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By James Stergios
Pioneer Institute, *Executive Director*



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WINNER

Operation Farm Team

By Phillip A. Washington

RUNNERS UP

Freight Demand Management

by Dr. José Holguín-Veras

Alternative Contracting Method Performance in U.S. Highway Construction

*by Arthur L. C. Antoine, PhD, PE, Assoc. DBIA
and Professor Keith Molenaar*

Bring the Providence Line in to the 21st Century

by Ari Ofsevit

Better Managing the I-93 Northern Expressway HOV Lane

by Conrad Crawford

SPECIAL RECOGNITION

North Station Seaport Ferry

by Erin Anderson

Innovative Approaches to Improving Pedestrian Safety

by Wendy Landman

GoMentum Station & Shared Autonomous Vehicles

*by Randell H. Iwasaki & Contra Costa
County - Planning*

Task Force on Regional Transit Authority Performance & Funding

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Mobility Data from MetroTech

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Truck Platooning with PlatoonPro

*by Stephen Boyd & Amanda F. Anderson,
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When Pioneer chose “Moving People, Moving Goods, Moving Forward” as the topic for the 2019 Better Government Competition (BGC), we knew transportation was an important issue. But no one could have known it would become as hot as it is today. After multiple derailments on the MBTA and a report finding that Boston is the nation’s most congested city, transportation seems to be on the tip of everyone’s tongue.

As always, Pioneer sought out entries that delved into the nuances needed to solve very complex problems. Competition Director Shawni Littlehale and her team did that by sharing the BGC guidelines with countless institutions, government officials, non-profits and—as always—interested citizens.

For 29 years, the BGC has highlighted programs and ideas from around the country that improve lives by raising the quality of services, while at the same time saving taxpayer money. This year is no exception.

Enhancing transportation talent, improving efficiency, reducing emissions

LA Metro, Los Angeles County’s transportation agency, is the 2019 Better Government Competition winner for “Operation Farm Team.” LA Metro is slated to deliver 40 major transportation projects over the next 40 years as it faces the prospect of losing 42 percent of its workforce to retirement over just the next five years.

To address the challenge, the agency has launched a career pathways program that combines education, mentoring and hands-on learning opportunities. Its centerpiece is a new transportation academy that will train high school students to be the next generation of the sector’s workers.

Several runners up also have the promise of delivering quality results for taxpayers. Although trucks make up less than 5 percent of registered motor vehicles, they consume more than a quarter of all fuel and are responsible for more than 40 percent of greenhouse gas emissions. To address this issue, Rensselaer Polytechnic Institute Professor José Holguín-Veras proposes off-hour deliveries and receiver-led consolidations, an approach that has been effective in other parts of the country and internationally, and holds the promise of reducing emissions produced by freight trucks by nearly two thirds in congested metropolitan areas like Boston.

In recent decades, delivery methods other than the traditional design-bid-build have often been shown to deliver better results for highway construction. To help transportation officials determine which delivery method is best for a given project, the Federal Highway Administration, in conjunction with the Colorado Department of Transportation,

has developed a project delivery selection matrix. Its application can result in work being done faster, more efficiently and with less disruption to the traveling public.

Another promising idea is a market-based reform that would make better use of the high-occupancy vehicle (HOV) lane on Interstate 93 north of Boston. Instituting dynamic road pricing on the 2.6-mile stretch would reduce congestion and decrease pollution in communities that have long borne the brunt of tailpipe emissions.

The final runner up is a plan to improve rail service between Boston and Providence by converting the trains from diesel to electrical power and building new station platforms that allow for level boarding. The upgrades would increase the frequency of rush hour service, while reducing travel time and per-trip staffing costs.

Six entries earned special recognition. They focus on improving pedestrian safety, reforming the Commonwealth's Regional Transit Authorities, and utilizing technology and water transportation to improve both passenger and freight mobility. The Citizens Award goes to Jacob Ventura

for his entry, "Employer-Incentive Traffic Reduction and Regional Economic Development Tax Credit Plan."

At the heart of the Better Government Competition's effectiveness and impact are its panel of independent judges. This year we were fortunate to benefit from the expertise of Pioneer board member Adam Portnoy, president and CEO of The RMR Group; Frederick Salvucci, senior lecturer at the MIT Transit Lab and former Massachusetts Secretary of Transportation; Stephen J. Silveira, who chaired the Commonwealth's Transportation Finance Commission and is a senior vice president at ML Strategies; Mary Skelton Roberts, co-director for climate at the Barr Foundation; and *Boston Globe* Transportation Reporter Adam Vaccaro. We thank each of them for their invaluable contributions to ideas that have the potential to benefit people across Massachusetts and beyond.

As she has for over two decades, Shawni Littlehale again did an outstanding job leading the herculean effort that culminates in the extraordinary proposals included in this volume. She was ably assisted by Robert "Cole" Wirtz and Saylor

Scheller, as well as Kelley Babphavong, Grace Golder, and Kylie Tomasiak.

I am grateful for the support we received from dozens of state legislators, executive branch officials and media outlets. Their involvement improved the quality of the contest submissions. With the winners selected, we will ask them to share these innovative proposals and programs.

Of course, none of the ideas included here that hold the promise of improving the economy by increasing individual and freight mobility, improving air quality, reducing greenhouse gas emissions and saving taxpayer dollars would be possible without Pioneer's generous donors and our many 2019 Better Government Competition sponsors. Your support will allow Pioneer to disseminate the ideas included in this volume to the policy makers and opinion leaders who can turn them from proposals to policy.



James Stergios,
Executive Director



OPERATION FARM TEAM

Global Transportation Infrastructure Workforce Initiative

by Phillip A. Washington

PROBLEM STATEMENT


Growing up in Altgeld Gardens, a public housing complex on the south side of Chicago, Phillip Washington, Chief Executive Officer (CEO), Los Angeles County Metropolitan Transportation Authority (LA Metro), saw people who did not look like him building infrastructure—transportation, utilities, streets & sidewalks—in his community. As a teenager, he sought employment on those projects. He was either told that he was too late to get employment or that he was not trained to work on the projects. He came away thinking that it was a tragedy, that as a resident of the oldest public housing complex in the United States, he could not get a job or even training to help build his own community.

In November 2016, the voters of Los Angeles County overwhelmingly approved LA Metro’s Measure M transportation sales tax ballot measure. The Plan will deliver 40 major projects over the next 40 years, with funding carved out for expanding bus and rail operations; local transportation projects in all 88 cities and unincorporated areas in LA County; bike and pedestrian

connections; programs for seniors, students, and the disabled; and maintaining a state of good repair to keep the system in working condition. Together the projects will create 778,000 jobs over the next four decades. The question is who will fill those jobs.

50% of transportation industry professionals are eligible to retire in the next 10 years¹. LA Metro itself will be losing 42% of its workforce to retirement in the next 5 years; 68.5% of its workforce is over 40. Even more alarming is

**HE CAME AWAY THINKING
THAT IT WAS A TRAGEDY...
HE COULD NOT GET A JOB OR
EVEN TRAINING TO HELP BUILD
HIS OWN COMMUNITY.**



ALTGELD GARDENS,
the oldest public housing
complex in the United States.

Credit: Zol87 from
Chicago, Illinois, USA,
Creative Commons

that 27% of its workforce could walk out the door today due to retirement.

PROPOSED SOLUTION

In the early 1920s the St. Louis Cardinals baseball club struggled to obtain players of quality from the minor leagues, outbid by teams with more money. In other words, the Cardinals had a workforce development problem. In response, the great baseball management legend Branch Rickey developed the “farm” system and forever changed the way Major League Baseball cultivates new players. In developing the farm team system, Rickey created a “production line of talent” for the Cardinals. When assessing his accomplishment, Rickey said, “I do not feel that the farming system we have established is the result of any inventive genius—it is the result of stark necessity. We did it to meet a question of supply and demand of young ballplayers.”²

At a time when the transportation workforce is graying, LA Metro’s Career Pathways Program is an innovative and progressive training model to prepare tomorrow’s transportation infrastructure leaders.

Perhaps the biggest barrier to building a career pathways program, and in turn a transportation workforce, is getting young people to realize they can even have a career in

LA METRO

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Drawing on the same basic logic that inspired Branch Rickey’s farm team system, LA Metro initiated a concept called E3 –

EXPOSE,
EDUCATE,
AND
EMPLOY.

transportation. Thus, LA Metro’s Career Pathways Program begins at a foundational level. Drawing on the same basic logic that inspired Branch Rickey’s farm team system, LA Metro initiated a concept called E3 –expose, educate, and employ. The goal is to provide students with STEAM (science, technology, engineering, arts, and math) programs, mentorships, hands-on learning, and other opportunities to expose and connect youth to transportation infrastructure-related career opportunities.

The centerpiece of the E3 initiative is an actual transportation school. LA Metro, in partnership with the County of Los Angeles, is developing a transportation academy, an educational and vocational program to train high school students to become the next generation of professional transportation workers.

Built on 4.2 acres of land in South Los Angeles, the charter public high school (grades 9-12), the SEED LA Transportation School (SEED LA), will be the first public boarding school nationwide to focus on the future workforce needs of the global transportation infrastructure industry, and will recruit students who can most benefit from the structured boarding school experience, including from the more than 18,000 youth in foster care and nearly 78,000 homeless youth in Los Angeles County. The selected school operator,

the SEED Foundation, has demonstrated success at its three established campuses in Washington, D.C., Baltimore, and Miami, in creating positive educational and personal experiences for young people with multiple poverty indicators. The SEED Foundation's college enrollment rate at its existing campuses is 94% and SEED graduates are 3.5 times more likely to complete college than other low-income, first generation students. Though it will be open to all youth in Los Angeles County, SEED LA will focus on recruiting "opportunity youth" who have, or are at risk, of contact with Los Angeles County's public safety, child protection and welfare departments, or youth who have historically been underserved educationally.

A transportation infrastructure curriculum will be embedded in both the traditional academic setting and as part of after-school programming. Focus areas will include engineering, information technology, public administration and policy, operations, urban and regional planning, and logistics and supply chain management. The curriculum will be developed such that students will have the opportunity to attain

industry certifications to successfully transition after graduation to transportation related careers with LA Metro, other transportation industries, or to pursue related Bachelor degrees.

This is an opportunity to build a qualified workforce for the transportation industry, while giving local youth a pathway to global careers and meaningful lives.

**THE SEED
FOUNDATION'S
COLLEGE
ENROLLMENT
RATE AT ITS EXISTING
CAMPUSES IS**

96%
&

**SEED GRADUATES
ARE**

**3.5x
More Likely to
Complete College**

than other low-income,
first generation students.

