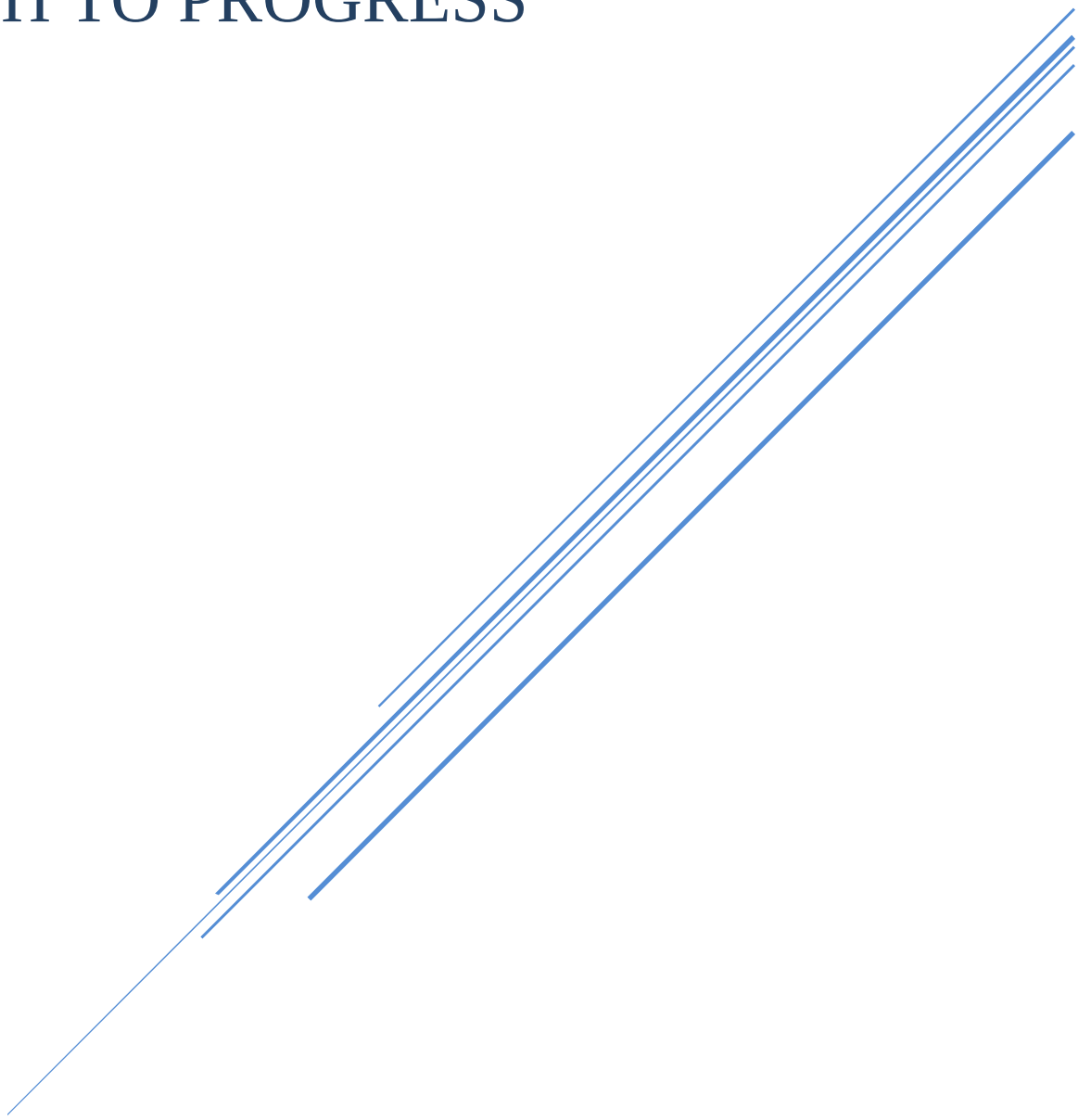
Massachusetts Taxpayers Foundation

THE FUTURE OF TRANSPORTATION: PAVING A PATH TO PROGRESS



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WHAT'S FIXED? WHAT'S NEXT? WHAT'S THE GOAL?

Introduction

In its recently released report on capital spending, *A Capital Primer*, the Foundation contrasted the development of the annual capital budget with the state's operating budget. As noted in the report, there are two key distinctions between the operating and capital budgets. The first pertains to the relative lack of transparency for what receives funding in the capital budget and the second relates to resource constraints that limit the size of the operating budget that do not necessarily apply to capital spending.

Against that background, the Foundation focuses this report on the capital financing of transportation. More specifically, MTF takes a critical first look at the two most important questions facing the transportation capital spending plan:

- How does the state decide which projects to fund? and
- How well does the state manage the spending of those scarce dollars?

With limited resources and a seemingly unending list of capital needs, these two questions determine where and how well the state can fix the transportation infrastructure.

The purpose of this report is twofold. First, it aims to provide business leaders, lawmakers, policymakers, and advocates with a clearer sense of the recent progress made in developing and managing the capital plan. Second, it highlights the critical areas that if left unaddressed, will lead to further deterioration of the transportation system.

The report is organized into three sections. It begins with a breakdown of the sources and uses of funds; that is followed by a review of the selection process for project inclusion in the capital plan. The last section of the report then describes some of the daunting obstacles confronting MassDOT

and particularly the MBTA and analyzes the agencies' capacity and capability to fix and maintain the transportation infrastructure. This report is intended to lay the foundation for subsequent discussions about the best plan of action to move MassDOT and MBTA forward.

In all, the state plans to spend $14.46 billion of the $15.4 billion in available resources ($9.1 billion from MassDOT sources and $6.3 billion from MBTA sources, Tables 1 and 2) over the next five years. It is noteworthy that the FY 2017 - FY 2021 CIP begins at the same point as the state's operating budget – a rigorous calculation of available resources that limit the size of the spending plan.

Sources and Uses of the FY 2017 – FY 2021 Capital Investment Plan:[1]

The Baker Administration released a draft of its five-year transportation capital investment plan (FY2017-FY2021) for public comment this past spring. Of the many changes made to the CIP development process, the most significant might be its starting point – documenting five years of reliable sources of revenues before selecting projects to fund. This tying of proposed investments to identified resources is a smart and pragmatic budgeting policy, and a refreshing change. It also contrasts greatly from recent transportation CIPs which have been somewhat 'aspirational' in nature, including an assortment of popular projects for which funding was unidentified and uncertain, making expectations unrealistic.

The challenge of quantifying available funds for the next five years was made easier by passage of the federal *Fixing America's Surface Transportation (FAST) Act* in late 2015. FAST is the first long-term authorization of federal transportation funds in more than a decade and provides predictability and stability for transportation agencies across the country. States now have realistic assurances of federal funds available for the five-year period covered by the FY 2017 – FY 2021 CIP.

As the two largest areas of spending, MassDOT and the MBTA are good starting points for examining capital spending. The Massachusetts Department of Transportation (MassDOT) accounts for 55 percent of the $14.46 billion total FY 2017- FY2012 CIP, or $8.1 billion. The MBTA receives $6.3 billion.

MassDOT Sources of Funds

Of the $9.1 billion in available MassDOT funds, $8.4 billion or 93 percent are from 'known sources' or sources for which there is a high degree of certainty. These include $3.7 billion from

[1] Data on sources of funds is from the Draft FY 2017 – FY 2021 CIP issued for public review on April 11, 2016, pages 131 – 132.

the state's bond cap; $3.3 billion in new and existing federal funds[2]; and over $800 million in projected tolls and reserves. Another $661 million are characterized as 'estimated sources' because they come with a greater degree of uncertainty. These include (Table 1) revenues from the Central Artery Trust Fund ($353 million) the use of which must be approved by the Federal Highway Administration (FHWA); federal competitive grants ($150 million), and gaming revenues ($125 million).

Table 1 – MassDOT Sources of Capital Funds[3]
($ millions)

MassDOT	FY 2017 - FY 2021	Percent
Known Sources		
State Bond Cap	3,724	41%
FHWA (new and existing)	3,339	37%
Accelerated Bridge Program	349	4%
Tolls and Reserves	828	9%
Federal Transit Funding	175	2%
Subtotal Known Sources	**8,416**	**93%**
Estimated Sources		
CA/T Trust Funds	353	4%
Third Party	33	0%
Federal Competitive Grants	150	2%
Gaming	125	1%
Subtotal	**661**	**7%**
Estimated Total Sources	**9,077**	**100%**

MBTA Sources of Funds

$6.3 billion of the CIP is allotted to the MBTA. The primary source of this funding, nearly 60 percent, comes from the federal government through an assortment of transportation programs and monies authorized for discreet transportation needs. These include new and existing funding from the Federal Transportation Administration (FTA) ($2.57 billion); funding for the Green Line Extension under the New Starts program, a part of the Full Funding Grant Agreement ($655 million of the $996 million total); federal loans and loan guarantees under the Transportation

[2] Total federal funds exclude state repayment of Grants Anticipation Notes (GANs) used to pay for the Accelerated Bridge Program.
[3] Five-year breakout of MassDOT sources in Appendix A.

Infrastructure Financing and Innovation Act (TIFIA); and the Railroad Rehabilitation and Improvement Financing (RRIF) program ($389 million) that help to defray the costs of the federally mandated positive train control system to prevent train-to-train collisions and excessive speed derailments (Table 2).

