The Fundamentals of Asset Management

Executive Overview

A Hands-On Approach
Emerging utility business conditions

- Increasing demand for utility services
- Diminishing resources
- Leveling of production efficiencies
- Increasing restrictions on output
- Aging infrastructure

Result: *increasingly expensive treatment options*
Emerging utility business conditions

- Aging customer base
- Diminishing technical labor pool
- Larger and more sophisticated facilities
- Loss of knowledge with personnel retirements
- Public resistance to rate increases

Result: *increasingly complex management environment*
Changing utility business environment

- Demand to do more with existing resources
- Need to make every dollar work – to better use capital and operating budgets
- Move from *reactive* to *proactive* work environment
A paradigm shift…

- Transition from *building and operating* to *managing* assets
  - Extending asset life
  - Optimizing maintenance and renewal
  - Developing accurate long-term funding strategies
  - *Sustain long term performance!*
Infrastructure is the foundation to sustained quality of life
Consequences of asset failure can be severe
Asset management improves…

Decision making throughout the life cycle of the asset
- Acquisition
- Operations
- Maintenance
- Renewal

Resulting in *lowest total cost of ownership*
This training describes…

- **What** is asset management?
- **Why** do it?
- What *deliverables* do I get from it?
- What are the *steps*?
- **How** do I move my organization forward?
Views on asset management

- Life cycle
- Conceptual framework
- Charter principles
- Asset management plan
What is asset management (AM)?

- Systematic integration of advanced and sustainable management techniques into a management paradigm or *way of thinking*, with
- Primary focus on the *long-term life cycle* of the asset and its sustained performance, rather than on short-term, day-to-day aspects of the asset
Views on asset management – a framework

- Asset management can be thought of as an object - a box or framework
- Following is a brief characterization of 8 different views on asset management
- These views make up the framework
View 1: Definition - asset management

- *Management paradigm* and *body of management practices*
- Applied to the *entire portfolio* of infrastructure assets at all levels of the organization
- Seeking to *minimize total costs* of acquiring, operating, maintaining, and renewing assets...
- Within an environment of *limited resources*
- While *continuously delivering the service levels* customers desire and regulators require
- At an acceptable level of *risk* to the organization
View 2: Life cycle business processes

Core Processes
- Plan
- Acquire
- Operate
- Maintain
- Renew
- Dispose

Support processes
- Demand management
- Knowledge of assets
- CIP validation
- Accounting & economics
- Condition & performance monitoring
- Business risk exposure
- Works resource management
- Review & continuous improvement
View 3: Core AM program elements

Total Asset Management Plan

- Information Systems
- Data & Knowledge
- People Issues
- Organizational Issues
- Lifecycle Process & Practices

Commercial Tactics

Sustainable, best value service delivery
View 4: Management framework

- Asset Management Business Processes
- Asset Management Plans
- Strategic Initiatives
- Annual Budgets

- Operating Budget
- Capital Budget
View 5: Five 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?

2. What is my required level of service (LOS)?
   - What is the demand for my services by my stakeholders?
   - What do regulators require?
   - What is my actual performance?

3. Which assets are critical to sustained performance?
   - How does it fail? How can it fail?
   - What is the likelihood of failure?
   - What does it cost to repair?
   - What are the consequences of failure?

4. What are my best O&M and CIP investment strategies?
   - What alternative management options exist?
   - Which are the most feasible for my organization?

5. What is my best long-term funding strategy?
View 6: AM plan 10-step process

1. Develop Asset Registry
2. Assess Condition, Failure Modes
3. Determine Residual Life
4. Determine Live 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

Fundamentals of Asset Management
View 6: AM plan 10-step process

1. System Layout; Data Hierarchy, Standards, and Inventory
   - Develop Asset Registry

2. Condition Assessment Protocol; Rating Methodologies
   - Assess Condition, Failure Modes

3. Expected Life Tables; Decay Curves
   - Determine Residual Life

4. Valuation; Life Cycle Costing
   - Determine Live Cycle & Replacement Costs

5. Demand Anal.; Balanced Scorecard; Perform. Metrics
   - Set Target Levels of Service (LOS)

6. Determine Business Risk (“Criticality”)
   - FMECA; Business Risk Exp.; Delphi Techniques

7. Optimize O&M Investment
   - Root Cause; RCM; PdM; ORDM

8. Optimize Capital Investment
   - Confidence Level Rating; Strategic Validation; ORDM

9. Determine Funding Strategy
   - Renewal Annuity

10. Build AM Plan
    - Asset Mgmt Plan; Policies and Strategy; Annual Budget

Fundamentals of Asset Management 19
View 7: Seven principles of asset management

1. The “Value Added/Level of Service” Principle—assets exist to deliver services and goods that are valued by the customer-stakeholder; for each consumer-stakeholder there is a minimum level of service below which a given service is not perceived as adding value.

