdf>

Work Description

Task 1 Information Gathering

Subtask 1.1 Coordinate with Stakeholders

MPO staff will coordinate with stakeholders involved in the research, development, testing, and use of AV/CV technologies in the Boston region to gain an understanding of the state of the technology, the legislative environment, and direction of this evolving technology. This coordination includes attending forums, seminars, and symposiums hosted by the Metropolitan Area Planning Council, MassDOT, Massachusetts Institute of Technology, USDOT's Volpe Center, City of Somerville, the AV Working Group, as well as advocacy organizations such as WalkBoston, Transportation for Massachusetts, and LivableStreets.

Subtask 1.2 Review Current Literature on AV/CV Technology

Staff will conduct a literature review to understand the benefits, drawbacks, and impacts of AV/CV technology in large urban transportation systems, as well as suburban environments. The literature review will focus on attempting to answer the following questions:

- How quickly is the adoption of AV/CV technology expected? What are the characteristics of the first adopters? Who will see the most gains in mobility and access?
- How might AV/CV technology impact mode shares, particularly for fixed-route transit, and single-occupant and multi-occupant vehicle modes?
- How might AV/CV ownership models impact trip generation, trip distribution, and land use?
- How might AV/CV technology impact roadway capacity and speeds?
- How might AV/CV technology impact air quality and greenhouse gas emissions?

Products of Task 1

- Coordination with local stakeholders, attendance at meetings, and other presence as needed
- An informal document (which will be incorporated into the final report as part of Task 5) describing current literature on AV/CV impacts and benefits, as well as questions that still need to be resolved

Task 2 Data Analysis

Staff will evaluate the primary and secondary research collected in Task 1 to determine which short-term planning measures to pursue in the most detail.

Products of Task 2

- An analysis of the data collected in Task 1, including supporting materials such as tables, graphs, and maps (which will be included in the final report)
- Development of a range of possible short-term planning measures to pursue

Task 3 Short-Term Planning Evaluation***Subtask 3.1 Evaluate Mechanisms for Updating Modeling Tools***

This task will consist of a literature review of current travel demand modeling practices used to assess the impacts of AV/CV technology. Staff will examine material from the USDOT, the Transportation Research Board, peer MPOs, and software vendors. Sketch planning methodologies and tools related to AV/CV technology will also be researched.

Various approaches are potentially available for incorporating impacts of AV/CV technology into the MPO's travel demand model set. These methodologies include adjusting variables such as roadway lane capacity, fuel efficiency, vehicle operating cost, in-vehicle value of time, parking costs, and trip rates. Many advanced modeling approaches would require the use of an activity-based model (ABM) to effectively capture trip-chaining behavior. Although staff does not currently use an ABM to forecast travel demand, these methodologies will be catalogued for future reference. Staff will investigate the following aspects of implementing these methodologies:

- Ease of implementation
- Availability of input data
- Realistic consideration of discrete choice variables

Subtask 3.2 Determine the Need for Changes in other Planning Tools

Staff presently uses other tools to analyze and evaluate the traffic, transit, air quality, greenhouse gas emissions, equity, and economic development impacts related to infrastructure and service planning projects. Staff will determine which of these tools may need adjustment to incorporate AV/CV technology impacts and suggest subsequent modifications.

Subtask 3.3 Examine How to Incorporate AV/CV Technology into LRTP Scenario Planning

Staff will conduct a review of how other MPOs across the country have incorporated AV/CV technology into scenario planning and goal development for their LRTPs. This subtask will also investigate how these agencies plan to account for the implications of this technology on the growing shared-vehicle

travel market. This effort includes reviewing the variables and conditions adjusted between scenarios as well as the performance indicators and metrics used to evaluate scenarios.

Product of Task 3

An informal document (which will be incorporated into the final report as part of Task 5) that describes current AV/CV modeling tools and planning practices

Task 4 Examine Implications for the MPO

Staff will review the infrastructure needs required for the implementation of AV/CV technology in light of the six defined levels of automation. Attention will be paid to the role that the MPO can potentially play in funding the infrastructure required to support the technology. Potential policies and funding needed to support these infrastructure elements will be examined.

Product of Task 4

An informal document describing possible implications of AV/CV technology for the MPO that will inform the final report

Task 5 Prepare a Final Report

Staff will produce a final white paper or report, summarizing the study's research and findings and incorporating earlier project documents. Staff will also make a presentation to the MPO board regarding this study.

Product of Task 5

- White paper or report
- Presentation to the MPO board

Estimated Schedule

It is estimated that this project will be completed 8 months after work commences. The proposed schedule, by task, is shown in Exhibit 1.

Estimated Cost

The total cost of this project is estimated to be \$50,000. This includes the cost of 13.4 person-weeks of staff time and overhead at the rate of 102.7 percent. A detailed breakdown of estimated costs is presented in Exhibit 2.

Exhibit 1
ESTIMATED SCHEDULE
Planning for Connected and Autonomous Vehicles

Task	Month							
	1	2	3	4	5	6	7	8
1. Information Gathering	[Task 1: Months 1-8]							
2. Data Analysis	[Task 2: Months 2-4]							
3. Short-Term Planning Evaluation	[Task 3: Months 4-6]							
4. Examine Implications for the MPO	[Task 4: Months 6-7]							
5. Prepare a Final Report	[Task 5: Months 7-8]							

Exhibit 2
ESTIMATED COST
Planning for Connected and Autonomous Vehicles

Direct Salary and Overhead	\$50,000
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Task	Person-Weeks			Direct Salary	Overhead (102.70%)	Total Cost
	M-1	P-5	Total			
1. Information Gathering	1.2	2.8	4.0	\$7,372	\$7,571	\$14,943
2. Data Analysis	0.2	1.0	1.2	\$2,311	\$2,373	\$4,684
3. Short-Term Planning Evaluation	0.2	3.2	3.5	\$6,429	\$6,603	\$13,033
4. Examine Implications for the MPO	0.8	1.0	1.8	\$3,215	\$3,302	\$6,516
5. Prepare a Final Report	1.0	1.9	2.9	\$5,340	\$5,484	\$10,824
Total	3.5	9.9	13.4	\$24,667	\$25,333	\$50,000

Other Direct Costs	\$0
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TOTAL COST	\$50,000
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Funding

MPO Planning Contract #95411 and MPO §5303 Contract #98873