EAM

Adoption of Electric Industry Geoprocessing Workflows for MTA Transit Operations

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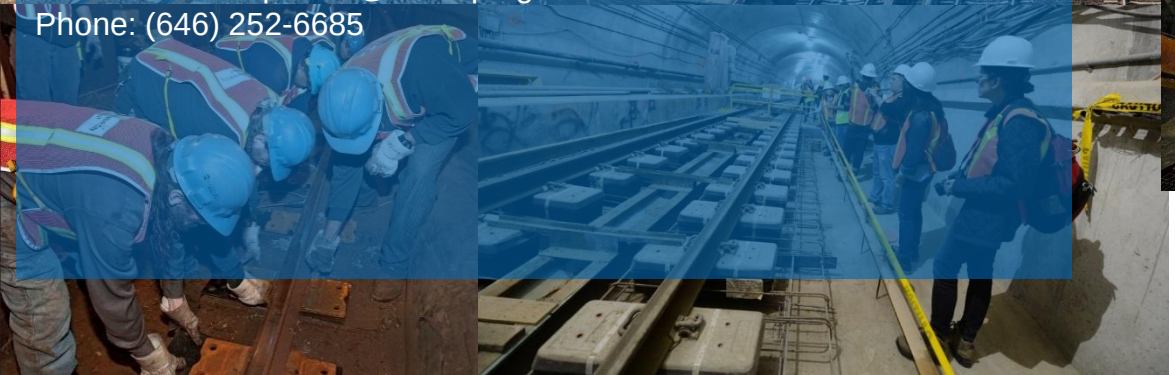


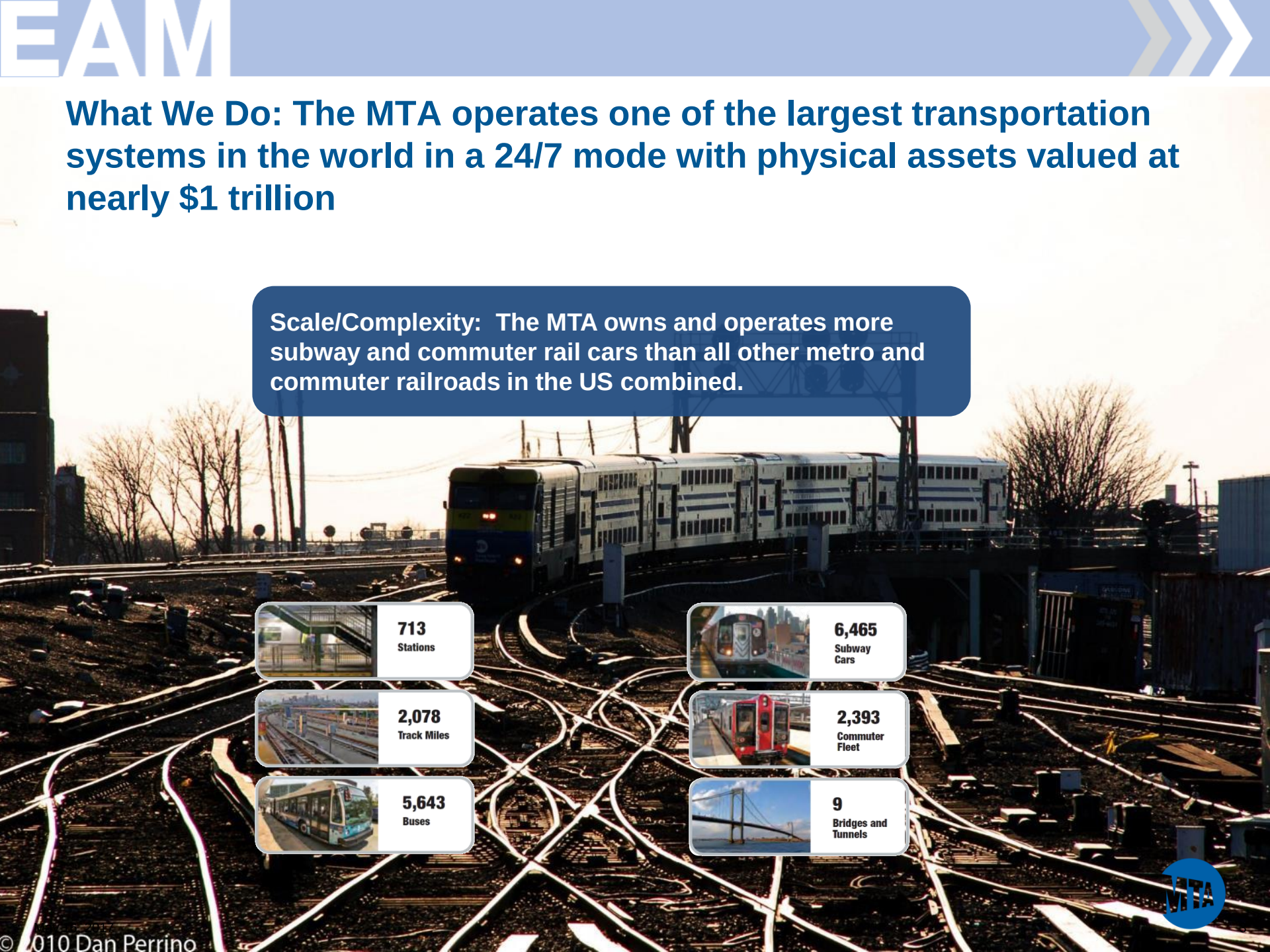
Metropolitan Transportation Authority
Enterprise Asset Management

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

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.

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.

What is asset management?

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

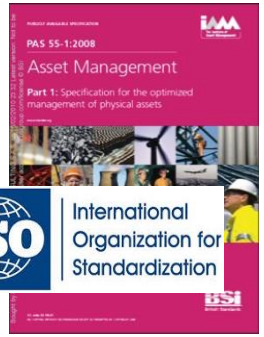
401 W. 118th St: Statistical Research Group (SRG)

Abraham Wald

Section of Plane	Bullet Holes per Sq Foot
Engine	1.11
Fuselage	1.73
Fuel System	1.55
Rest of plane	1.8

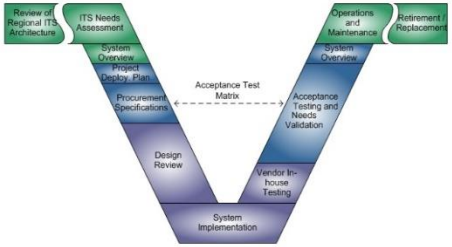
Some of the practices the MTA uses to manage change in a controlled manner

International Standards



ISO International Organization for Standardization

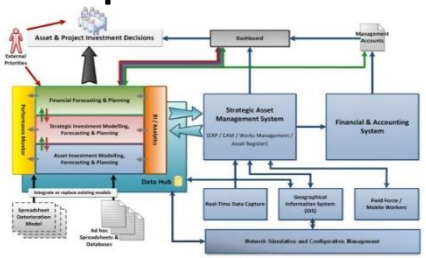
Systems Engineering



Delivery

agile™

Enterprise Architecture



Program / Project Management

MSP®

PRINCE2®

Change Management

Prosci®

The MTA is developing enterprise asset information standards, requirements and models based on international best practices

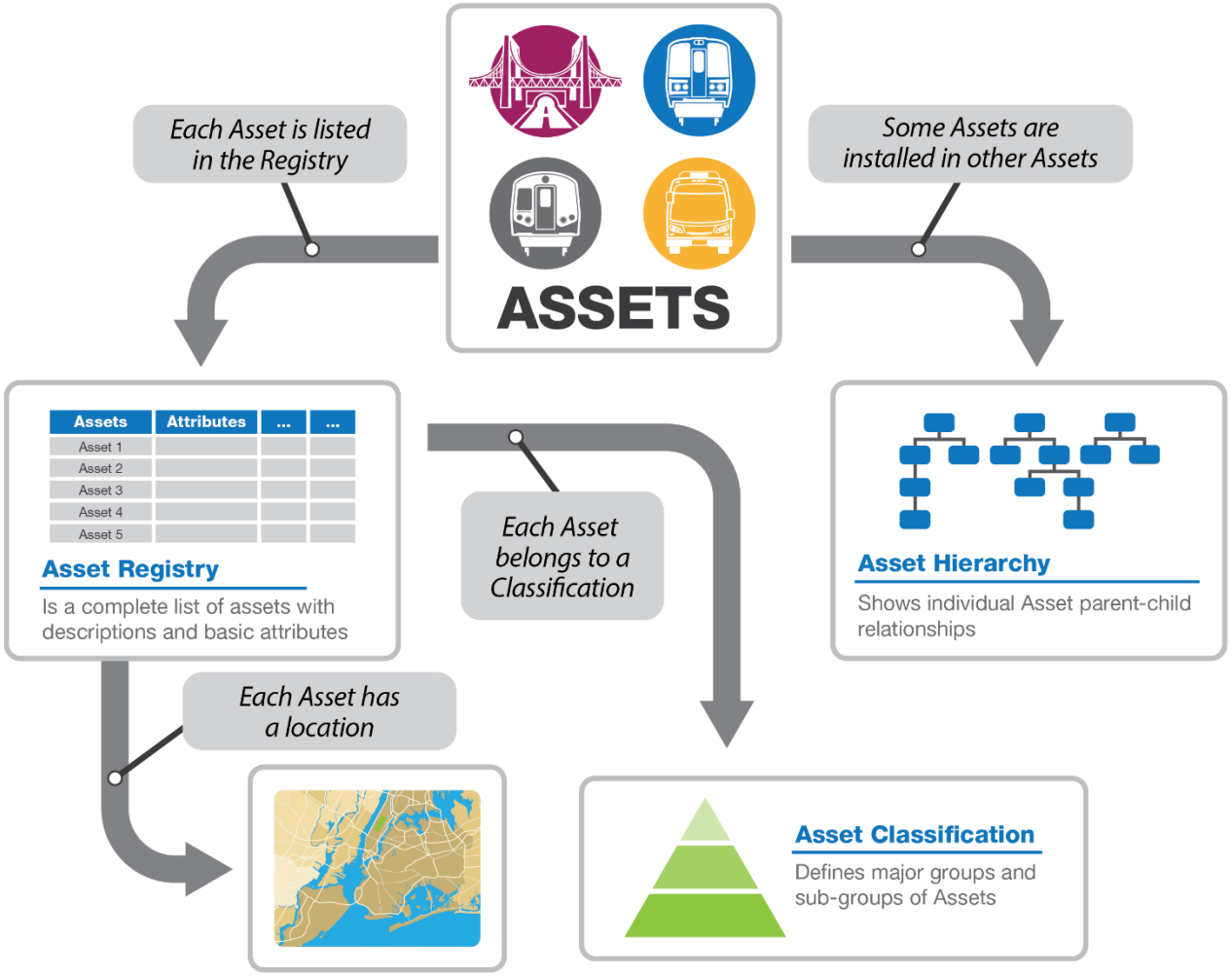
Standards for
management
ISO 55000 /PAS
AS/ISO 31000
AS/ISO 10007

