

**Massachusetts Bay
Transportation Authority**

Preventative Maintenance & Inspection Improvements

Fiscal and Management Control Board

April 27, 2020

Joe Cheever

Background

- The vision of modernizing to **Full Cycle Asset Management** of the MBTA transit system infrastructure is over five years old with a transition of Asset Management Group from Engineering & Maintenance (E&M) to the Office of Chief Engineer
- Modernizing maintenance management within the E&M divisions began with asset data collection
- E&M divisions went live with a new **enterprise asset management system (EAMS)** in January 2019, and work management is now digitally tracked at the individual asset
- Since fall 2019, E&M managers, with the assistance of an industry-leading consultant, have developed **preventative maintenance & inspection (PM&I) schedules for critical assets**
- These maintenance intervals are being input into the asset management system to allow for scheduling and tracking

The screenshot displays the 'Work Management Portal' interface. At the top, there is a navigation bar with links for Messages, Screens, Reports, and Admin. Below this is the 'Asset Management' logo and a main menu with options: Home, OCC Track Restrictions, Work Management, Technician, Service Request, Reports, Query, Mobile Focus, Supervisor Portal, Storekeeper, Scheduler, and Notification. The 'Work Management Portal' section includes a 'Current Working Location' dropdown set to 'MOW-GL - MOW GREEN LINE'. There is an 'Asset Search' field with an 'Asset ID' input and a 'Go' button. To the right, a 'Work Summary' table shows the following data:

Filter	Saved Filter	Pending	Open	Finished
ALL		1	76	5

Below the summary is a 'Map' section with a satellite view of a city area. A green line traces a path through the city, with several green circular markers numbered 2, 4, and 5. A search bar is located at the top right of the map area. The bottom of the map shows a scale bar for 1 km and 3900 ft, and a footer that reads 'Leaflet | Esri, Inc. Powered by Esri, Geocoding by ESRI WORLD GEOCODING'.

System Safety Through Full-Cycle

Safety Review Panel recommendation:

“The establishment of **PMI safety performance targets** and safety performance indicators must ensure that these activities:

- Are aligned with industry best practice.
- Are occurring at the required frequency.
- Are monitored to ensure required mid-life or other critical system overhauls are conducted
- Have sufficient human capital to be carried out
- Are properly funded

Key initiatives:

- Introduced structured PM&I implementation
- Developing data-driven compliance checks and informed business decision making
- Continuous improvement towards best-in-class asset management



Modernized Maintenance– A Confluence of Efforts

This fall, the oldest subway in America will be maintained by a modern maintenance management system.

- MBTA field technicians armed with tablet computers will be logging **scheduled critical inspections** in real time on geo-located assets.
- Efficient digital **work management** streams such as defect tracking and repair works will revolutionize maintenance effectiveness.
- Data of **critical asset conditions** will feed dashboards and key performance indicators where all management levels will monitor compliance.

Historical Milestones:

- | | |
|---|------------------|
| • EAMS go-live | JAN 2019 |
| • PM&I improvement program established | DEC 2019 |
| • Critical Asset Digital PM&I Tracking | FALL 2020 |



Four Departments of E&M Critical Assets



Transit Facilities Maintenance (TFM)

- 180 Stations & 90 Facilities
- 135 Bridges & 39 Miles of Tunnels



Maintenance of Way (MOW)

- 162 miles of active track
- Over 600 switches



Power Systems Maintenance (PSM)

- 200 Miles of AC cable
- 1,000 Miles of DC cable
- 46 Traction Substations & 96 Unit Subs
- 125 Miles of Overhead Catenary



Signals & Communications Maintenance (SCM)

- 985 AC Track Circuits
- Over 400 Power Switches



Categories of PM&I Priorities

- 31 discrete schedules or tests are classified as **Safety Critical**: “uncontrolled risk of a safety incident or safety event if not undertaken as per requirement”
 - Visual track inspections and switch certifications
 - Ultrasonic rail & track geometry testing
 - Signal, switching, and train stop testing
 - Fire & life safety systems compliance
 - Emergency generator, egress, & exhaust fan certifications
 - Power generation PM
 - Structural Inspections
- 72 additional **System Critical & Routine PM&I** schedules are identified as “activity that form part of the routine E&M schedules to maintain the performance and reliability of the asset.”
- 32 **Future Improvement or Best Practice** protocols are being considered, and assessments to continually improve the discrete list of actions



Example: Safety Critical Test of a Critical Asset

- Inspections by the Signals Department are governed by SM1, laying out 20+ tests to be conducted on the Signal Systems at various intervals: monthly, quarterly, annually, or every two, four, or ten years
- Test 13 “Test of Switch Obstructions” is completed monthly on over 400 switches across all lines
- Test ensures that when switch points are fully closed, they are prevented from opening more than 1/4" by lock rods
- On average, **155,000 switch throws** occur across the MBTA system per month
- This test is classified as “Safety Critical”

