Asset Management
Value and Implementation

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Annual Conference
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WHAT is our asset management perspective?

- Asset Management
  - Benefits
  - System Approach
  - Alternative perspective

- Performance metrics and management
- Systems to support asset management
HOW does asset management impact our organization?

- City’s, Regional Districts, Utility’s
- Regulated Utilities
  - Investor owned
  - Mostly water systems
- Environmental Services (Public Private Partnerships)

People + Process + Technology = Level of Service
Efficiency
Performance
Costs
**WHY** do we make an investment in asset management?

**Management Strategy**

- Asset Management is a management strategy designed to achieve the following objectives
  - Utilize assets to provide defined levels of service
  - Maintain a level of risk acceptable to the organization
  - Achieve service level and risk objectives at the lowest life cycle cost

**Benefits**

- Improved communications
- Access to information (reduce silos)
- Risk based decision making
- Improved data to support planning (financial)
- Consistent process developed for continuous improvement
- Stakeholder ownership
- Extend the life of assets and support reliability
Can we sustain a business case for asset management?

- Challenges
  - Uncovering value in the investment
  - Organization buy-in and impact (culture)
  - Managing expectations and competing interests

![Diagram showing the life-cycle of asset management](image-url)

*Life-cycle of asset management – temporary enthusiasms (Woodhouse, 2009).*
How do we measure level of service? (Triple Bottom Line)

- Consider alignment with other initiatives
- Consequence of Failure
  - Environmental obligations
  - Energy
  - Customer service
  - Safety
  - Management/personnel

<table>
<thead>
<tr>
<th>TBL Factor</th>
<th>Level of Service</th>
<th>Likelihood of Failure</th>
<th>Consequence of Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>Permit Obligations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social</td>
<td>Safety</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Customer Service</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economic</td>
<td>Energy</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fiscal Responsibility</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# How do we measure level of service?

## City of Indianapolis (Became Citizen’s Water) Exhibit 6 Performance Incentives

<table>
<thead>
<tr>
<th>PERFORMANCE INCENTIVE</th>
<th>% MAX. INCENTIVE FEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 1 Maximize Treatment of Wet Weather Flows</td>
<td>20%</td>
</tr>
<tr>
<td>No. 2 Maximize TSS Removal at the AWT Facilities</td>
<td>10%</td>
</tr>
<tr>
<td>No. 3 Maximize Belmont Facility Primary Treatment TSS Removal</td>
<td>5%</td>
</tr>
<tr>
<td>No. 4 Reduce Dry Weather SSOs</td>
<td>5%</td>
</tr>
<tr>
<td>No. 5 Eliminate SSOs (dry weather and wet weather) from Sanitary Sewers</td>
<td>15%</td>
</tr>
<tr>
<td>No. 6 Critical Equipment Availability</td>
<td>10%</td>
</tr>
<tr>
<td>No. 7 Reduced Corrective Maintenance</td>
<td>10%</td>
</tr>
<tr>
<td>No. 8 Maintain Effective Solids Handling at the AWT Facilities</td>
<td>10%</td>
</tr>
<tr>
<td>No. 9 Prevent odor complaints and control H₂S and odor levels at the AWT Facilities</td>
<td>5%</td>
</tr>
<tr>
<td>No. 10 Prevent odor complaints and control H₂S and odor levels in the Collection System</td>
<td>5%</td>
</tr>
<tr>
<td>No. 11 Exceed MBE/WBE Requirements</td>
<td>5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>
**Performance Incentive No. 6 – Critical Equipment Availability**

<table>
<thead>
<tr>
<th>Performance Payment</th>
<th>Performance Measure (PM)</th>
<th>Percent of PM Met in Contract Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>PM No 1. – Percent of time that daily Equipment availability data is provided and confirmed accurate</td>
<td>95%</td>
</tr>
<tr>
<td></td>
<td>PM No. 2 – Percent of time (based on days) that no more than one Critical Equipment or process tank unavailable for service for each unit process</td>
<td>95%</td>
</tr>
<tr>
<td></td>
<td>PM No. 3 – Percent of time (based on days) that critical Equipment and process tanks available for service relative to total number of critical Equipment and process tanks.</td>
<td>&gt;97%</td>
</tr>
<tr>
<td></td>
<td>PM No. 4 – Percent of AWT Facility and Lift Station work orders closed out within 60 days of being entered into CMMS.</td>
<td>95%</td>
</tr>
<tr>
<td></td>
<td>PM No. 5 – Percent of violations of Applicable Law caused by insufficient availability of critical Equipment or process tankage</td>
<td>5%</td>
</tr>
</tbody>
</table>