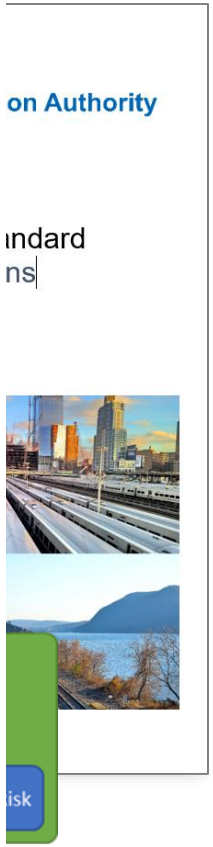
Standard for S
Engineering
ISO 15288

Standards for
information ar
ISO 14224
PAS 1192

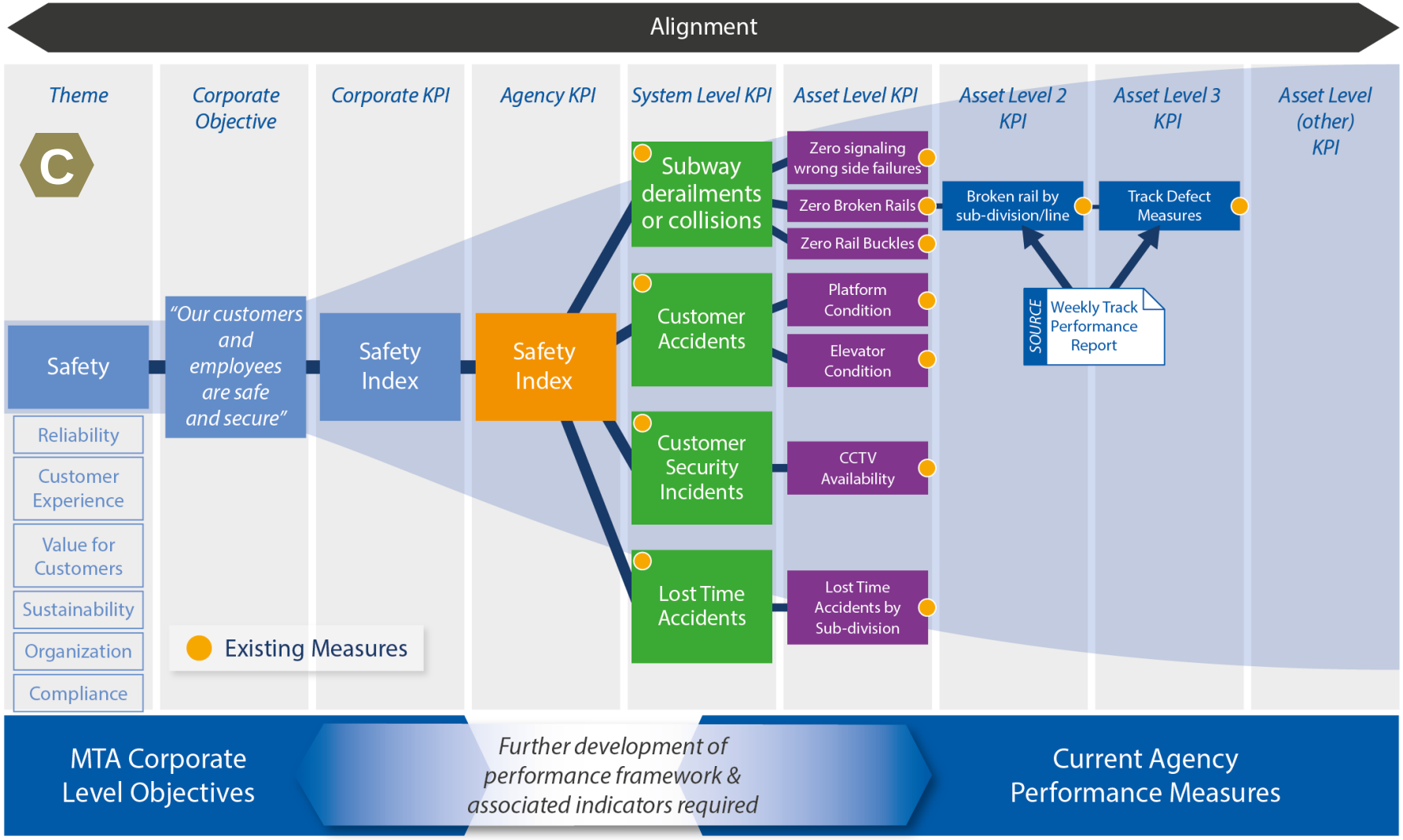
Standards for
ISO 8000 (Quali
ISO 15926 (Aut

Standards for
Referencing S
ISO 15046
ISO TC 211





Information System (Infor) Functionality – Leveraging the MTA Performance Management Framework



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The Reason Why EAM is a Big Deal for Transit

Leaders		Laggards
3.5%	Unscheduled Asset Downtime	16%
89%	Overall Equipment Effectiveness	69%
-13%	Maintenance Costs Trend	+1%
24%	Return on Assets vs Corporate Plan	-7%

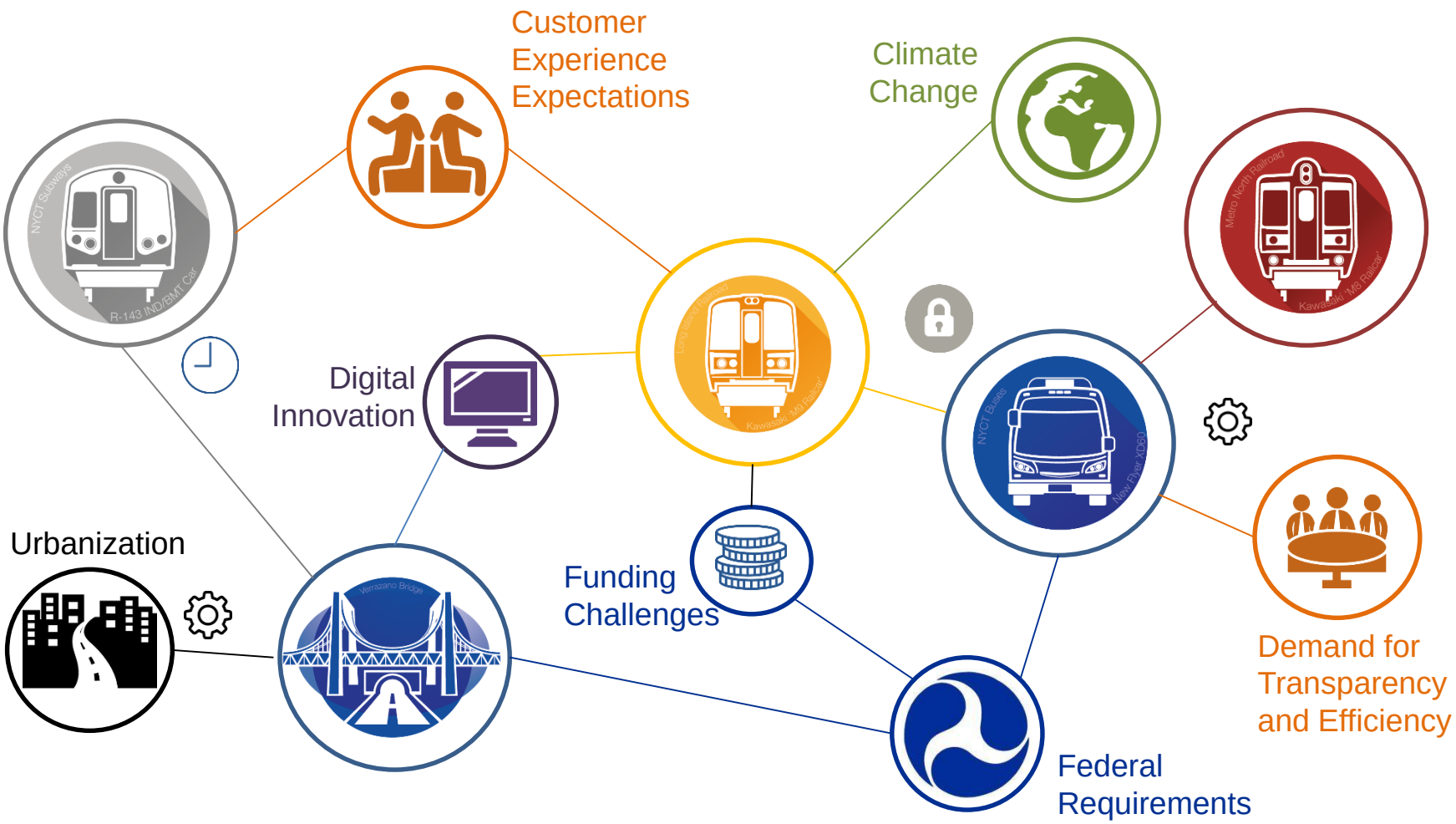
Visible Benefits

- 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

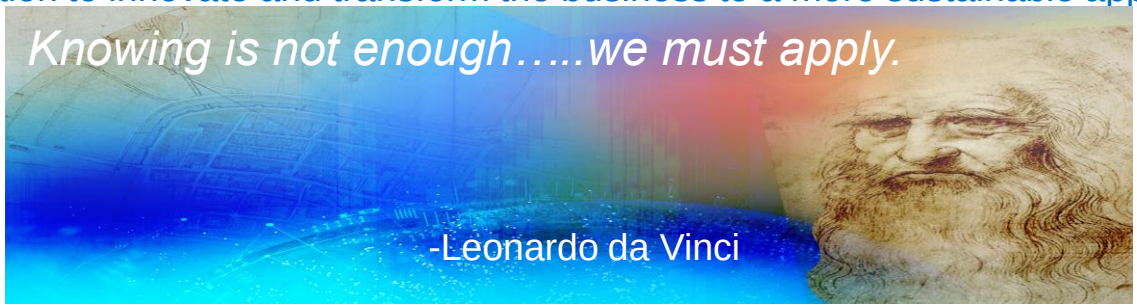


EAM is investing to treat information as an asset: Infonomics

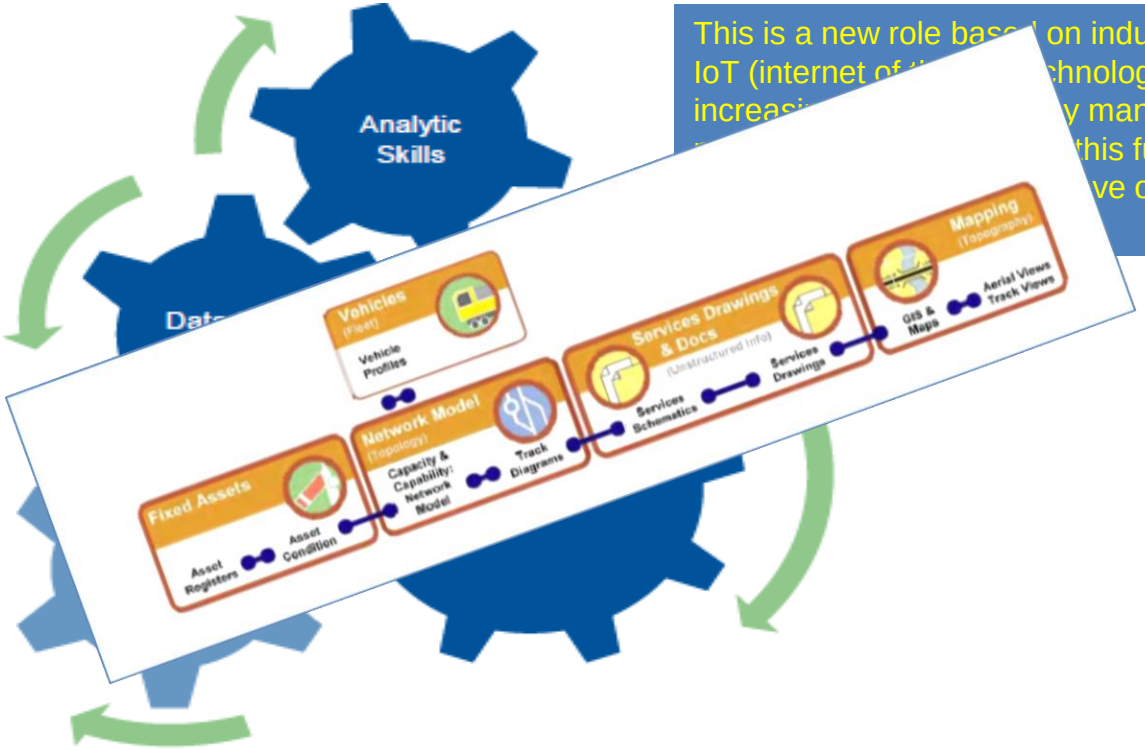
- **Need to strengthen Enterprise Information Management**
  - Manage information to provide business value
  - Setting up formal program to manage information
- **Why is it important:**
  - Information driven decision making
  - Information management must becomes business as usual
  - The key enabler 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

