Adoption of Electric Industry Geoprocessing Workflows for MTA Transit Operations

July 2018

Sean Fitzpatrick, Director and Program Executive
Enterprise Information and Asset Management
Email: sean.Fitzpatrick@mtahq.org
Phone: (646) 252-6685
Content

- Introduction to the MTA
- Comparison of transit operations to electric utility
- Asset Management in Transit
- Geospatial workflows
- Challenges of underground infrastructure
- “Smart Grid” and what it means for transit
What We Do: The MTA operates one of the largest transportation systems in the world in a 24/7 mode with physical assets valued at nearly $1 trillion.

Scale/Complexity: The MTA owns and operates more subway and commuter rail cars than all other metro and commuter railroads in the US combined.

- 713 Stations
- 2,078 Track Miles
- 5,643 Buses
- 6,465 Subway Cars
- 2,393 Commuter Fleet
- 9 Bridges and Tunnels
MTA is committed to delivering customer services and regional benefits as efficiently and effectively as possible through a more informed and transparent decision-making processes, implementing cost saving strategies and new technologies.

**Good practice asset management is key.** Coordinating the operation, maintenance and replacement of our fleets, facilities and infrastructure ensures that we spend every dollar on the essentials that provide the highest value for the MTA and its stakeholder.

Managing a $1 trillion public asset that operates 24/7 is costly and complex. That’s why we’re pursuing world class asset management practices.
What is asset management?

**Asset management** is the “coordinated activity of an organization **to realize value from assets**” (ISO 55000)

<table>
<thead>
<tr>
<th>Section of Plane</th>
<th>Bullet Holes per Sq Foot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine</td>
<td>1.11</td>
</tr>
<tr>
<td>Fuselage</td>
<td>1.73</td>
</tr>
<tr>
<td>Fuel System</td>
<td>1.55</td>
</tr>
<tr>
<td>Rest of plane</td>
<td>1.8</td>
</tr>
</tbody>
</table>

401 W. 118th St: Statistical Research Group (SRG)

Abraham Wald
Some of the practices the MTA uses to manage change in a controlled manner.
The MTA is developing enterprise asset information standards, requirements and models based on international best practices.
Information System (Infor) Functionality – Leveraging the MTA Performance Management Framework

MTA Corporate Level Objectives

Further development of performance framework & associated indicators required

Current Agency Performance Measures
The Reason Why EAM is a Big Deal for Transit

**Leaders**
- 3.5% Unscheduled Asset Downtime
- 89% Overall Equipment Effectiveness
- -13% Maintenance Costs Trend
- 24% Return on Assets vs Corporate Plan

**Laggards**
- 16% Unscheduled Asset Downtime
- 69% Overall Equipment Effectiveness
- +1% Maintenance Costs Trend
- -7% Return on Assets vs Corporate Plan

**Visible Benefits**
- Reduced Labor Cost
- Lower Inventory Cost
- Reduced Transportation Cost

**Stealth Benefits**
- Increased Production
- Better Customer Service
- Increased Asset Life Cycle
There are many factors driving the MTA to rethink how it manages its assets:

- Digital Innovation
- Customer Experience Expectations
- Climate Change
- Demand for Transparency and Efficiency
- Funding Challenges
- Urbanization
- Federal Requirements
EAM is investing to treat information as an asset: Infonomics

• **Need to strengthen Enterprise Information Management**
  – Manage information to provide business value
  – Setting up formal program to manage information

• **Why is it important:**
  – Information driven decision making
  – Information management must becomes business as usual
  – The key enabler for executive situational awareness

• **MTA planning investments into Enterprise Information Management**
  – Information management and government
  – Data architect / scientist
  – Business Intelligence analyst

• **Benefits**
  – Provides an enterprise view on all related assets
  – Support data-driven decisions
  – Prevents silos of information

*Knowing is not enough…..we must apply.*
- Leonardo da Vinci
Need for Enterprise Information Mgmt

• Role of Chief Data Office
  – Manage information to provide business value
  – Setting up formal program to manage information
  – Enterprise Information Management (EIM): information as an asset

• Why is it important:
  – Information driven decision making
  – Information management becomes business as usual
  – Capabilities focused on modernization
  – The key enabler for executive situational awareness

• How it aligns with EAM
  – Provides an enterprise view on all related assets
  – Information Driven Optimization instead of arbitrary prioritization
  – Prevents silo approach
  – Use information to innovate and transform the business to a more sustainable approach

Knowing is not enough…..we must apply.