START-UP COSTS

The pre-development budget for the School is \$3.6 million, to be funded by \$1 million from LA Metro, approved at its September 2018 board meeting; \$1 million from LA County, approved in February 2019; and \$1.6 million raised by the SEED Foundation. The LA Metro contribution will go towards the architectural and engineering work to design the project, environmental assessments, and administration (including support of the development of the school) during the pre-development phase of the project.

FUNDING SOURCES FOR FUTURE OPERATIONAL COSTS

The SEED Foundation provided a proforma for the costs associated with the round-the-clock, boarding school services provided in a 5-day week. Once the school is fully operational, serving 450 students, 52 staff members will be dedicated to the non-academic portion of the boarding school facility. Their duties will range from dedicated mental and physical health service delivery, facility operations and maintenance,

resource coordination, and management. The total expenses associated with these personnel costs are approximately \$3.76 million per year.

Other costs associated with the school include debt service for the facility, estimated at approximately \$2.25 million per year, food at \$1.3 million per year, student transportation at \$350,000 per year, and various building, programmatic and administrative-related expenses at \$2.34 million per year.

In October 2018, the LA Metro Board approved program/operating funds as

follows: \$2.875 million in FY21, \$3.631 million in FY22, \$4.494 million in FY23 and, once the school is fully operational, \$5 million annually from FY24 through FY35. Annual budgeted commitments from LA Metro shall be no greater than \$5 million. The maximum cumulative program allocation shall be no greater than \$71 million. In February 2019, the Board of the County of Los Angeles formally approved the same amounts for program/operating costs for a period of 15 fiscal years.

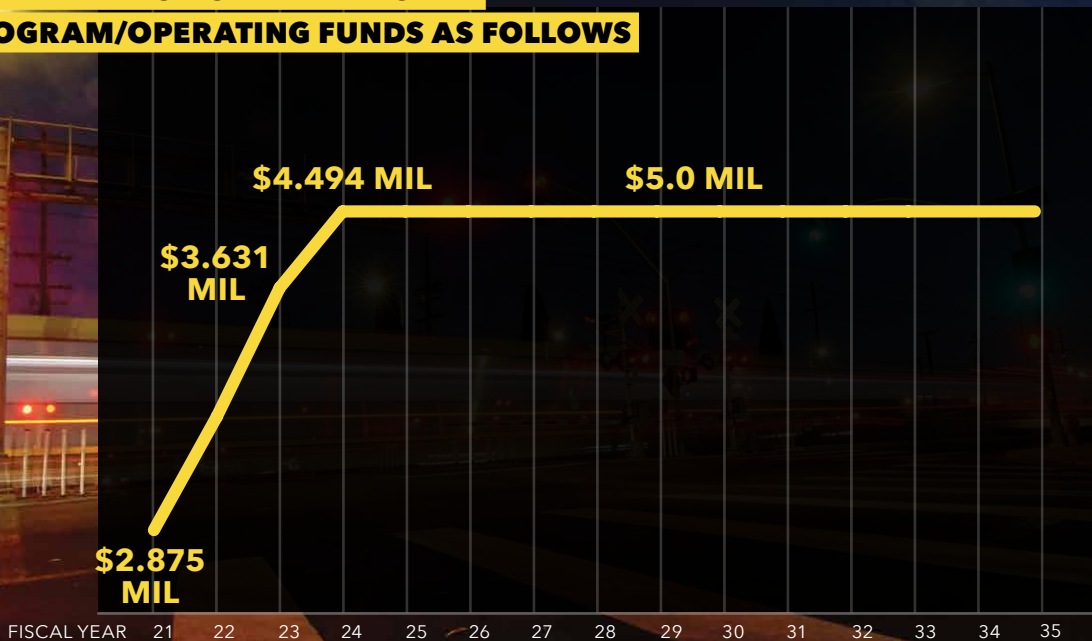
The annual LA Metro allocation can be reduced depending on external state and federal grants sought by LA Metro, and other

charitable contributions to the SEED Foundation. SEED has committed to raising any necessary funds beyond the \$10 million annual operating subsidy that is required from LA Metro and the County of Los Angeles.

PROJECTED OUTCOMES

The Los Angeles metropolitan area struggles with one of the highest youth unemployment rates in the country. At the same time, the transportation infrastructure industry is struggling to meet the national demand for a skilled workforce. The Transportation School effort is being implemented to meet

IN OCTOBER 2018, THE LA METRO BOARD APPROVED PROGRAM/OPERATING FUNDS AS FOLLOWS





TO FOSTER A PIPELINE OR FARM TEAM OF QUALIFIED, LOCAL INDIVIDUALS FOR THOSE PROJECTED 778,000 JOBS, LA METRO IS ENGAGING YOUTH AS PART OF THEIR SCHOOL EXPERIENCE.

the needs of both industry and Resilience Youth: "Students for whom high quality, trauma-informed education, healthcare, housing, mentoring, nutrition, recreational opportunities, and/or supportive services would have a measurable impact on well-being, motivation, and self-sufficiency and offer significant prospects they may otherwise not have been able to access."³

The school will annually serve 450 students who have faced adversity in their lives. Students eligible to attend will meet criteria such as:

- 1 - living below 200% of the federal poverty threshold;
- 2 - experience with housing instability;
- 3 - eligibility for Title IV-B dollars; and

- 4 - a history of contact with the child welfare and/or juvenile justice systems through the Department of Children and Family Services or the Probation Department.

Following the passage of Measure M, LA Metro is poised to transform the region's transportation infrastructure and, in doing so, develop a workforce to support the planning, construction, operations, and maintenance of the expanding system. The Los Angeles Economic Development Corporation

(LAEDC) estimates that 778,000 jobs and \$133.6 billion in economic output will result from transportation infrastructure projects funded by LA Metro's Traffic Improvement Plan over the next half century.

To foster a pipeline or farm team of qualified, local individuals for those projected 778,000 jobs, LA Metro is engaging youth as part of their school experience. The Career Pathways Program, through E3 and SEED LA, will change the lives of thousands of young people by providing training and skills that allow them to lead productive lives, while at the same time addressing the growing need for a skilled transportation infrastructure workforce.

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FREIGHT DEMAND MANAGEMENT

Experiences, Research Results, and Potential to Help Address Climate Change and Foster Economic Productivity

by Dr. José Holguín-Veras

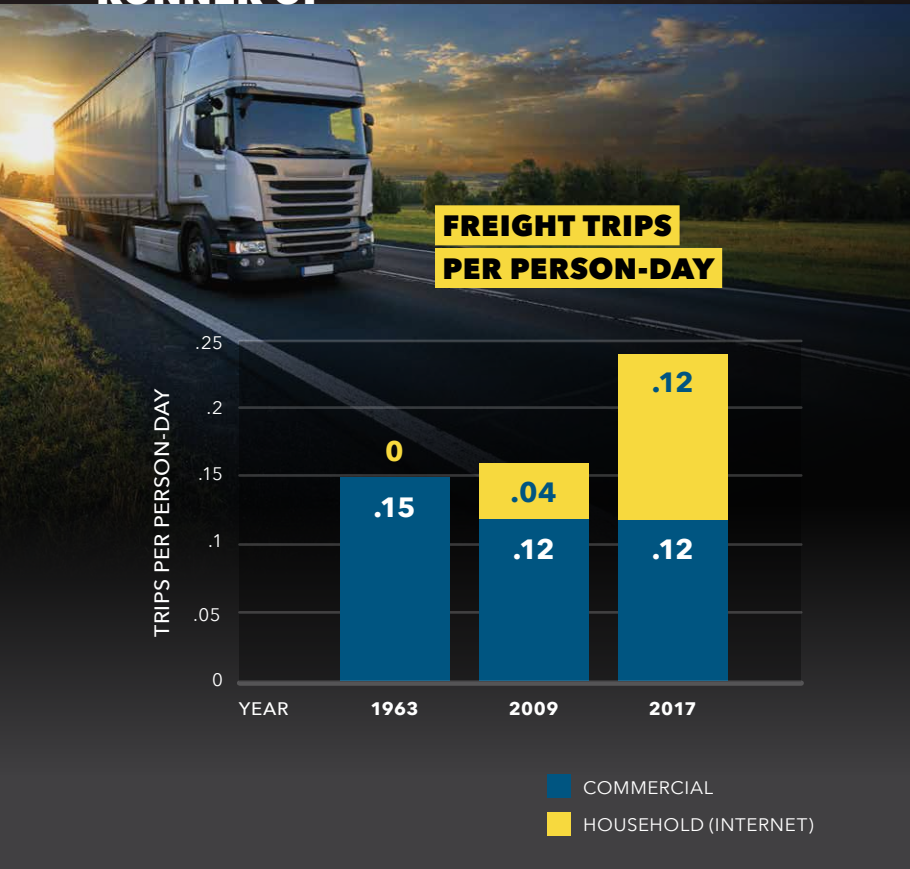
PROBLEM STATEMENT

The transportation sector consumes **27.8%** of the total energy and 70% of the petroleum used in the United States; it produces 53% of the carbon monoxide, 31.3% of the nitrogen oxide, 24.2% of the volatile organic compounds, and 39.3% of the carbon dioxide. Though only 4.3% of all motor vehicles registered, trucks generate 9.8% of the vehicle-miles-traveled (VMT), consume 26.5% of the fuel and produce 41% of the greenhouse gas emissions¹. Yet we need freight. Without an efficient flow of supplies modern life would not be possible.

Policy-makers have been tightening fuel efficiency standards for decades. As a result, between 1970 and 2014 energy use per vehicle-mile decreased at an annual rate of 1.4% and 0.3% for light and medium/heavy trucks respectively, but, still, total energy use by these vehicles increased annually by 4.0% and 3.1%¹.

This is the 21st century version of the "Efficiency Paradox," whereby technological advances in efficiency help induce demand that outpaces reductions. Demand driven by just-in-time production and internet delivery is undermining advances in supply-side energy efficiency. This does not imply that technological advances are not needed, but is merely to point out that (1) technological advances are only part of the solution; and (2) without behavioral changes to counteract the tendency to induce demand, the Efficiency Paradox will materialize. In other words, managing freight demand is key.

Doing so is urgent because of the impact of e-commerce on the number of internet deliveries to households. The figure on the next page shows that the commercial FTG rate declined from 0.15 to 0.12 freight trips/person-day in the 46 years between 1963 and 2009, but the rate of household deliveries jumped from 0.04 to 0.12 freight trips/person-day in the subsequent eight. The result is that the total FTG in 2017 was 50% higher than it was in 2009, and double what it would have been if not for internet home deliveries: 0.12 freight trips/person-day absent internet home deliveries and 0.24 percent with them.



SOLUTION

Freight Demand Management (FDM) is: "...the area of transportation policy that seeks to induce the demand generator to enact changes in demand patterns to increase economic productivity and/or efficiency; and/or enhance sustainability, quality of life, and/or environmental justice...". Receivers set the operational constraints that must be satisfied by carriers and shippers. By seeking to change the behavior of the receivers who generate freight demand, FDM can improve the economic, social, and environmental performance of urban supply chains. Moreover, because

congestion and pollution are most acute in busy commercial areas, modifying the time and number of deliveries at these locations can have a noticeable effect where its impact can be most felt.