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

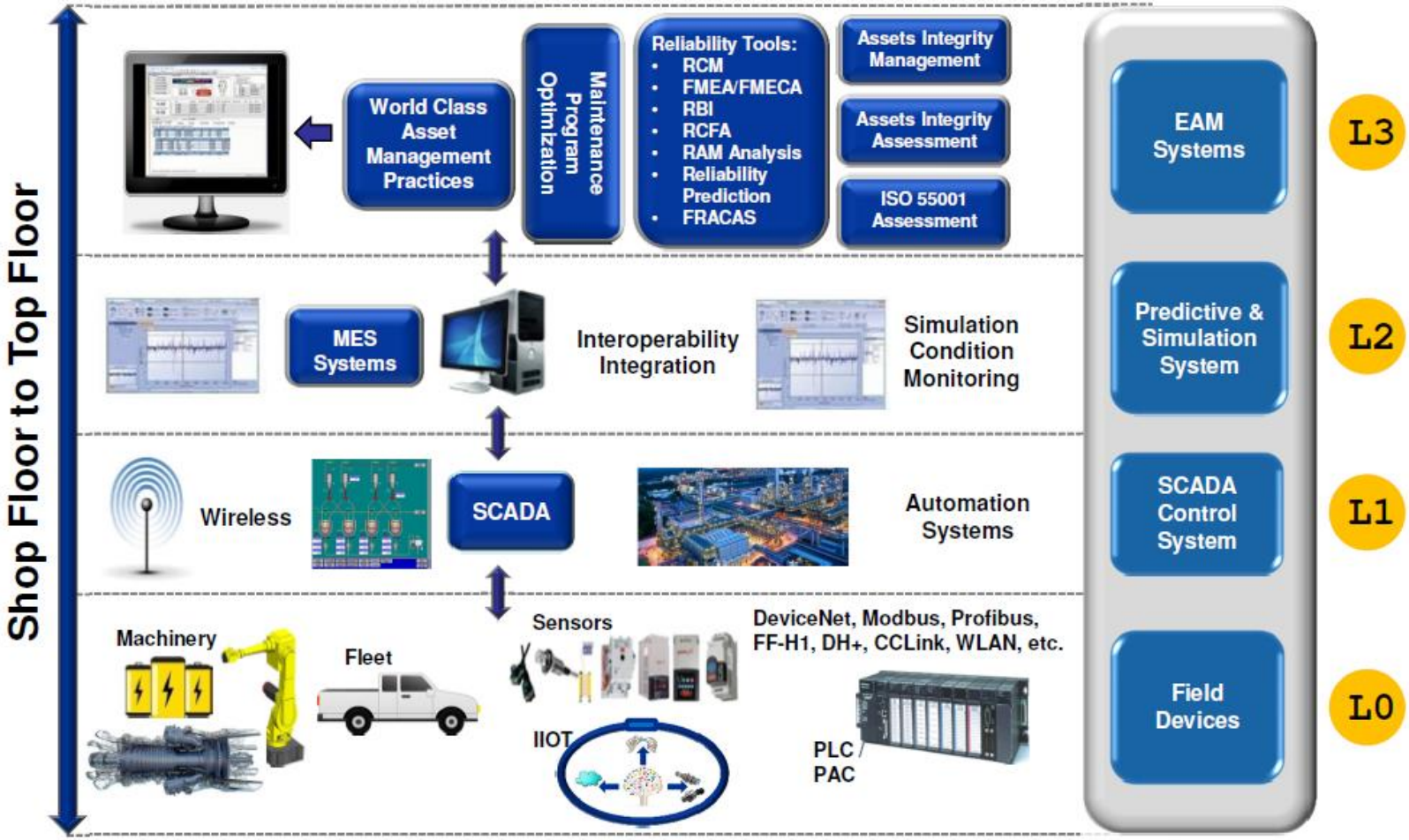


Information Management: Chief Data Officer

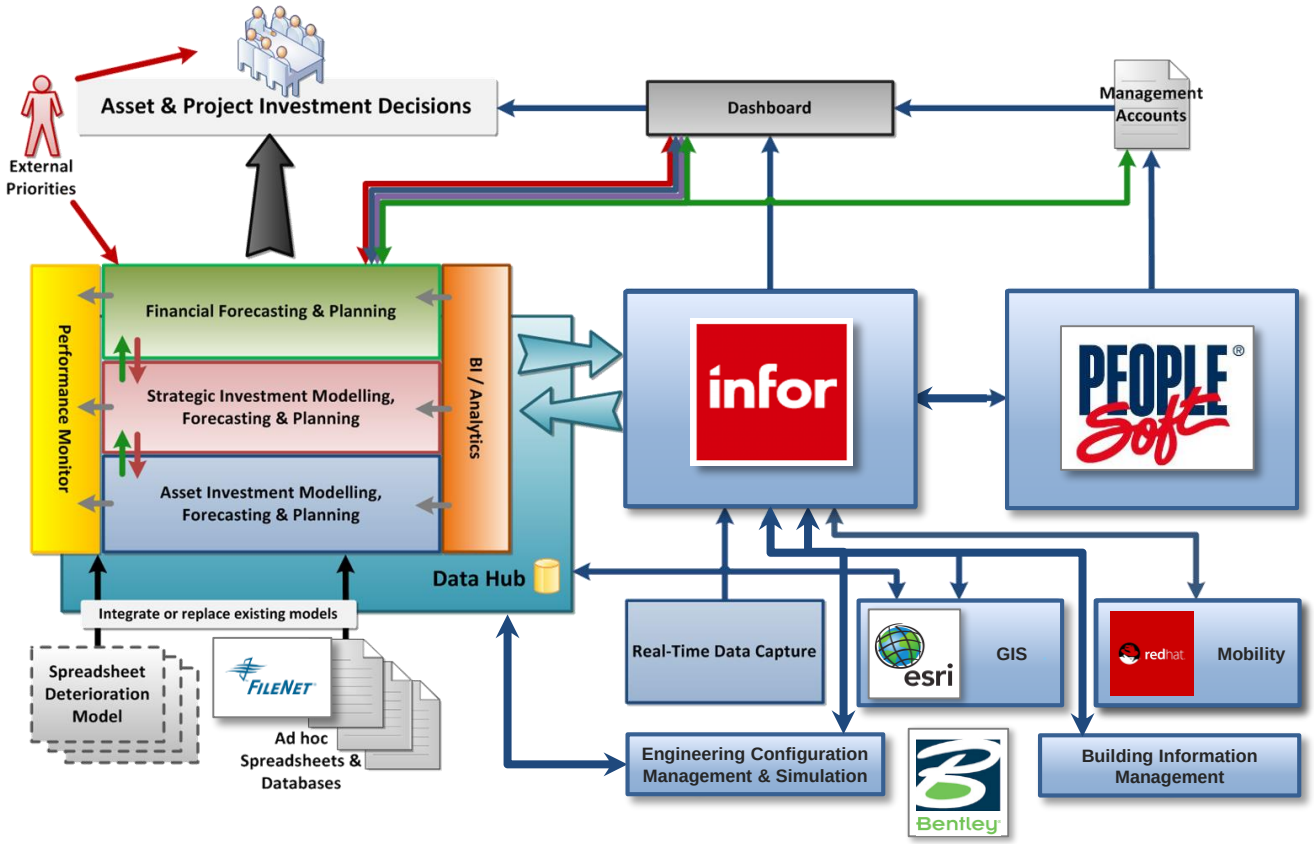


This is a new role bas l on industry trends. The IoT (internet of chnologies that are increasi y many orders of this function be firmly ve optimal ROI on

Comparison of Transit Operations to Electric Utility



Technology Stack



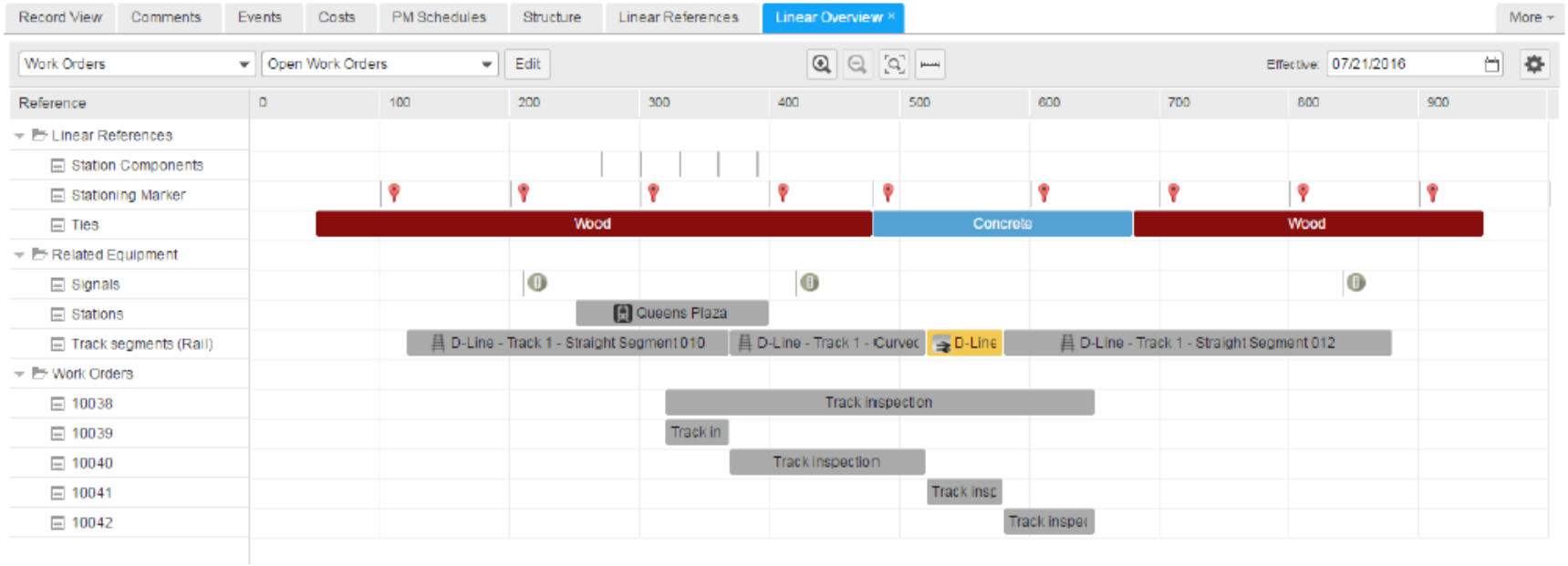
The MTA EAM Information System

- 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

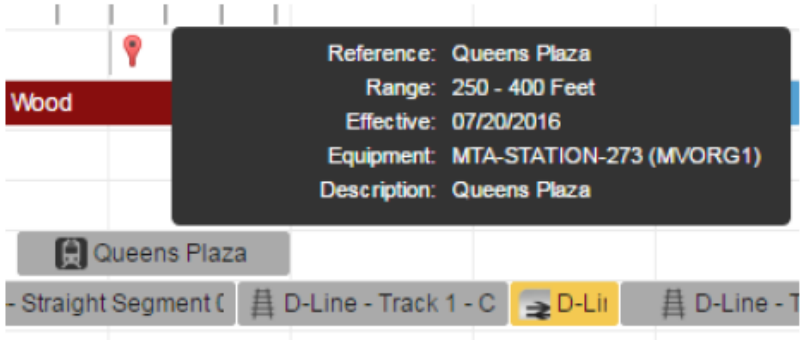
EAM is a system for maximizing assets and the resources used to manage them

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.

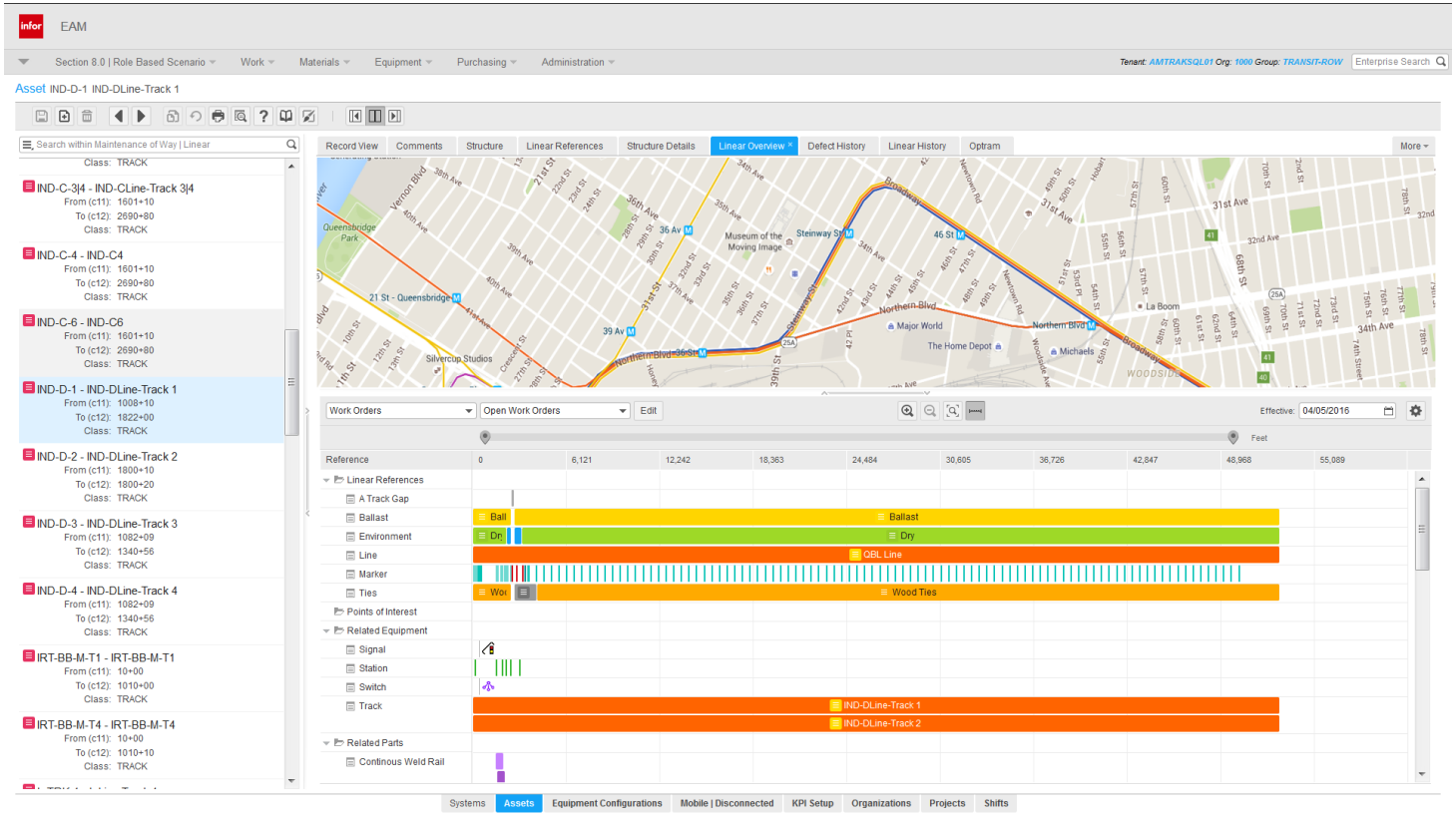


You can hover over any feature on the overview and a popup with details will open.