Revenue bonds issued by the MBTA and backed by dedicated sales tax revenues from the state total $750 million. Special obligation transit bonds from the Rail Enhancement Program equal $1.13 billion, $455 million of which is set aside for the Green Line Extension. Together these bonds account for another 30 percent of available sources.

Table 2 – MBTA Sources of Capital Revenues[4]
($ millions)

MBTA	FY 2017 - FY 2021	Percent
FTA (new and existing)	2,571	41%
Revenue Bonds	750	12%
Special Obligation Transit Bonds	1,127	18%
Non-GLX	672	
GLX	455	
GLX - Full Funding Grant Agreement	655	10%
TIFIA & RRIF (Postive Train Control)	389	6%
Pay-Go Capital	700	11%
Other	130	2%
Subtotal	**6,321**	**100%**

The final source of funds, pay-as-you-go capital, is particularly noteworthy. The MBTA projects $700 million in cash – 11 percent of the $6.3 billion total – from operational budget savings that the Fiscal and Management Control Board and MBTA leadership hope to achieve in the next five years. These savings would be realized through a combination of controlling costs, raising own source revenues including fare increases in FY 2017. The T's ability to divert $700 million from operating expenses to capital investments would be a remarkable achievement if realized and an extremely valuable source of flexible capital funding because it does not contribute to the T's enormous and growing debt obligation.

[4] Five-year breakout of MBTA sources in Appendix A.

Uses of Funds

The MassDOT / MBTA CIP, which integrates the plans of the two entities for the first time, includes a total of $14.46 billion in capital spending. This money is almost equally divided between projects that are underway ($7.46 billion) and new project recommendations ($7 billion).[5] Of the $14.46 billion total, $8.14 billion or 56 percent is directed to MassDOT and $6.3 billion is committed to the MBTA (Table 3).

In a testament to its new pragmatic approach, the state does not allocate the full $15.4 billion in projected resources. Rather, it leaves over $900 million uncommitted in acknowledgement that $661 million in estimated but uncertain MassDOT sources may not materialize during the five-year period. MassDOT officials also recognize that some of the federal reimbursements in the later years of the CIP are likely to flow to the state after FY 2021.

Table 3 – FY 2017 – FY 2021 Planned Capital Investments[6]
($ millions)

MassDOT / MBTA FY 2017 - FY 2021 CIP	Projects Underway	Projects Recommended	Total
MassDOT	**3,734**	**4,409**	**8,143**
Aeronautics	57	144	201
Chapter 90	1,000	0	1,000
Commonwealth Project	50	70	120
Highway	2,246	3,563	5,809
IT	33	36	69
Planning & Enterprise Services	205	0	205
Rail	57	255	312
RMV	3	118	121
RTA Transit	83	224	307
MBTA Uses	**3,728**	**2,592**	**6,320**
Total	**7,461**	**7,002**	**14,463**

MassDOT Uses of Funds

MassHighway is the largest recipient of capital funds within MassDOT, receiving $5.8 or 64% of the total MassDOT spend. MassHighway will spend the majority of the money in five key areas.

[5] According to MassDOT, projects are considered underway if they are multiple year and have received a notice to proceed or procurement or construction has begun.
[6] Data used to analyze the CIP spending are from two Excel files Projects Underway and Recommended, Design and Proposed Projects released at MassDOT's CIP documents collection.

$2 billion or one-third of the money will be devoted to the state bridge program.[7] MassHighway will spend another $802 million for interstate and non-interstate pavement and $786 million on roadway reconstruction. $553 million will be allotted to design and engineering of which nearly $100 million will be invested in asset management systems, and $331 million is targeted for expansions (Table 4). These five initiatives combine for $4.47 billion of spending or more than 75 percent of MassHighway's total capital allocation.

Chapter 90 is the next largest spending area within MassDOT with $1 billion allotted to it. The remainder of MassDOT capital spending is spread among a variety of smaller projects outlined in Table 3.

Table 4 – FY 2017 – FY 2021 MassHighway Spending Breakdown
($ millions)

Highway Spending	Projects Underway	Projects Recommended	Total	Percent
All Electronic Tolling	55	130	185	3%
Bike / Pedestrian / Multi-Use	88	132	220	4%
Bridges	792	1,209	2,001	34%
CAT Trust Spending	23	71	93	2%
Capacity / Expansion	212	119	331	6%
Design, Engineering, ROW	553	0	553	10%
Facilities	27	130	156	3%
Intersection Safety	25	99	124	2%
ITS	22	60	82	1%
Municipal Bridge Program	0	50	50	1%
Pavement - Interstate	110	221	331	6%
Pavement - Non-Interstate	62	409	471	8%
Roadway Maintenance	35	138	173	3%
Roadway Reconstruction	185	601	786	14%
Safety Maintenance	46	121	167	3%
Other	13	72	85	1%
Total	**2,246**	**3,563**	**5,809**	**100%**

[7] The $2 billion in bridge spending includes $349 million of Accelerated Bridge Program funds.

MBTA Uses of Funds

The $6.3 billion in MBTA investments included in the FY 2017 – FY 2021 CIP allocates the money among a combination of equipment purchases, capacity improvements, routine and deferred maintenance and safety enhancements. $1.58 billion will be used for the purchase of Orange, Red, and Green Line subway cars, commuter rail locomotives and coaches, and bus purchases and overhauls. Capacity improvements of $389 million target Red and Orange Line infrastructure improvements to accommodate the new vehicles purchased and reduce headway times.$379 million is invested in MBTA bridges to help reduce the state-of-good repair backlog of approximately $800 million. Further, the state will spend $540 million on federally required programs covering positive train control ($487 million) and automated train protection for the Green Line ($47 million) (Table 5).

Table 5 - FY 2017 – FY 2021 MBTA Spending Breakdown
($ millions)

MBTA Uses	Projects Underway	Projects Recommended	Total
Accessibility	0	147	147
Bridges	192	187	379
Capacity Improvements	3	386	389
Expansion Projects	1,386	209	1,595
Federally Mandated	487	53	540
Other Facilities	366	278	644
Revenue Vehicles	1,024	556	1,579
Track, Signals, and Power	270	776	1,046
Total	**3,728**	**2,592**	**6,320**

The CIP sets aside $1.6 billion for MBTA expansion projects with the Green Line Extension receiving the vast majority of MBTA expansion capital - $1.36 billion or 85 percent. Included in this recommendation is $182 million to extend the project from College Ave. to Route 16; however, $152 million of that has since been committed to help close the recently disclosed $1 billion project budget gap making expansion of the Green Line beyond the College Ave station much less feasible.

MassDOT plans to spend $131 million on the South Coast Rail project for design and permitting. The remainder of the money is spent on a handful of smaller expansions throughout the state as shown in Table 6.

Table 6 - FY 2017 – FY 2021 MBTA Expansion Projects
($ millions)

MBTA Expansion Projects	Projects Underway	Projects Recommended	Total
Fairmont Line	25	0	25
South Coast Rail	131	0	131
Knowledge Corridor	21	19	40
Fitchburg Line - Wollaston Ext	25	0	25
Green Line Extension	1,180	182	1,362
Federal	655	0	655
FY16-21 Mitigation Costs	70	0	70
State	455	0	455
College Ave to Route 16	0	182	182
Wachusett Ext.	4	8	12
Total	**1,386**	**209**	**1,595**

Informed Choices – Deciding Which Projects to Fund

Like most states, Massachusetts lacks the full resources necessary to maintain and modernize its transportation infrastructure. This gap is well-documented – reports have shown that the state's total funding shortfall is in the billions. What is new is the state's deployment of a rigorous, data driven process for selecting which projects to fund. This should enable the state to better utilize its finite capital by investing funds only in the most viable projects.

In the current CIP, the state tied the allocation of resources to specific priorities, such as the increased safety and reliability of its transportation system. Changing the capital plan from a collection of projects to one that distributes resources to the most beneficial and cost-effective projects aligned with explicit goals is a monumental improvement.

