PNCWA Webinar

Computerized Maintenance Management Systems (CMMS)
Benefits to Smaller Agencies

January, 2015
Presentation Outline

• Introduction – Jeremy Coles
• What is a CMMS – Brown and Caldwell (BC)
• How can a CMMS help my utility – (BC)
  • Manage information about your assets
  • Manage work information and history
  • Track customer complaints
• How can a CMMS help my utility – (BC)
• Case Study – Santa Barbara
• Case Study – Tony Bisson, Clark Regional WWD (WA)
• What does a utility need to get started? – BC
• Q&A – Jeremy Coles
Our assets – their ownership and care
Agency assets – what we all would like to know.....

- What do we own and where is it?
- What condition is it in?
- What are the likelihood and consequence of failure?
- How should we maintain it?

Focus on critical assets
Analyze how data is collected
Work Orders (WO’s) go to prioritized assets
Better updates for financial forecasting (and rates)
Why is AM important?........without it the owner could be:

- Not saving enough $$ for maintenance
- Not have enough $$ for replacements
- Over/under-charging rate-payers
- Putting level of service (LOS) at risk (e.g. boil notice)
- Operating inefficiently
Data – best to store and manage asset information somewhere other than our heads…..

“With a lot of our staff nearing retirement, we risked losing all the knowledge in our heads. We realized we needed to capture and organize information in a whole new way.”

Greg Farmer, Operations
Littleton/Englewood WWTP, Colorado
Goals (Purpose) for AM Program

From “Effective Utility Management, a Primer for Water and Wastewater Utilities”

- **Operational optimization** – timely, cost-effective, reliable operations (efficient work, right time)

- **Infrastructure stability** – High service level, low cost, reliable/low risk water delivery

- **Measurement and continuous improvement**
What is a CMMS system?

A software package designed to manage high volumes of asset information

• Data Driven
  • Houses the asset register

• Detailed information about an agencies assets (size, HP, condition etc.)

• Schedule and history of the work performed on those assets
Goals are to better manage our utilities – where does the CMMS fit in?

Five fundamental areas to a well run utility:

1. Agency policies and procedures
2. Equipment data
3. Work order control
4. Preventative maintenance practices
5. Materials control

CMMS systems strongly support these
CMMS systems - manage the detail of both assets and the work performed

The “What and When”

- Detailed asset inventory
- Maintenance history
- Maintenance and budget planning tool
- Generates reports
- Dynamic/transactional
- What you own, what you’ve done, what you have to do
How can a CMMS help my utility?
Even the smallest agencies can have thousands of assets worth hundreds of millions of $$$

<table>
<thead>
<tr>
<th>Unit Name</th>
<th>Type</th>
<th>Supplier</th>
<th>Model Details</th>
<th>Age in Years</th>
<th>Age at Install</th>
<th>Manufacturer</th>
<th>Model Number</th>
<th>Asset ID</th>
<th>Status</th>
<th>Remarks</th>
<th>Make</th>
<th>Model</th>
<th>Serial No</th>
<th>Installed Date</th>
<th>Warranty</th>
<th>Warranty Expiry</th>
<th>Condition</th>
<th>Hours</th>
<th>Hours at Install</th>
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</table>
| RAW-02-VTP-101-M | Motor | Brown and Caldwell | 400HP Vertical Turbine Pump | 2 | 2023 | Brown and Caldwell | RAW-02-VTP-101-M | RAW-02-VTP-101-M | New | N/A | N/A | N/A | 30,000 | 2023-01-01 | 12 months | January 2024 | 1000 | 0

“RAW-02-VTP-101-M”

400HP Motor 1 – Vertical Turbine Pump
Each individual asset has its own set of detailed information

<table>
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<tr>
<th>Asset ID</th>
<th>Asset Name</th>
<th>Type</th>
<th>Description/Function</th>
<th>Design Type</th>
<th>Design Voltage</th>
<th>Phase</th>
<th>Rated AMPS</th>
<th>HP</th>
<th>Watts/KW</th>
<th>RPM</th>
<th>Service Factor</th>
<th>Efficiency</th>
<th>Power Factor</th>
<th>Thermal Protection</th>
<th>Y/N</th>
<th>Ambient Temperature (Max.)</th>
<th>Design Code</th>
<th>NEMA Insulation Class</th>
<th>Frame number</th>
<th>Drive End Bearing</th>
<th>Non Drive End Bearing</th>
<th>Serial number</th>
<th>Model number</th>
<th>Size</th>
<th>Frame number</th>
<th>Manufacturer &amp; Vendor Information</th>
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</thead>
<tbody>
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</tbody>
</table>

- **HP, Voltage, RPM**
- **Serial Number, Model Number, Year made**
- **Purchase Cost, Date and Expected Life & Owner!**