The majority of receivers in urban areas are small businesses of less than nine employees, estimated to produce between 45% and 60% of the freight traffic. Typically, the owners of these businesses do not think much about their ordering patterns and their environmental impacts. They are preoccupied with surviving in the market, but there are ways for FDM to help receivers make more informed decisions, and since

receivers in commercial areas are interested in enhancing quality of life and walkability, which translate into more attractive shopping districts, receivers are naturally inclined to support FDM.

The focus here is on two FDM initiatives: off-hour deliveries and receiver-led consolidation.

1 - Off-Hour Deliveries (OHD) Programs

Freight carriers travel during congested hours only because receivers of the supplies demand it. If receivers were to accept deliveries during off-hours (7PM to 6AM) most carriers would gladly alter their operations. Achieved through incentives offered to receivers in exchange for their participation, OHD leads to: reduced urban congestion and air pollution; increased economic productivity and lower costs; enhanced sustainability and quality of life, with reduced conflicts between freight traffic and passenger vehicles, pedestrians, and bicyclists.

New York City is where OHD research started and the first successful pilot took place. Leading private-sector partners include: Manhattan Chamber of Commerce, Truck Association of New York, SYSCO, Anheuser-Busch, Whole Foods, Footlocker, CVS, Duane Reade, Waldorf-Astoria,

and Beverage Works.

Estimates for NYC indicate that the annual economic benefits amount to between \$100 and \$200 million. A major portion of these savings represent reductions in delivery costs, estimated to be between 35% and 45%, similar to those achieved in OHD programs in Bogotá and São Paulo, where 30% delivery cost reductions have been reported.

The estimated impacts on emissions are even more compelling, even though they consider only the reduction in emissions from the freight vehicle themselves. To estimate the emission reductions, the team developed a computer

program that reads GPS data and applies appropriate emission factors. The pollutants estimated are CO₂, CO, NO_x, total organic gases (TOG), reactive organic gases (ROG), and particulate matter with aerodynamic diameters of less than 10 μm and 2.5 μm (PM₁₀ and PM_{2.5}, respectively). The GPS data come from the OHD programs in Bogotá, NYC, and São Paulo, though the data from Bogotá are from vehicles operated from 6PM to 10PM, while in São Paulo and NYC, the data represent vehicles operated from 7PM to 6AM. Table 1 shows the results.

Even the small shift in delivery times in Bogotá reduced emissions by 13%. In

the case of NYC and São Paulo, where OHD took place deep into the night and early hours of the morning, reductions reached 48% and 64%. To put these impacts in perspective, the emission standards promulgated by President Obama sought engine efficiency increases of 25% in ten years. Assuming that these OHD programs capture a 30% market share, the emission reductions accrued would reach the amounts in Table 2.

On a worldwide basis, if only 10% of deliveries in metro areas with more than 10 million residents switch to OHD, emission reductions would be 11 times greater than the totals in Table 2. Implementing OHD in all metro areas with more

TABLE 1: OFF HOUR % OF EMISSIONS REDUCTIONS PER KILOMETER

CITY\POLLUTANT	ROG	TOG	CO	CO ₂	NO _x	PM ₁₀	PM ₂₅	TOTAL
BOGOTÁ (6PM-10PM)	13.49%	13.49%	13.50%	13.12%	12.70%	13.41%	13.41%	54.8%
NEW YORK CITY (7PM-6AM)	67.17%	67.17%	67.00%	55.14%	59.47%	65.53%	65.53%	100.0%
SAO PAULO (7PM-6AM)	49.98%	49.98%	51.43%	42.52%	44.64%	45.90%	45.90%	79.7%

TABLE 2: REDUCTIONS IN EMISSIONS DUE TO OHD IN STUDIED CITIES

CITY	Veh-km shifted (millions)	ROG (tons)	TOG (tons)	CO (tons)	CO ₂ (million tons)	NO _x (tons)	PM ₁₀ (tons)	PM ₂₅ (tons)
NEW YORK	10.5	1,733.2	1,973.2	2,5273.5	8.9	3,616.3	591.8	566.2
SAO PAULO	5.2	806.9	918.6	9,015.2	2.9	1,197.0	221.0	211.4
BOGOTÁ	2.3	333.3	379.4	4,762.2	1.7	671.0	114.8	109.8
TOTAL	17.9	2,873.4	3,271.2	39,051.0	13.5	5,484.3	927.6	887.5

than two million residents would reduce total emissions by 22 times Table 2's totals. In terms of CO₂, these scenarios would lead to reductions of 148 million tons/year and 298 million tons/year respectively².

2 - Receiver-Led Consolidation

Receiver-Led Consolidation (RLC) exploits the power of receivers to foster cargo consolidation across supply chains. By doing so, receivers reduce interruptions produced by receiving supplies; suppliers benefit from increased productivity; while the city benefits from reduced traffic. Surveys indicate that 20.6% of respondents are interested in "asking ... vendors to reduce the number of individual deliveries ... through consolidation."³

Depending on the scenario, RLC could reduce by 3.0% to 8.8% the total delivery traffic in the NYC metropolitan area, and between 3.5% and 11.2% in Manhattan³. The estimated total savings for the carriers could range between \$376,906 and \$1,186,128 per day, as a result of the 4,740 to 15,062 hours saved in operations. In terms of vehicle-miles traveled (VMT), the expected savings range from 33,445 to 104,255 VMT per day. In addition to the savings for the carriers participating in RLC, a reduction in truck traffic of between 6.49% and 14.10%

in Manhattan is expected to generate between \$57.10 and \$84.42 million per year in economic benefits. The environmental benefits are also likely substantial, though they have yet to be quantified.

CONCLUSION

FDM has demonstrated great potential to foster sustainability, economic productivity, and efficiency in urban supply chains. These initiatives exploit the power of receivers to establish how, when, and how frequent deliveries are made. With increasing freight activity produced by household internet purchases, FDM techniques provide a template for action to contain the negative externalities associated with internet deliveries to households. Amazon recently took a tentative step into FDM by providing an option to its Prime customers, allowing them to consolidate their deliveries on a single day. Essentially, Amazon is inducing its customers to practice RLC.

FDM provides city governments with a new set of tools to foster urban freight sustainability. The estimates produced through the research, based on professionally collected surveys, indicate that between 40% and 70% of urban deliveries could be influenced in a beneficial manner by FDM. Undertaking a global FDM effort is a cost-effective way to start addressing the threat of climate change, while at the same time increasing economic productivity and health across the world.

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ALTERNATIVE CONTRACTING METHOD PERFORMANCE IN U.S. HIGHWAY CONSTRUCTION

by Arthur L. C. Antoine, PhD, PE, Assoc. DBIA and Professor Keith Molenaar

PROBLEM STATEMENT

There are three primary contracting methods for federally funded highways: design-bid-build (D-B-B)¹, design-build (D-B)², and construction manager/general contractor (CM/GC)³. The vast majority of the U.S. highway system was built employing D-B-B. D-B delivery began in the 1990s; CM/GC delivery began after 2005.⁴ Potential benefits of using D-B and CM/GC include expedited project delivery, shortened construction schedules, project cost savings, improved constructability, enhanced innovation, and reduced risk. Notwithstanding, the two alternative contracting methods can create challenges. How do state transportation agencies know when and when not to employ alternative contracting methods?

SOLUTION

The Federal Highway Administration (FHWA), in conjunction with Colorado's Department of Transportation, developed a Project Delivery Selection Matrix (PDSM)⁵ into which the results of its report, "Alternative Contracting Method Performance in U.S. Highway Construction," have been integrated. The PDSM provides a formal approach for selecting highway project delivery methods. The process uses evaluation worksheets and forms to guide agency staff and project team members through a delivery selection workshop. The result is a Project Delivery Selection Report that matches the unique goals and characteristics of each individual project.

THE PRIMARY OBJECTIVES OF THE PDSM ARE TO:

- ▶ Present a structured approach to assist agencies in making project delivery decisions.
- ▶ Assist agencies in determining if there is a dominant or optimal choice of delivery method.
- ▶ Provide documentation of the selection decision.

What follows is a discussion of the data informing the matrix. The findings are based on empirical data from the Federal Highway Administration (FHWA) study Quantification of Cost, Benefits and Risk Associated with Alternative Contracting Methods and

Accelerated Performance Specifications. The research team collected data from 291 completed projects that met the methodological specifications⁶, with an eye toward answering, among others, the following questions:

- ▶ For what project size, complexity, and risk characteristics are agencies currently applying alternative contracting methods?
- ▶ How do alternative contracting methods affect cost certainty and cost growth?
- ▶ How do alternative contracting methods affect project delivery speed and schedule growth?
- ▶ How do alternative contracting methods affect production rates or project intensity?

The research team began by assessing risk. From the data, eight risk factors were perceived to have a high impact on project performance regardless of delivery method: 1. Delays in completing railroad agreements. 2. Project complexity. 3. Uncertainty in geotechnical investigation. 4. Delays in right-of-way process. 5. Unexpected utility encounter. 6. Work zone traffic control. 7. Challenges to obtain environmental documentation. 8. Delays in delivery schedule.

Next, FHWA's National Highway Construction Cost

EIGHT RISK FACTORS WERE PERCEIVED TO HAVE A HIGH IMPACT ON PROJECT PERFORMANCE REGARDLESS OF DELIVERY METHOD:

- 1** Delays in completing railroad agreements.
- 2** Project complexity.
- 3** Uncertainty in geotechnical investigation.
- 4** Delays in right-of-way process.
- 5** Unexpected utility encounter.
- 6** Work zone traffic control.
- 7** Challenges to obtain environmental documentation.
- 8** Delays in delivery schedule.

Index was used to convert all project costs for those included in the study to equivalent costs in June 2015. The projects ranged in cost from \$69,108 to \$357,760,287, with an average award cost of \$27,140,363⁷.

Publicized success of large, high-profile D-B and CM/GC projects gives the impression that alternative contracting methods are applicable only to larger projects. The data collected for this study, however, show that alternative contracting methods are widely applied on small projects. More than half of the CM/GC and D-B/LB projects included in the research are under \$20 million in value, and more than half of the D-B/LB projects are less than \$5 million in value. And though, on average, D-B/BV is used on larger projects, 45% of the D-B/BV projects are less than \$20 million in value.

Agencies frequently choose alternative contracting methods not just based on cost, but to shorten project durations. Data from the study show they are achieving this objective.⁸ When compared to D-B-B, the mean project duration for the CM/GC projects was 48% shorter, and the mean D-B/BV project duration was 15% shorter, despite the fact that the mean project costs for CM/GC and D-B/BV projects are approximately twice that of the D-B-B projects.