Work orders can also be viewed on the overview. The Dataspy 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.



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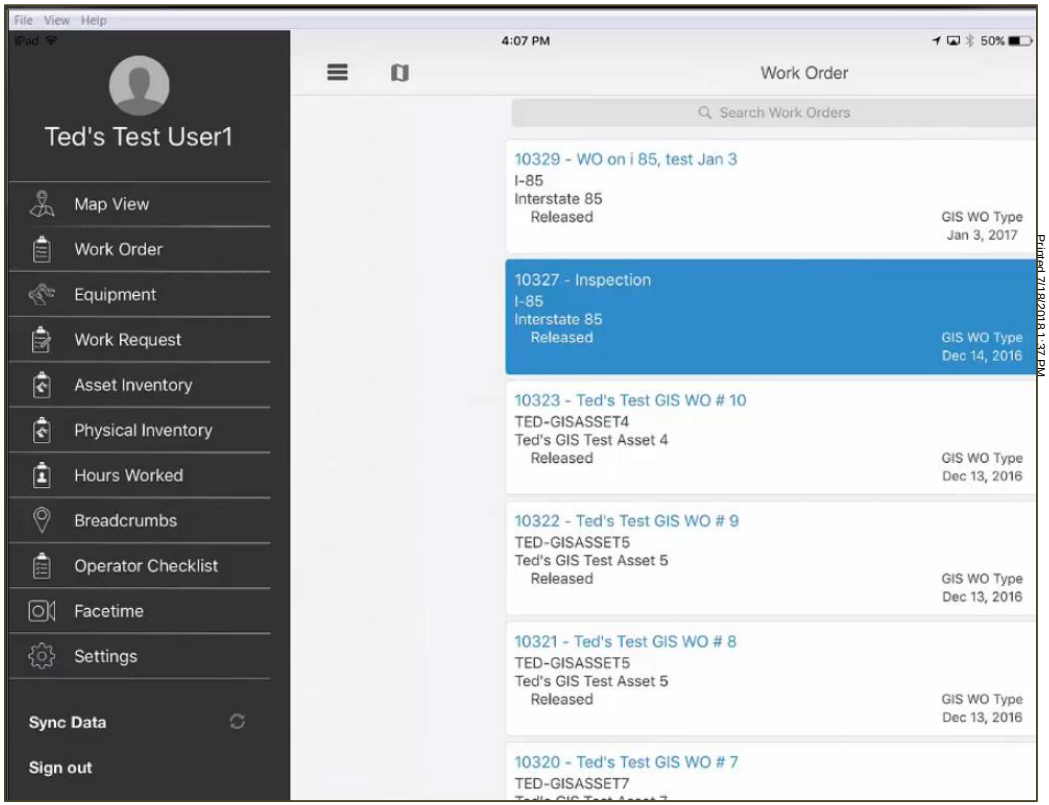
Mobile Transit App

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



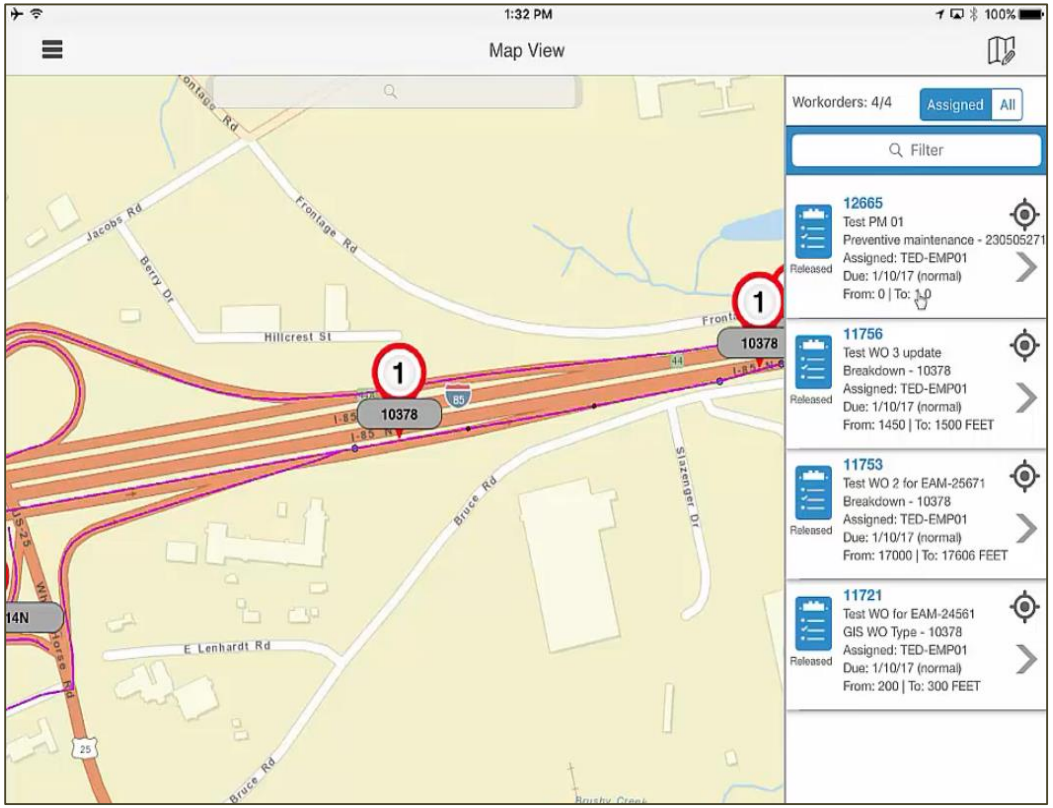
Mobile Transit App – Map View

Description

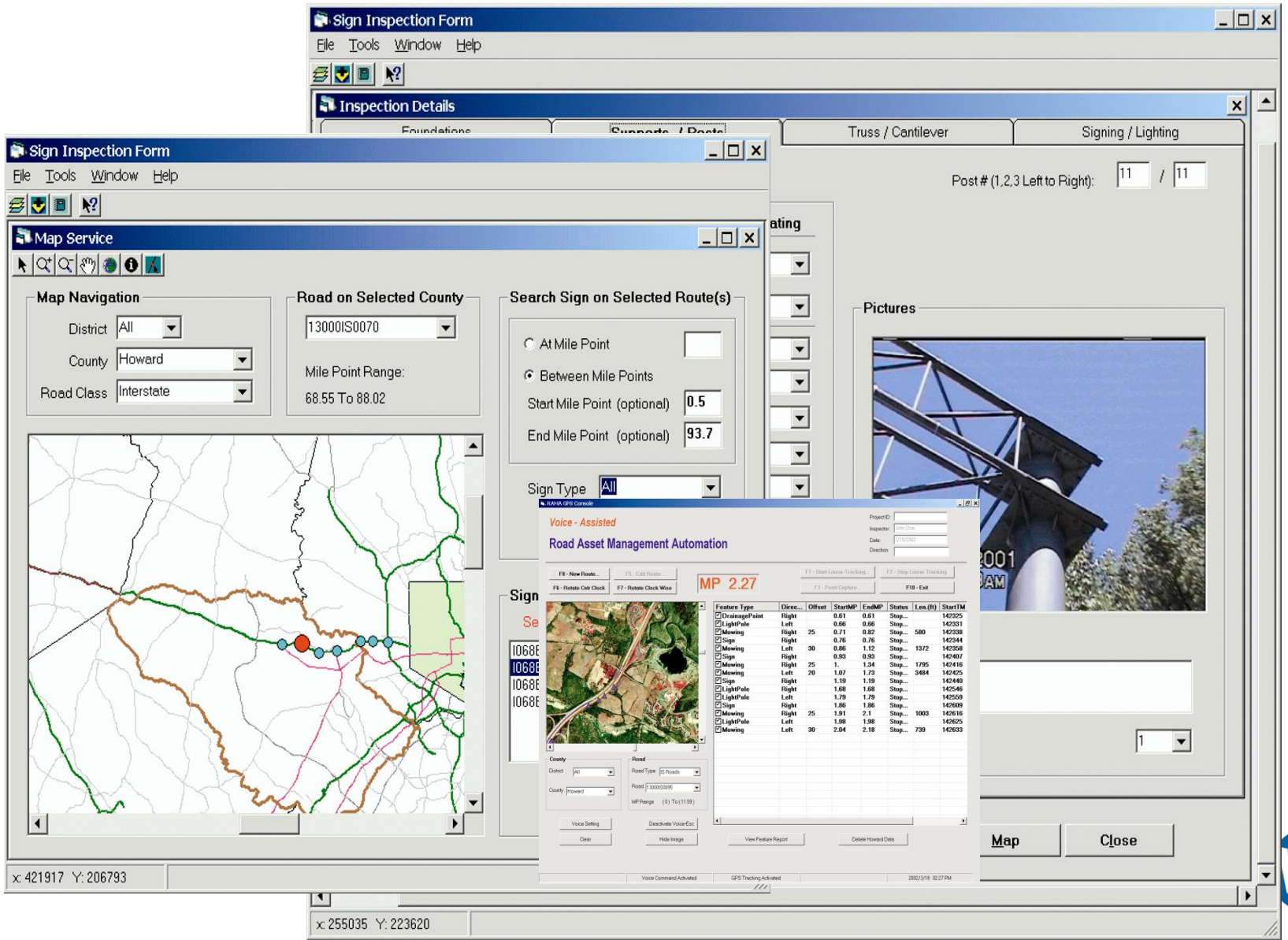
Improvements to support the view and editing of GIS and Equipment features for linear assets from within GIS

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



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Visualizing the WHERE of EAM

Example: visually **select** Defects to be processed in EAM

Infor EAM

Nonconformity	Observation Num	Observed Date	Description	Responsible Division	Responsibility Center	Class	Division	Line
[A]	=	=	[A] asdf	[A]	[A]	[A]	[A]	[A]
14243	1	04/24/2015 00:00	Leak: Active; 3'	MOW-INF-OPS	2697	IN-LEAK	IND	IND-A
14279	1	04/24/2015 00:00	Leak: Active;	MOW-INF-OPS	2697	IN-LEAK	IND	IND-A

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Visualizing the WHERE of EAM