But this data-driven approach is not ground-breaking. In fact, it has been used in other areas of capital spending for years. In the 2009 state transportation law that created MassDOT, lawmakers required the agency to develop an integrated asset management system to help preserve and maintain the state's transportation infrastructure.[8]

Federal laws went further. The *Moving Ahead for Progress in the 21st Century Act* (MAP-21), a federal funding bill for surface transportation, was signed into law in July 2012. A key feature in

[8] Chapter 25 of the Acts of 2009, AN ACT MODERNIZING THE TRANSPORTATION SYSTEMS OF THE COMMONWEALTH

the law establishes national performance goals that cover safety, infrastructure condition, congestion reduction, system reliability, freight movement, sustainability, and reduced project delivery delays for federally-aided programs.[9]

To implement these goals, MAP-21 establishes state performance measures that include:

- Pavement condition on the Interstate System and on the remainder of the National Highway System (NHS)
- Performance of the Interstate System and the remainder of the NHS
- Bridge condition on the NHS
- Fatalities and serious injuries – both number and rate per vehicle mile traveled--on all public roads

Furthermore, MAP-21 requires states to set performance targets to support these measures,[10] include these targets in its statewide transportation plans, and report on the progress made in achieving these targets not later than 2016.[11] Any state that does not make sufficient progress in achieving these targets must submit in its next report the actions the state will take to successfully reach these objectives.[12]

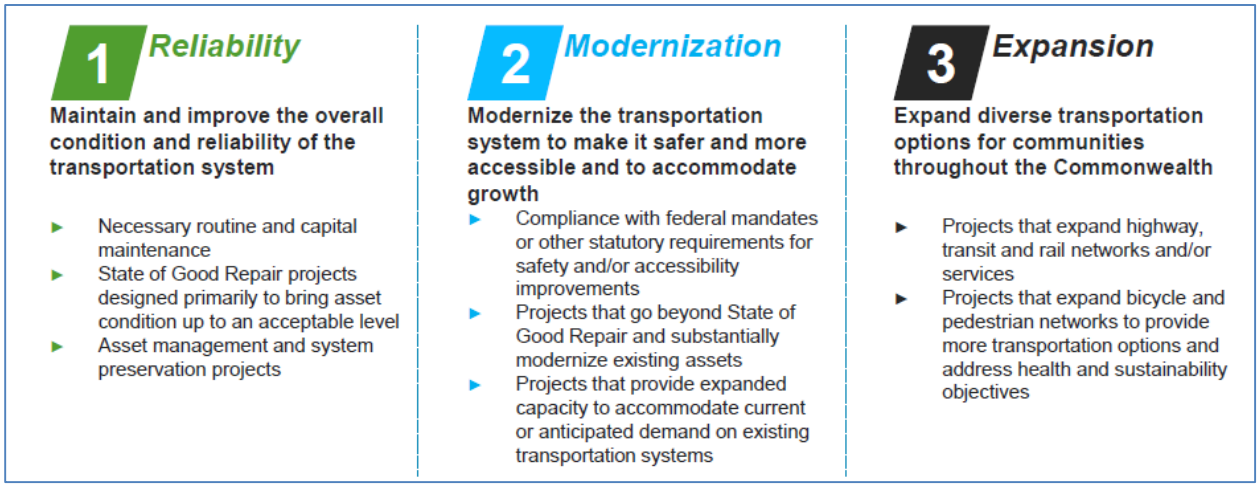
Massachusetts has finally begun to align its capital plans with federal requirements and is now playing catch-up to other states in its adoption of performance based planning. The changes made to the Commonwealth's selection criteria for funding are substantial and they promise a new era in the management of capital assets.

A New CIP: Goal Focused; Data Driven

The development of the FY 2017 – FY 2021 transportation CIP starts from three clearly articulated priorities shown in (Figure 1).

[9] Subsequent legislation, *Fixing America's Surface Transportation (FAST) Act* or FAST, signed into law in 2015, re-affirms these requirements.
[10] An Act to authorize funds for Federal-aid highways, highway safety programs, and transit programs, and for other purposes (MAP-21), Section 150(d).
[11] Ibid. Section 150 (e).
[12] Ibid. Section 119, National highway performance program, subsection (7).

Figure 1- Capital Investment Priorities[13]



The first priority, reliability, includes spending for necessary and routine capital maintenance. State of good repair (SGR) backlog projects, routine maintenance to sustain asset life, and asset management systems used to manage and measure asset conditions are all examples of reliability spending.

Modernization, the second priority, includes investments intended to upgrade the condition of the asset beyond the original useful life as well as investments that provide expanded capacity to the existing system to support increased demand.

Expansion projects bring services to new communities that were unserved or underserved in the past.

After establishing these goals, the state sought inputs related to fiscal constraints, historical spending, internal estimates of needs, performance projections, and board guidance to determine the relative size of funding for each priority spending area.

Divisions within MassDOT and the MBTA selected from the universe of almost 5,000 projects. Those that advanced the stated goals were deemed a high priority.

The state then deployed two important tools to select projects from among the high priority subset. The first is the *Planning for Performance* tool, a multi-modal management system that uses asset performance data to predict long-term asset conditions based on different levels of investments. The ability to estimate and compare the benefits of an investment across different asset types and

[13] *MassDOT / MBTA 2017 – 2021 Capital Investment Plan*, Draft for Public Review, April 11, 2016, p. 11.

modes provides the state with the data needed to determine the most cost-effective returns – a substantial improvement over previous CIPs.[14]

The CIP also relied on input from the Project Selection Advisory Council, a body created in 2013 by the legislature to develop the criteria used for scoring nearly 1,000 projects. Project scores, weighted by the project type and goal (Figure 2), provide the ability to compare potential investments across divisions and were factored into the selection process.

Figure 2 – Weighting Factors by Division and Goal[15]

Goals/Criteria	Roads & Paths Modernization	MBTA/Regional Transit Modernization	Roads & Paths Capacity	MBTA/Regional Transit Capacity
Cost Effectiveness	15	20	20	25
Economic Impact	10		15	20
Environmental & Health Effects	10	5	10	10
Mobility	10	30	25	25
Policy Support	10	10	10	10
Safety	10	10	10	
Social Equity			10	10
System Preservation	35	25		
Total	**100**	**100**	**100**	**100**

Utilization of these tools allowed the five-year CIP to make a significant move towards performance-based capital planning, a method designed to improve the efficiencies of capital investments.[16] Spending on reliability projects far surpassed the other two spending categories. Of the 1,900 unique projects that the $14.46 billion CIP proposes to fund (475 underway, 1,433 recommended), two-thirds is devoted to safety and reliability.

Table 7 – Two-Thirds of $14.46 Billion Directed towards Reliability

Priorities	Projects Underway	Projects Recommended	Total	Percent
Reliability	4,895	4,818	9,713	67%
Modernization	830	1,622	2,452	17%
Expansion	1,686	492	2,178	15%
Not associated with a priority	50	70	120	1%
Total	**7,461**	**7,002**	**14,463**	**100%**

[14] Planning for Performance management tool screen shot, Appendix B.
[15] PSAC scoring chart, Appendix C.
[16] MassDOT and FMCB boards are scheduled to vote on the FY 2017 – FY 2021 on June 20, 2016. The plan reviewed in this report is the copy released for public comment.

Performance Based Capital Planning Relies on Current and Credible Data

The benefits of performance based planning are numerous but are reliant on quality data. If the data upon which the CIP is based are not current and accurate, selections will be based on faulty information and the outcomes will suffer accordingly. To date, MassDOT and the MBTA have not had adequate data and this has undermined the improvements made to the project selection process.

For example, "total asset replacement value" and "asset conditions" are two key determinants of the level of investments necessary to maintain a state's transportation infrastructure. Therefore, it is critical to the performance-based planning process that these data inputs are accurate. In other words, to develop a comprehensive count of estimated replacement value of assets, along with a process to monitor and update their performance and condition, it is vital to know what is needed to prevent further decay in the system.

Both MassDOT and the MBTA have struggled with producing accurate total asset replacement values and asset conditions for their inventory, largely because their asset management systems are not up to par. MassDOT has not yet developed an integrated asset management system and has not released an asset management portal for municipalities. The MBTA failed to keep its asset management system operative after its last report in 2009 providing obsolete and inaccurate SGR backlog data for years. Further, neither MassDOT nor the MBTA have achieved a comprehensive collection of transportation assets in their respective systems to date.

MassHighway

The need for MassDOT to develop a better asset management system is well-known and the legislature has attempted to statutorily require improvements. In the Transportation Reform Act of 2009, the legislature required MassDOT to "develop and implement a single integrated asset management system to oversee and coordinate the maintenance, preservation, reconstruction and investment of all of the assets in its possession, custody and control."

In 2013, MTF produced a report entitled *Delivering on the Promise: Improving the Performance of Massachusetts Transportation Agencies* that reviewed progress by MassDOT in achieving those reforms and contrasted MassDOT processes with best practices used by transportation agencies in other states. It concluded:[17]

[17] *Delivering on the Promise: Improving the Performance of Massachusetts Transportation Agencies*, State Smart Transportation Initiative, University of Wisconsin, March 2013.

MassDOT should improve how it assesses and reports on transportation needs, project delivery and outcomes.

- MassDOT and stakeholders need better data to measure both progress and problems with respect to the agency as a whole and to specific projects. MassDOT should continue to develop its project information system in order to enable easier and timelier access to such performance information.

- In order to better respond to modern system-preservation demands, MassDOT should implement an agency-wide asset management system that maximizes the life of assets.

One outcome of the SSTI report was a 2013 legislative requirement for MassDOT to develop a performance assent management system defined as[18]:

> the permanent, comprehensive and integrated system … that requires the operation, maintenance, upgrade and expansion of all transportation assets, that are cost-effectively administered throughout their lifecycle, by continuously updating physical inventory, condition assessments and performance information. The system shall establish goals, metrics and outcomes to measure transportation performance pursuant to section 6.

The legislation also created the Performance and Asset Management Advisory Council to advise and review the development of the asset management system and report annually on the progress to the House and Senate Committees on Ways and Means. The council submitted its most recent report on January 15, 2016. In it, the Council details MassHighway's progress while noting several legislative requirements that remain outstanding.[19]

In the Council's report, MassHighway estimates that it is responsible for managing transportation assets with a replacement value of $33 billion comprised of 9,600 lane miles of state roads ($22.5 billion) and 5,000 state bridges ($10.7 billion). These pavement replacement value projections were calculated by taking an inventory of lane miles managed by the state and multiplying it by cost estimates from the Federal Highway Administration (FHWA) Elemental Capital Improvement Costs.[20]

To collect and update pavement condition data, MassHighway uses automated data collection from a pavement management vehicle that assess current roadway conditions. These results reveal a

[18] Chapter 46 of the Acts of 2013, An Act Relative to Transportation Finance

[19] *Report of the Performance and Asset Management Advisory Council: Progress by MassDOT Highway Division on Integrated Asset Management*, January 15, 2016. According to the council's report, MassHighway has not completed the required asset data collection covering traffic signals, signs, sidewalks, bridges of less than 20 feet in length, and pedestrian ramps.