Essentially, projects twice as large are being built in half the time by using alternative contracting methods.

Mean agency design durations are notably shorter for CM/GC and D-B projects. D-B/LB project had the lowest mean construction durations, perhaps due to the smaller size of these projects and the higher level of design completion at the time of award. And though D-B/BV had the highest mean construction durations, this was probably because D-B/BV projects had the largest mean cost, and the construction durations included the design builder's design time and coordination with other agencies.

Because the mean costs of the projects vary so substantially, the research team analyzed two smaller pools of projects independently. The first pool involved the smallest projects (\$2 to \$10 million), the second larger projects (\$10 to \$50 million). Since D-B-B and D-B/LB are most frequently chosen for projects in the lower cost range, only those two methods were analyzed within it.

The mean D-B/LB duration for smaller projects was 49% shorter than that of D-B-B projects. Agencies took approximately 77% less time for design for D-B/LB as compared to the mean D-B-B agency design duration on



these projects, and the mean D-B/LB construction time, which included both the design-builder design and construction time, was still approximately 25% shorter on average. D-B/LB appears to be delivering substantially shorter durations on smaller projects.

For larger projects the mean cost of the CM/GC projects was approximately 11% higher than D-B-B and 22% higher than D-B/BV, but the mean CM/GC project duration was 69% and 43% shorter than D-B-B and D-B/BV, respectively. Shorter CM/GC mean durations were observed in both design and construction. D-B/BV also showed substantially shorter mean durations as compared to D-B-B. Like CM/GC, this shorter construction duration is likely because of contractor involvement with the design.

Both results suggest that agencies gain substantial time savings by using alternative contracting methods.

Alternative contracting methods also provide agencies with earlier cost certainty. For smaller D-B-B and D-B/LB projects, D-B/LB cost certainty is known more than 60% earlier. On larger projects, when compared to D-B-B, the average point of cost certainty for CM/GC is more than 60% earlier and for D-B/BV approximately 40% earlier.

Project intensity is a measure of how much money is spent per day on a project. Projects with a greater intensity can have a shorter impact on traffic, providing an excellent measure of how agencies are serving the commuting public. The shorter project duration and higher contract cost of CM/GC and

ALTERNATIVE CONTRACTING

METHODS ARE:

40-60%
SHORTER IN DURATION

EARLIER
COST CERTAINTY

HAVE A
HIGHER PROJECT
INTENSITY

D-B/BV projects result in a much higher project intensity than D-B-B.

Award growth is the ratio of the difference between the engineer's initial estimate of the cost of a project and the actual contract award. Any differences can indicate trends in the accuracy of agency cost estimating and highlight projects that experience significant change in cost during procurement. The mean award growth is lowest for D-B-B projects and highest for CM/GC projects. The low award growth in D-B-B projects could be a result of more competition and agencies' use of historic unit pricing for estimates, whereas CM/GC uses negotiated pricing.

Conversely, CM/GC projects provide, over the course of the project, slightly more award certainty. Though no statistically significant difference in cost growth from the time of the award to the

final contract cost was found between any of the contracting methods, CM/GC did see the lowest growth—only 0.9%. In summary, agencies are expediting overall project delivery and gaining early cost certainty using alternative contracting methods without seeing additional cost growth.

As for change orders, no delivery method seems to be immune to the effect of unforeseen conditions. However, agencies could be transferring some risk to contractors through alternative

contracting methods, as reflected in the fewer change orders with CM/GC methods.⁹

Increases due to plan quantity changes, plan errors, and omission changes agree with what would be expected between delivery methods. D-B-B has the largest percentage of plan quantity changes, which is likely attributable to the designs being performed by the agency and the pricing being predominantly unit price. Plan errors and omissions are also highest in D-B-B.

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CONCLUSION

The information used to inform the PDSM provides an up-to-date perspective on the types of alternative contracting methods. Agencies are using alternative contracting methods on projects of all sizes to reap benefits, as illustrated by the high frequency of use of the CM/GC, D-B/BV, and D-B/LB methods on projects valued under \$20 million. Agencies are saving substantial time in project

delivery, with 40% to 60% savings over D-B-B average project durations. They are also greatly accelerating the point of cost certainty in the project development process. Contrary to intuition, the alternative contracting methods do not seem to have an impact on cost growth when compared to the traditional D-B-B method. With regard to project intensity, the alternative

contracting methods are facilitating project delivery at a faster pace in terms of the rate of resources invested in the project per day.

In summary, alternative contracting methods are shorter in duration, have an earlier cost certainty, and have a higher project intensity. In essence, agencies are getting more work in place with less disruption to the traveling public.

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1. Design-Bid-Build is the traditional delivery method where the agency contracts separately for design and construction services, the construction bid is based on complete (100%) plans and specifications, and design and construction occur sequentially. D-B-B is typically a unit-priced contract, but it can also include lump-sum items.
2. In Design-Build the agency contracts with one entity to complete both the design and construction of a project under a single contract, typically a lump sum with allowances or unit cost items to address risk. D-B has been implemented using various procurement approaches, including qualified low bid (LB) and best value (BV).
3. With a Construction Manager/General Contractor, the agency procures professional services on a qualifications or best-value basis from a construction manager during the design phase to offer suggestions on innovations, cost and schedule savings, and constructability issues. Upon completion of the design or individual design packages, the contractor and agency negotiate a price for the construction contract, and then the construction manager acts as a general contractor to complete construction. The contract can employ a guaranteed maximum price administered on a cost-reimbursable basis, unit price, or lump-sum contract.
4. Federal Highway Administration. (2015). *Every Day Counts, EDC-2 Final Report*, pp. 22-25 and 69-72, Federal Highway Administration, Washington, DC. Available online: <https://www.fhwa.dot.gov/everydaycounts/reports/edc-2-final-report/>, last accessed June 10, 2016.
5. Transportation Construction Management Pooled Fund. (2014). "Alternate Contracting Methods." (website) Available online: <http://www.colorado.edu/tcm/projects/alternate-contracting-methods>, last accessed October 11, 2016.
6. For a discussion of data collection and methodology, see "Alternative Contracting Method Performance in U.S. Highway Construction," FHWA Publication No: FHWA-HRT-17-100.
7. It should be noted that contractor design costs are included for the D-B projects; no design costs are included for the D-B-B and CM/GC projects.
8. Final project durations include all contractual changes and/or builder delays. Please note that the mean project duration is longer than the sum of the design and construction durations because procurement times and other agency administrative tasks are not shown. Additionally, note that construction duration for D-B projects includes design-builder design and construction duration (i.e., the D-B contract duration from award to completion).
9. It should be noted here that agency changes are not automatically bad. They can also have positive impacts on project goals. Negative impacts occur with incomplete scopes or lack of clarity in the RFP. Positive changes can add value to a project that was awarded below budget, as with more than half of the agency-directed change orders across the analyzed projects, projects whose initial award was lower than the engineer's estimate. In these instances, the changes could have added value to the project.

BRING THE PROVIDENCE LINE IN TO THE 21ST CENTURY

by Ari Ofsevit

PROBLEM STATEMENT

Providence is only 40 miles from Boston, but at rush hour, driving between the cities can take up to two hours, and the rail line between them hosts outdated commuter trains that are slow at peak hours and infrequent the rest of the day.

First opened in the 1830s, the railroad has been upgraded over the years: in the mid-20th century to remove roadway grade crossings, and in the 1990s when Amtrak upgraded the tracks and electrified the line to make it a high-speed corridor. Nearly two centuries after it opened, the Boston-to-Providence line is still in heavy use, Amtrak running fast, reliable, electrified service, with trains from Westwood to Providence averaging 102 mph, start-to-stop.

Yet the MBTA, which owns the railroad itself, does little to take advantage of operating in the fastest corridor in the country. Its

diesel trains are not only less reliable and more polluting than electrified trains, but considerably slower: some average only about 40 miles per hour over the same distance, and when they do reach their top speed, it's only 75 mph. Passengers board and alight via narrow, steep stairs, leading to long waits—called “dwell times”—and safety requires that each door be staffed by a conductor, resulting in an inefficient use of both equipment and people, and a failure to attract as many passengers as would

**DIESEL TRAINS ARE NOT
ONLY LESS RELIABLE AND
MORE POLLUTING THAN
ELECTRIFIED TRAINS, BUT
CONSIDERABLY SLOWER**



**THE BOSTON AND
PROVIDENCE RAILROAD,**
built the Canton Viaduct in 1835.

31 March 1977. American
Engineering Record,
HAER: MASS,13-BOST,83-7

otherwise ride transit if the trains were faster.

PROPOSED SOLUTION

The Caltrain line between San Jose and San Francisco is approximately the same distance as between Boston and Providence. It, too, has been operated in about the same manner for more than 150 years. Yet with growing congestion on parallel highways and increasing ridership, Caltrain made a decision to electrify the railroad, and buy newer, faster, more-efficient rolling stock. And they're doing it from scratch. Every catenary pole and electrical feed has to be installed and tested and every track at the terminal station needs electrification. Between Boston and Providence, the infrastructure is already built. It's just not fully used.

In addition to local-source pollution, diesel trains are limited in their acceleration and do not have top speeds as high as electric trains. Carrying a power plant on board, diesels are also significantly more prone to mechanical issues. In fact, the MBTA's diesel fleet breaks down between 10 and 50 times as often as electric commuter trains in other American cities¹.

Greater acceleration at low speeds and higher top speeds mean that an electric train cannot only go faster than a diesel, but it can attain that top

speed more quickly. If a diesel and an electric train pulled out of Route 128 at the same time, the diesel would arrive at Sharon in seven minutes, but the electric train in five.

At many stations, low-level platforms are still in use, as they have been since 1835. Every passenger getting on or off has to use a narrow, steep staircase to board or alight, which is much slower than stepping off onto a platform. The doors are operated manually, and regulations require that each pair of doors be attended by a crew member; so conductors keep half the doors shut even when hundreds of people wait to board. Combining electrification and level boarding would cut 15 to 20 minutes off the trip to Providence.

START-UP COSTS

Nearly all the physical infrastructure is in place. The right-of-way was built in the 1800s, roadway crossings removed in the 1900s (today it is the only MBTA Commuter Rail line with no grade crossings), the tracks upgraded for high speeds in the 1990s, and the electrification built around the same time. Only some minor modifications would be required.

The largest cost would be building new stations. Providence, Route 128, Back Bay and South Station already have level-boarding platforms

**COMBINING
ELECTRIFICATION &
LEVEL BOARDING
WOULD
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off the trip to
Providence**

that allow passengers to get on and off trains as if they were subways. The rest of the stations on the line, however, would need these platforms. These stations already have ramps to provide "vertical circulation" to keep passengers from crossing the high-speed tracks at grade; so the main cost would come from building the new platforms.² In addition to improving travel times, this would create a fully-accessible service for passengers with mobility needs.