High Level WHERE: Subway Map embedded in EAM

Detailed WHERE, and WHAT: Track Chart embedded in EAM

Nonconformity Details

Nonconformity: 14243 | Leak: Active, 3

Equipment: 15923 | SEC: IND - A - SUB - N/O Euclid Av to S/O Inwood-207 St

Responsible Division: MOW-INF-OPS

Responsibility Center: 2697

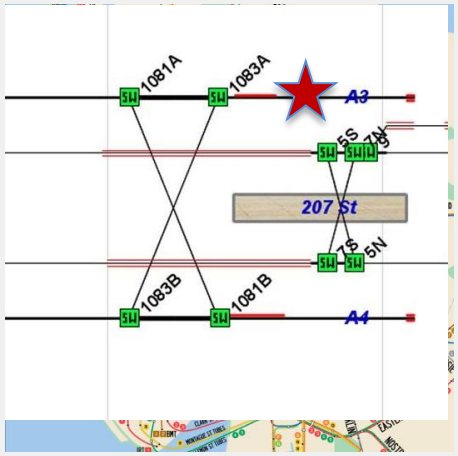
Monitoring Division: MOW-ENG

Class: IN-LEAK

External Defect System: DRAW

External Defect ID: 1338344

Source: MOW Engineering



Division: IND

Line: IND-A

Section: IND-A-SUB-11+49to15

In/Nearest Station: 144-DyckmanSt-8AV-A

Track: IND-A-3

Column Number: 1,504

+ Offset: 20

Component:

Where: W-Wall

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EAM

infor

iPad VPN 12:03 PM 13%

iPad VPN 12:03 PM 13%

Work Order # 10623

JSI Work Order

10623 1

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

Target Start Date	Target Complete Date
Jan 5, 2018	Jan 5, 2018

Checklist

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

Sign Reject

Work Order

User Defined

User Defined

User Defined

User Defined

User Defined

User Defined

User Defined

Custom Field

mvw Cust Cha

mvw Cust Nur

mvw Cust Dat

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MTA

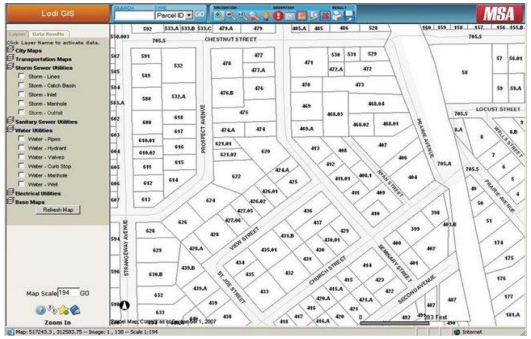
Infor EAM – GIS Enhancements

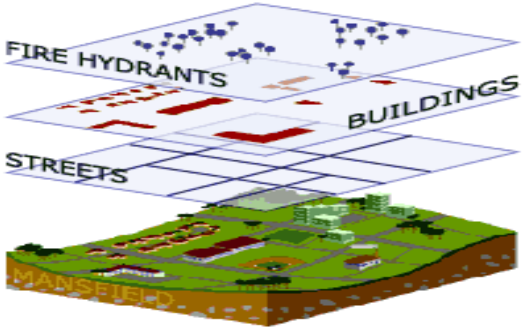
Description

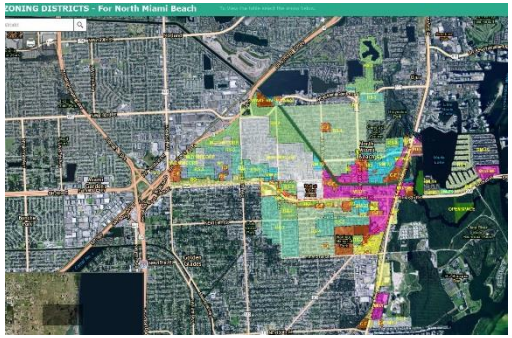
Improving performance and extending GIS to Mobile for both connected and disconnected modes

Value Propositions

- Field use of GIS with EAM
- Expanded functionality
- Faster response times



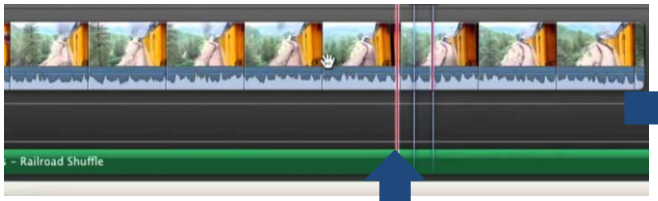




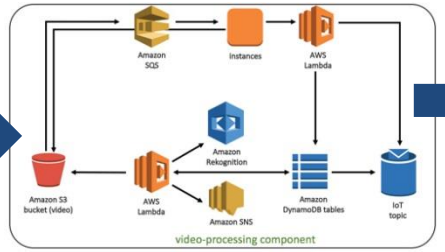
Asset Condition

Can we automate the identification of areas with garbage?

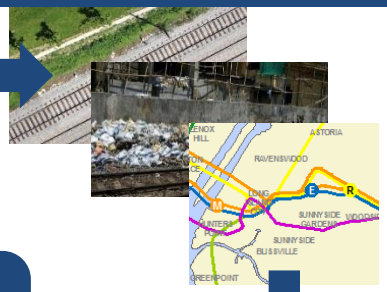
EAM



2. Upload video to cloud

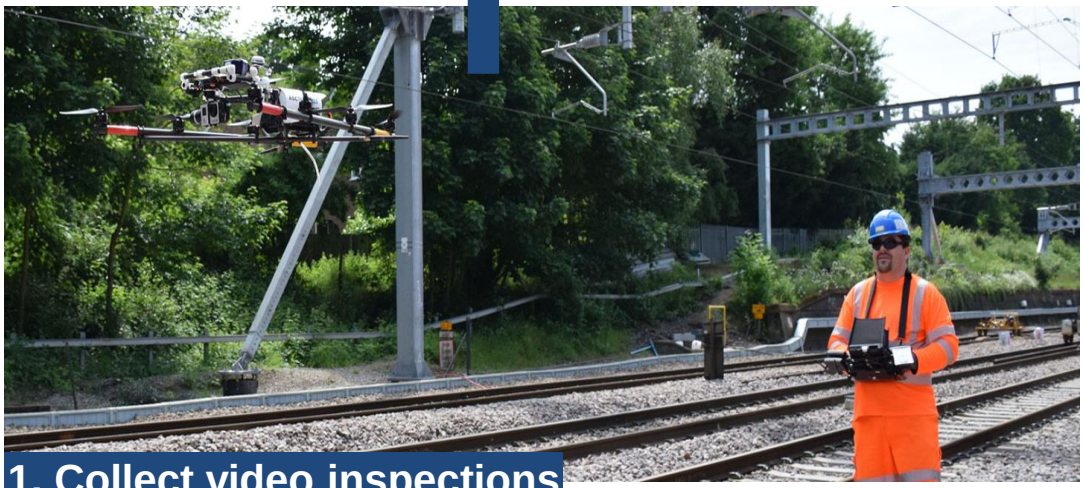


3. Splice video into frame images
4. AI image recognition



5. Geocode and store EAM

6. Human triage



1. Collect video inspections

7. Work crews

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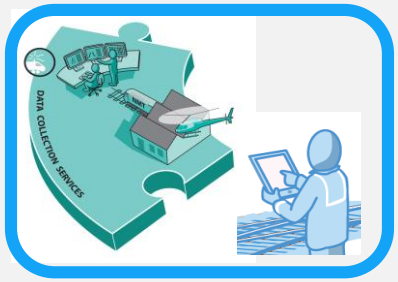
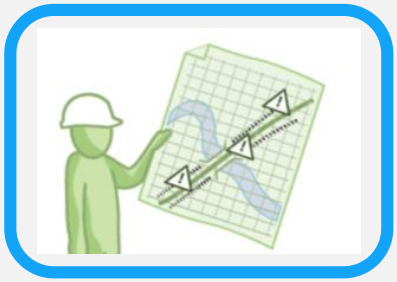
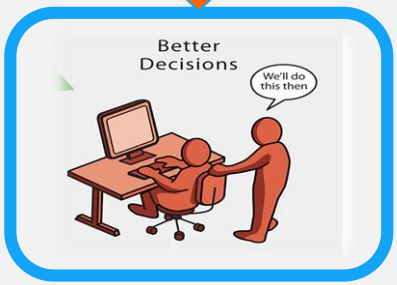
Linear Asset Decision Support (LADS) provides the capability to deliver true predictive insight for Asset Management



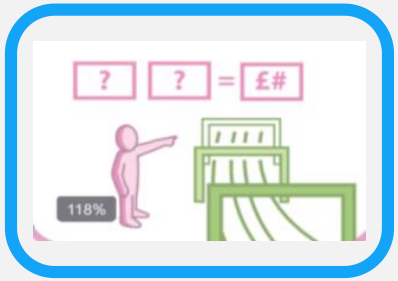
Data collected from monitoring fleet, manual inspections and other sources



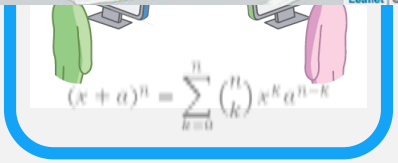
For example, better understanding of underlying cause of problems relating to track geometry



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



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

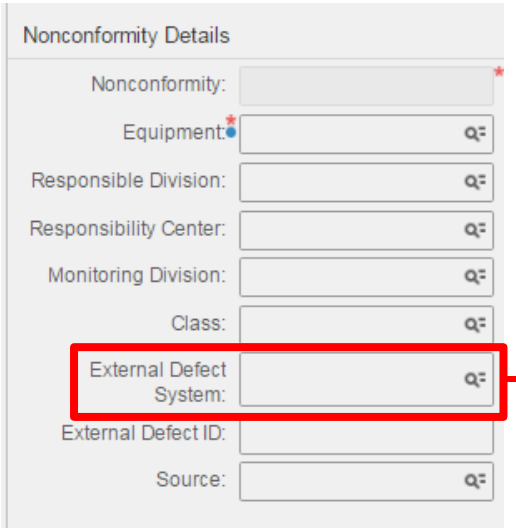


LADS enables consistent, evidence-based decision making and application of policy over time through use of algorithms

NetworkRail

Nonconformity Status: List of Values

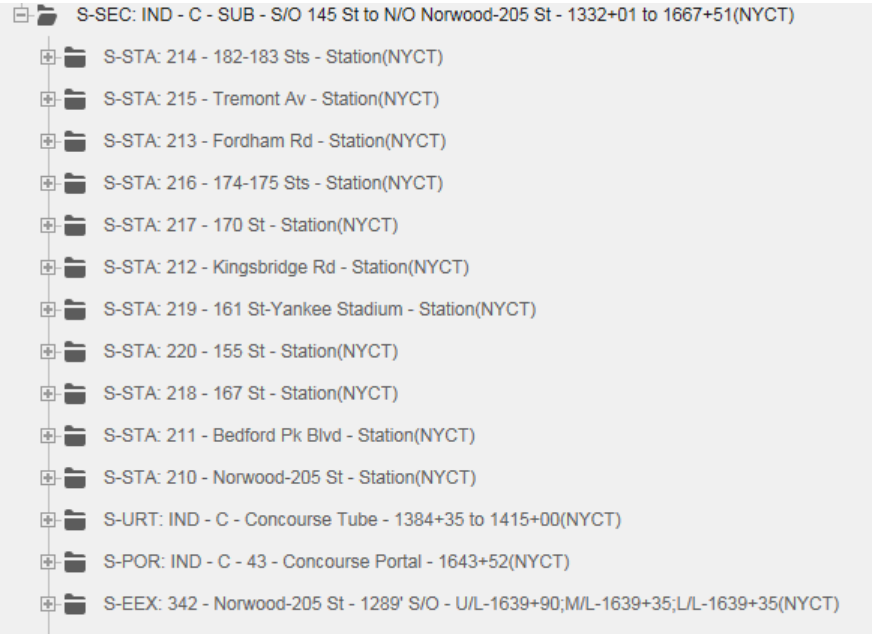
Represents the name of the external system where the Nonconformity may also be tracked. This is for traceability back to an area which may have its own system.