2. The “Life Cycle” Principle—all assets pass through a discernable life cycle, the understanding of which enhances appropriate management.

3. The “Failure” Principle—usage and the operating environment work to break-down all assets; failure occurs when an asset can not do what is required by the user in its operating environment.

4. The “Failure Modes” Principle—not all assets fail in the same way.

5. The “Probability” Principle—not all assets fail at the same time.

6. The “Consequence” Principle—not all failures have the same consequences.

7. The “Total Cost of Ownership” Principle—there exists a minimum optimal investment over the life cycle of an asset that best balances performance and cost given a target level of service and a designated level of risk.
View 8: Enterprise asset management plan

- Executive Summary
  - State of the Assets
    - Section - 1
  - Levels of Service
    - Section - 2
  - Growth & Demand
    - Section - 3
  - Lifecycle Management
    - Section - 4
    - O&M
    - Renewal
    - Augmentation
  - Risk Profile
    - Section - 5
  - Management Strategies
    - Section - 6
  - Financial Planning
    - Section - 7
  - Business Improvement Plan
    - Section - 8
The enterprise asset management plan
Example of organizational AM strategies

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Objective/ Description</th>
<th>Related Service Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategic Planning</td>
<td>Manage the wastewater system through a structure that maintains a separation between asset management and service delivery to promote accountability, transparency and efficiency. Asset management staff will be responsible for ensuring the Council achieves its objectives for wastewater services through setting, implementing, and monitoring of strategy and process. The actual delivery of wastewater services will be contracted, through competitive market mechanisms, to various service providers, who are concerned with the way the assets are operated and maintained in order to meet defined service standards.</td>
<td>Value for money, Financial management, Maintain service potential of assets</td>
</tr>
<tr>
<td>M.1 Organisational Structure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M.2 Human Resources</td>
<td>Develop the professional skills of the staff through adequate training and experience. Training needs will be agreed with staff each year at performance reviews and a register maintained to record training history. Staff are encouraged to belong to appropriate professional bodies and to attend appropriate conferences, seminars and training courses. The Asset Management Plans remain strategic ‘living’ documents and will be reviewed on a regular basis. The scope of the review will be influenced by changes in service standards, improved knowledge of assets, introduction of AM improvements and corporate strategy/policy and process. The Wastewater Asset Manager, Policy Advisor and other senior management members will be involved in the plan review process.</td>
<td>Value for money, Legislative standards</td>
</tr>
<tr>
<td>M.3 AM Plan Updates</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M.4 Risk Management</td>
<td>Manage risk exposure by completing an annual risk assessment to update the Wastewater Risk Management Plan and implement risk mitigation measures to maintain risk exposure at a level compatible with the Corporate risk policy.</td>
<td>Service continuity, Service standards, Financial standards</td>
</tr>
</tbody>
</table>
Inside the AM framework
Inside the AM framework

- Condition Assessment
- Business Risk Exposure

Levels:
- Level 3
- Level 2
- Level 1
Inside the AM framework

- Condition Assessment
- Business Risk Exposure
- Level 3
  - Level 2
  - Level 1
Three fundamental management decisions

1. What are my work crews doing, where are they doing it—*and why*?
2. What CIP projects should be done—*and when*?
3. When should I *repair*, when should I *rehabilitate*, and when should I *replace*?

These decisions typically account for *over 80%* of a utility’s annual expenditures.
Understanding how our assets fail

Yin-yang of asset failure
Understanding how our assets fail

Pipe failure

- Soil characteristics, groundwater
- Physical loads
- Internal corrosion
- Galvanic action
- Pipe attributes
- Bedding condition
Understanding how our assets fail

Managing asset deterioration

“Failure is…the inability of any asset to do what users want it do to.”

John Moubray
Understanding how our assets fail

Monitoring performance is a key to reliability
Understanding how our assets fail

Experience indicates…

- Failure can be subjected to systematic study – a science
- **30-70%** of equipment maintenance activity is typically *misdirected* – *it is not cost effectively deterring failure*
Understanding how our assets fail

From the science of failure - tools for proactive management

- Root cause analysis
- Failure mode, effects, and criticality analysis (FMECA)
- Condition-based monitoring, failure/survival curves
- Predictive maintenance (PdM)
- Proactive maintenance (zero breakdown, reliability centered maintenance, total productive maintenance)
- Reliability centered management (design, O&M)