New rolling stock would be required as well. The MBTA's fleet is relatively old, and some cars are downright ancient, dating to the 1970s. It's as if 15,000 commuters rely on a Dodge Dart to get to work every day. New trains acquired for operation on the Providence Line would allow

**GIVEN CURRENT
RIDERSHIP,
COMMUTERS
WOULD SAVE
A TOTAL OF
APPROXIMATELY
6,000 HOURS
OF TRAVEL TIME
PER DAY –**

**1/2
HOUR**

per commuter

its current equipment to move to the rest of the system or, for the oldest railcars and locomotives, be removed from the system altogether. Since the MBTA will need to acquire new equipment anyway, the net capital cost is at worst negligible and the long-term operating costs are quite favorable.

FUNDING SOURCES

When Caltrain wanted to electrify its main line, it used \$650 million in Federal Transit Authority money known as Core Capacity funding, reserved for existing fixed-guideway systems in corridors that are at or over capacity and where the project in question will increase capacity by at least 10%. This pot of money is only applicable to about half a dozen cities in the country. Since a portion of federal funds have been carved out for these sorts of projects—and the Bay Area has already applied this funding to a very similar corridor—there is no reason to believe the Providence Line would not be eligible.

PROJECTED OUTCOMES

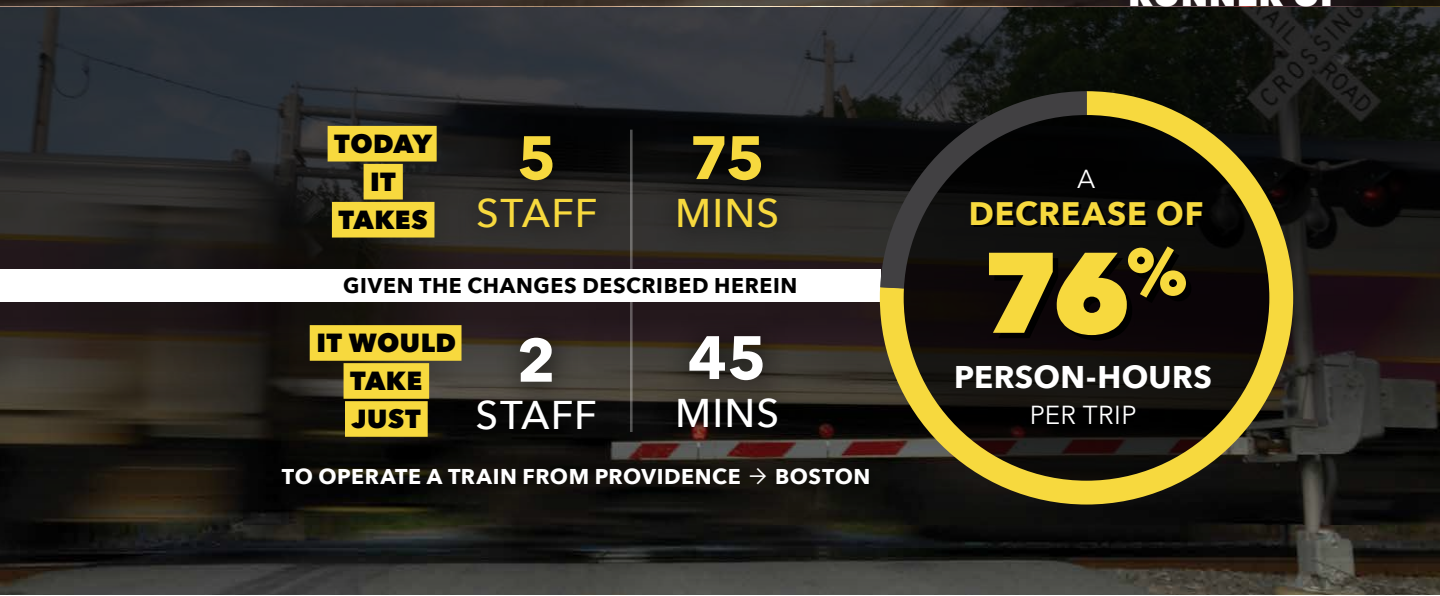
While the trains in use on the Providence line today are comparatively slow, they still provide a faster trip than driving. Given current ridership, commuters would save a total of approximately 6000 hours of travel time per day—more than half an hour

per commuter. If passengers value their travel time at \$15 per hour, this yields a net benefit of \$22.5 million per year, a benefit that would only increase as more commuters ditch their cars for a faster train.

As faster trains will draw more people out of their cars, service, as necessitated by demand, may need to be provided more frequently during both peak and off-peak hours. Will this cost more? Not necessarily. Faster service times allow the same number of staff and vehicles to provide more service, and will attract more passengers, resulting in increased fare revenue.

Today, the first train leaves Providence at 5:00 a.m. and arrives at South Station at 6:10. It turns around and heads back to Providence at 6:25, arriving there at 7:35, and leaving again at 7:50 to arrive back in Boston at 9:00. The "cycle time" from when it leaves a terminal to when it makes its second trip, is nearly three hours. Thus, this single train provides two rush hour trips in the peak direction. But the next train at 5:30 completes only one; its second trip wouldn't arrive in Boston until 9:30. So to provide eight trips to Boston during rush hour—approximately one every 30 minutes—current service requires seven trains, most of which then sit idle in Boston until the evening rush hour.

Now, imagine a train that makes the same trip in 45



minutes. This train would leave Providence at 5:00, arrive in Boston at 5:45, return to Providence by 6:45 and be ready for its next trip at 7:00. The next train, starting at 5:30, would be able to complete the 7:30 trip, and so forth. By 9:00, the same number of trips—one every half-hour—could be run with only four trains.

Finally, allowing passengers to board trains at high-level platforms would improve the efficiency of Commuter Rail staff. Today, a Red Line train with 1000 passengers requires one staff person. A Commuter Rail train with the same number of passengers requires five. When the Red Line train stops at Broadway or Harvard, it takes less than a minute for 400 passengers to board: 24 doors open, each door accommodating only 16 passengers with a step-free entry to the train. Yet a similar number of people boarding a Commuter Rail train requires four staff (plus the engineer),

boarding through eight narrow doors. The dwell time at the busiest Providence Line stations is four minutes, when those for a train with all its doors open and a level platform would be only one.

With off-board fare payment, a single conductor and single engineer could operate a Commuter Rail train. Today, it takes five staff 75 minutes—6.25 person-hours—to operate a train from Providence to Boston. Given the changes described herein, it would take just two staff 45 minutes to make the same trip—1.5 person hours, a decrease of 76% in person-hours per trip.

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2. Mansfield is a special case: it sits on the STRACNET military route which links Joint Base Cape Cod to the national rail network and would require significant changes to build new switches and bypass tracks to allow freight movements to pass a passenger track. Still, compared to the cost of building a high speed rail line, these costs are orders of magnitude less, and the benefits, in terms of passenger time savings, decreased highway congestion, and reduced operation costs, would pay dividends on the investment.

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BETTER MANAGING THE I-93 NORTHERN EXPRESSWAY HOV LANE

by Conrad Crawford

PROBLEM STATEMENT

Greater Boston has the worst traffic congestion in the United States.¹ The typical driver wastes more than \$2,200 each year stuck in traffic. Traffic is holding back our economy and hurting our quality of life.² According to recent polling from the MassINC Polling Group,³ two-thirds of drivers have rearranged their schedule to try to beat traffic, and about one-third have considered leaving the region entirely because of their frustration with our transportation system.

Interstate 93's "Northern Expressway" was completed in 1973. The highway bisects Medford, Somerville, and Cambridge, north of Boston. Originally envisioned to accommodate just 45,000 vehicles per day each way,⁴ it now carries on a typical weekday between 75,000 and 85,000 in each direction.⁵ Average daily traffic counts have grown by more than 25% since 2012.

Research shows that burning gasoline and diesel fuel releases particulate matter, nitrogen oxide, carbon monoxide, and volatile organic compounds.⁶ This tailpipe exhaust increases risks of cancer, asthma, heart disease, and pre-term births. People living within 1,000 feet of a highway are most at risk, but vehicle emissions can travel up to a mile away. Traffic congestion compounds the negative impacts, and residents of Medford, Somerville, and Cambridge bear the greatest risk.

In addition to creating public health problems, Boston's congested highways contribute to climate change. Transportation is the largest source of greenhouse gases of any sector of the Massachusetts economy, comprising more than 40% of total emissions. Idle car engines also contribute heat to already warming urban climates.

Since the late 1990s, the Northern Expressway has included a 2.6-mile High-Occupancy-Vehicle (HOV) lane in its southbound direction. The lane starts in Medford and is physically separated from the general lanes until the Zakim Bridge in Cambridge. On weekdays from 6:00AM to 10:00AM, the lane is reserved exclusively for vehicles with at least two occupants (HOV2+). Outside of those hours, it serves as a general-purpose lane open to all. The HOV lane is enforced by State Police.

Because of the higher occupancy per vehicle, the HOV lane moves more people, in fewer vehicles, than general-purpose lanes during peak periods. The latest analysis shows that the HOV lane moves an average of 2,250 people per hour, with vehicles taking about three minutes to traverse it. Each general-purpose lane

moves an average of 1,500 people per hour, with vehicles taking about ten minutes to go the same distance.⁷ The HOV lane is working.

However, the lane is still “underutilized” in that it could accommodate some additional vehicles without degrading the speed and experience of existing HOV users. Because of this underutilized capacity, in May 2019, MassDOT decided to temporarily eliminate the HOV lane and open it to general-purpose traffic at all times, arguing that this capacity could be used by commuters avoiding the Tobin Bridge’s active construction zone. This action, however, seems to run contrary to a key recommendation of the Governor’s Commission on the Future of Transportation: that the state needs to focus on moving more people, not more vehicles.⁸

MassDOT is right to identify the HOV lane’s extra capacity as an opportunity, but the agency’s decision to eliminate the lane squanders that opportunity rather than leveraging it. Now that it is open to all vehicles, the lane will likely become oversubscribed by the crush of single-occupancy vehicles using I-93.⁹

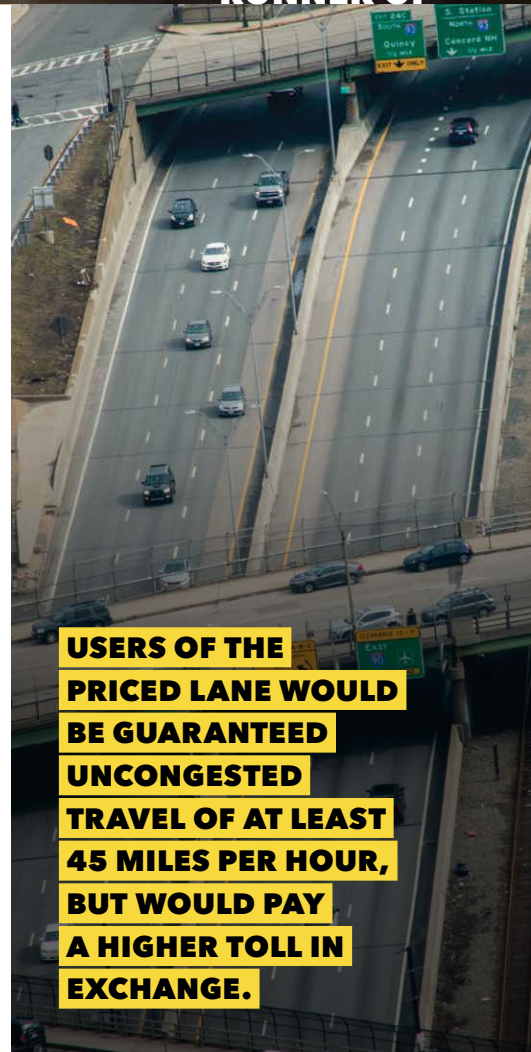
PROPOSED SOLUTION

Dynamic road-pricing is a market-based reform of a poorly utilized public asset.