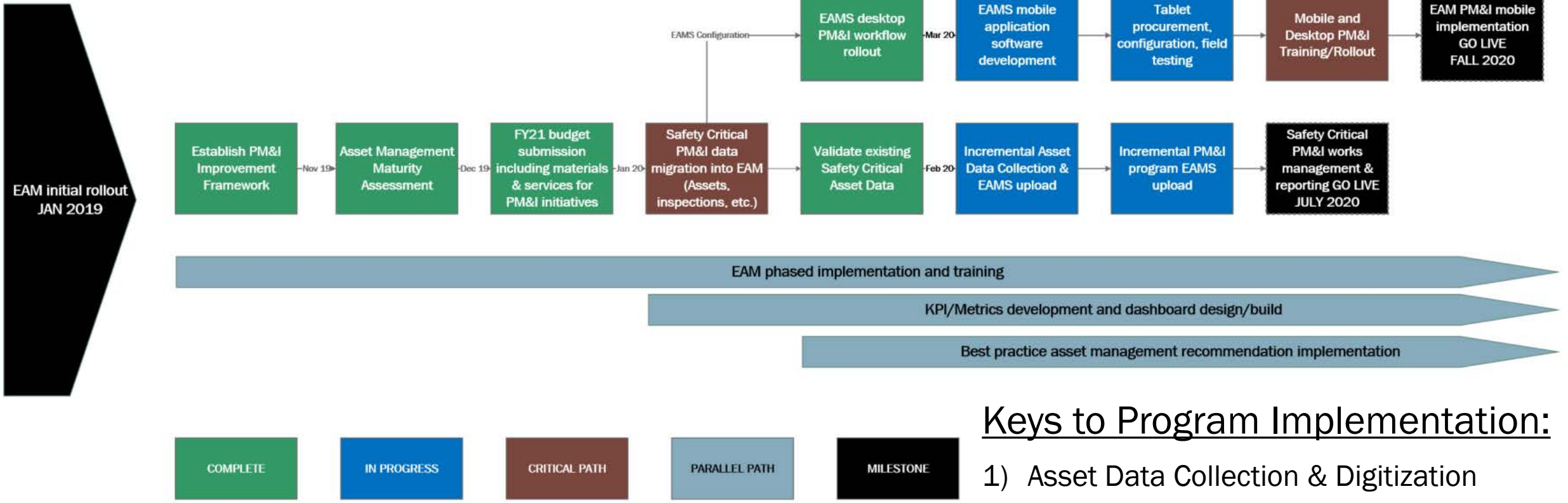
Switch set for reverse move, but is out of correspondence



The point is not fully closed due to an incident that damaged a lock rod



PM&I Improvement High Level Program

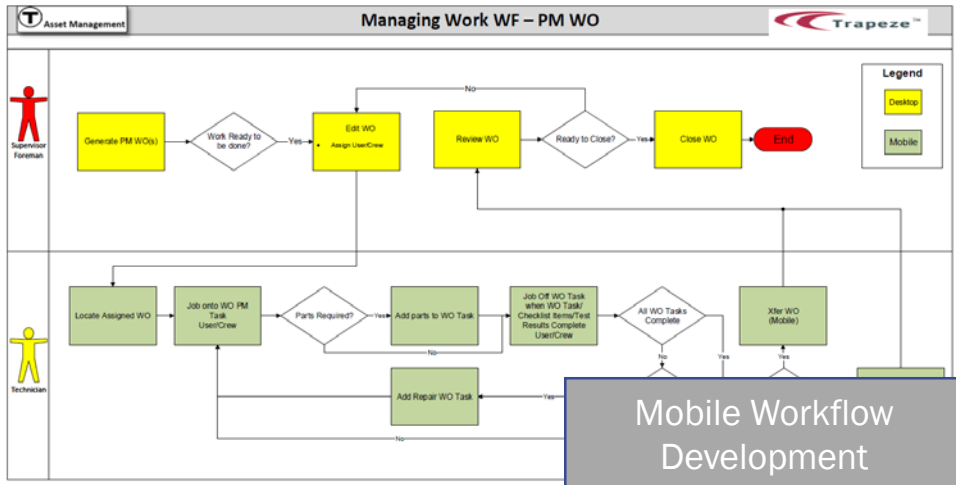


Keys to Program Implementation:

- 1) Asset Data Collection & Digitization
- 2) PM&I Digitization & Tracking
- 3) Mobile Software Development
- 4) Improving Inspection Methods

