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 *remaining useful life*?
   - What is its *remaining economic value*?
1. What is the current state of my assets?

AM plan 10-step process

- Develop Asset Registry
- Assess Condition, Failure Modes
- Determine Residual Life
- Determine Live Cycle & Replacement Costs
- Set Target Levels of Service (LOS)
- Determine Business Risk (“Criticality”)
- Optimize O&M Investment
- Optimize Capital Investment
- Determine Funding Strategy
- Build AM Plan
What exactly is an asset?
Tom’s wastewater collection system layout
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
Asset hierarchy, levels 1 and 2

- Facility
  - Parent Asset
    - Level 2
      - Child Asset
        - Grandchild Asset
      - Grandchild Asset
    - Child Asset
Asset hierarchy, level 3
Asset hierarchy, level 4

- Facility
  - Parent Asset
    - Child 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
  - Level 1
    - Eastern Systems
    - Northwest Systems
    - Southern Systems
  - 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 (Level 1)
- Collection Systems (Level 2)
- 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

- Gravity Sewers
- 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

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

Level 3

Level 4
Asset hierarchy example, levels 2 and 3

Collection System

Level 2

- Gravity Sewers
- Siphon Structures
- Pump Stations
- Force Mains

Level 3
Asset hierarchy example, levels 3 and 4

- 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
    - Level 4
      - Inlet Sewer and Screen
      - Wet & Dry Well
      - Superstructure
      - Pumps and Motors
      - Force Main
      - Electrics
      - Controls
      - Land and Surroundings
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”
Using process layout with asset registry

See Detailed Schematic of Blower System Below

Air Discharge Header

Check Valve
Centrifugal Blower
Butterfly Valve
Venturi Meter
Silencer

1 2 3
25,000 CFM Blower System
40,000 CFM Blower System
40,000 CFM Blower System
40,000 CFM Blower System

Air Intake Duct

Filter
Louver Damper

To Aeration Tanks

Air Intake

25,000 CFM Blower System

1234 5
To Aeration Tanks

See Detailed Schematic of Blower System Below
Using process layout with asset registry
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  
40%  

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
x 1.0 (Facility, Parent Asset, Child Asset)

x 1.7

x 2.5

x 4.5
Examples of tree-style asset hierarchy

<table>
<thead>
<tr>
<th>Asset Hierarchy</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sanitation System</td>
<td></td>
</tr>
<tr>
<td>Disposal System</td>
<td></td>
</tr>
<tr>
<td>Collection System</td>
<td></td>
</tr>
<tr>
<td>Treatment Plants</td>
<td></td>
</tr>
<tr>
<td>Westerly Treatment Plant</td>
<td></td>
</tr>
<tr>
<td>Southerly Treatment Plant</td>
<td></td>
</tr>
<tr>
<td>Easterly Treatment Plant</td>
<td></td>
</tr>
<tr>
<td>Aeration System</td>
<td></td>
</tr>
<tr>
<td>Aeration Facility</td>
<td></td>
</tr>
<tr>
<td>Building &amp; Services</td>
<td></td>
</tr>
<tr>
<td>Influe Header</td>
<td></td>
</tr>
<tr>
<td>Blower Assembly</td>
<td></td>
</tr>
<tr>
<td>Motor Starter</td>
<td></td>
</tr>
<tr>
<td>Blower Assembly 1</td>
<td></td>
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<tr>
<td>Blower Assembly 1</td>
<td></td>
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<tr>
<td>Blower Assembly 1</td>
<td></td>
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<tr>
<td>Blower Assembly 4</td>
<td></td>
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<tr>
<td>Oil pump</td>
<td></td>
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<tr>
<td>Circulation tubing</td>
<td></td>
</tr>
<tr>
<td>Oil sensor</td>
<td></td>
</tr>
<tr>
<td>Motor Cooling System</td>
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<tr>
<td>Cooling Water Pumps</td>
<td></td>
</tr>
<tr>
<td>Electric Motor for Cooling System</td>
<td></td>
</tr>
<tr>
<td>Piping and valves</td>
<td></td>
</tr>
<tr>
<td>Electric motor</td>
<td></td>
</tr>
<tr>
<td>Front motor bearing</td>
<td></td>
</tr>
<tr>
<td>Front bearing temp sensor</td>
<td></td>
</tr>
<tr>
<td>Coupling</td>
<td></td>
</tr>
<tr>
<td>Rear blower bearing</td>
<td></td>
</tr>
<tr>
<td>Rear bearing temp sensor</td>
<td></td>
</tr>
<tr>
<td>Centrifugal blower</td>
<td></td>
</tr>
<tr>
<td>Housing</td>
<td></td>
</tr>
<tr>
<td>Main shaft</td>
<td></td>
</tr>
<tr>
<td>Impeller</td>
<td></td>
</tr>
<tr>
<td>Seals</td>
<td></td>
</tr>
<tr>
<td>Front bearing temp sensor</td>
<td></td>
</tr>
<tr>
<td>Front blower bearing</td>
<td></td>
</tr>
<tr>
<td>Discharge check valve</td>
<td></td>
</tr>
<tr>
<td>Inlet butterfly valve</td>
<td></td>
</tr>
<tr>
<td>Silencer</td>
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<tr>
<td>Flow Meter</td>
<td></td>
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<tr>
<td>Nut Bearing</td>
<td></td>
</tr>
<tr>
<td>Blower Assembly 5</td>
<td></td>
</tr>
<tr>
<td>Discharge Header</td>
<td></td>
</tr>
<tr>
<td>Aeration Tanks</td>
<td></td>
</tr>
</tbody>
</table>

Fundamentals of Asset Management
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?)
- 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>
<td>Asset</td>
<td>CoF, Valuation</td>
</tr>
<tr>
<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>

Etc.
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 details to retain control
Recording data—new technology

Ricoh Caplio Pro G3
## Data responsibilities

<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>
</tr>
<tr>
<td>Probability of failure</td>
<td>Maintenance</td>
</tr>
<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

![Spreadsheet Image]

#### Fundamentals of Asset Management