-Leonardo da Vinci
This is a new role based on industry trends. The IoT (internet of things) technologies that are increasing the volume of data by many orders of magnitude will require that this function be firmly established in order to achieve optimal ROI on EAM investment.
Comparison of Transit Operations to Electric Utility
Technology Stack
The MTA EAM Information System

- **Infor** (and MMS like it) is the **body**, it manages how and when work is performed
- **Bentley AssetWise** is the **analytic** as it informs the what and why it should be done.
- **Red Hat** is the **nervous system**, it ensures commands from the brain and feedback from the senses are shared
- **ESRI** is **brain** forefront as the geospatial platform which enables all assets to have location based information that can be visualized and analyzed

EAM is a system for maximizing assets and the resources used to manage them
Linear Reference Overview

After setting up the linear references for the equipment right away these can be viewed on the Linear Overview tab of the equipment screen. From Point and To Point are internally used for proper positioning.

You can hover over any feature on the overview and a popup with details will open.

Work orders can also be viewed on the overview. The Dataspyle determines what selection criteria are applied to the work order search. On the overview we can see a work order for a track inspection.
GeoSpatial & Straight Line Diagrams Combined where it matters.
# Mobile Transit App

## Description

Mobile application that supports the unique requirements within the transit industry, including linear assets.

## Value Propositions

- View/update asset details on ESRI maps
- View/update WO’s and initiate new work requests
- View/update equipment including documentation
- Track activities and book labor
- Inspect equipment using configurable checklists
- Issue and track parts
**Mobile Transit App – Map View**

**Description**

Improvements to support the view and editing of GIS and Equipment features for linear assets from within GIS.

**Value Propositions**

- Equipment codes > 8 characters
- Display features that intersect map click points
- Enable/disable viewing details for specific layers (e.g. WO’s, routes, signals, etc.)
- From/To slider to easily view/edit linear assets
- Select and update linear events (e.g. accidents, gradients, etc.)
Asset Inspection
Visualizing the WHERE of EAM

Example: visually **select** Defects to be processed in EAM
Visualizing the WHERE of EAM

High Level WHERE: Subway Map embedded in EAM

Detailed WHERE, and WHAT: Track Chart embedded in EAM
Infor EAM Mobile Joint Switch Inspections

**JSI Work Order**

10623
Switch 18 / 05-Jan-2018 /JSI

500-018
500-018-Switch (SM A10,LH,EF,RFROG-EF - 8)

mvw JSI Work Completed
Jan 2, 2018

Blocked/Clamped

**Checklist Approval**

Signals Signature
MVWLPJ
Logan PJ van Wingerden
2018-01-05 09:20

Track Signature
MVWMT
Matthew T van Wingerden
2018-01-05 09:32

Track Superintendent Signature

**Work Order Images**

User Defined
User Defined
User Defined
User Defined
User Defined
User Defined
User Defined
User Defined

Custom Field
mvw Cust Chg
mvw Cust Num
mvw Cust Date
Infor EAM – GIS Enhancements

Description

Improving performance and extending GIS to Mobile for both connected and disconnected modes

Value Propositions

• Field use of GIS with EAM
• Expanded functionality
• Faster response times
Asset Condition
Can we automate the identification of areas with garbage?
1. Collect video inspections

2. Upload video to cloud

3. Splice video into frame images
4. AI image recognition

5. Geocode and store EAM

6. Human triage

7. Work crews
Linear Asset Decision Support (LADS) provides the capability to deliver true predictive insight for Asset Management.

Data collected from monitoring fleet, manual inspections and other sources.

LADS provides visual layered view of multiple information sources providing root cause analysis.

For example, better understanding of underlying cause of problems relating to track geometry.

LADS enables NR to deliver more effective maintenance, fewer renewals of the right specification for at least the same level of performance.

LADS enables consistent, evidence-based decision making and application of policy over time through use of algorithms.

More reliable decisions around track maintenance processes, refurbishment and renewals processes.