[20] Ibid., p. 12.

repair backlog of $1.44 billion based on FHWA costs estimates for pavement repairs of roadways in fair and poor condition.[21]

Similarly, bridge asset values were calculated by multiplying the number of bridges by the average bridge deck area replacement costs based on the previous years' construction contracts.[22] MassHighway estimates the number of structurally deficient bridges from biennial inspections of a bridge's substructure, superstructure, bridge deck, and culverts. However, the number of structurally deficient bridges is of little use in estimating total costs of repair and maintenance. Unfortunately, MassDOT has not had the ability to calculate the backlog data for state and municipal bridges.

Publishing bridge deck area, which is employed by several states to measure bridge performance by the percentage of deck area in good condition, provides far better performance metrics and reliable cost estimates. If MassHighway used total bridge deck area for the 5,000 state bridges, it would be able to provide a more accurate assessment of bridge conditions for those bridges rated structurally deficient or functionally obsolete, and more realistic funding needs for their repair and maintenance.[23]

MBTA

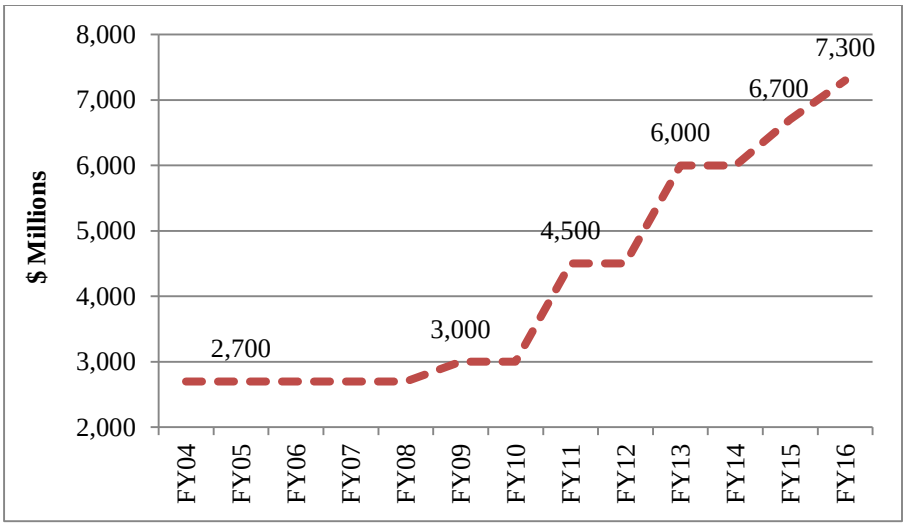
Like MassHighway, the MBTA struggles with managing its capital assets, however, its challenges are more recent in nature. The T developed, maintained and operated one of the premier transit asset management systems in the country until a decade ago. Around 2008 – 2009, quite possibly for budget reasons, the T stopped maintaining its system. That lack of support rendered the asset management system useless and the data the T continued to publish obsolete and inaccurate.

In 2012, the T secured a $950,000 FTA grant as part of a MAP-21 compliance pilot program to develop and populate a new asset management system. The T has had as many as 40 staff and consultants working on the Transit Asset Management so that the authority can revive its asset management system and once again provide policymakers with relevant data. Their recent progress is noteworthy. The number of assets captured in the system has grown from 95,000 in 2009 to approximately 250,000 to date, offering far greater granularity and reliability. This progress enabled the T to release an updated state of good repair backlog figure for the first time in six years.

[21] However, MassDOT has been criticized for higher costs of pavement repairs on a lane mile basis than FHWA estimates suggesting that $1.44 billion may understate the size of the problem.
[22] Ibid., p. 24.
[23] According to a recent report, under FHWA performance metrics, structurally deficient bridges in Massachusetts are projected to double to 17 percent, among the highest totals in the country.

The condition of the T, however, has deteriorated badly in the interim period. The state of good repair (SGR) backlog has soared to an estimated $7.3 billion as of August 2015, from $3.1 billion since 2009 (Figure 3). The true cost could be even higher as T officials have noted "major gaps" in the asset data for commuter rail tracks, power, and signals. Given that $3 billion of the $7.3 billion estimate relates to commuter rail SGR backlog (of which $1.5 billion involves tracks, signals, and power), it would be helpful for the T to clarify which commuter rail and other assets have not yet been added to its asset management database and to make input of that information a top priority.[24]

Figure 3 – MBTA's Evolving State of Good Repair Backlog Estimates



While a precise SGR backlog figure would allow for continued refinement and progress in the T's asset management system, the more salient issues remain (1) the amount of annual capital spending needed to keep the T's infrastructure from deteriorating further and (2) the amount of spending necessary to eliminate the SGR backlog over 25 years.

In the T's most recent report issued in 2015, the agency indicated that $472 million in annual capital investments will preserve the current condition of transit assets and $765 million is needed to eliminate the $7.3 billion SGR backlog over 25 years.[25] Consistent with those estimates, the FY 2017 – FY 2021 CIP chose to spend $3.65 billion over the five-year period on MBTA 'reliability' projects or an average of $730 million annually. This approximates the $765 million estimate to eliminate the maintenance backlog.

[24] Focus 4 T, *The 2040 Investment Plan for the MBTA, State of the System*, MBTA, 2015, p. 9, and *State of the System Report: Commuter Rail*, MBTA, December 2015, p. 35 and Appendix D.
[25] *SGR & Capital Working Group Initial Overview*, MBTA, August 31, 2015, p. 17-19.

However, there are several reasons to be skeptical of the MBTA's $472 million and $765 million estimates. A primary reason is that the amount of annual capital spending needed to keep the SGR backlog from increasing should correlate with the amount of total assets in the T's portfolio that need to be preserved. And as we documented, that data may be incomplete. Some have argued that replacement value may not be the best metric for driving annual capital investment decisions, but it does provides a valid proxy for the amount of assets to be maintained.

In the recent past, the MBTA has estimated total replacement value of assets to be within a range of $11 billion to $14.7 billion. At the same time, the MBTA maintained that $470 million was needed to keep the T's infrastructure from deteriorating further.

Since rebuilding its asset management system in 2015, the T has issued new estimates that double the total replacement value of all assets from the previous $11-14 billion range to $24 billion. And yet, the T maintains that the annual cost to preserve $24 billion in assets remains the same – $472 million. The notion that approximately $470 million in annual spending will prevent the SGR backlog from increasing regardless of the value of the T's total value of assets strains credulity.

Given the T's recent history of inconsistent and inaccurate data regarding the condition of its assets[26], the T should publicly release a comprehensive breakdown and methodology used to calculate total asset value and document its estimate of annual spending needed to preserve MBTA assets. As the figure upon which the maintenance plan is predicated, it is crucial that board members and policymakers can verify the accuracy of the amount of investment needed to prevent the T's infrastructure from deteriorating further so they can develop a capital plan for fixing assets that has a reasonable likelihood of success.

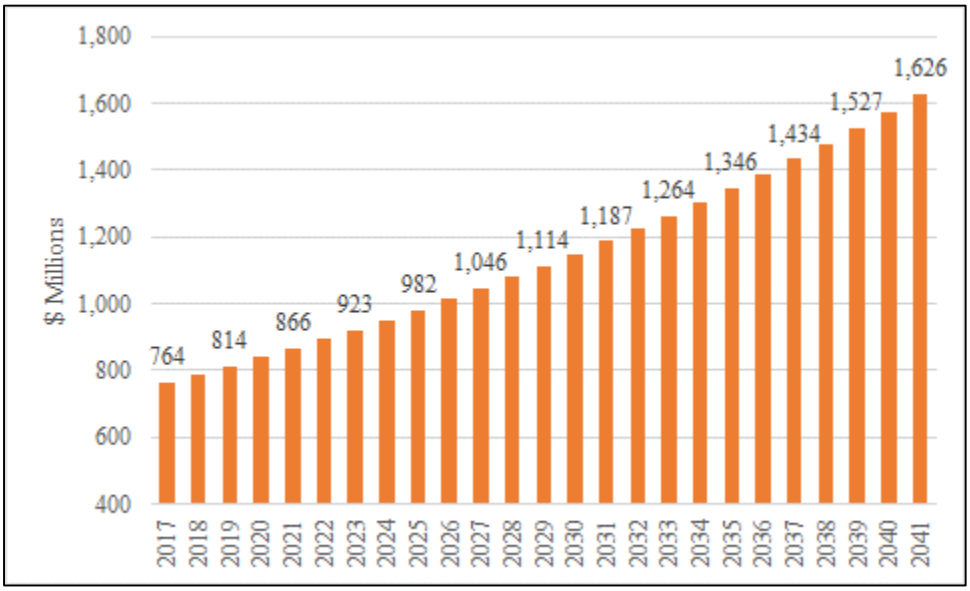
A second concern with the MBTA cost projections is its failure to account for inflation. The $765 estimate of annual capital spending to eliminate the SGR backlog is based on simple arithmetic. If you divide the $7.3 billion SGR backlog by 25 (the number of years to eliminate it) you get $292 million. This amount when added to the aforementioned $472 million needed to maintain the current SGR backlog, brings the total to $764 million. Unfortunately, that simple calculation ignores the costs of inflation.