Field Label	Summary
DRAW	Drawing Realtime Access Website
SHIP	Stations Handheld Inspection Program
Ticket	Paper Ticket

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 Norwoord-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

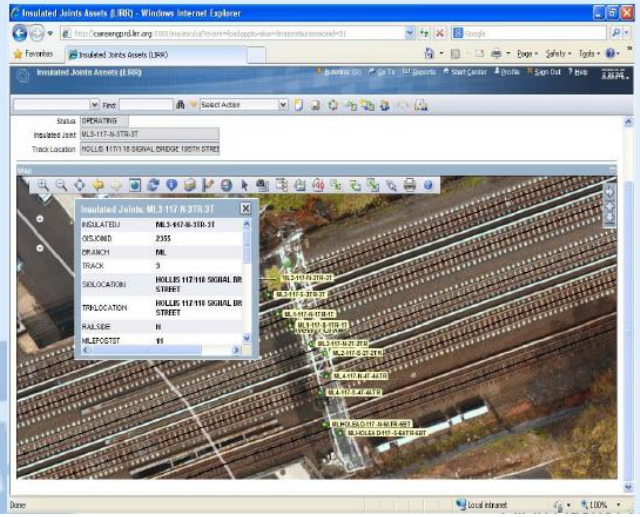
Signals Responsibilities

Sample :

Insulated Joints

Need of IJ Condition Assessment

Field Inspection & Update



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

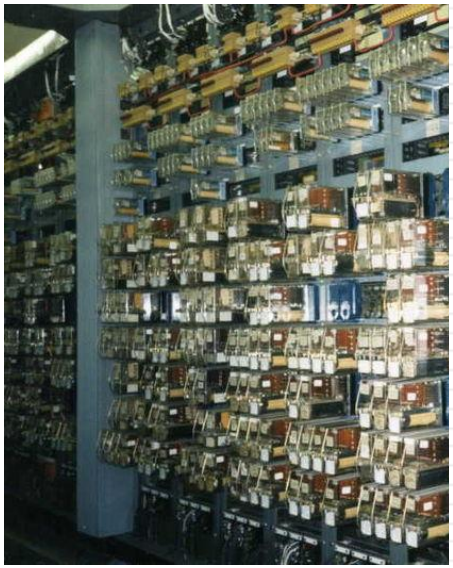
ame on Master 20

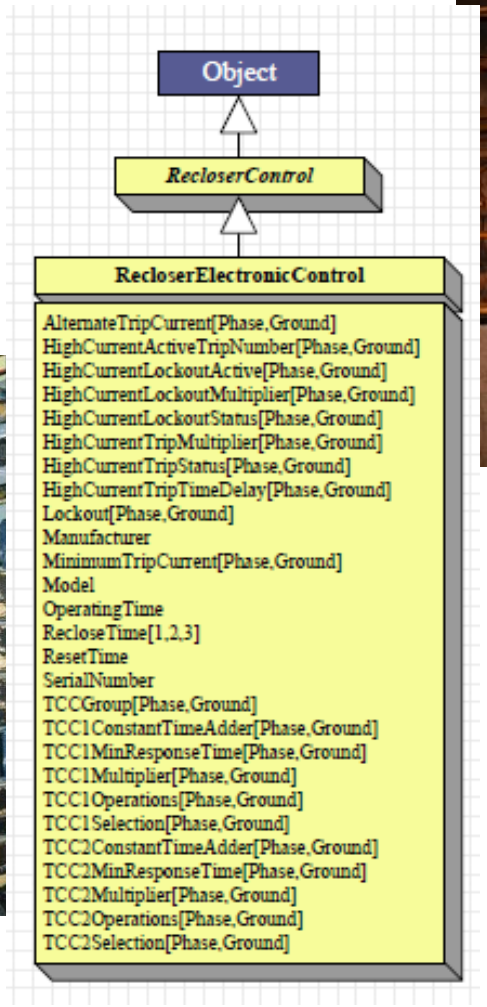
Signals Responsibilities

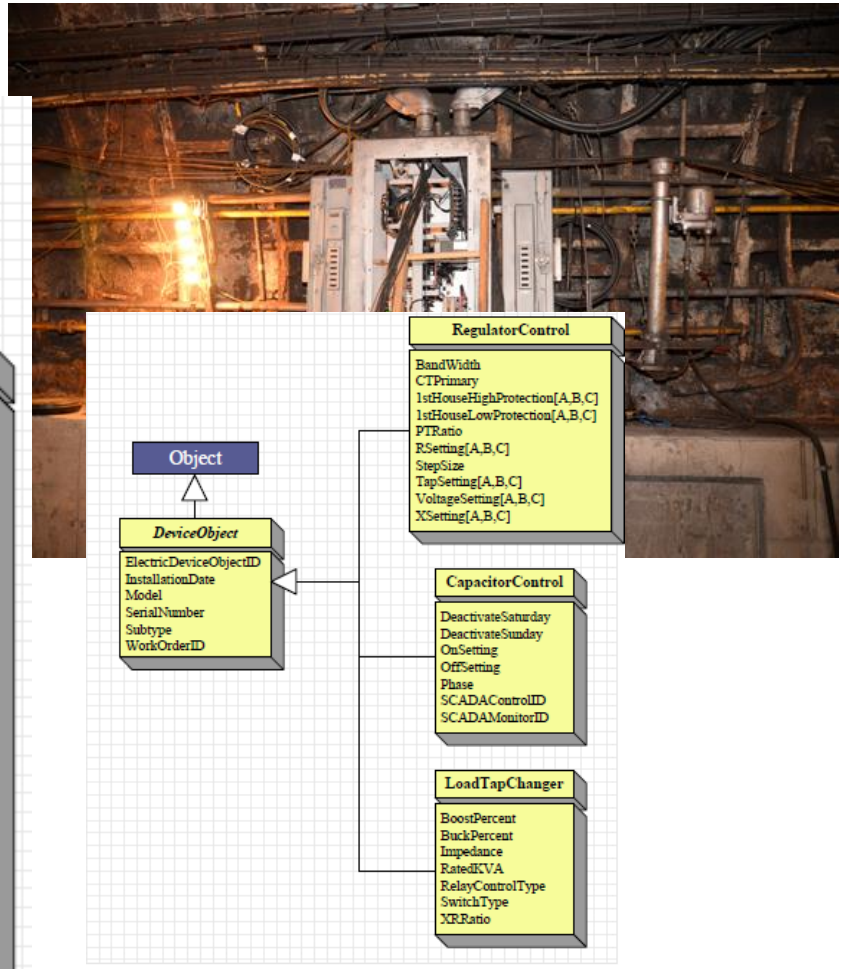
Signal Heads

Signals Responsibilities

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

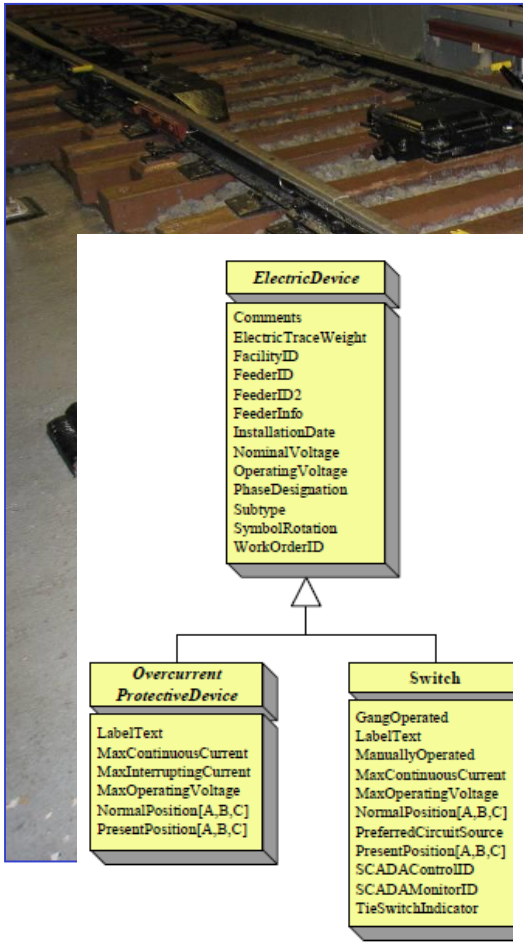
Selecting the relays (Which)

- Physically tag each relay
- Tie into EAM

Incorporate a Mobile Data Collection Application

Signals Responsibilities

Switches

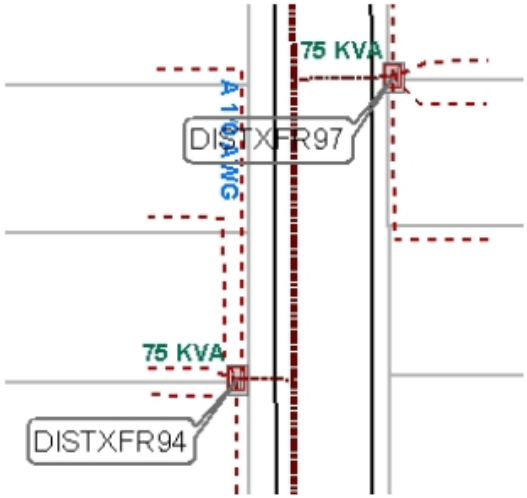


Switch feature class inherits attributes of ElectricDevice

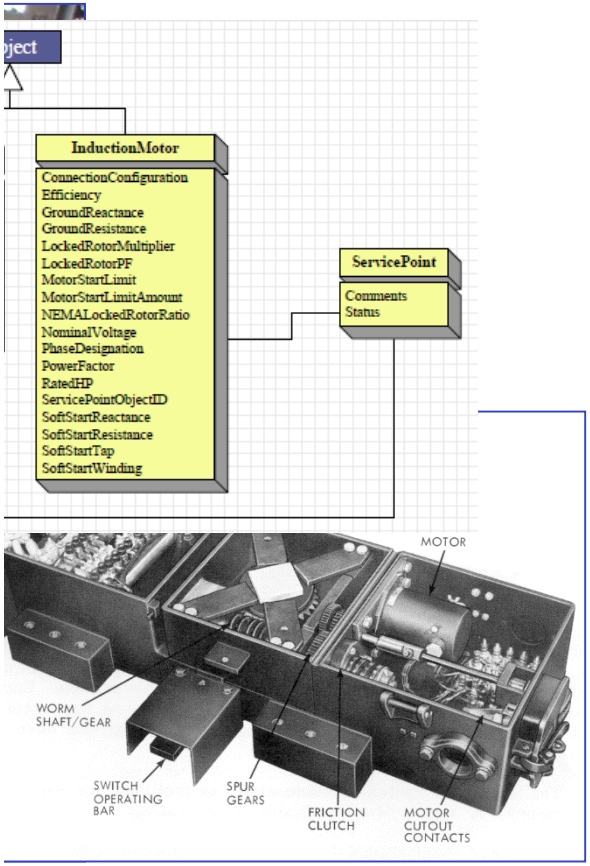
Design discussion

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.



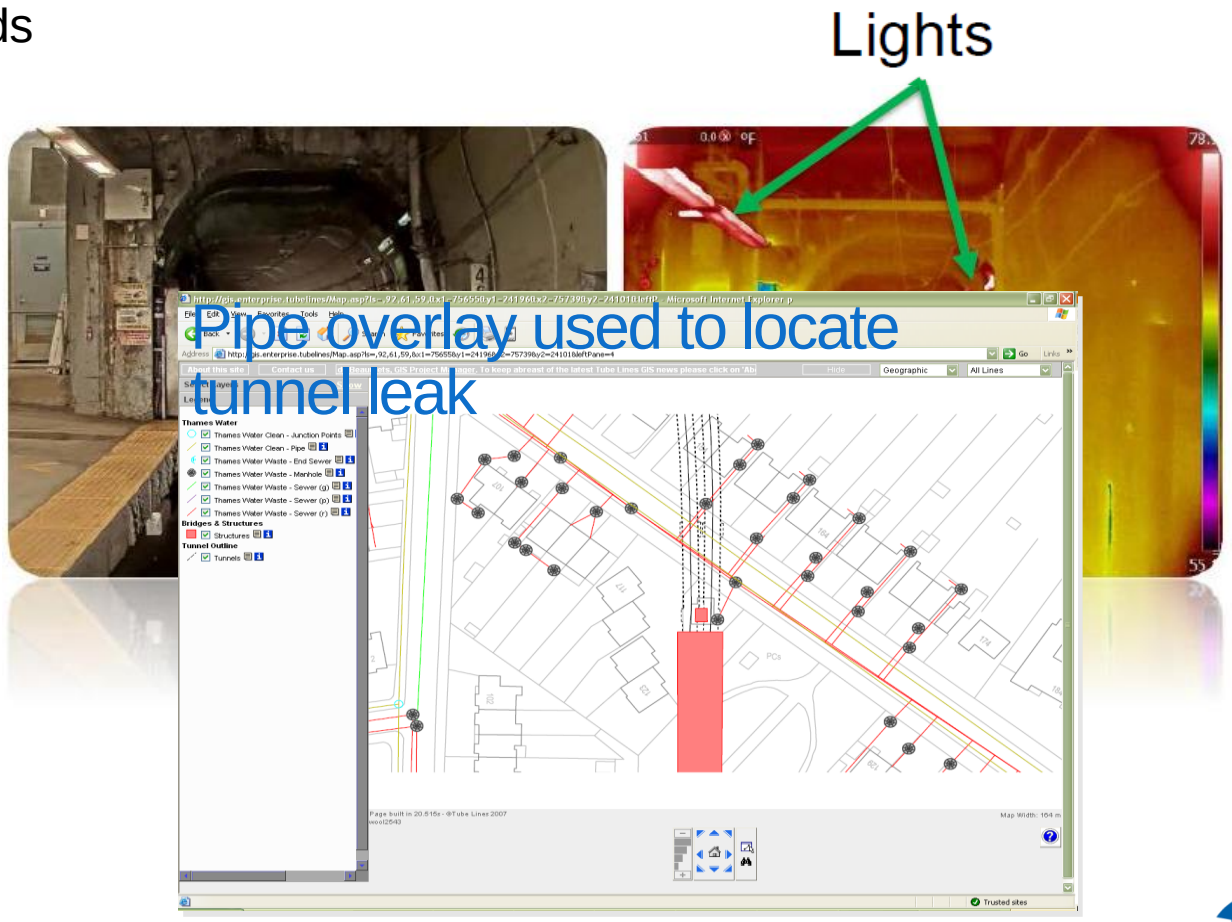
Section of Transformer placement job sketch (Source: map sketch created for Arizona Public Service Co. by Miner and Miner Consulting Engineers, Inc.)