Converting the I-93 Northern Expressway’s 2.6-mile HOV lane to a dynamically-priced Tolerated Express Lane at some or all hours of the day would ensure the free-flow of vehicles. At times when the general-purpose lanes are congested, users of the priced lane would be guaranteed uncongested travel of at least 45 miles per hour, but would pay a higher toll in exchange. At times of less congestion, the HOV lane price would go back down. MassDOT could choose one of two options:

Option 1: Full conversion to a 24/7 Tolerated Express Lane, eliminating accommodations for high-occupancy vehicles:

This would be the simplest option from an operational perspective and might deliver greater benefits, though it would represent the more radical shift from past practice. Under this option, the exclusive availability for HOV2+ from 6:00AM to 10:00AM on weekdays would be eliminated. Instead, any and all vehicles choosing to pay a variable toll to use the lane would be allowed to do so. Drivers would be guaranteed a fast trip on the Express Toll corridor, but in exchange would pay a rate that fluctuates depending on real-time demand. The lane would operate 24 hours a day, 365 days a year. Prices would be low (perhaps a minimum of \$0.25 for the 2.6-mile trip) during off-peak periods, but increase



significantly during busy rush-hour periods when the demand for the road is high.

Option 2: Conversion to a Tolerated Express Lane outside of existing HOV2+ hours:

This option would preserve the exclusive reservation of the lane for HOV2+ vehicles from 6:00AM to 10:00AM on weekdays, consistent with MassDOT’s long-standing practice. But outside of those hours the existing “free” lane would convert to a tolled express lane for all vehicles (with no preference for HOV2+

at these times). This option would be somewhat more operationally complex, as it would require strong and clear communications with drivers about whether the lane was “available” for non-HOV vehicles. However, enforcement would be similar to what it is today, and it would remain open to all vehicles for the 20 hours each weekday outside of morning rush-hour (as long as drivers are willing to pay the toll).

There are many examples across the country of state departments of transportation converting existing HOV lanes into Tolloed Express Lanes. The Federal Highway Administration (FHWA) has approved at least eight HOV conversions in the last few decades, including in California, Colorado, Florida, Minnesota, Texas, Utah and Washington.¹⁰

START-UP COSTS

The costs of a well-run electronic tolling system are negligible compared to those of constructing new highway capacity. Using FHWA data¹¹ to calculate capital and operating costs for converting the HOV lane to a tolloed express lane, rough estimates show that conversion will generate sufficient revenue to offset the capital and operating costs of the project. The table below lays out estimated capital costs, operating costs,

and revenue for Option 1 (full conversion to a 24/7 Tolloed Express Lane). These estimates indicate that the priced lane could produce an operating surplus of \$1.6 million per year, providing MassDOT a roughly two-year payback period on its capital costs. Option 2 would have similar capital and operating costs, but would produce less revenue, and would have a longer payback period. Both options would be integrated into the state’s existing EZ Pass and open-road-tolling systems.

CAPITAL COSTS

CONSTRUCTION (E.G., OVERHEAD GANTRY, ELECTRONIC SIGNS, NETWORK EQUIPMENT, FIBER AND WIRING)	\$1,500,000
DESIGN & ADMINISTRATION	\$300,000
SYSTEM STARTUP COSTS	\$1,500,000
TOTAL CAPITAL COSTS	\$3,300,000

NET OPERATING REVENUE/COSTS

AVERAGE TRANSACTIONS PER DAY	15,000
AVERAGE REVENUE PER TRANSACTION	\$0.50
AVERAGE TRANSACTION COST (E.G., PROCESSING, ADMINISTRATION, POSTAGE)	\$0.15
NET REVENUE PER TRANSACTION	\$0.35

Once up-and running, the priced lane would be among a small number of MassDOT programs producing revenue in excess of costs. These revenues would pay back startup costs of less than \$4 million, which could come from MassDOT’s \$18 billion five-year capital plan.

LEGISLATION AND REGULATION REQUIRED

MassDOT would need to receive approval from FHWA and the Massachusetts Department of Environmental Protection. However, the recent change in the status of the HOV2+ lane demonstrates regulatory feasibility.

Converting to a tolloed express lane would also likely require state legislation, both to enable or mandate the new toll and to specify the uses of any net revenue. This could either be done as a standalone “session law”, or as a change to Section 13 of Chapter 6C of the General Laws.

PROJECTED OUTCOMES

First, by efficiently moving vehicles at a consistent speed, the Tolloed Express Lane would improve traffic flow and reduce

congestion for commuters and other road users. Second, improved traffic flow will reduce air pollution in communities that have long borne the brunt of tailpipe emissions.¹² Third, the use of pricing to manage demand for other state roads, bring MassDOT more in line with peer agencies, and build the necessary institutional expertise.

A successful pilot would advance the road-pricing conversation. Conservative thinkers have long-supported road pricing because it is a market-based reform of a poorly-managed government resource, the public right-of-way. In 1993, the Reason Foundation wrote, “A consensus is emerging among transportation economists that the best way to deal with freeway congestion is to charge for driving during peak hours...[a Tolled Express Lane] would utilize more of the lane’s capacity, demonstrate congestion pricing on a wide scale, and generate revenues.”¹³ More recently, progressive advocates have begun to rally around road pricing for its justice and environmental benefits.¹⁴

Finally, the net revenue generated could mitigate the detrimental effects of I-93 on nearby neighborhoods by enabling investment and improving equity. For example, net revenue could be used to

fund public transportation, biking, and walking improvements in Medford, Somerville, and Cambridge, options that could be used by residents and commuters alike. Revenue could also be used to fund investments to grow and maintain urban tree canopy or high performing green infrastructure that filters harmful pollutants and improves local air quality.

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NORTH STATION SEAPORT FERRY

by Erin Anderson

PROBLEM STATEMENT

The Seaport District has in the last two decades been one of Boston’s fastest growing neighborhoods. However, development has generated an acute need for more transportation. In the South Boston Waterfront Sustainable Transportation Plan (“the Plan”), released in 2015, access to the Seaport District from North Station was highlighted as a critical need.

Several large employers in the area have in the past attempted to address the issue by providing shuttle-bus service for employees, but the cost was prohibitive and led to increased traffic. One solution was to consolidate employer-operated shuttle service between North Station and the Seaport District, which was done in 2015, operated by the Massachusetts Convention Center Authority (MCCA). However, the Plan also set a long-term goal to transition from shuttle buses to ferry service on the underutilized Boston Harbor.

A 2017 study funded by MassDOT and DEP analyzed potential dock locations and route options to operate a ferry between Lovejoy Wharf at North Station and Fan Pier

in the Seaport District.¹ A subsequent business and implementation plan was funded by A Better City, Fan Pier Owners Corporation, PricewaterhouseCoopers LLP, WS Development, the Seaport TMA, Skanska, Vertex Pharmaceuticals, Fidelity, and John Hancock. The result—the Seaport Ferry—is a public-private partnership: companies cover service costs while administrative and operational responsibilities are managed by the MCCA.

Analysis included two options for service: a two-vessel option with ferries running every 20 minutes and a bus at alternating 20-minute intervals for an overall service frequency of every 10 minutes, and a three-vessel option running every 15 minutes. Both would operate between 6am–9am and 3:30pm–7pm.² Ultimately, based on the bids received and feedback from the funding companies, the two-vessel option was selected,

**THE SEAPORT DISTRICT...
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A COMFORTABLE, RELIABLE TRIP

JUST 14 MINS

FROM NORTH STATION → THE SEAPORT DISTRICT

but the alternating service with the shuttle was removed from the plan.

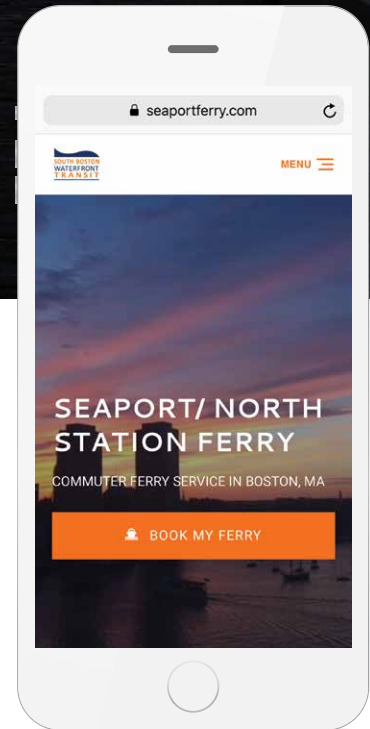
The fees charged to participating companies are based on percentage of ridership. During shuttle-bus service, riders were allowed on by showing their corporate ID and ridership was tracked by what stop in the Seaport riders were using, as most of the larger companies had dedicated drop-off locations. Since ferry service has a single stop, it is necessary to establish which riders are coming from the respective companies via a mobile-app for ticketing.

Ferry service began in January for corporate employees and opened to the general public in February, which had been part of the plan from the outset. The ferry costs \$5 for the public to ride. The final cost of the winning bid was \$2,275,380, which included start-up costs for the boats, website, app for riders, and staffing and administrative

costs incurred by the MCCA.

By taking individual companies' shuttles off the road, the ferry reduces traffic congestion and mitigates the impact of air pollution. For riders, the service provides a comfortable, reliable trip of just 14 minutes from North Station to the Seaport District.

If participating companies continue the service, next steps will include recruiting new companies to increase ridership and, in turn, decrease member fees, and potentially integrating the Seaport Ferry's payment system with the MBTA to allow commuters to travel seamlessly between the two modes.



