Fundamentals of Asset Management

Step 1. Develop Asset Registry

A Hands-On Approach
Tom’s bad day...
First of 5 core questions

1. What is the current state of my assets?
   - What do I own?
   - Where is it?
   - What condition is it in? What is its performance?
   - What is its remaining useful life?
   - What is its remaining economic value?
1. What is the current state of my assets?

**AM plan 10-step process**

1. Develop Asset Registry
2. Assess Performance, Failure Modes
3. Determine Residual Life
4. Determine Life Cycle & Replacement Costs
5. Set Target Levels of Service (LOS)
6. Determine Business Risk ("Criticality")
7. Optimize O&M Investment
8. Optimize Capital Investment
9. Determine Funding Strategy
10. Build AM Plan

**Additional Information:**
- System Layout; Data Hierarchy, Standards, and Inventory

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**Fundamentals of Asset Management**
What exactly is an asset?
Tom’s wastewater system diagram
Jones Street pump station cross-section view
Jones Street pump station “aerial” view
What is an asset register?

- *Systematic recording* of all assets an organization owns or for which it has responsibility
- Uses *asset identification numbers* to which attribute information can be linked
Sources of data

- As-built drawings
- Design drawings
- Manufacturers’ manuals
- Bid documents
- Schedules of quantities
- Staff—current and previous
- Photos and videos
Types of asset registers

- Hierarchical—parent, child
- Category-based
- Process loops
- Spatial relationships—GPS-generated
- Business unit responsibilities
- Service provisions

GPS is global positioning system
Asset hierarchy

- Facility
  - Parent Asset
    - Child Asset
      - Grandchild Asset
    - Child Asset
      - Grandchild Asset
  - Parent Asset
Asset hierarchy, levels 1 and 2

- Facility
- Parent Asset
  - Child Asset
    - Grandchild Asset
  - Grandchild Asset
    - Child Asset
    - Grandchild Asset
Asset hierarchy, level 3

- Facility
  - Parent Asset
    - Child Asset
      - Grandchild Asset
      - Grandchild Asset
    - Child Asset
  - Parent Asset
Asset hierarchy, level 4

- Facility
  - Parent Asset
    - Child Asset
      - Grandchild Asset
        - Grandchild Asset
      - Grandchild Asset
    - Child Asset
  - Parent Asset
“Whole of government” asset hierarchy
Asset hierarchy example, levels 1 and 2

Sanitation Program

Level 1

- Eastern Systems
- Northwest Systems
- Southern Systems
Asset hierarchy example, levels 1 and 2

Sanitation Program

- Eastern Systems
- Northwest Systems
- Southern Systems

Level 1

Level 2
Asset hierarchy example, levels 1 and 2

Sanitation Program

Level 1

Collection Systems

Treatment Systems

Disposal Systems
Asset hierarchy example, levels 1 and 2

Sanitation Program

Collection Systems

Treatment Systems

Disposal Systems
Asset hierarchy example, levels 2 and 3

Collection System

- Gravity Sewers
- Siphon Structures
- Pump Stations
- Force Mains
Asset hierarchy example, levels 2 and 3

Collection System

Level 2

Gravity Sewers

Level 3

Siphon Structures

Pump Stations

Force Mains
Asset hierarchy example, levels 3 and 4

Gravity Sewers

- Manholes
- Pipelines
- House Connections
- Drop Structures
- Sewer Ventilation
Asset hierarchy example, levels 3 and 4

Gravity Sewers

Level 3

- Manholes
- Pipelines
- House Connections
- Drop Structures
- Sewer Ventilation

Level 4
Asset hierarchy example, levels 2 and 3

Collection System

Level 2

Gravity Sewers

Level 3

Siphon Structures

Pump Stations

Force Mains
Asset hierarchy example, levels 3 and 4

- Pump Stations
  - Level 3
    - Inlet Sewer and Screen
    - Wet & Dry Well
    - Superstructure
    - Pumps and Motors
    - Force Main
    - Electrics
    - Controls
    - Land and Surroundings
Asset hierarchy example, levels 3 and 4

Pump Stations

Level 3

- Inlet Sewer and Screen
- Wet & Dry Well
- Superstructure
- Pumps and Motors
- Force Main
- Electrics
- Controls
- Land and Surroundings

Level 4
Confidence at the asset level is required to roll up cost management (and asset performance) with confidence.
Maintenance managed item

- **Maintenance managed item (MMI)** is an item at the lowest level—*the smallest subdivision*—of an asset registry composed as a nested hierarchy.

- Typically, it is the level at which an asset is *maintained* (for example, parts are identified), or *decisions* are made to repair, refurbish, or replace.

  **Think “work order”**
Stated another way...

- We manage the lifecycle of maintainable units ("maintenance managed items"), not components or parts.
- A maintainable unit is repaired by replacing a component or part.
- A component is replaced upon failure, not repaired.
Using process layout with asset registry

See Detailed Schematic of Blower System Below

1 2 3 4 5
To Aeration Tanks

Air Discharge Header

Check Valve

Centrifugal Blower
Butterfly Valve
Venturi Meter
Silencer

40,000 CFM Blower System

25,000 CFM Blower System

40,000 CFM Blower System

25,000 CFM Blower System

Air Intake Duct

Filter

Louver

Damper

Air Intake

To Aeration Tanks
Using process layout to build the asset registry
Asset hierarchy

What hierarchy level is *best* for identifying a *maintenance management item (MMI)*?

- Facility
- Parent Asset
- Child Asset
- Grandchild
- Component
- Subcomponent

*That* level?

*This* one??