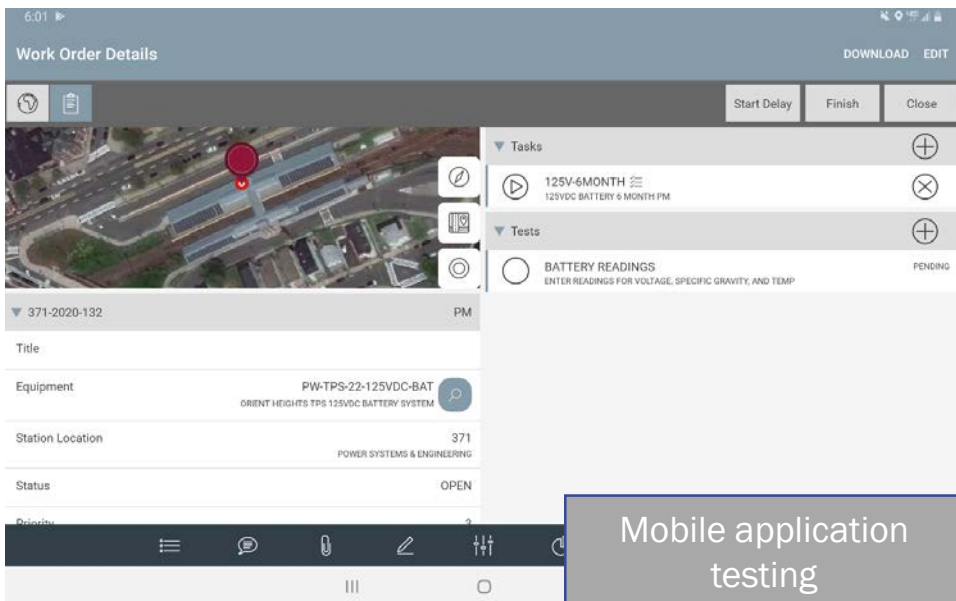


PM&I Improvement - Mobile Software Development



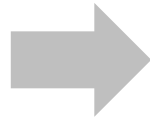
Mobile Software Development

- The MBTA will be working to convert its paper work management processes to digital processes that can be managed with tablets operated by technicians in the field, enabling real time asset status and work tracking.
- Project Milestones:
 - **EAM mobile workflows** designed and implemented in mobile software solution
 - **Field testing for Mobile workflow** and tablet.
 - **Training** provided to E&M front line staff and managers.



PM&I Improvement – Improving Inspection Methods

Implementing International “Best in Class” Inspection Methods



Current Inspection Protocol

Future Inspection Protocol

Example I: Use of Drones for Thermal Imaging

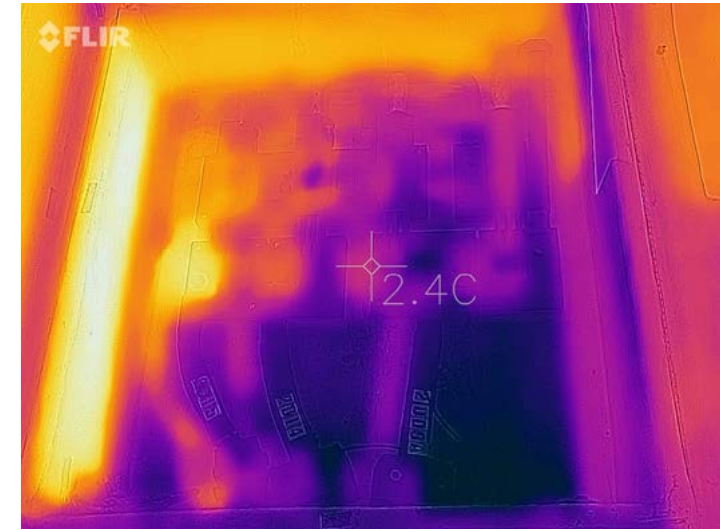
- **Manual visual inspection** of rail yards can be very time consuming due to the size of the yard.
- **Thermal imaging** via drone can be used to pinpoint defects in rail yard such as defective bonds or heating elements. Some of these defects cannot be observed visually.
 - Reduced inspection time
 - Early detection of defects



PM&I Improvement – Improving Inspection Methods

Implementing International “Best-in-Class” Inspection Methods

Example II: Introduce thermal image capture to manual switch box inspections



Current Inspection Protocol

Future Inspection Protocol



PM&I Improvement - Next Steps



Mobile Software Testing

Deployment of Critical Asset tracking:

- Mobile software and tablet field testing ONGOING
- Employee training (PM&I and mobile) JUNE 2020
- Critical asset digital PM&I tracking FALL 2020



Conclusion

- In developing full cycle asset management for the MBTA transit infrastructure, employee technicians are given the tools to be efficient and build competence in all aspects of systems maintenance.
- Data-driven decisions are now accessible through real-time tools, such as trending to highlight early indicators, work management, and clear management view of compliance.
- Engineering & Maintenance is better positioned to succeed at infrastructure maintenance, supporting a best-in-class transit system that is reliable and safe.