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INNOVATIVE APPROACHES TO IMPROVING PEDESTRIAN SAFETY

by Wendy Landman

WALKBOSTON

In 2018, 72 pedestrians were hit and killed in Massachusetts. In Boston alone, almost 700 pedestrians were injured as a result of traffic crashes. In addition to these alarming statistics, a robust body of research documents walking's benefits for personal, economic, environmental, and civic health, further building the case for enhancing the walkability of the Commonwealth's communities. For instance, a 2013 study in the academic journal, *Cancer Epidemiology, Biomarkers, and Prevention*, found that walking at least 7 hours per week is associated with a 14% lower risk of developing breast cancer after menopause.

In light of the many benefits that come from improving walking conditions, municipal staff who have spent years trying to solve transportation problems by adding roads and parking, now need help reclaiming their streets as multi-modal places that serve pedestrians alongside bicycles, buses, and cars. Local organizations and residents also seek technical assistance to enhance the walkability of their communities.

WalkBoston's technical assistance, advocacy, and education initiatives increase pedestrian safety and advance the work of achieving walkable communities across Massachusetts. WalkBoston was founded in 1990 as the first pedestrian advocacy group in the country. During

the last decade, WalkBoston has developed the capacity to provide technical assistance to grassroots organizations and municipal and state staff.

WalkBoston maintains strong relationships with city and state transportation, environmental, and public safety officials. WalkBoston's approach to effecting change combines working from "inside" to improve state and municipal policies and programs, with building a cohort of effective and committed community voices to press for improvements from the "outside."



**IN BOSTON ALONE,
ALMOST 700
PEDESTRIANS WERE
INJURED AS A RESULT
OF TRAFFIC CRASHES.**

A key goal for WalkBoston is to reduce pedestrian injuries and fatalities across the state by:

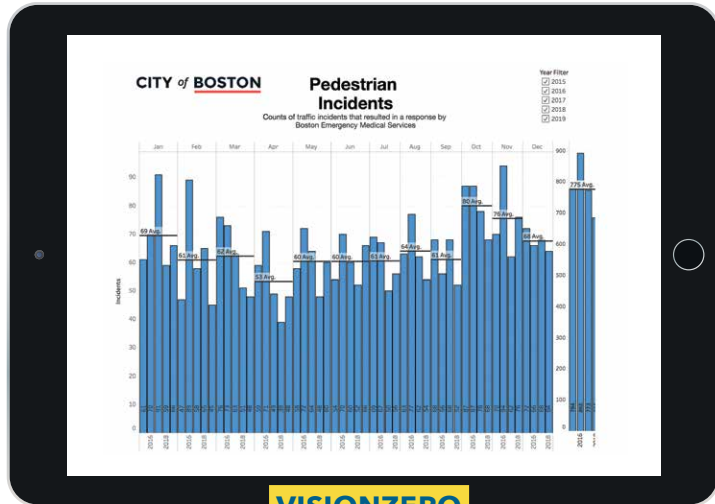
- ▶ Developing strategies for Massachusetts’ communities beyond Boston, Cambridge, and Somerville to adopt data-driven approaches to improving safety modeled on Vision Zero¹.
- ▶ Addressing signal timing in Boston and other Massachusetts municipalities.
- ▶ Conducting walk audits in high-crash locations to identify built-environment improvements to reduce crashes and enhance pedestrian safety.

Another focus of WalkBoston’s work is influencing design and policy on the state and local levels by:

- ▶ Strengthening advocacy in communities outside metro Boston.
- ▶ Promoting legislation, regulation, and funding to improve walking.
- ▶ Reviewing and influencing transportation and development proposals.

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1. Vision Zero is a multi-national road traffic safety project that aims to achieve a highway system with no fatalities or serious injuries involving road traffic. See <https://www.boston.gov/transportation/vision-zero> and <https://visionzeronetwork.org/>



VISIONZERO

<https://dashboard.cityofboston.gov>

WalkBoston is also focused on fostering policies and practices that increase pedestrian safety for children and older adults by:

- ▶ Implementing policy and built-environment changes to support Age-Friendly Communities in Massachusetts’ cities and towns.
- ▶ Continuing built-environment improvements near schools to enhance “walk to school” efforts.
- ▶ Broadening the reach of walkable school-campus design principles.

Lastly, WalkBoston works to ensure safe access to transit across the state and promotes walkability in rural communities.

While almost everyone is a pedestrian, walkers do not have a natural way to organize and voice concerns about safety, accessibility, and the quality of their community’s built-environment. WalkBoston strengthens local voices, convenes municipal staff and concerned community residents, and advocates for the rights of pedestrians across Massachusetts.

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GOMENTUM STATION & SHARED AUTONOMOUS VEHICLES

by Randell H. Iwasaki & Contra Costa County - Planning

CCTA

Founded in 2014, GoMentum Station is a 5,000-acre miniature “city,” a partnership between the Contra Costa Transportation Authority (CCTA) and the City of Concord, to repurpose the decommissioned Concord Naval Weapons Station as a site for testing autonomous and connected vehicles and smart infrastructure, including hands-off-wheel, feet-off-pedal capabilities; smart cars that communicate with each other and their surroundings; and driverless, shared electric autonomous vehicles.

At GoMentum Station, CCTA partners with infrastructure owners/operators, local jurisdictions and transit agencies, vehicle manufacturers, in-vehicle and roadside equipment vendors, technology companies, and academia to study infrastructure, connected vehicles, autonomous vehicles, and other innovative applications.

**ZERO-EMISSION,
LOW-SPEED
AUTONOMOUS
SHUTTLES HAVE THE
POTENTIAL TO EASE
CONGESTION,
REDUCE EMISSIONS,
& PROVIDE ACCESS
TO TRANSPORTATION
HUBS THROUGHOUT
CONTRA COSTA
COUNTY.**





Photos left & right: <https://gomentumstation.net/about/>

Recently acquired by AAA of Northern California, Nevada & Utah, GoMentum Station gives partners space to test new technology in a setting that includes:

- ▶ 20 miles of roadway with a wide array of pavement textures, from the recently refinished to 40-year old pavement and striping;
- ▶ The infrastructure of a typical city—buildings, parking lots, stop signs, sidewalks, curbs, gutters, and striping—plus more complex elements such as bridges, undercrossings, railroad crossings, cattle guards, profile and elevation changes, and curvilinear alignment.
- ▶ A large grid of streets with sections striped according to US standards and, in the future, according to European and Asian standards.
- ▶ Long straightaways to test at high speeds.
- ▶ Twin-bore 1,400-foot long tunnels—with diameters of 14 feet, 3 inches—cut through a hillside to test in a scenario that lacks GPS reception.

In 2016, the California State Legislature passed Assembly

Bill 1592 to allow CCTA to pilot a program to integrate electric autonomous, shared shuttles with public transit. The shuttle was tested at GoMentum Station.

The shuttle selected for the pilot is manufactured in France by EasyMile. CCTA was the first agency to bring it to North America, going through the U.S. Department of Transportation's National Highway Traffic Safety Administration (NHTSA) process to obtain a waiver from the Federal Motor Vehicle Safety Standards—required because the vehicle was not made by a traditional automobile manufacturer, and was heavier than a golf cart—to test the vehicle on public roads.

After successful testing at GoMentum Station and in parking lots at Bishop Ranch Business Park in San Ramon,

California, CCTA advanced to testing on public streets, which required permission from NHTSA and the California Department of Motor Vehicles. Permission was granted in early 2018, and by March the EasyMile shuttle was traveling public streets within the Bishop Ranch business park. It marked the first time the California Department of Motor Vehicles allowed a shared autonomous vehicle to travel on public roads in the state.

Zero-emission, low-speed autonomous shuttles have the potential to ease congestion, reduce emissions, and provide access to transportation hubs throughout Contra Costa County. CCTA's vision is for the shuttles to serve as a complement to existing public transit infrastructure, not as a replacement. In surveys, county residents say they want to use public transit, but often do not because the bus stop is too far from their house, or by the time they arrive at the train station the parking lot is full. CCTA can eliminate those barriers by deploying automated shuttles to provide Mobility-on-Demand for first-and-last mile trips to transit.

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TASK FORCE ON REGIONAL TRANSIT AUTHORITY PERFORMANCE & FUNDING

by Astrid Glynn

PROBLEM STATEMENT

Outside Greater Boston, 15 Regional Transit Authorities (RTAs) provide public transportation to Massachusetts residents. For those who must rely on public transit, RTAs are often the only option. However, RTA ridership declined by 9% from 2016 to 2018. A host of factors—shifting demographics, climate change, new travel options such as Uber and Lyft, higher levels of automation, telecommuting and e-commerce—create uncertainty about the future of mobility.^{1,2} To thrive RTAs not only need stable funding sources but must find ways to improve and innovate.

PROPOSED SOLUTION

The Massachusetts Legislature created a Task Force on Regional Transit Authority Performance and Funding to investigate challenges and opportunities facing RTAs.

SPECIFICALLY HOW TO:

- ▶ Provide service that meets identified community needs;
- ▶ Conduct service planning to maximize ridership using available resources; and
- ▶ Ensure fares, local contributions, and other revenues cover an appropriate share of costs.

THE NEWLY OPENED SPRINGFIELD UNION STATION

8 February 2018, Source: own work, by Newflyer504, License: <https://creativecommons.org/licenses/by-sa/4.0/deed.en>



The Task Force's recommendations³, across five categories, included:

Investment and Performance

RTAs should receive predictable increases in state operating assistance starting in 2020, but also be required to adopt performance targets for ridership, customer service and satisfaction, asset management, and financial performance.

Accountability

RTAs should report on recommended metrics quarterly to MassDOT, and MassDOT and the RTAs should reinvalidate an existing legally required body, the RTA Council, to sustain the momentum of the Task Force.

Service Decisions

RTAs should periodically update their Comprehensive Regional Transit Plans to identify where riders are, target expansion to demonstrated need, and identify partnerships. The Task Force recommended pilot programs to test innovative transit delivery models, increase cross-border services for communities that sit on the border of two RTAs, enhance access to rural services, improve the reliability of paratransit service, and adopt fare policies that include regular, equitable, and modest fare adjustments.

Quality of Service

To improve the transparency of decision-making, RTAs should use social media to increase feedback and include the public in planning new projects, fare changes, and service expansion and redesign, and maximize multi-modal connectivity to cut travel times for commuters.

Environmental Sustainability

The RTAs and MassDOT should collaborate to determine the mode shift that will help Massachusetts meet its goal to reduce greenhouse gas emissions (GHG) 40% by 2040. The Task Force urged RTAs to change to purchasing zero-emission buses by 2035.