In contrast, MassHighway used a 4 percent inflation rate in its 2015 *Report of the Performance and Asset Management Advisory Council* analysis of future bridge spending needs, and a 3.5 percent annual escalation factor in its 2015 triennial reports on the Metropolitan Highway System and the Western Turnpike. The final report of the Green Line Extension review, presented to the FMCB and MassDOT boards on May 9, 2016, included a 3.5 percent annual inflation rate plus a one-time 2 percent mark up to "reflect the local construction market."[27]

[26] The MBTA reported in 2009 and again in 2013 that $694 million in annual capital spending was needed to keep the estimated $3.1 billion SGR backlog from increasing and $808 million in annual spending would eliminate the backlog over 20 years. See *Asset Management at the MBTA: Past, Present, and Future*, Robert Guptill, p. 4.
[27] *Green Line Extension Review Interim Project Management Team – Final Report*, May 9, 2016, p. 21.

As shown in Figure 6, factoring in a 3.5 percent escalation rate to the $765 million estimate in FY 2017 dramatically increases the amount of spending required to eliminate the $7.3 billion backlog. For the FY 2017 – FY 2021 CIP, spending would climb by $300 million to $4.1 billion over the five-year period. Further, total cumulative spending over the 25 years would exceed $28 billion – nearly 50 percent greater than the amount derived from simply multiplying $765 million by 25 in annual investments in SGR.[28]

Figure 4 - 3.5 Percent Inflation Increases Costs to Eliminate SGR Backlog



To summarize, the T's SGR spending estimates appear unrealistic and understate what will be needed to fix the T because the data on which it is based is incomplete and inaccurate. These findings are based on a $7.3 billion SGR backlog but could be much larger because the asset management system is not comprehensive. The T's estimated $472 million in annual investments necessary to maintain $24 billion in replacement asset values is also dubious because it is based on questionable data too. Finally, factoring in a reasonable rate of inflation on spending to eliminate the SGR backlog drives long-term costs to astronomical levels.

While it appears that spending needs for the MBTA could be measurably higher than current published estimates, what is of far greater concern to the long-term health of the state's public transit system is the inability to spend currently available capital resources to fix the MBTA. As section three will outline, both MassDOT and the MBTA are struggling to spend all of their available capital resources.

[28] See *First Annual Report*, Fiscal and Management Control Board, December 22, 2015, p. 43 for similar results.

Operational Excellence – Maximizing Every Dollar Spent

Whether the state has the requisite resources to address the long-term transportation infrastructure needs will likely become a point of inquiry in the near future. But before that discussion can gain serious traction, the state must demonstrate the capacity to manage spending of existing resources. Presently, both MassDOT and the MBTA have insufficient manpower to oversee capital projects, have difficulties spending all funds in their current capital plans, and lack the capacity to deliver the full range of projects on time. These shortcomings put the state's transportation infrastructure at risk. While there have been some recent success stories of effective use of resources in these areas, it is clear that state transportation agencies have not demonstrated a sustained capacity for effective allocation of resources.

In fact, the Governor's Special Panel to Review the MBTA presented some startling findings regarding the T's inability to manage its assets. In its final report issued in April of 2015 entitled *Back on Track: An Action Plan to Transform the MBTA,* the panel concluded that the T suffered from:[29]

- Flawed processes for procurement and contract management that were inefficient and decentralized, and
- A bottlenecked project delivery that impedes the MBTA's ability to get all types of projects out the door.

These shortcomings in all aspects of project oversight further impedes the ability of the MBTA to deliver transportation capital projects on time and on budget.

In order to understand this current incapacity, it's important to consider the experiences of MassDOT and the MBTA individually and to look at several discrete elements of resource use including procurement processes; project management, construction and maintenance; and the role of information technology in resource allocation decisions.

Procurement

MBTA

In documenting its findings, the Special Panel noted that during the most recent five-year period for which data is available the T failed to spend almost half of available capital monies due to lack of capacity. $2.2 billion of $4.5 billion in available funds went unspent contributing to "chronic

[29] *Back on Track: An Action Plan to Transform the MBTA,* Governor's Special Panel to Review the MBTA, April 8, 2015, p. 6.

underinvestment and an acute backlog in fleet, facilities, systems, and infrastructure".[30] As a direct result, the T estimated that the SGR backlog escalated from $3 billion to $7.3 billion during that five-year period.[31]

In examining the T's failure to advance important investments, the panel highlighted two of the more egregious cases where procurements languished for more than 25 years – re-building Government Center Station and purchasing Red and Orange Line vehicles. In both cases, the T displayed an inherent inability to maintain vital capital assets.

Unfortunately, these are not the only examples of poorly managed procurement contracts.

In 2008, the T purchased 75 commuter rail cars from a Korean vendor for $190 million. Managing the procurement became a monumental challenge for the T and caused the delay of car delivery. When the cars eventually arrived in early 2014, more than two years late, they were seriously defective. Brand new cars placed into service had to be removed and transferred to an out-of-state facility for repairs.

More recently, the T purchased 40 commuter rail locomotives for $222 million. Defects detected after their delivery kept the locomotives out of service for over a year while repairs were made. These locomotives were scheduled to be in service in the fall of 2014 and their absence contributed to commuter rail service disruptions during the winter storms of February and March 2015.

In neither instance did the T disclose the cause for the delays and defects. Were the problems related to poor designs that made the vehicles inoperable? Or were the problems caused by manufacturing defects by the vendor? Whatever the cause, it is critical that the MBTA learn from past mistakes to prevent future procurement mishaps, particularly with the acquisition of the Red and Orange Line cars.

Another issue that concerned the Special Panel because it does not always yield the best result was an MBTA practice of selecting the lowest bid.

One example is the procurement to assemble 284 Red and Orange Line cars in Springfield. The T selected the lowest offer of four proposals, accepting a $567 million bid from a Chinese company that was approximately $100 million less than the next lowest bidder. The price was so much lower than other bids that it raised concerns regarding the vendor's ability to deliver the cars on-time given that this would be the first attempt to deliver heavy-rail vehicles in North America.

Another example is the T's request for proposal in 2012 to operate over 600 miles of commuter rail service over eight years. The T's procurement team anticipated receiving as many as a dozen bids for the state's largest operating contract in history but they actually got only two proposals –

[30] Ibid., p.17.

[31] The underspending of capital resources combined with inaccurate SGR backlog data from the T's inoperative asset management system kept lawmakers in the dark for years as to the true condition of the T's infrastructure.

Massachusetts Bay Commuter Rail (MBCR), the existing contractor, and Keolis, a Paris based company largely owned by the French National Railways Corporation (SNCF). The MBTA awarded the contract to Keolis, the lowest bidder, for $2.68 billion with an option to extend the contract to $4.3 billion over 12 years. The T touted the savings from the lower bid to its operating budget when the contract was awarded. However, T management discovered that the contract did not adequately address performance metrics and was forced to negotiate a service improvement plan covering on-time performance, fare collection goals, and enhanced communication with riders.

To address the myriad of issues related to procurement, the Special Panel urgently recommended that the MBTA use 'best value' rather than the lowest price when evaluating bids and awarding contracts. They also suggested that the T restructure and centralize its procurement systems for better control. Soon after the release of the report, the T hired a chief procurement officer to manage procurement contracts and update purchasing policies. The impact of that hiring has brought important improvements. They include: a new contract for the supply of electricity; RFPs for a ride sharing pilot and a centralized call center for paratransit services; a new service improvement plan for commuter rail services; and a pending RFP for cash management services among others.

There have been two discernible benefits in the first year from the procurement policy changes. In addition to material savings to the operating budget, they have also improved the outcomes of capital investments and the customer experience. A few examples of these procurement improvements include a contract to refurbish 74 commuter rail coaches at nearly 20 percent savings, an agreement to install positive train control (PTC) by the federal deadline with a creative financing plan to assist with capital spending flows, and an accelerated upgrade to CharlieCard to expand customer payment options and reduce fare evasion.

While the initial results are promising, it will take significant time and resources to complete a system wide transformation of the antiquated, paper-based, procurement process into an online, streamlined system that enhances management and control.

MassHighway

MassHighway has not been in the same state of disarray as the MBTA. In recent years, MassHighway considerably improved its ability to procure services. One important measure of the agency's ability to advance projects is the amount of time between the day a contract is advertised and the start date of construction. In 2008 MassDOT reduced the amount of time between the advertisement and construction start dates from an average of 422 days to 217 days. That time was further reduced to an average of 111 days by 2010.[32]

[32] *Performance Management Report*, MassDOT, December 31, 2010, p. 30.