- **Percent of Time Critical Equipment is Available**: 100%
- **Percent of Work Orders Closed Within 60 days**: 99%
WERF asset management planning process

WERF 10 Step Process (asset management plan)
- Best business practice
- Supports asset management culture
- Serves as a framework for capital planning

- Develop Asset Registry
- Assess Condition, Failure Modes
- Determine Residual Life
- Determine Life Cycle and Replacement Costs
- Set Level of Service Targets
- Determine Business Risk (Asset Criticality)
- Optimize O&M Investment
- Optimize Capital Improvement
- Determine Funding Strategy
- Build AM Plan
WHAT may the AM process look like in practice?

**Maintenance Planning and Execution**
- Capital Repair and Replacement

**Condition Assessment**
- Total maintenance costs
- Asset condition
- Remaining useful life

**Asset Repair and Replacement Model**
- Prioritized Capital Report
- Total maintenance costs
- Asset condition
- Remaining useful life

**Maintenance Management Systems**
- Equipment Maintenance
- Asset Hierarchy
- Equipment Attributes
- Costs

- Establish Risks
- Routine condition assessments
HOW do we model maintenance?

- Use asset registry as base line
- Provides a foundation for maintenance needs, staffing, repair/replacement
- Expectation is for continuous improvement

<table>
<thead>
<tr>
<th>Model Attributes</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td><strong>Year Installed</strong></td>
</tr>
<tr>
<td><strong>Equipment Replacement Cost</strong></td>
<td><strong>Useful Life</strong></td>
</tr>
<tr>
<td><strong>Total Replacement Cost</strong></td>
<td><strong>Assessed Life</strong></td>
</tr>
<tr>
<td><strong>PM (Hours/Year)</strong></td>
<td><strong>PM Costs</strong></td>
</tr>
<tr>
<td><strong>PM (Material/Yr)</strong></td>
<td><strong>CM Base Multiplier</strong></td>
</tr>
<tr>
<td><strong>CM Costs</strong></td>
<td></td>
</tr>
</tbody>
</table>
HOW do we measure maintenance performance?

“If you can’t measure it, you can’t improve it.”... Peter Drucker

- % work generated from alarms
- Cost of functional failures
- Alarms acknowledged

- PM Compliance
- % Proactive
- % Work planned
- Backlog
- Schedule compliance

- % Action plans implemented
- % Implementation hours
- # Mods/redesign

- Down time
- Quality
- Maintenance Costs
- Safety
USE maintenance metrics to tell a story

- **PM Schedule Completion**
  - Foundational High level view
  - Percent of PMs completed by target date (95% is best practice)
  - 10% rule (PMs completed inside 10% of frequency interval)

- **Labor Utilization**
  - Available hours (not necessarily 8 hours documented hours)
  - Best practice is 85% of maintenance work day

- **Proactive to Reactive**
  - 6 or 8 hours to 1 is best practice
Best Maintenance Practices

- Non-Emergency Breakdown: 15%
- Emergency Breakdown: 15%
- CM Resulting from PdM: 5%
- PdM: 35%
- PM: 15%
- CM Resulting from PM: 15%

Legend:
- CM: Corrective Maintenance
- PM: Preventive Maintenance
- PdM: Predictive Maintenance
Best Maintenance Practices (Proactive vs. Reactive)

- Non-Emergency Breakdown: 80% is Proactive
- Emergency Breakdown: 15%
- CM Resulting from PdM: 5%
- CM Resulting from PM: 15%
- PdM: 15%
- PM: 80% is Proactive
Best Maintenance Practices (Planned Maintenance)

- Emergency Breakdown
- Non-Emergency Breakdown
- CM Resulting from PdM
- Predictive Maintenance (PdM)
- Preventative Maintenance (PM)
- CM Resulting from PM

95% of Work Should be Planned and Scheduled

15% of Work Should be Emergency Breakdown
15% of Work Should be Non-Emergency Breakdown
35% of Work Should be CM Resulting from PdM
5% of Work Should be Predictive Maintenance (PdM)
95% of Work Should be Preventative Maintenance (PM)
# Planned Maintenance Metrics