AM is all about managing the potential to fail
Our investment toolkit

- Maintenance

- Renewal:
  - Repair – repair beyond normal periodic maintenance, relatively minor in nature, anticipated in the long-term operation of the asset; no enhancement of capabilities; typically funded by operating budget
  - Refurbish/Rehabilitate – replacement of a component part or parts or equivalent intervention sufficient to return the asset to level of performance above minimum acceptable level; may include minor enhancement of capabilities; typically funded out of capital budgets
  - Replace
    - Without enhancement – substitution of an entire asset with a new or equivalent asset without enhancement of capabilities
    - With enhancement - substitution of an entire asset with a new or equivalent asset with enhanced capabilities
- “Augmentation”
Failure mode-based management logic

- **Failures**
  - **Some Are Significant**
    - Cannot Be Prevented by Maintenance
      - Redesign, Replace, Overhaul
      - Run to Failure, Repair
  - **Can Be Prevented by Maintenance**
  - **Some Are Not Significant**
    - Prevention Effective?
      - Yes
        - Schedule for Maintenance
      - No
        - Repair & Monitor
Determining significant failures

What is probability of failure? What is consequence of failure?

- **A**: Low probability - low consequence
- **B**: High probability - low consequence
- **C**: Low probability - high consequence
- **D**: High probability - high consequence

Business risk drives work program (O&M, CIP)
The big picture

- Risk-Sequence
- LOS
- Customer
- Cost of Service
- Capital
  - Growth (New Assets) Augmentation
  - System Renewal
  - System Improvements (Environmental, LOS)
  - O&M
    - Maintenance Program
    - Operations and Administration
AM-oriented structure

- Customer Service Demands
- Sustained Performance
- Executive Management
  - AM Thinking (AM Steering Committee)
  - Engineering
  - Operations
  - Maintenance
  - Finance
  - IT

AM Tools
AM-based decisions produce real savings

From assessment of Australia’s advanced management practices, 20-30% future life cycle cost savings typically is achievable for US water and wastewater utilities.

Where savings develop from…

- Efficiency gains
- Cost avoidance (defer, eliminate, reduce)
- Cost effectiveness and redirection
Making business case for AM
AM payoffs

- Reduced life cycle costs from better-focused (redirected) resource use
- Better value-per-dollar spending
- Confidence in decision-making

The right work, the right investment, at the right time, for the right reasons.
Realistic expectations for AM

- Takes several years of detailed, *nitty-gritty work* to fully deploy
- Requires eventual *buy-in* commitment of the whole organization
- Needs *upfront* investment to get started, with *hidden* returns for initial years
AM is a business model…

- *What* we do
- *Why* we do it
- *How* we do it
- *Where* we invest
- What our *costs* are
- What our *return* is
Tom’s bad day…
### Tom’s spreadsheet

#### A Step-By-Step Asset Management Plan

<table>
<thead>
<tr>
<th>Prologue</th>
</tr>
</thead>
<tbody>
<tr>
<td>It’s twilight. Night is the 40%. Tom is standing in his office. Raw street. An old pick-up truck and has hit the power of the wind and are sitting up at any moment with their white to the dim. His emergency response is calling an electrical pump station’s president and fall into this: demand. The owner, and asks the owner. Meanwhile, the size of the area and from there in the river is the soil water makes the water worse, up-stream local industries and wastewater backups. This, unfortunately, is not the only problem in a control plan. Tom has been a CTA Supervisor, and was promoted to an Assistant Manager.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What is the State of My Asset?</th>
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</thead>
<tbody>
<tr>
<td><strong>Current Condition</strong>: Poor</td>
</tr>
<tr>
<td><strong>Condition Rating</strong>: 4</td>
</tr>
<tr>
<td><strong>Probability of Failure</strong>: 0</td>
</tr>
<tr>
<td><strong>Consequence of Failure</strong>: 2</td>
</tr>
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<table>
<thead>
<tr>
<th>Asset Register and Hierarchy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Installed Date</strong>: 1963</td>
</tr>
<tr>
<td><strong>Original Cost</strong>: $75,000</td>
</tr>
<tr>
<td><strong>Annual Dep</strong>: $7,500</td>
</tr>
<tr>
<td><strong>Accum Dep</strong>: $7,500</td>
</tr>
<tr>
<td><strong>Current Dep</strong>: $7,500</td>
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<table>
<thead>
<tr>
<th>Task</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Task A</strong>: Complete</td>
<td>Complete</td>
</tr>
<tr>
<td><strong>Task B</strong>: In Progress</td>
<td>In Progress</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Backup System (If Required)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Backup System</strong>: Yes</td>
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</tbody>
</table>

<table>
<thead>
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<th>Microsoft Excel - FEMA Seminar Master.xlsx</th>
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### Fundamentals of Asset Management

45
Integration of 5 core questions with 10-step process

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   - Assess Condition, Failure Modes
   - Determine Residual Life

2. What is my required level of service?
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The Bear and the Butterfly