Even more remarkable were the agency's results with projects funded through the federal American Recovery and Reinvestment Act of 2009 (ARRA). In those instances, the Executive Office of Transportation was able to reduce the advertising, bid, contract process down to just 44 days.[33]

However, in its latest annual performance report MassDOT has shown indications of slippage. A chart that tracks the percentage of federally funded STIP projects that were advertised provides a "useful lens into the execution of the work that was planned".[34] MassDOT explains that:

> "This measure tracks the number of projects, listed on the STIP (State Transportation Improvement Program), that are scheduled to begin in the upcoming year. The number of projects scheduled to begin in the following fiscal year is derived based on the number of projects expected to be given a Notice-to-Proceed in the fiscal year, using an average time of 220 days between advertisement and Notice-to-Proceed." [35]

This current 220 day average between advertisement and notice to proceed is twice the amount of time taken to the 111 day average in 2010 and five times longer than what was achieved for ARRA funded projects providing an important metric of MassDOT's slowing efficiency in moving projects forward.

In another example of potential diminished capacity, a recent status report on the FFY 2016 STIP indicates that less than 20 percent of the approximately $540 million in STIP projects have been advertised eight months through the current federal fiscal year.[36] Without this future project initiation, capital spending delays will continue.

Project Management and Construction and Maintenance Throughout

MassHighway: FAST 14 – The Gold Standard

MassHighway has shown more capacity to manage large capital projects than the MBTA but struggles to do so consistently. MassHighway completed one of the most successful construction projects in memory replacing 14 bridges on Route I-93 in ten weekends. The bridge repairs were originally scheduled to begin in 2012 as a design-bid-build project, but when a major hole opened on the Fellsway Bridge in 2010, the timeframe was accelerated by a year to minimize further deterioration and traffic impact.

As a result, the project changed to a design-build contract. The project was successfully completed in 550 hours – 55 hours per weekend over 10 weekends using accelerated bridge construction

[33] *Transportation ARRA Update*, Executive Office of Transportation, July 29, 2009, p. 10.
[34] *MassDOT's Annual Performance Report*, Fiscal Year 2015, December 2015, p. 18.
[35] Ibid., p. 18.
[36] The state would lose federal funds for FFY2016 STIP projects not advertised by mid-September, 2016.

methods that included prefabricated modular bridge units and fast-setting concrete mix as part of the design-build contract. The keys to success were a clearly defined scope and schedule, identified funding, sufficient and experienced staff to oversee all aspects of the project, superior communications among all participants, and financial incentives/disincentives to complete construction on time.

Had MassDOT used conventional construction techniques, the project would have taken at least four years with disastrous traffic impacts.[37]

In an aftermath review, however, FHWA acknowledged that the FAST 14 project had a negative impact on other MassDOT construction projects as staff devoted their attention to this project at the expense of other responsibilities. FHWA warned other states to use dedicated staff for the design-build procurement, design review and construction oversight to avoid that unintended consequence.[38]

MassHighway: The Accelerated Bridge Program (ABP) – Lessons and Limits

MassHighway also had a series of successes with its accelerated bridge program. During its eight-year duration, MassHighway introduced a number of innovative techniques to fast-track progress on this $3 billion program to repair and replace structurally deficient bridges. MassHighway employed prefabricated girders, deck panels, and substructures, used modular bridges in the FAST 14, 'heavy lift' methods in Phillipston and Wellesley bridges, and a "bridge-in-a-backpack" construction technique at the Scott Reservoir Outlet bridge project in Fitchburg.

These innovations combined with the FAST 14 success demonstrated MassDOT's growing proficiency in expediting capital investments – an outcome envisioned when ABP was first passed into law. However, there are growing indications that the experiences gained through ABP innovations have not been replicated and are not being applied to other MassDOT capital projects.

A driving factor in the MBTA's inability to consistently manage projects is its loss of talent, which greatly restrains MassDOT's ability to manage large projects,[39] and leaves it almost incapable of managing the hundreds of small projects included in the current CIP. Having too few project managers, coupled with difficulty in extracting status of capital projects from its capital management systems, and an inability to shift funding to other projects within a CIP category, compounds the problem.[40]

[37] *Massachusetts Demonstration Project: Reconstruction of 14 bridges on I-93 in Medford using accelerated bridge construction techniques*, Final Report, FHWA, October 2014, p. 89.
[38] I-93 FAST 14 Projects Lessons Learned, FHWA, Pamela S. Stephenson, p. 7.
[39] Three ABP 'mega-bridge' projects, with a combined construction budget of $785 million, have fallen seriously behind schedule with unknown cost overruns that could affect funding for other projects in the FY 2017 – FY 2021 CIP driven largely by design and construction issues unique to each bridge.
[40] For example, shifting funds from one non-intestate paving project to another non-interstate paving project as opposed to using those funds for an interstate project.

Many ABP project managers have left MassDOT and the remaining managers lack the authority to establish firm schedules and a clear scope of work. Since last year, MassDOT's workforce has been reduced by 300 personnel.[41] While the decline is due to attritions, reductions in force, and early retirement incentives, a major cause derives from moving the cost of all personnel from the capital to the operating budget beginning in July 2014 forcing the state to curtail spending in order to manage large operating budget shortfalls in FY 2015 and FY 2016.

MBTA – Still Floundering

As noted earlier, the MBTA has had significant difficulties managing capital spending and its infrastructure has deteriorated as a result. The T has been overwhelmed by both large scale projects and basic maintenance and repairs of subway cars, buses, tracks, signals, and power. And despite considerable attention and pressure to spend the entirety of FY 2016 capital funds spending is projected to fall short. The MBTA will spend $770 million of $1.05 billion — approximately the same amount as FY 2015 – and $330 million shy of the total, raising more serious doubts about the T's ability to fix its infrastructure.

Some of the delays in spending are understandable. For example the T reduced FY 2016 capital spending on the GLX by $72 million as the state reevaluates the project; the T underspent its plan by $46 million for Red and Orange Line vehicle acquisition likely due to payment schedule adjustments; and underspent $23 million for the Positive Train Control (PTC) project until scope and funding were established. However, the larger problem, the T's inability to shift the unspent $330 million to other projects, persists.

The T's inability to advance capital projects is due to many issues including:

- a lack of staff capacity,
- inadequate staff capability,
- inefficient processes and procedures that delay procurement and project delivery, and
- changing funding priorities.

It is greatly exacerbated by multiple data-tracking and reporting systems that are out of date and mask project activity and accountability. There is no centralized source for project reporting which makes it exceedingly difficult for management to discover project issues in a timely manner and shift resources to other projects.

If these data systems and reporting issues remain unresolved, it is difficult to see how the T will be able to spend the $6.3 billion in resources available in the FY 2017 – FY 2021 CIP. Clearly,

[41] MassDOT employee count fell to 4,074 in May 2016 from 4,378 in May 2015. Source: Office of the Comptroller.

the T's ability to manage spending to preserve its assets remains an enormous risk to the system and fixes could take years.

The Revised Green Line Extension Project – A Familiar Recipe

Whether or not the MBTA can deliver the revised Green Line Extension project creates a dilemma for the agency. *The Green Line Extension Review Final Report* presents a path to successfully complete the project. The strategy to fix GLX has many similarities to the successful FAST 14 – a clearly re-defined scope and schedule, identified funding, an autonomous group with clear lines of authority, the requisite number of experienced and trained staff to oversee all aspects of the project – this time with no other obligations, and superior communications among all participants.

The scope and schedule of GLX have been modified. The remaining funding gap of less than $100 million (down from $1 billion assuming the T can assure the FTA of its ability to manage the project at the revised cost) does not pose serious risks to the T's capital resources but funds would have to be taken from other projects in the CIP.

The report proposes an autonomous governance structure comprised of a program manager who reports directly to the general manager, a director of construction, and five deputy program managers together with another 40-50 staff to oversee the project – all dedicated to the GLX with no responsibility for day-to-day MBTA operations. Further, GLX team members would be trained to become proficient in the design-build contracting method as that competency must reside within the MBTA to effectively manage the project.

The report suggests that the T will, in all likelihood, have to pay outside its current wage schedule to attract candidates with the necessary experience. A strong sense of ownership and accountability among staff and leadership are viewed as vital to keep the project on track and made more likely by higher wages and autonomy from the MBTA's daily grind. However, establishing different compensation packages within the MBTA structure will create unnecessary tensions while encouraging personnel to move from the core of the MBTA to the GLX project – a potential talent flight that the T cannot afford.

The solutions to fix the GLX project include many of the Special Panel's recommendations as well – hire new leadership, recruit experienced talent for critical positions, train personnel on core functionalities, and improve internal communications.

But the GLX project could become an ill-advised distraction given the FTA requirements to approve funding for the project. In a recent letter the FTA regional director states "the timing and completeness of these reviews will depend on the level of design and detail you make available, the onboarding of your new project management team (emphasis added), and any questions that may arise in our review."

Given that the T does not have a permanent general manager and has had considerable difficulties recruiting senior management for a range of unfilled positions, changing search priorities to recruit a program manager, a director of construction, and five deputy program managers for the GLX project increases the T's already daunting recruiting challenges. Hiring another 40-50 project staff should the project go forward puts even more pressure to recruit for the MBTA's core system. The GLX could be the right project at precisely the wrong time for the MBTA.