**Example – Indianapolis PPP**

<table>
<thead>
<tr>
<th>Performance Payment</th>
<th>Performance Measure (PM)</th>
<th>Percent of PM Met in Contract Year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PM No. 1 - Planned maintenance costs as a percentage of total maintenance dollars for the Contract Year</td>
<td>2008</td>
</tr>
<tr>
<td>100%</td>
<td>≥60%</td>
<td>≥65%</td>
</tr>
<tr>
<td>50%</td>
<td>≥50%</td>
<td>≥55%</td>
</tr>
</tbody>
</table>

**Planned Maintenance $** 60% 65% 70% 75% 80%

**Total Maintenance $**
WHAT is the difference between maintenance and asset management?

- Difference between computerized maintenance management and asset management
  - Condition monitoring
  - Asset values
  - Residual life
  - Probability/Consequence of failure
  - Business risk and renewal strategy
- Utilize data and systems to analyze risk and performance based on risk and life cycle costs
- Identify indicators and manage performance at different levels

From EPA Simple
Data management and communications are the key

Data Management Software
- Enterprise Environment
- Data Entry
- Data Management
- Business Risk
- Mobility
What can this look like with SCADA/Historian

**Level 1**
- Local Instruments
- Local Control

**Level 2**
- PLC
- Local Auto Facility Control
- SCADA Monitoring

**Level 3**
- Remote Auto Control
- Networked Architecture
- System Alarming

**Level 4**
- SCADA network
- System Level Automation
- Historical Data and Automated Reporting

**Level 5**
- Manage KPIS, Mobile Technology
- Integration Into Business Systems
- Continuously Improve
Connectivity Supports Asset Management

Integrated Systems Are Integral to Asset Management
- Support Communications
- Condition Based Maintenance
- Energy Management
- Mobility

Water Treatment
Water Distribution
Lift Stations
Public Works
Administration
HOW do we use this information for asset management?

“Control the whole by controlling the parts”
Maintenance performance impacts process

Primary Treatment Unit Process Performance - 2015

- Primary Effluent TSS (mg/l)
- Primary Clarifiers Available for Service
- Primary Sludge Pumps Available for Service

CMMS Tags
LIMS Tags
Cost factors are critical to measuring maintenance performance.
How do we roll up risk

Primary Treatment - Risk Register - 2016

- Measure and Monitor Risks
- Develop Risk Register

Number of Risks Identified

- High Risks
- Moderate Risks
- Low Risks

CMMS Tag

- 2016
WHAT an integrated model can look like (orange county model)

1. Asset System Description and Physical Characteristics

Evaluate by System

Figure 1 - Process Flow Diagram for Primary Clarification & Primary Sludge Handling

Unit Process Goals
- Primary Clarification: Remove settleable solids from the influent wastewater. Reduce solids and phosphorus loadings to the Aeration Basins
- Primary Sludge Handling: Remove debris from the primary sludge and pump sludge to the Anaerobic Digesters; screens protect downstream pumps and Anaerobic Digesters

Figure 2 - Operation Performance for Major Process 2

3. Operation and Maintenance Information
The Maintenance and Capital Parameters are depicted for the prior 5 years on the following table and chart. The O&M information indicates ..........

Table 2 - Maintenance and Capital P&Ms and Performance

<table>
<thead>
<tr>
<th>O&amp;M Parameter</th>
<th>Description</th>
<th>5 Prior Years Average</th>
<th>Current Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM &amp; PdM Cost</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CM Cost</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital Spending</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% of Assets with Estimated Rehab/Replace Year &amp; Cost</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1 Operation P&Ms and Performance

<table>
<thead>
<tr>
<th>Assets</th>
<th>Performance Goal</th>
<th>2010-2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Clarifiers</td>
<td></td>
<td>Available for Service</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Primary sludge Pumps</td>
<td></td>
<td>Available for Service</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Primary Sludge Mass</td>
<td></td>
<td>Dry Tons per Day</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>Primary Effluent TSS</td>
<td></td>
<td>(mg/l)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

Measure Asset Performance

Figure 3 - Maintenance Performance for Major Process 2

4. Risks Summary and Capital
The 2015 Windshield Survey of the Water Reclamation Facilities identified zero high risks, zero moderate risks and one low risk.

Measure Risk and Plan R&R/Capital

Figure 4 - Risks for Major Process 2

Table 3 Recent and Current Capital Improvement and MCRR Projects

<table>
<thead>
<tr>
<th>Project No. and Title</th>
<th>Description</th>
<th>Cost</th>
<th>Start/End Dates</th>
</tr>
</thead>
<tbody>
<tr>
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