Warranty Information - Effective Date, Expiration Date

<table>
<thead>
<tr>
<th>Warranty Information - Shipping Date</th>
<th>Warranty Information - Effective Date</th>
<th>Warranty Information - Expiration Date</th>
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Manufacturer & Vendor Information

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<th>Address</th>
<th>City, ST, Zip</th>
<th>Phone #</th>
<th>Fax #</th>
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</table>

- **LOCATION INFORMATION**
  - **Address**
  - **City, ST, Zip**
  - **Phone #**
  - **Fax #**
  - **Email**
  - **Website**

- **MANUFACTURER**
  - **Address**
  - **City, ST, Zip**
  - **Phone #**
  - **Fax #**
  - **Email**
  - **Website**

Notes
All of that asset information can live in many different places.....(or not be captured at all)

Institutional memory (risky data sources)

- Senior staff knowledge
- Random spreadsheets
- Old paper sources

Idyllic location for detailed asset data and work history

- Financial Data (Oracle)
- Vertical Asset Inventory (Maximo)
- Linear Asset Inventory (GIS)
- Condition Data (Historical Evaluation)
- Supplemental Data Sources
CMMS systems provide a clean & standardized platform for information management

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CMMS can track the full life of each asset and report on it (and across all assets)

- Replacement
- Scheduling & executing WO's
- R&R Planning
- Transaction history
- Comparative reporting
- Houses asset data
If my CMMS was fully populated with asset and work information benefits can include...

- Easier to find information gaps
- Can report across groups of assets
- Streamline and focus work management
- Systematically prioritize work and record work history
- Good data to other systems (e.g. financial or HR/staffing)
Maintenance work

**Scheduling, completing, tracking and reporting**
Prioritizing, managing and reporting on work can be tough to track
CMMS systems help organize work management (and show trends)

- Preventative Maintenance (PM’s)
- Corrective Maintenance (CM’s)
- Predictive Maintenance (PDM’s)
- Emergencies (out of service/shut-downs etc.)

- Want to comply with warranties and perform the RIGHT amount of maintenance over the asset lifecycle
**CMMS - Planning, tracking and executing PM’s (warranty and beyond)**

- One asset
- One maintenance schedule
- One start date

- Thousands of assets
- Different maintenance schedules
- Different start dates
- Reporting & regulatory requirements
CMMS systems provide a vehicle for work structure including schedules, prompts etc.

*This is an ongoing process that will take several iterations before the process changes are made.*
### Key Performance Indicators (KPI’s) – prove you are efficient.....or that you need more resources

<table>
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<th>Measurement</th>
<th>Goals**</th>
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<tr>
<td><strong>Work Order Backlog</strong></td>
<td>Planned 6 weeks (SMRP 5.4.8)</td>
</tr>
<tr>
<td></td>
<td>Ready to schedule 2-3 weeks (SMRP 5.4.9)</td>
</tr>
<tr>
<td><strong>Overtime</strong></td>
<td>&lt;5% (SMRP 5.5.8)</td>
</tr>
<tr>
<td><strong>Preventive Maintenance Compliance</strong></td>
<td>&gt;90% (SMRP 5.4.14)</td>
</tr>
<tr>
<td><strong>Schedule Compliance</strong></td>
<td>&gt;90% (SMRP 5.4.4)</td>
</tr>
<tr>
<td></td>
<td>Report as to why the schedule was broken (equipment not ready, emergency breakdown, staffing etc..)</td>
</tr>
<tr>
<td><strong>Planned Maintenance Ratio</strong></td>
<td>85% (AWWA benchmark)</td>
</tr>
<tr>
<td><strong>Reactive Work</strong></td>
<td>&lt;10% (SMRP 5.4.1)</td>
</tr>
<tr>
<td><strong>Mean Time Between Failure</strong></td>
<td>Higher the better. Don’t want failures between PM’s</td>
</tr>
<tr>
<td>(start on critical assets)</td>
<td></td>
</tr>
<tr>
<td><strong>Budgeted vs Actual</strong></td>
<td>95%-100% of Budget</td>
</tr>
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</table>
CMMS reports can show performance against industry benchmarks........and trends
Organized CMMS information (pipe age, condition, material etc.) supports Replacement and Rehabilitation (R&R) modeling

- Probability of Failure
- Years
- New asset's mean year of failure is in its 50th year
- 50 year old asset's mean year of failure is in its 57th year
- 70 year old asset's mean year of failure is in its 73rd year

Asset with mean useful life of 50 years, standard deviation of 10 years
More realistic R&R planning supports financial forecasts......
Which leads to more accurate and defensible rate adjustments and CIP funding
Opportunity to capitalize on (and quantify) savings