Electrified Rail with Electronic Signals: Water is Bad!

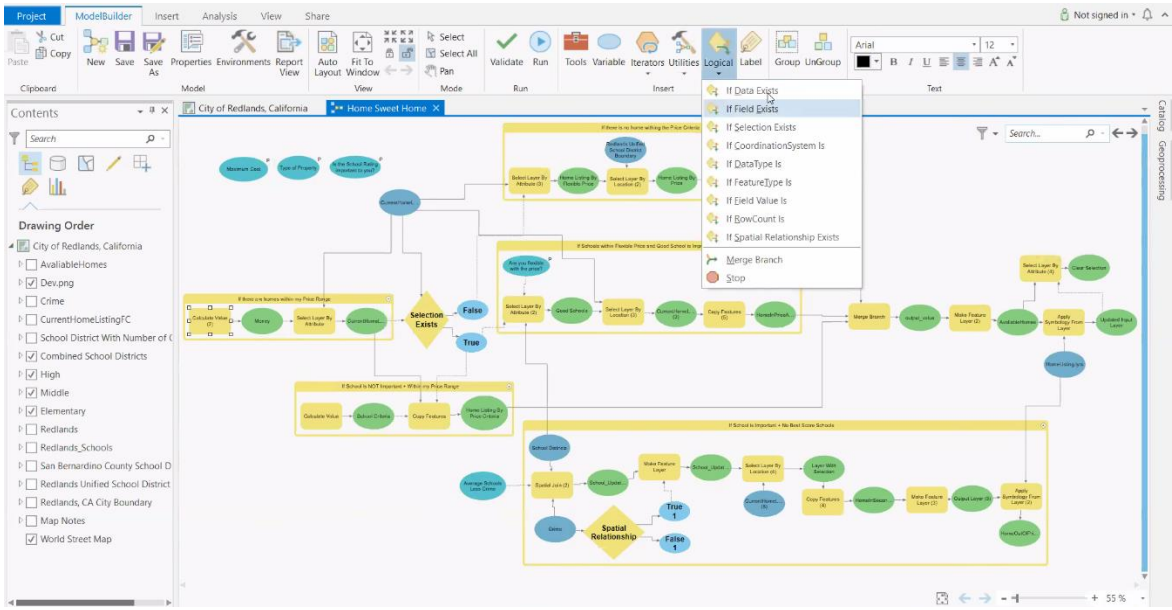
Periodic Thermal Sensing:

- Massive data yields
- Vehicle sensors
- Spatial Analysis

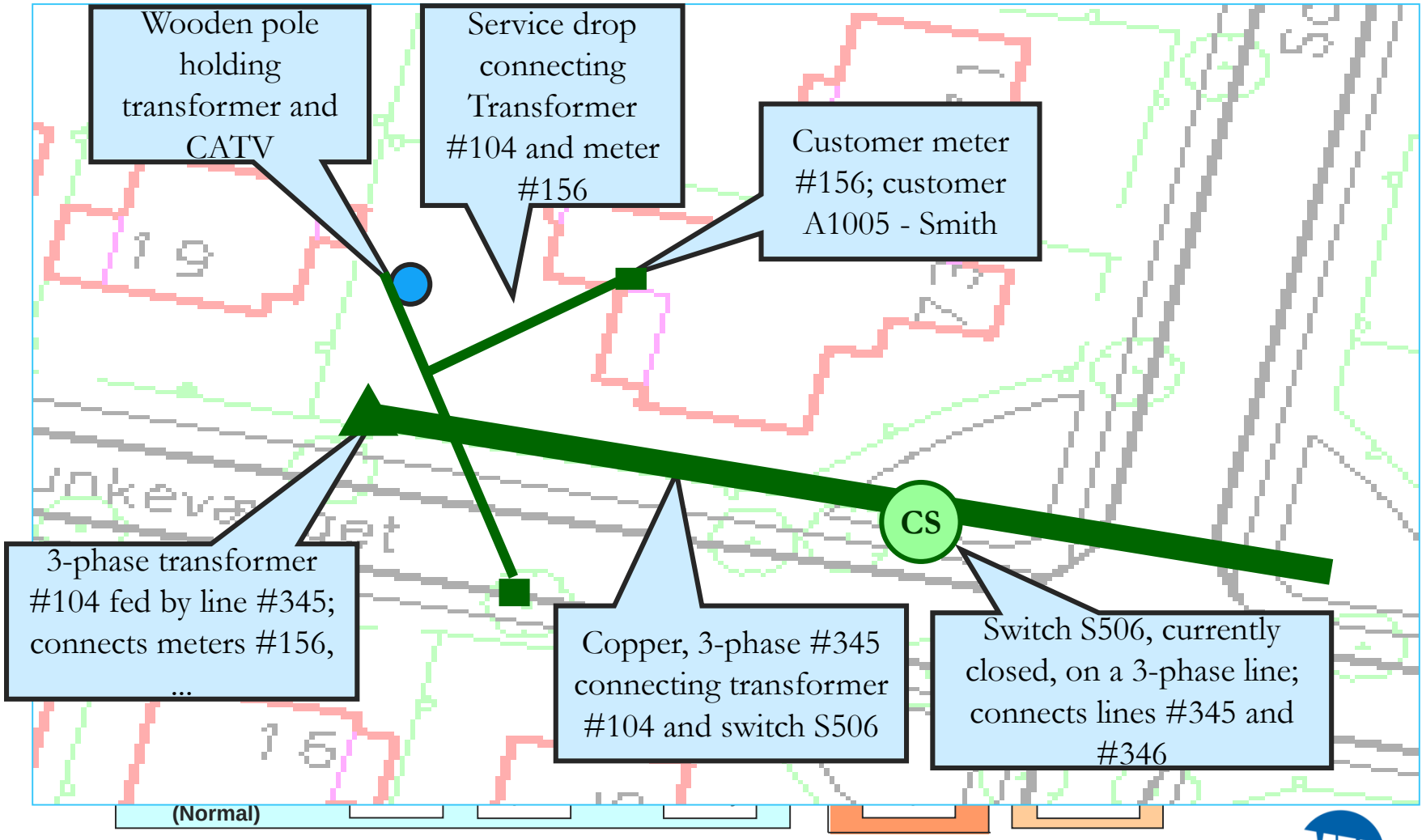


Electric Geoprocessing Workflows that translate to transit:

- 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



FacilityMap.mxd - ArcMap

File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help

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  - Circuit Breaker
  - Recloser
  - Switch
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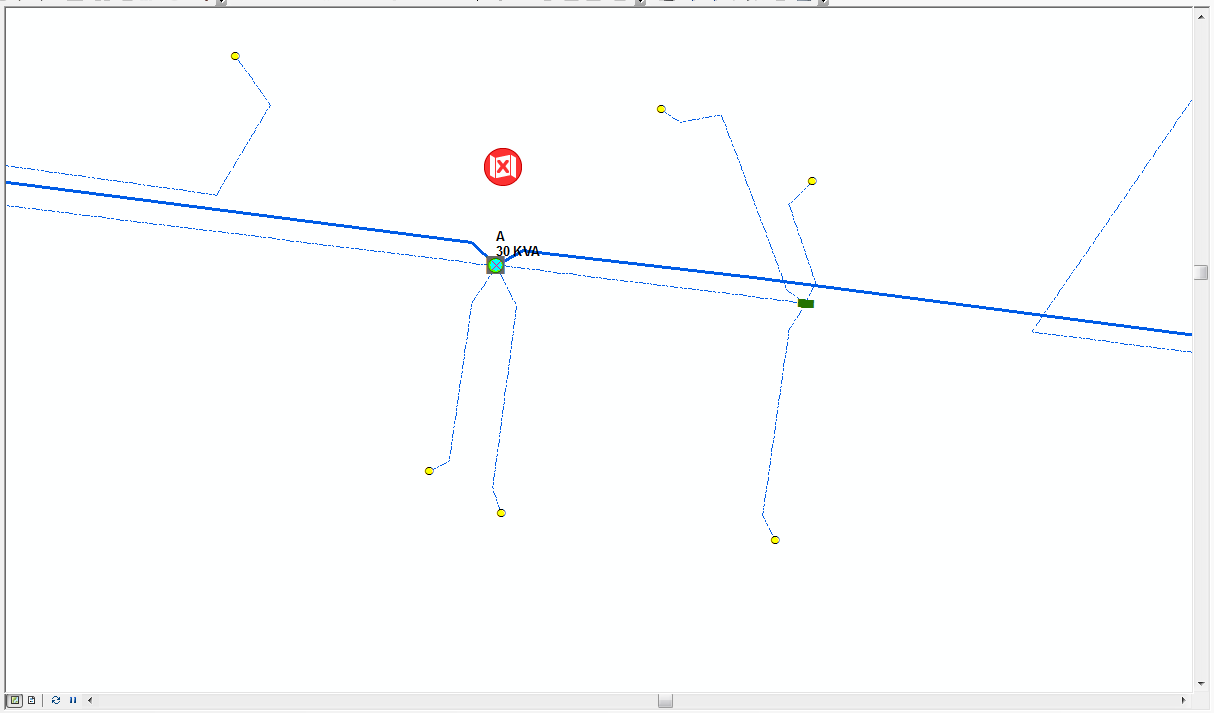
  - Primary Meter
  - Streetlight
  - Poles
  - Surface Structure
  - Electric Station
  - Switching Facility
  - Primary Overhead Conductor
  - Primary Underground Conductor
  - Secondary Underground Conductor
  - Secondary Overhead Conductor
  - Bus Bar



Attributes

Transformer
RAMTeCH

Facility ID	1609
Feeder ID	RMT003
Operating Voltage	34.5 kV Grounded Wye
Construction Status	Existing
Installation Date	6/5/1995
Phase Designation	A
Rated kVA	<Null>
Low Side Protection	A
Low Side Voltage	B
OWNER	C
OPERATINGCLASS	Distribution
CONSTRUCTIONTYPE	Underground

Phase Designation
Long Integer
Coded value domain: Single Phase

Table

Map Change Request

OBJECTID	What is the issue?	How severe is the issue?	Be notified when resolved?	Other notes or comments	GlobalID	Shape *
3	Asset Misplaced	Low	No	Pole located on the wrong side of road.	c8f84fb5-e00f-4f4e-8ad8-6dc671a4f82e	Point
1	Incorrect Attribute	Medium	Yes	Incorrect transformer tag number	e1aa6a53-ac9c-44ce-a8f7-b19a2f160d22	Point
2	Incorrect Attribute	Medium	Yes	Incorrect Phase	1778386a-cdae-4091-8cd1-d60babf30293	Point

(1 out of 3 Selected)

Map Change Request

-32199281.313 16828286.7 Friday, June 26, 2015

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

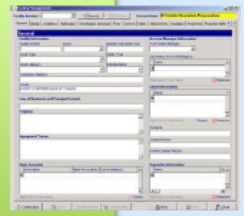
Stores the assets that reside at a geographic location

