Metro-North Railroad’s Enterprise GIS Program: Yesterday, Today, and Tomorrow

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Metro-North Railroad

- Three states, twelve county service area, 2,701 square miles.
- Five lines, three branches, 384 route miles, and 775 track miles.
- 1,072 bridges, 119 grade crossings, 77 substations.
- 124 stations, 1,258 railcars, 711 weekday departures carrying 284k customers.
- Full service commuter railroad with engineering responsibility for track, signals, power, structures, stations, and railcars.
Business Case

• Use company-wide survey instrument to generate interest in GIS

• Benefits:
  – Accurate mapping
  – Ensure uniform standard for capturing geographic data
  – Proximity analysis of assets belonging to different depts.
  – Integrate multiple mapping systems in use by different depts.

• Strategy:
  – Hire GIS Specialist, recruit via online GIS networks
  – Initiate Concept of Operations study, identify early action items
  – Sacrifice server resiliency/redundancy in the short-run to limit costs, but build-in expandable architecture
  – Leverage Enterprise virtual server infrastructure

<table>
<thead>
<tr>
<th>GIS Need</th>
<th>% Respondents</th>
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<tbody>
<tr>
<td>Describing a location (at least monthly)</td>
<td>90%</td>
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<tr>
<td>Communicating a location (e.g. geocodes) to an outside entity</td>
<td>66%</td>
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<tr>
<td>Locate a fixed asset in the field</td>
<td>62%</td>
</tr>
<tr>
<td>Plot a map for sharing, reporting, etc.</td>
<td>34%</td>
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<tr>
<td>Count features within a geographic area</td>
<td>62%-66%</td>
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Trigger Events

- **Identified GIS Needs**
  - Real-time incident management
  - Post-event reconstruction

- **Westport 1532** (2011-07-22)
  - Real-time train location
  - Emergency access to ROW
  - Fire/EMS jurisdictions
  - Milepost/catenary pole/street address correlation

- **Hurricane Sandy** (2012-10-20)
  - Real-time storm tracking
  - Elevation of key rail assets
  - Post-event insurance claims
  - Mapping recovery efforts
  - Flood proofing future design
Hudson Line: “Water Level Route”

- Kemeys Cove MP 29.7
- Bear Mountain MP 45.1
- Scarborough MP 29
- Sandy Surge MP 25
Early Action—Inventory Existing Condition

- Hardware and Software
- Existing Systems
- Data Sources
  - Past projects (e.g., Positive Train Control LiDAR)
  - Publicly available
- Business Processes
- User base and skills

Metro-North Railroad

**Grand Central Terminal (GCT) Building Model**

**Bridge Management System**

**Visual Train Tracking System (VTTS)**
Early Action—Policies

• **Human Capital:** GIS/CAD as “preferred skill” in job qualifications
• **Software:** Push users towards GIS web viewers; limit desktops
• **Procurement (Boilerplates):** Require GIS deliverable in all capital projects, i.e. As-built and other drawings, database outputs (track defect measurement system)
• **Data Security:** 3 levels of GIS Data
• **Data Hygiene:** Check-in/check-out, QA/QC procedures, etc.
• **Data Ownership and Update:** Working with ongoing Enterprise Asset Management (EAM) effort
Concept of Operations (ConOps) Study

- **Goals and Objectives Meetings**
  - Co-opt senior management support
  - Loosely define user requirements
  - Find possible use cases

- **Data Inventory and Gap Analysis:**
  “Fishing expedition” to discover more data and resources

- **Business & Operational Processes:**
  “Institutionalization” of GIS
  - Straight Line Diagrams (SLD) Viewer
  - Integrated Property Boundary GIS (Yardi)
  - Plan Room Drawing Retrieval (CPRDRM)
  - Visual train tracking replacement
  - Ridership & Demographics Visualization

- **Staffing:** “Who’s doing what?”
  Add new staff if nobody there!
Marketing

- **Portal:** “at a glance” GIS resources webpage

- **REST Services Directory:** wide open (on purpose)

- **Email Blasts:** exec. level “this is what GIS can do”

- **“Infomercial” Videos:** like home shopping...