OUTCOMES

At the time of the Task Force's final report, the House and Senate were preparing for the budget cycle. The Commonwealth of Massachusetts has since passed the Fiscal Year 2020 Budget Act which became law on July 31, 2019. The

resulting increase in RTA funding requires the RTAs to establish performance metrics, baselines and targets in a Bilateral Memorandum of Understanding with MassDOT. Additionally, acting on the recommendation to reinvalidate the RTA Council, MassDOT convened the first meeting on April 30, 2019.

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MOBILITY DATA FROM METROTECH

by Christian Kotscher

PROBLEM STATEMENT

Lack of accurate, timely data feeds congestion.

Most signal-timing systems are not driven by real-time traffic measurements. Precise data is unavailable and predictive data based on historical averages, not accurate trends.

Yes, state and local governments are investing in fiber networks and deploying more sensors and cameras. But even if a single metro entity did deploy a cloud-based Internet of Things (IOT) exchange to store and analyze the data, the system would not include data from surrounding jurisdictions. The problem, then, is both lack of data and siloed data.

SOLUTIONS

Connected/Autonomous Vehicles (CAVs) will require better information to increase safety and efficiency. Sensors will need to be synchronized to coordinate with mobile devices in both time and location. The type of coordination required will encompass whole ecosystems. The solution MetroTech suggests is about

organizational innovation as much as technological application. The theory that unites the following solutions, some of which MetroTech already deploys, is that many sensors will need to be integrated across multiple systems. Wireless, cloud computing, IoT, Big Data, etc., will all have to be incorporated into the infrastructure to keep up with the hyper-evolving CAV industry.

1 - Leverage Existing Infrastructure for Better Signal Timing

To date roadside video is used to see what happened, not help predict what will happen. Santa Clara County (CA) has over 500 cameras producing more than 700 Terabytes of video daily. The MetroTech RTT server analyzes the video, producing real-time traffic counts and speeds to change signal-timing patterns.

2 - Traffic Safety Alerts

The start of congestion after an accident, or a hazard like

Santa Clara County (CA) has over 500 cameras producing more than 700 Terabytes of video daily.

THE METROTECH RTT SERVER ANALYZES THE VIDEO, PRODUCING REAL-TIME TRAFFIC COUNTS AND SPEEDS TO CHANGE SIGNAL-TIMING PATTERNS.

a wrong-way driver, is best captured and measured by sensors in the infrastructure. MetroTech has deployed pilots where existing cameras were used for identifying suspected wrong-way drivers. The data were processed to avoid false alarms, confirmed wrong-way drivers tracked by other nearby cameras, and safety alerts sent to connected vehicles and apps to warn drivers or autonomous vehicles. Following the example of Amber Alert, MetroTech's solution could broadcast wrong-way driver alerts, road closures, evacuation instructions, and other information to mobile devices or connected vehicles in an affected area.

3 - The Digital Streets Platform (DSP)

MetroTech's DSP, functioning regionally, will ingest IOT data from multiple infrastructure owners through a transparent information exchange. The sensor data will be normalized and analyzed before being broadcast over various networks to both drivers and autonomous vehicles as maps or as dashboards that can depict lane-level volume, speed, and headway. The network types include V2X, CV2X, and Satellite.

4 - The Autonomous City Safety Network (ACSN)

The ACSN is the suggested name for a nationwide network that would take

information from exchanges, such as the Digital Streets Platform, and put it into a standard that all CAVs could access, allowing vehicle makers and app developers to share data.

5 - CAV Data Subscriptions

CAVs, smart fleets, and apps will be enhanced by subscribing to infrastructure data. Audi already has a type of subscription service that allows their connected cars to communicate with infrastructure.

6 - Pedestrian Safety

CAVs have blind spots that infrastructure could illuminate. Let CAVs navigate with assistance from infrastructure. MetroTech's pedestrian safety solution uses LiDAR (Light Detection and Ranging) sensors to pinpoint pedestrians to a 10-centimeter accuracy 10 times per second. A pedestrian's path is followed as an object and their predicted path is then converted into exact GPS coordinates. The information

**METROTECH'S
PEDESTRIAN SAFETY
SOLUTION USES LIDAR
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RANGING) SENSORS TO
PINPOINT PEDESTRIANS
TO A 10-CENTIMETER
ACCURACY 10 TIMES
PER SECOND.**

is then sent to devices on vehicles five times per second, using the US DOT's V2X standard on a 5.9GHz local network.

CONCLUSION

The emerging era of connected and autonomous driving will demand accurate, real-time information that cannot be estimated from GPS probes. Life-saving applications and greater harmonized driving will require that the "Autonomous City" can communicate with pedestrians and vehicles moving around its streets.

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TRUCK PLATOONING WITH PLATOONPRO

by Stephen Boyd & Amanda F. Anderson, Peloton Technology

PROBLEM STATEMENT

Typical trucking operations have slim margins (an average of 6% in 2017¹), high fuels costs (fuel comprised \approx 22% of total costs for an average trucking company in 2018²), and the need to ensure safety (the number of large trucks involved in fatal crashes increased 10% from 2016 to 2017³).

Driver-Assistive Truck Platooning (DATP) can make trucking safer and more fuel efficient. DATP uses electronic vehicle-to-vehicle communication to connect advanced safety systems between pairs of trucks, allowing them to accelerate and brake as a single system, while reducing fuel consumption through safe aerodynamic drafting. The connected safety systems allow for a small gap between the two linked trucks—less than 60 feet. Similar to Adaptive Cruise Control, the follow truck driver has hands on the wheel and eyes on the road, but feet off the pedals. The lead driver continues to drive normally, controlling the platoon’s speed, and benefiting from collision avoidance always monitoring the road ahead.

Peloton Technology, Inc. has developed PlatoonPro, a DATP system that links pairs of heavy trucks for connected driving. When the lead truck brakes, the follow truck responds automatically in approximately one tenth of a second, significantly faster than a human driver’s reaction time. Peloton’s cloud-based system pre-maps a network of approved roads for platooning which includes multi-lane, divided, limited access highways. Platooning is automatically disabled outside this geofenced road network including in unsuitable platooning areas such as construction zones or on lower capacity bridges. Trained drivers can also relay safety information or coordinate lane changes through a dedicated push-to-talk radio link and a real-time video feed of the roadway ahead.

A CON-WAY STUDY

FOUND A

71%

**REDUCTION
IN
REAR-END
COLLISIONS**

for trucks equipped
with FCAM⁴



Fuel efficiency benefits of Peloton's PlatoonPro average approximately 7.25%. Analysis has shown a 10% fuel savings for the follow truck and 4.5% fuel savings for the lead truck at a 40-foot gap and 65 mph⁴, bringing with them corresponding reductions in carbon emissions and other air pollutants.

Safer than average American commercial trucks, platooning trucks are built on top of leading active truck safety technologies, including radar-based Forward Collision Avoidance Systems (FCAM) with Automatic Emergency Braking, Electronic Stability Control, Tractor Air Disc Brakes, and Trailer Anti-lock Braking Systems. These systems can dramatically reduce the frequency and severity of truck rear-end collisions—a Con-way study found a 71 percent reduction in rear-end collisions for trucks equipped with FCAM⁵—but can cost thousands of dollars upfront. DATP's fuel savings provide an economic incentive for fleets to adopt these platoon-required advanced safety features.

State following-distance laws can pose a barrier to commercial deployment of truck platooning. In about half of all U.S. states, a numeric following-distance for commercial vehicles—ranging from 100 to 500 feet—is found in statute, most based on an assessment of the ability of human-only driving

operations. A uniformity of state following-distance laws would allow for DATP and help to optimize interstate commerce. The U.S. National Renewable Energy Laboratory determined that $\approx 65\%$ of total miles driven by commercial trucks could be in platoon formation⁶. Higher utilization rates are expected for long/regional haul trucks that operate mostly on-highway. If remaining state close-following statutes are revised to consider DATP, states could see significant safety and environmental benefits. Concurrently, freight carriers' cost of moving goods would decline, with savings potentially passed on to consumers.

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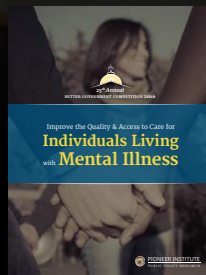
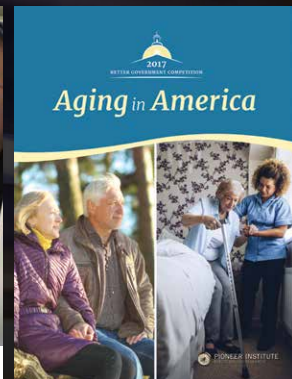
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Pioneer Institute's Better Government Competition, founded in 1991, is an annual citizens' idea contest that seeks out and rewards the most innovative public policy proposals. The Competition grand prize winner receives \$10,000; four runners-up receive \$1,000 each, and other proposals receive special recognition. Recent winners have included proposals on pension reform, virtual schooling, job training, housing, and many other pressing topics.

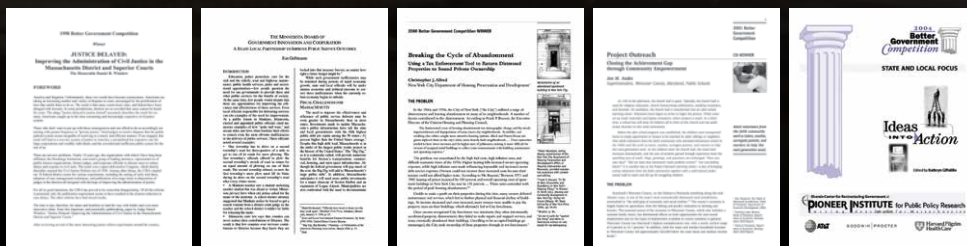
HISTORY

- 2018 Making Higher Education & Career Training Options Affordable & Effective
- 2017 Aging in America
- 2016 Improving Care for Individuals Living with Mental Illness
- 2015 Fixing Our Troubled Justice System
- 2014 Leveraging Technology to Improve Government
- 2013 Revving Up the Great American Job Engine
- 2012 Restoring Federalism





- 2011 20th Anniversary - Budget Busters
- 2010 Governing in a Time of Crisis
- 2009 Health Care Reform
- 2008 Sustaining School Reform
- 2007 Improving Government at the State and Municipal Levels
- 2006 15th Anniversary - Better Government Competition
- 2005 Streamlining Government
- 2004 State & Local Focus
- 2003 Innovative Ideas on Key Public Issues
- 2001 Law Enforcement, Education, Housing, Family Preservation
- 2000 Ideas Into Action
- 1999 A Wise & Frugal Government
- 1998 Streamlining Government
- 1997 Bringing Competition to State & Local Government
- 1996 Public Safety & Fight Against Crime
- 1995 Local Solutions to Public Problems
- 1994 Welfare in Massachusetts
- 1993 Improving Policies & Programs Affecting Children
- 1992 Improving Environmental Policies & Programs
- 1991 Restructuring/Privatizing State Operations



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