Information Technology

MassDOT and the MBTA must acquire greater proficiency in areas such as data analytics, performance metrics, communications, social media, and more if they are to deliver 21st century transportation services. Although the state has made tentative steps recently, such as introducing all electronic tolling (AET) on the Tobin Bridge with a planned roll out on the Turnpike later this year, MassDOT and the T are a decade or more behind other public transportation systems in the deployment of information technology solutions.[42]

A growing list of IT projects will require a substantial infusion of software developers. Recruiting additional IT talent to the transportation agencies poses yet another daunting challenge for the administration.[43] A short list of the transportation software projects follows:

> **MassDOT** must integrate asset management systems, complete the collections of all assets within the system, and develop a web portal for municipalities to populate and monitor assets, deploy geographical information systems (GIS) for project transparency, test peak pricing technologies, explore the deployment of smart infrastructure sensors to diagnose failures and mechanical damage on roads and bridges, and prepare for the arrival of a diverse set of ride sharing options and autonomous vehicles.
>
> **The T** must complete and update the collection of all assets in its asset management system and integrate its maintenance management system, procure the next generation automated fare collection system (an upgrade to the CharlieCard) for customer convenience, and, to reduce fare evasion and boarding delays, install modern fare readers on buses, commuter rail service, and the Green Line.

Heeding the lessons of past failed procurements, MassDOT and the MBTA must take the time to review software packages in the market before deciding which solutions are best. And most

[42] All electronic tolling of highways has been around for 30 years (Norway in 1986, Portugal in 1995, Toronto in 1997). Hong Kong, Singapore, London, Sydney, and Chicago, among others, introduced cashless fare collection systems years ago that allow bank issued credit and debit cards and mobile payments such as Apple Pay and Android Pay.

[43] *The war for tech talent escalates*, John Dodge, The Boston Globe, February 19, 2016.

importantly, the state should rely on commercial off the shelf software packages (COST) and refrain from the more costly custom built programs that take years to develop. There are a myriad of solutions already in use that can accelerate adoption and expedite systems reporting and communication. MassDOT and the T should catch up to other states and the commercial market as soon as possible.

Conclusion: Talent, Leadership, Better Data and Systems, or Failure Looms

The capital needs of both MassDOT and the MBTA are expansive and the challenges are numerous. There have been several promising improvements to how the capital budget is developed and how projects are prioritized; however, there is still much work to be done in terms of the quality of data in the assets management systems, better managing projects, better leveraging of capital investments and better accountability of how the money is spent.

It is critically important that in these next few years meaningful progress be made. Without it, the Commonwealth's transportation assets will further deteriorate and its ability to make necessary improvements will continue to erode. Perhaps most importantly, policy makers may lose the public's trust in their ability to manage these vital assets and to spend the state's capital funds wisely.

The MBTA and MassDOT have had recent successes and they must learn how to replicate them on a broad scale. Keys to successful delivery of large scale and smaller projects include a clearly defined scope and schedule, identified funding, dedicating a sufficient number of experienced staff to oversee all aspects of the project, superior communications among all participants, and financial incentives/ disincentives to complete construction on time. These best practices should be incorporated into every transportation project.

To do that, MassDOT and the T must find and recruit more talent. That is a tall order for both agencies although the T has a considerably steeper hill to climb.

The administration has made impressive strides due to the work of the Secretary, the time and commitment of Fiscal and Management Control Board members, the re-constituted MassDOT board of directors, and key new hires that include a chief administrator, chief financial officer, chief procurement officer, director of capital programs, and other senior managers. The impact of these hires in such a short time is notable. Yet, there are too few individuals upon whom success is dependent and until the T acquires more talent that can change the T's work culture, successes will be fleeting.

Among the hurdles confronting the MBTA is its governance structure. While the Fiscal and Management Control Board has brought great oversight in the short-term, an uncertain governance structure after the FMCB's term expires detracts from the T's ability to attract top flight talent. No general manager candidate is likely to consider an offer of employment without clear knowledge

of to whom she/he would report. At a minimum, the next governance structure must provide the next general manager with a level of authority to demand performance and accountability similar to what the FMCB presently enjoys. To revert to the previous structure of an inattentive and weak board invites failure.

Compensation packages, which are not competitive with other major transit systems, pose another recruitment challenge for all levels of management. Although the MBTA has the authority to increase pay levels, the T should first review compensation levels at competitive transit agencies to evaluate appropriateness, quantify the fiscal impact to its operating budget, and submit a report of its findings and recommendations to the Legislature for review.

MassDOT has a slightly different personnel problem – understaffing due to recent state budget woes that will persist into FY 2017. It is difficult to provide the level of management and project throughput after losing hundreds of personnel over the past couple of years but hiring more staff poses significant challenges when revenues fall short of expectations and spending must be tightly constrained.

Both MassDOT and the T must aggressively update or replace the myriad of antiquated data tracking and reporting systems that mask project activity and accountability across the organizations. These include capital management systems, procurement, human resources, and project management. All such systems should be reviewed against best practices in other states.

Finally, gathering and disseminating accurate and credible data regarding the condition of the state's transportation infrastructure is a critical next step. MassDOT and the T should develop and employ consistent methodologies to measure all aspects of their performance starting with metrics for the total replacement value of assets, SGR backlog data, and inflation adjusted costs to maintain and eliminate SGR backlogs over 20 years (rather than 25 years). These asset management systems should be extended to include the 62,000 lane miles of municipal roads and regional transit authorities' assets.

These data and methodologies should be updated and published quarterly to monitor and manage.

The importance of implementing these reforms immediately and successfully cannot be overstated. The financial assumptions underpinning the capital investment strategy could be wrong and could grossly underestimate the size of the problem. Without accurate, current and complete information, the state cannot begin to address its numerous transportation capital needs. Delay will only compound the problem.

The stakes are enormous especially for the MBTA. Hard won successes could be fleeting; progress could evaporate. Should the T fall short of these measures, failure looms – an unimaginable outcome that would devastate the state's economic future.

Appendix A

MassDOT Sources – FY 2017 – FY 2021

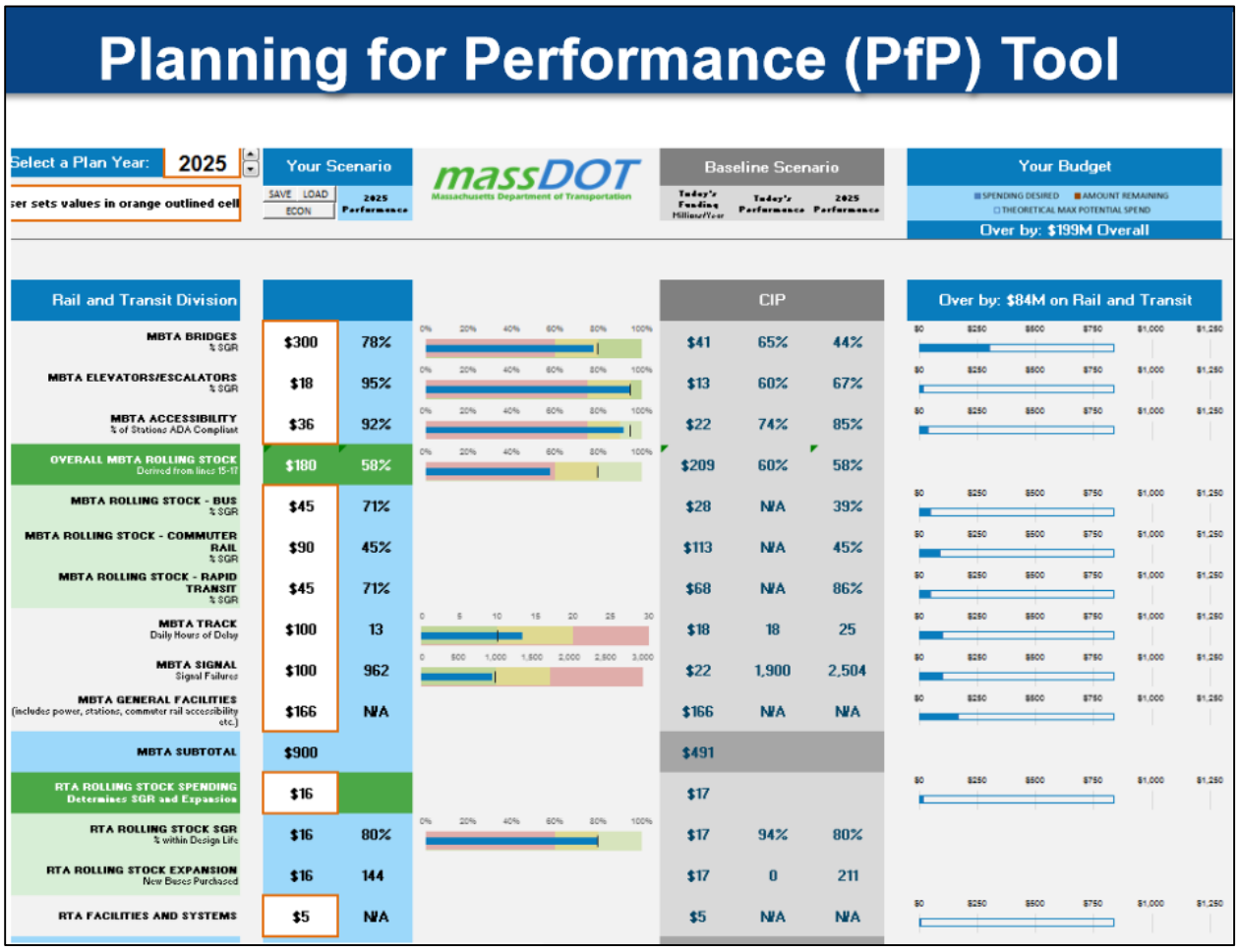
Known Sources	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	Total
State's Bond Cap		724	750	750	750	750	3,724
FHWA New Obligation (minus GANs)		525	529	537	547	543	2,681
FHWA - existing		409	169	58	15	7	659
Accelerated Bridge Program		205	86	50	8		349
Toll Revenues and Reserves	230	108	124	123	121	122	828
Federal Transit Funding		35	35	35	35	35	175
Subtotal Known Sources		**2,007**	**1,692**	**1,553**	**1,477**	**1,456**	**8,416**
Estimated Sources							
CA/T Trust Funds		81	78	93	78	24	353
Third party		7	7	7	7	7	33
FTA Competitive Grants		30	30	30	30	30	150
Gaming revenues		10		31	42	42	125
Subtotal Estimated Sources		**128**	**114**	**160**	**157**	**103**	**661**
Available MassDOT Sources		**2,135**	**1,806**	**1,714**	**1,634**	**1,559**	**9,077**