- **Roadshows:** visit regular departmental meetings or set up special targeted sessions

- **Ask Project Manager to Approve:** when receiving data, always circle back to PM (more for education than for review)

- **Early Products:** use 3D visualization, heat maps, BigData, etc., and circulate example map to generate interest
Early Data Products

• Employee Residences to estimate commute time
• Station Catchment to estimate feeder demand
• Third Rail Burner and Mud Spot tracking for maintenance
Enterprise GIS Web Viewers

- Map railroad features on web application to improve data access
- Publicly available GIS layers overlaid with railroad locations
  - Census Demographics
  - Environmental features
  - FEMA flood information; Public and Quasi-Public facilities, etc.
- Link existing PDF maps into viewer as repository of drawings
  - Signal block plans, Power sectionalizing diagrams, Val maps, etc.
  - Avoids labor intensive Georeferencing for now
- Google Maps and Street View Integration at critical points
Enterprise GIS Architecture

- ESRI ArcGIS for Server 10.2
  - with Web Adaptor
  - Access via web viewers and REST services (intranet only)
- File geodatabase on server
  - Migrating to Oracle
  - Effectively read-only for now
  - Power users on Desktops
  - GIS Manager is gatekeeper
- Mobile access via tablets with AirWatch software
- Inter-agency (MTA, LIRR, TA) access via selected opening in the firewall
Metro-North Enterprise GIS Web Viewers

Enterprise GIS

Environmental Features

U.S. Census Demographics

Public Facilities
Metro-North Enterprise GIS Web Viewers

- **Track Sensor Data**
- **Rock Slopes**
- **Sandy Project**
- **West of Hudson Signal Project**
Metro-North Enterprise GIS Web Viewers

- GCT Building Model
- Topographical Contours
- Limited English Proficiency
- Drainage Structure (2011)
Metro-North EGIS: Asset Locations
Charts, Plans, Val Maps, and Power Diagram
Metro-North EGIS Tools: Search
Enterprise GIS Tools: Measure Distance
Enterprise GIS Tools: Google Street View
Enterprise GIS Base Map Choices
EGIS Next Steps

• Migration Issues
  – ArcGIS 10.2 to 10.3
  – Dev/Prod Resiliency

• Implement Five Baseline Applications

• GIS Staffing Roles
  – SLD Engineer
  – Licensed Surveyor
  – Drawing Archivist/CADD
  – GIS App Developer
  – Demographer

• In House Training

• Other Applications
  – GIS Viewer for Security Management
  – Sustainability “Green” GIS
  – GIS Viewer for Emergency Management Application
Questions?
Data Request?

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Straight Line Diagrams

- Plot GPS coordinates, milepost, locations on a straight line diagram (SLD) like track chart
- Overlay data on marked-up track chart: slow orders, outages, tonnages, track geometry, signal/power/buried utility, etc.
- Replaces current laborious process of producing track charts
- Enables interdisciplinary information & intelligence sharing
- Improved capability & speed in identifying defects
- Vastly improve field data accessibility over paper
Property Management
GIS Integration

• Provide accurate, surveyed property lines of Metro-North rights of way, yards, leases, etc.
• Integrate with proprietary tenant management system
• Supports capital project planning, asset maintenance, operations, and emergency management
• Support entry permit process
• Support rent collection process and lease requests from utilities

Metro-North Railroad
Virtual Train Tracking System Replacement

• Display live train locations in near real-time on a diagrammatic map, line chart, as a colorized delay diagram, and allowing drill-downs into additional and historical data
• Display train movements relative to location features & infrastructure
• Delay visualization on mobile devices
• More accurate prediction of delays
• Better data for trainmasters making real-time assignments due to tight integration with crew and consist management systems
Plan Room Drawing Retrieval Mapper

- Recently scanned 100,000+ as-built drawings to PDF
- Allow user to visually look for drawings “by map”—self service drawing retrieval
- Geo-reference and improve indices by keyword/discipline
- Strikes balance between fully digitizing versus text-based location descriptions only
- Allows archivist to focus on minority of exception cases