NetworkRail
Nonconformity Status: List of Values

Represents the name of the external system where the Nonconformity may also be tracked. This is for traceability back to an area which may have its own system.
System Structure

The following picture represents the proximity hierarchy for the subway section IND-C that extends south of station 145 St to the north of station Norwood-205 St and spans stationing 1332+01 to 1667+51. This section includes various stations, under river tubes, portals, and emergency exits.
Signals Responsibilities

Signals Assets and Locations include:

- Manned towers
- Control Boards
- Signal Heads
- Cabling
- Relay Enclosures
- Relays
- Switch Machines
- Switch Heaters
- Interlockings
- Insulated Joints
- Repair Shops
Signals Responsibilities

Sample signal diagram

Insulated Joints

Need of II Condition Assessment

Update Record - Save Changes

Field Inspection & Update

Mobile Technology Adopted for Asset Inspection and Inventory Update in the Field
Signals Responsibilities

Signal Heads
Relay Enclosures & Relays
Business Goals

Identifying the relays (What)
• Configure an Enterprise repository
• Create a common set of attributes

Locating the relays (Where)
• Build out Location / Position hierarchy
• Assign relay assets to positions

Selecting the relays (Which)
• Physically tag each relay
• Tie into EAM

Incorporate a Mobile Data Collection Application
Signals Responsibilities

Switches

Devices are often moved to different locations during their life span.

During the lifetime of a particular transformer or switch, the individual piece of network equipment may be installed in one location, only to be removed and stored in a truck or warehouse for a period of time. This process can be repeated for the same piece of equipment several times during its useful lifetime. From an asset management standpoint, an accurate accounting for depreciation purposes is important. It is also important to continue to link historical maintenance, repair, and inspection data to understand when the equipment has reached the end of its reliability curve.
Electrified Rail with Electronic Signals: Water is Bad!

Periodic Thermal Sensing:

- Massive data yields
- Vehicle sensors
- Spatial Analysis
Electric Geoprocessing Workflows that translate to transit:

- Conservation/load management
- Demand response
- Theft of current
- Billing
- Materials management
- Asset management
- Capital optimization
- Switch design
- Land management
- Emergency management
- Schematics
- Work Order planning
- Substation planning
- Medium/Low Voltage
- SCADA integration
Electric Distribution Work Flow: Similar to Electrified Rail Network

- Wooden pole holding transformer and CATV
- Service drop connecting Transformer #104 and meter #156
- Customer meter #156; customer A1005 - Smith
- 3-phase transformer #104 fed by line #345; connects meters #156, ...
- Copper, 3-phase #345 connecting transformer #104 and switch S506
- Switch S506, currently closed, on a 3-phase line; connects lines #345 and #346

Other related systems:
- Customer Information System
- Materials Management System
- Work Management System
- Geographic Information System (AM/FM)
- Planning Engineering Systems
- Outage Management System
- Maintenance Operations (Normal)
- Service Request
- Service Status
- Service Billing
- Facilities Locate
- Work Design
- Record As-Built
- Maintain Maps and Records
- Engineering Analysis
- Proposed Facilities Service
- Interruption Reporting
- Estimate Loading
- Restoration Analysis
- Dispatch Restoration Process
- Inspect/Maintain
- Repair/Replace
- Reliability History
- Distribution SCADA
- Meter Reading
- Material Order
- Material Reconcile
- Material Issue
- Material Availability
- Schedule
- Work Initiation
- Work Estimate
- Work Schedule
- Work Reporting
- Work Closing
- Capital Accounting/Tax Record
- Supplier
- Operation Analysis
- Maintain Connectivity
- Model
Geospatially Enabled EAM

Geographic Information System

Asset Geo-Location Management
- Geospatial location
- Geographic visualization
- Spatial hierarchy
- Spatial query
- Spatial analytics
- Spatial cost tracking
- Discrete and linear assets

GIS Data
- **ASSET LOCATION REGISTRY**
- Location attributes
- Linear reference

Stores the assets that reside at a geographic location

Stores the geographic locations at which assets reside

Asset Management Information System

Asset Life Cycle Management
- Material stock/inventory
- Installation
- PM
- Repair
- Decommission
- Replace
- Asset hierarchy
- Cost tracking
- Discrete and linear assets

Asset Management Data
- **ASSET REGISTRY**
- Attributes
- Specifications
- Condition
Pervasive sensors, information and communication technologies are already generating massive amounts of information about our infrastructure assets, systems and cities. Sensors, information and communication technologies (SICT) enable a wide range of solutions for smarter, more sustainable and resilient cities.

The marriage of digital technologies and physical urban infrastructure has given rise to **SMART INFRASTRUCTURE**.
PHYSICAL SCALES AND HIERARCHIES

Integration OF BIM to GIS Physical hierarchies

GIS extends the value of digital Building Information Modeling (BIM) design data through visualization and analysis of structures in the context of the natural and built environment.
Where / how do I start?

**Information Product Description**

**Electric Data Model Input**

**Geoprocessing Tool Development**

**Information as an Asset**
Our Vision for asset information is to ‘to get the right information, to the right people, at the right time, via the right technology’