-40% -35% -30% -25% -20% -15% -10% -5% 0% 5%

Australia average:
Savings ~19%

Hunter Water
Savings ~39%
Case Study – Allan Scott – Santa Barbara
Benefits to Small Agencies

• Provides visibility and transparency
  • Management understands what is happening in the field
  • Field crews understand what is important for effective utility management

• Collect reliable data to measure performance
  • Workload backlog
  • Productivity
  • Effectiveness of preventative maintenance
  • Improves focus on critical assets
  • True O&M costs

• Standardize O&M practices
  • Extend useful life and reduce O&M-related equipment failures
  • Facilitates continual improvement
  • Captures system O&M knowledge
  • Streamline work practices
Santa Barbara Case Study

• Implemented Cartegraph CMMS for Sewer Collection System Group and for Water Distribution

• About
  • 95,000 customers
  • 260 miles of gravity sewers
  • 298 miles of water distribution pipe
Key Challenges

• Waste water SSO consent decree requiring increased performance for sewer pipe cleaning and inspection

• Aging water infrastructure and O&M resource limitations raised concerns over effectiveness of O&M program and identification of future needs.
Standard Workflows Supported by Technology Helped Santa Barbara Achieve its Goals

- Improve Management and Operation of WW Collection System
  - Supported by CarteGraph and other technology systems
  - Inspection & Cleaning
  - R&R Planning
  - SSO Response
  - Flow Monitoring
  - FOG
  - RCM (FM/PS)

- Aging Infrastructure
- Regulatory Requirements
- Limited Resources

Updated SSMP
Streamlining Work Practices By Aligning Technology and Data With Efficient Work Processes
Streamlining Work Practices By Aligning Technology and Data With Efficient Work Processes

Assign basin → Identify Priorities → Plan route → Clean pipes → Record results → Supervisor review

Interactive Maps

CarteGraph → Scheduling

GIS

New work requests
Performance reports
Preventative Maintenance Metrics

- **PMs Planned**: The number of schedule PMs for the time period defines the overall maintenance plan.
- **PMs Completed**: How many of the planned PMs were actually completed?
- **%PMs Completed**: How well was the plan followed?
- **Hours Estimated**: Number of planned hours for preventative maintenance
- **Actual Hours**: Number of hours spent on preventative maintenance
- **Hour Actual vs. Estimated**: How close is the plan to the actual execution?
- **PMs total hours**: Same as Actual Hours.
- **CMs Total Hours**: Number of hours spent on corrective maintenance.
- **% CMs vs. PMs**: Helps identify high areas of unplanned maintenance.
- **CM/PM vs PMs Completed**: Compares areas of high unplanned maintenance with how effective the planned preventative maintenance program is being executed.
### Performance Analysis of Preventative and Corrective Maintenance

- Where are my highest failure rates and why?
- Where are my most expensive maintenance costs?
- Which assets are the most expensive to maintain?
- What changes can I make to reduce failure rates?
- What do I need to do to reduce costs of my problem assets?

<table>
<thead>
<tr>
<th>Station Number</th>
<th>PM Count</th>
<th>CM Count</th>
<th>Total</th>
<th>% CM</th>
<th>Total Cost</th>
<th>Unit Cost</th>
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<td>20</td>
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<td>28</td>
<td>152</td>
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<td>129</td>
<td>298</td>
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<td>22</td>
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<td>32</td>
<td>176</td>
<td>18%</td>
<td>$102,000</td>
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Accomplishments for Collections

• Improved business processes (pipe cleaning, CCTV inspection, FOG Management, SSO Response, R&R planning)

• Improved use of GIS and CMMS
  • “Dynamic” cleaning schedules
  • Risk-based CCTV inspections
  • Streamlined SSO documentation
  • Implemented Sewer Lateral Inspection Program
  • Implementing R&R Program
Collections Results

- New processes and systems in use for 2 years
- Decreased annual SSOs over 40% (on average)
- Successfully meeting Consent Decree requirements
- On track to clean entire system over 5 years
- On track to inspect entire system over 10 years
- Developed new Sewer CIP process that is managed by Engineering instead of Collection Systems
- Formalized FOG Restaurant Inspection program
- Developed Sewer Lateral Inspection Program
- Updated and audited Sewer System Management Plan
Accomplishments for Water Distribution

• Early stages of implementation
• Developing visibility of what it really takes to maintain system
• Standardized work processes improves performance and versatility
• Starting to see and react to patterns, inefficiencies and costs
• Improved communication and visibility between work groups and management
Today’s Topics

- Vision
- Program Development
- Buy In
- Existing Data
- Staff usage
- Engineering and Maintenance working together!
- Condition Assessment
- Asset Risk
- Project Scoring
- Next Steps
Vision
Vision