MBTA Sources – FY 2017 – FY 2021

MBTA Sources	FY 17	FY 18	FY 19	FY 20	FY 21	Total
FTA New	750	286	291	296	296	1,918
FTA Existing	434	153	59	6	0	652
Revenue Bonds	150	200	200	0	200	750
Transit Special Obligation Bonds	249	199	199	225	255	1,127
Non-GLX	158	108	108	134	164	672
TIFIA & RRIF	0	389	0	0	0	389
Bond Cap & ABP	33	2				34
Pay-Go	100	150	150	150	150	700
Cash & Excess Debt Service	89	2				91
other	5					5
Subtotal	**1,719**	**1,289**	**808**	**585**	**810**	**5,211**
GLX Funding	**FY 17**	**FY 18**	**FY 19**	**FY 20**	**FY 21**	**Total**
GLX Special Ob. Bonds	91	91	91	91	91	455
Full Funding Grant Agreement	55	150	150	150	150	655
Total GLX funds	**146**	**241**	**241**	**241**	**241**	**1,110**
Total	**1,865**	**1,530**	**1,049**	**826**	**1,051**	**6,321**

Appendix B

Figure 5 – Planning for Performance Management Tool



Appendix C

Figure 6 – PSAC Project Scoring

What was scored?

A preliminary analysis

	1. # of New Projects in Universe that were Scored (Excluding SGR)	2. # of New Projects in CIP that were Scored (Excluding SGR)	3. Total # of New Projects in CIP (Excluding SGR)	4. % of Non SGR Projects in CIP that were Scored	5. Total # of New Projects in CIP (Including SGR)	6. % of All Projects in CIP that were Scored
Aeronautics	16	3	3	100%	121	2%
2: Modernization	16	3	3			
HWY	288	105	228	46%	537	20%
2: Modernization	234	82	192			
3: Expansion	54	23	36			
IT	7	6	6	100%	10	60%
2: Modernization	7	6	6			
MBTA	20	14	45	31%	113	12%
2: Modernization	17	12	40			
3: Expansion	3	2	5			
Rail	33	3	3	100%	118	3%
2: Modernization	22	2	2			
3: Expansion	11	1	1			
RMV	34	21	24	88%	25	84%
2: Modernization	34	21	24			
Transit*	74	32	149	21%	384	8%
2: Modernization	74	32	249			
Grand Total	472	184	458	40%	1308	14%

*All Modernization and Capacity Projects over $500,000 were scored

Compares what we were able to score to what we said we would score (Modernization and Expansion Projects that were not already underway). Looks at what we scored in the CIP relative to the total available to score (includes SGR projects in the total).

All Dollars in Millions	1. Cost of New Projects in Universe that were Scored (Excluding SGR)	2. Cost of New Projects in CIP that were scored (Excluding SGR)	3. Total Cost of New Projects in CIP (Excluding SGR)	4. % of Non SGR Projects in CIP that were scored	5. Total Cost of New Projects in CIP (Including SGR)	6. % of All Projects in CIP that were Scored
Aeronautics	$54	$14	$14	100%	$147	9%
2: Modernization	$54	$14	$14	100%		
HWY	$3,210	$857	$1,830	47%	$4,410	19%
2: Modernization	$2,050	$747	$1,530	49%		
3: Expansion	$1,160	$110	$297	37%		
IT	$25	$23	$23	100%	$37	61%
2: Modernization	$25	$23	$23	100%		
MBTA	$707	$596	$1,030	58%	$4,630	13%
2: Modernization	$659	$569	$799	71%		
3: Expansion	$49	$27	$229	12%		
Rail	$308	$47	$47	100%	$255	18%
2: Modernization	$147	$15	$15	100%		
3: Expansion	$161	$32	$32	100%		
RMV	$219	$163	$175	93%	$176	93%
2: Modernization	$219	$163	$175	93%		
Transit*	$245	$39	$63	62%	$227	17%
2: Modernization	$245	$39	$63	62%		
Grand Total	$4,770	$1,740	$3,170	55%	$9,880	18%

A major conclusion is that the vast majority of projects and dollars were state of good repair projects that were not set out to be scored. However, a concerted effort was made to score a sizeable portion of the P2 and P3 projects that were in the CIP.

Appendix D

Figure 7 – Commuter Rail SGR Backlog Data

COMMUTER RAIL STATE OF GOOD REPAIR (SGR)

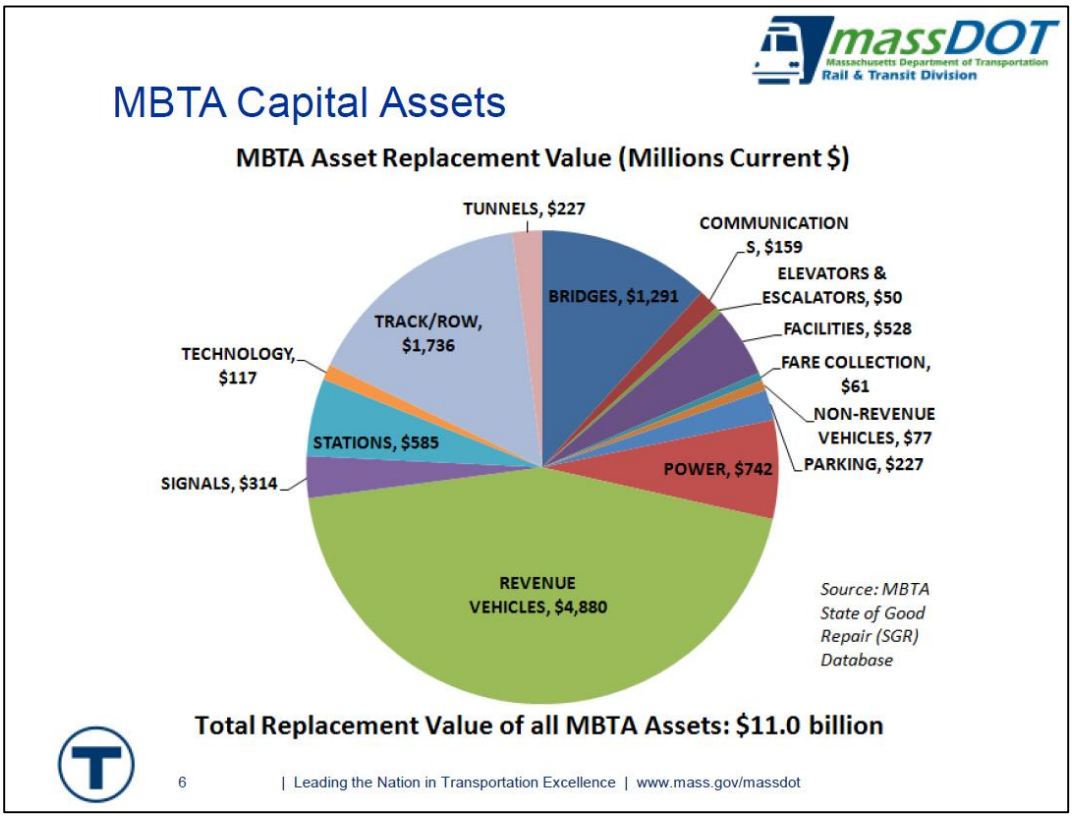
Commuter rail assets have an SGR backlog of **$3.04 billion** and a replacement value of **$9.62 billion.**

Asset Category	Average SGR Rating (0 to 5 Scale)	Backlog ($millions)	Compared to Other MBTA Modes
Revenue vehicles	2.86	$1,049.9	Similar
Track/Right-of-Way	2.70	$1,039.6	Best
Signals	2.70	$481.1	Worst
Communications	2.55	$15.9	Worst
Fare Equipment	4.22	$0	Best
Power	2.10	$43.4	Worst
Stations	2.87	$80.3	Worse
Elevators /Escalators	3.25	$0	Similar
Parking	2.43	$35.8	Similar
Facilities	3.12	$49.6	Similar
Bridges	3.23	$245.8	Similar
Tunnels	3.87	$0	Best
Total		**$3,041.4**	

Source: Draft SGR report 8/10/15; *Green = Excellent to Good*; *Yellow = Fair to Marginal*; *Red = Substandard to Poor* 35

Appendix E

Figure 8 – MBTA Total Replacement Value of Assets, April 2014[44]



[44] *Prioritization Methodologies used by the MBTA State of Good Repair Database and Decision Support Tool*, Robert Guptill, MBTA, April 29, 2014, p. 6.

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