The Fundamentals of Asset Management

Welcome

A Hands-On Approach
AGENDA

Day 1
• Welcome, Introductions & Housekeeping Details
• “Storyline” Introduction, Background And Context
• Overview Of Fundamental Concepts & Core Practices
• The Storyline: Tom’s Really Bad Day
• Core Question 1: What Is The Current State Of My Assets?
• Core Question 2: What Is My Required “Sustainable” Level Of Service?
• Review of Key Slides; Discussion / Q & A

Day 2
• Core Question 3: Which Assets Are Critical To Sustained Performance?
• Core Question 4: What Are My Minimum “Life-cycle-cost” CIP and O&M Strategies?
• Core Question 5: Given The Above, What Is My Best Long-term Funding Strategy?
• Focus Topic 1: Deploying An AAM Program
• Focus Topic 2: Meeting The IT Challenge – Toward An Enterprise Asset Management System (EAMS)
• Summary, Addressing Your Questions, Comments
Drawing from the AM Knowledge Base

This workshop is produced by GHD Inc.

- Australian-based international company with over 100 offices worldwide
- 6500+ management consultants, engineers, scientists, planners, architects
- Recognized as a world leader in advanced asset management – over 25 years
- Literally, “wrote the book” on Best Practices
- Hundreds of engagements over two decades
Our “Faculty”

Mr. Steve Allbee

- USEPA Project Director, Gap Analysis;
- Primary author, USEPA’s The Clean Water and Drinking Water Infrastructure Gap Analysis;
- 30 years EPA - development of financing programs;
- BA, MA, MPA.

Mr. Duncan Rose

- Principal Consultant; AM Technical Director – GHD Inc;
- Former city/county manager;
- Co-author of WEF’s Managing the Water & Wastewater Utility;
- 30 years state & local management;
- Adjunct Faculty, Florida State University, Askew School of Public Policy and Administration;
- BA, MSP, MAPA.
By the end of this workshop you should be able to address these five questions

- What is AM?
- Why do AM?
- What “deliverables” do I get?
- How to do it?
- How do I move forward?
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
- Operation
- 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?
What, then, 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
- Human 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

Service Delivery

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 performance?
   - 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 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

Determine Business Risk ("Criticality")
Optimize O&M Investment
Optimize Capital Investment
Determine Funding Strategy
Build AM Plan

Develop Asset Registry
Assess Performance, Failure Modes
Determine Residual Life
Determine Life Cycle & Replacement Costs
Set Target Levels of Service (LOS)
View 6: AM plan 10-step process

- System Layout; Data Hierarchy, Standards, and Inventory
- Condition Assessment Protocol; Rating Methodologies
- Expected Life Tables; Decay Curves
- Valuation; Life Cycle Costing
- Demand Anal.; Balanced Scorecard; Perform. Metrics

- Develop Asset Registry
- Assess Performance, Failure Modes
- Determine Residual Life
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- Set Target Levels of Service (LOS)

- Determine Business Risk ("Criticality")
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- FMECA; Business Risk Exp.; Delphi Techniques
- Root Cause; RCM; PdM; ORDM B/C Analysis
- Confidence Level Rating; Strategic Validation; ORDM
- Renewal Annuity
- Asset Mgmt Plan; Policies and Strategy; Annual Budget
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 of the same age 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
The enterprise asset management plan
Inside the AM framework
Inside the AM framework
Inside the AM framework

- Condition Assessment
- Business Risk Exposure

Levels:
- 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
Bedding condition
Galvanic action
Pipe attributes
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

![Decay curve diagram]

- Vibration
- Oil loss
- Noise
- Heat
- Failure

Time

Performance

Excellent

Poor

Decreasing

Increasing
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:**
  - **Major 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

- Are Significant
  - Cannot Be Prevented by Maintenance
    - Redesign, Replace, Overhaul
    - Run to Failure, Repair
  - Can Be Prevented by Maintenance
    - Schedule for Maintenance

- 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?

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

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

### Prologue

It’s twilight. Night is on the 42’s. Tom is standing at the top of the Hill Station. Raw street. An old pickup truck and has hit the power been called and are still up at any moment with their white to the dim of the street. His emergency response waiting for an electrical system to the pump station motor they want, would force main to divert the water. It can not be found an underground warehouse. June, the owner, and asks the owner.

Meanwhile the size of drain and from there is the side water main on matters worse, going to the up stream local industry wastewater backups.

This, unfortunately, is the first of the three problems in a control system. The third main from a 50 year significant wastewater, water caused wastewater, made the six o’clock news.

Tom has been a C3 supervisor, was promoted.

### Asset Register and Hierarchies

<table>
<thead>
<tr>
<th>Asset Register and Hierarchies</th>
<th>Installed Date</th>
<th>Asset Class</th>
<th>Original Cost</th>
<th>Estimated Life</th>
<th>Conditions Rating</th>
<th>Annual Dep</th>
<th>Accum Dep</th>
<th>Required LOS</th>
<th>Current LOS</th>
<th>Minimum Condition</th>
<th>Backup Reduction (Redundancy)</th>
<th>Probability of Failure</th>
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### Storyline:

A Step-By-Step Asset Management

- [Microsoft Excel: EPA Seminar Master.xls](#)
Integration of 5 core questions with 10-step process

1. What is the current state of my assets?
   - Develop Asset Registry
   - Assess Performance, Failure Modes
   - Determine Residual Life
   - Determine Life 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

2. What is my required level of service?

3. Which assets are critical to sustained performance?

4. What are my best O&M and CIP investment strategies?

5. What is my best long-term funding strategy?

Decision making
The Bear and the Butterfly