Stores the geographic locations at which assets reside

Asset Management Information System

Asset Life Cycle Management

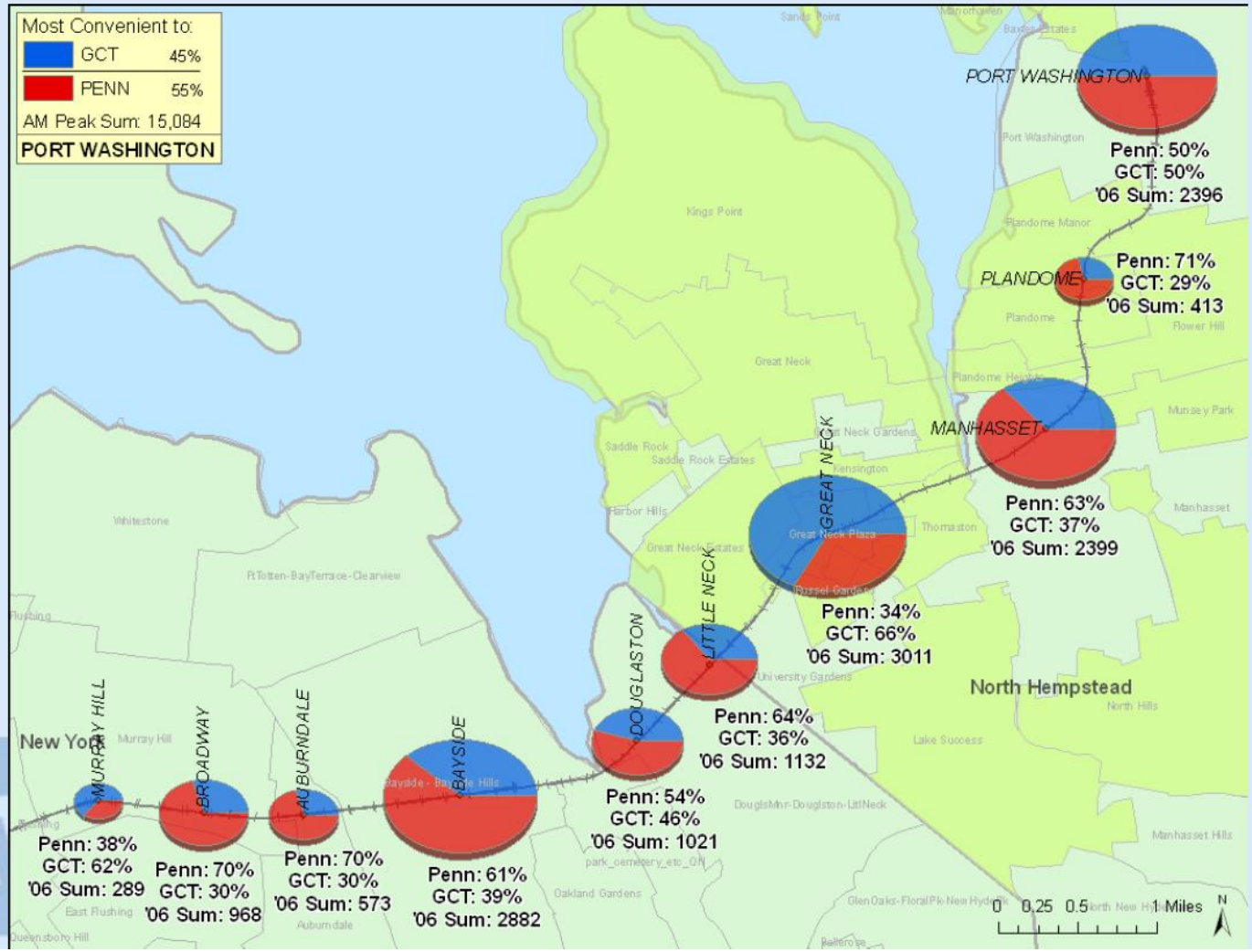
- Material stock/inventory
- Installation
- PM
- Repair
- Decommission
- Replace
- Asset hierarchy
- Cost tracking
- Discrete and linear assets



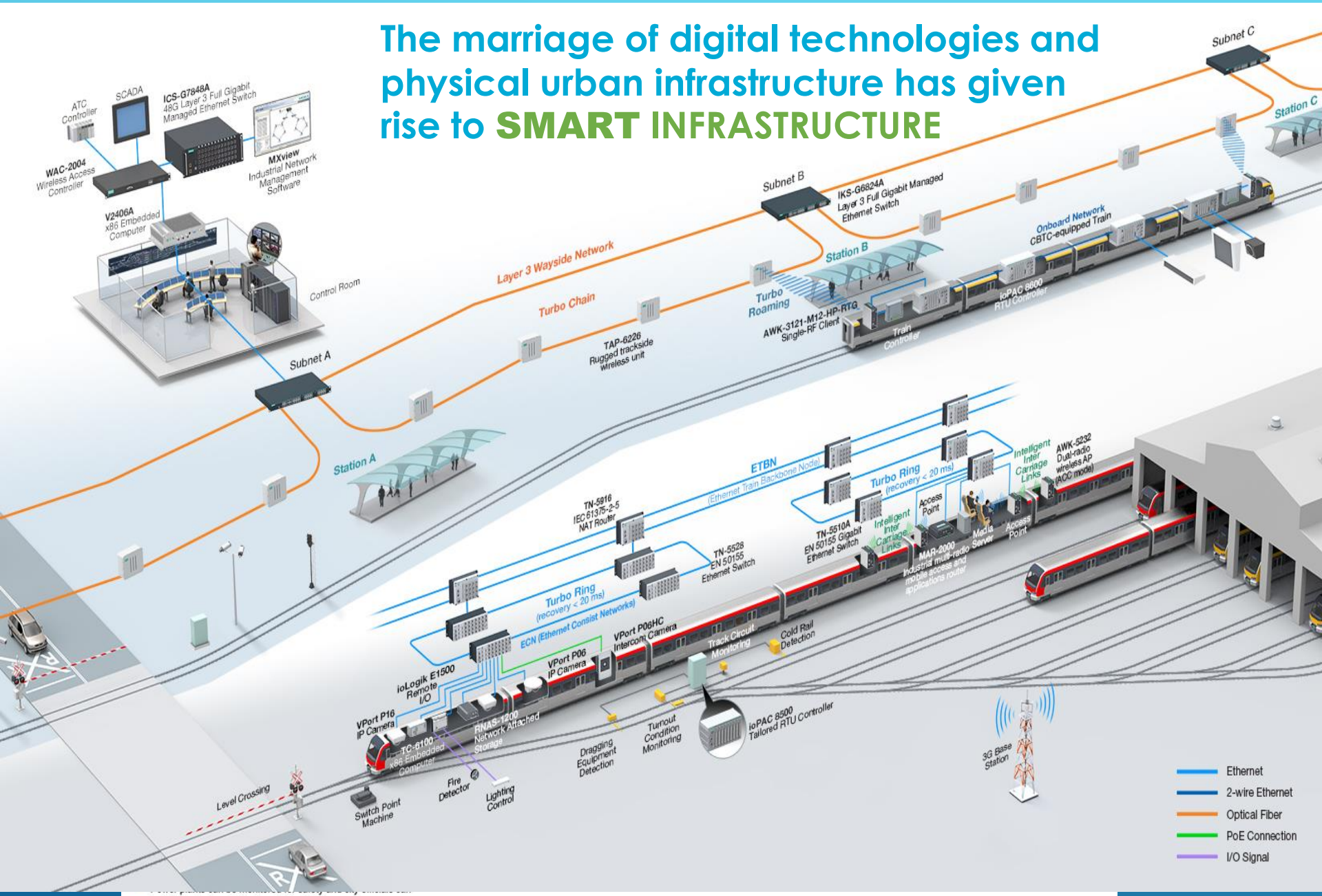
Asset Management Data

- ASSET REGISTRY
- Attributes
- Specifications
- Condition

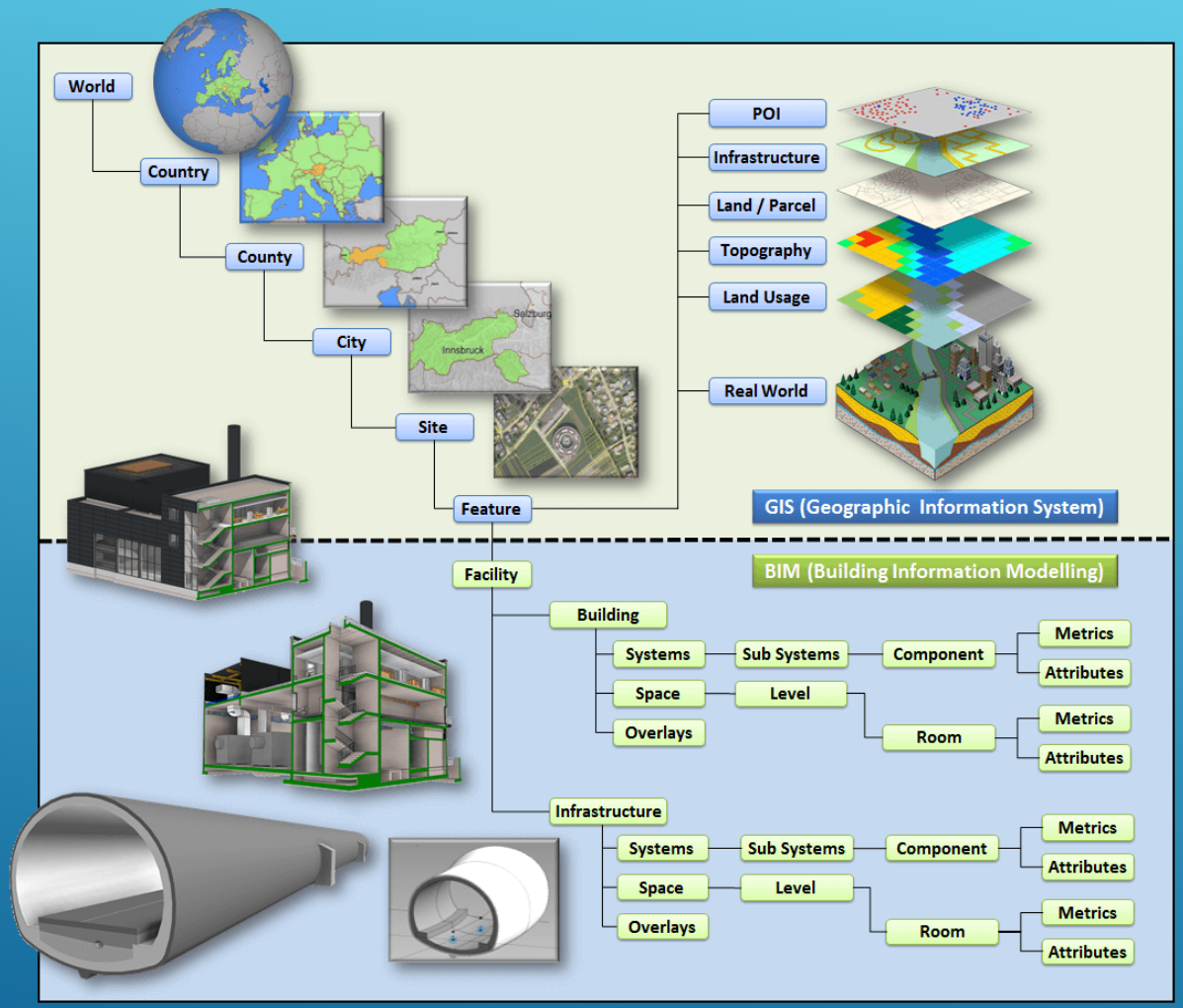
ESA Analysis- Port Washington Branch



The marriage of digital technologies and physical urban infrastructure has given rise to **SMART** INFRASTRUCTURE



be informed of any influx in radiation levels.



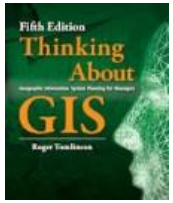
PHYSICAL SCALES AND HIERARCHIES

Integration OF BIM to GIS Physical hierarchies

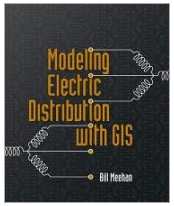
GIS extends the value of digital Building Information Modeling (BIM) design data through visualization and analysis of structures in the context of the natural and built environment

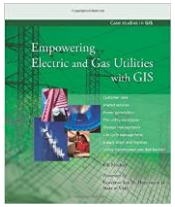
Where / how do I start?

Information Product Description

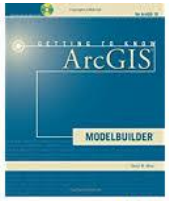


Electric Data Model Input

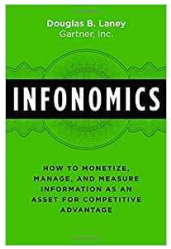




Geoprocessing Tool Development



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'*