*Here***??
Data confidence levels within asset hierarchy

Confidence level in this context means the confidence the decision-maker has that the decision rendered is the best solution at the right time.
Data costs within asset hierarchy

Cost factor for obtaining asset data increases with increasing depth in the asset hierarchy.

Cost Factor
- Facility: x 4.5
- Parent Asset: x 1.7
- Child Asset: x 1.0
- Component: x 1.7
- Subcomponent: x 2.5
- Spare: x 4.5
Examples of tree-style asset hierarchy
Data standard

Written record:
- Asset identification naming convention
- Attributes
- Record layouts
- Database architecture and protocols
- Data collection protocols
Asset ID naming convention issues

- What is an asset? (What gets a unique ID?)
- Who creates the asset ID?
- How is it assigned?
  - Linear (pipe) vs. vertical (plant) assets
    - Geo-reference
    - CAD versus GIS
  - Active vs. passive
    - Lock-out/tag-out
    - Asset ID vs. asset location for mobile assets

CAD is computer-aided design, GIS is geographic information system
# Data collection strategy

<table>
<thead>
<tr>
<th>ATTRIBUTE</th>
<th>SOURCE</th>
<th>LEVEL</th>
<th>USE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asset List</td>
<td>SPL / Drawings</td>
<td>Asset</td>
<td>All</td>
</tr>
<tr>
<td>Asset Hierarchical</td>
<td>SPL / Drawings</td>
<td>Asset</td>
<td>All</td>
</tr>
<tr>
<td>Asset ID / Number</td>
<td>SPL / Data Standard</td>
<td>Asset</td>
<td>All</td>
</tr>
<tr>
<td>Asset Status</td>
<td>Field Inspection, Staff Interviews</td>
<td>Asset</td>
<td>All</td>
</tr>
<tr>
<td>Asset Type</td>
<td>SPL / Data Standard</td>
<td>Asset</td>
<td>See Level Column</td>
</tr>
<tr>
<td>Installation Date</td>
<td>Drawings / Staff Interviews</td>
<td>Asset</td>
<td>Renewal Timing</td>
</tr>
<tr>
<td>Last Rehab Date</td>
<td>Staff Interviews</td>
<td>Asset</td>
<td>Renewal Timing</td>
</tr>
<tr>
<td>Size</td>
<td>Drawings / Field Inspection</td>
<td>Asset</td>
<td>CoF, Valuation</td>
</tr>
<tr>
<td>Size Unit</td>
<td>Drawings / Field Inspection</td>
<td>Asset</td>
<td>CoF, Valuation</td>
</tr>
<tr>
<td>Length</td>
<td>Drawings / Field Inspection</td>
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<td>CoF, Valuation</td>
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<td>Length Unit</td>
<td>Drawings / Field Inspection</td>
<td>Asset</td>
<td>CoF, Valuation</td>
</tr>
<tr>
<td>Capacity</td>
<td>Drawings / Field Inspection</td>
<td>Asset</td>
<td>CoF, Valuation</td>
</tr>
<tr>
<td>Capacity Unit</td>
<td>Drawings / Field Inspection</td>
<td>Asset</td>
<td>CoF, Valuation</td>
</tr>
<tr>
<td>Condition</td>
<td>Inspection, Staff Interviews</td>
<td>Asset</td>
<td>Renewal Timing, PoF</td>
</tr>
</tbody>
</table>

Use drives collection strategy!
Major components of asset data

Tied to the *asset ID*…
- Physical attributes
- Geo-reference
- O&M manuals
- Drawings and photos
- Life cycle costs
- Knowledge and strategy
Two approaches to generating registry data

What we already have—retrospective

- Critical first
- Use existing crews as they respond to Work Orders
- Use engineering students

What we are about to acquire—prospective

- Tie to commissioning or handover process
- Use contract retainage to ensure control
Recording data—new technology

Ricoh Caplio Pro G3
Data responsibilities: example

<table>
<thead>
<tr>
<th>Data Task</th>
<th>Organization Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asset details</td>
<td>Operations</td>
</tr>
<tr>
<td>Condition assessment</td>
<td>Maintenance</td>
</tr>
<tr>
<td>Asset values</td>
<td>Engineering</td>
</tr>
<tr>
<td>Residual physical lives</td>
<td>Engineering</td>
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<tr>
<td>Probability of failure</td>
<td>Maintenance</td>
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<tr>
<td>Consequence of failure</td>
<td>Engineering</td>
</tr>
<tr>
<td>Business risk exposure</td>
<td>Engineering</td>
</tr>
<tr>
<td>Optimal renewal strategy</td>
<td>Maintenance or Engineering</td>
</tr>
</tbody>
</table>
Key points from this session

What do I own and where is it?

Key Points:
- We have to know what we have before we can manage appropriately what residual life is left.
- Everything in AM starts with the Asset Registry.
- The “data standard” is the key building block for AM asset registries.

Associated Techniques:
- Asset registry/inventory
- Data standards, asset hierarchy
- System maps
- Delphi approach to locating other sources of data
- Process diagrams
- “Handover” procedures
Tom’s spreadsheet

<table>
<thead>
<tr>
<th>Asset Register and Hierarchy</th>
<th>What is the State of My Assets?</th>
<th>Required Loss?</th>
<th>Which Are Most “Critical”?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installed Date</td>
<td>Asset Class</td>
<td>Original Cost</td>
<td>Estimated Effective Life</td>
</tr>
<tr>
<td>2020</td>
<td>Class A</td>
<td>1000</td>
<td>5</td>
</tr>
<tr>
<td>2019</td>
<td>Class B</td>
<td>1000</td>
<td>5</td>
</tr>
<tr>
<td>2018</td>
<td>Class C</td>
<td>1000</td>
<td>5</td>
</tr>
</tbody>
</table>

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