• 10 Attributes of Effectively Managed Utilities
Vision

- Financial Viability
  - Understand full life-cycle cost of utility
  - Establish & maintain effective balance between:
    - Long-term debt
    - Asset values
    - Operations / maintenance expenditures
    - Operating revenues
  - Establish predictable rates (consistent with community expectations / acceptability) adequate to recover costs
  - Provide for reserves
  - Maintain support from bond rating agencies
  - Plan / invest for future needs
Vision

• Infrastructure Stability
  • Understand condition of & costs associated with critical infrastructure assets
  • Maintain / enhance condition of all assets
    • Over long-term at lowest possible life-cycle cost
    • Acceptable risk consistent with customer, community & regulator-supported service levels
    • Consistent with anticipated growth & system reliability goals
  • Assure asset repair, rehabilitation & replacements are coordinated to minimize disruptions & other negative consequences
Vision

• Customer Focused
  • Meet customer expectations - public values survey

• Environmental Stewardship / Protecting Water Resources
  • Proactive management of the system minimizes backups, I&I and unexpected pipe failures

• Financial Responsibility
  • Stable rates
  • Staffing and workload planning
  • Minimize the high cost of emergency repairs and overflows
  • Prioritizing limited resources - Fix the Worst First!

• Responsible Management
  • Practicality of managing 9,500 main line pipes segments

• Supporting Economic Development
  • Reliable sewer system
  • Targeted investments
Program Development
Program Development

• Develop a ground level record system capable of Work order and asset management

AND

– Critical Sewers Analysis
– Condition Assessment
– Asset Risk
– Project Prioritization Process
– Program Level Project Scoping
– Documentation
Program Development

• Program Outline
  ✓ Identify Existing Data
    • GIS and CCTV Investments
    • Historical data and “tribal Knowledge”
  ✓ Critical Sewer Analysis
    • Consequence of Failure (GIS Analysis)
  ✓ Asset Condition
    • Probability of Failure (CCTV Data)
Program Development

- Program Outline
  - Asset Risk
    - Combining Condition and Criticality (GIS Analysis)
  - Develop Prioritization Concept
  - Define R&R Projects
  - Prioritize R&R Projects
  - Project Priority Array
Existing Data
Gaining Staff Buy In
Non Tech Savvy?
Giving Ownership
Existing Data

• Identify Existing Data
  • Assets
    • GIS
    • Hand written WO
  • Asset Condition
  • CCTV Data
    • 475 miles of CCTV in Maintenance Management System (Granite & Lucity)
    • Data collected since 2005, 95% of main lines
    • All lines televised at some point
  • Tribal Knowledge of known defects
Existing Data

Sewer Lines Televised
An example of non Work Order usage:

Critical Sewer Analysis
Critical Sewer Analysis

• Defining Criticality
  • 1 to 3 scoring scale based on potential impact of asset failures or “consequence of failure”
Critical Sewer Analysis

• Score of 3 includes pipes:
  • in major roads (parkways, arterials)
  • in environmentally sensitive areas
    • Includes all difficult to access canyon lines
  • Greater than 18" diameter
  • More than 14’ deep

• Score of 2 includes pipes:
  • In urban collectors
  • Inaccessible lines
  • 10” to 18 ” diameter

• Score of 1 includes all other pipes
Critical Sewer Analysis - GIS Working for Us
Critical Sewer Analysis

GIS Working For Us
Critical Sewer Analysis
Condition Assessment
Condition Assessment

- CCTV Data
  - Infiltration / Inflow
  - Structural – Cracks / Shears
  - Sags
  - Roots
  - Fats, Oils, Grease (FOG)
Condition Assessment

- CCTV Data Collected from Cues CCTV trucks.
Condition Assessment

• CCTV Data Scoring “Weight”
### Condition Assessment

#### CCTV Data

| US Structure | 43-180 | 0.00 | Pipe ID | 3444 |
| DS Structure | 43-167 | Lakeshore Trunk | 11.00 | TV Rec # | 2333 |
| At Pipe ID | 3474 | Flow Basin | | Most Recent Inspect | |

#### Set-up | Pipes | Data | TV Observation | Summary | Rehab | Custom | Comment

| # of TV Connections | 5 |

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<th>Distance (ft)</th>
<th>VCR Counter</th>
<th>Location Text</th>
<th>Description Text</th>
<th>Rating (1-5)</th>
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| Record 1 of 25 | View Mode | Ready... |
# Condition Assessment

[Image of a computer interface for condition assessment]

**Sewer TV Inspection - Unnamed Filter Set**

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<th>US Structure</th>
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### Setup | Pipes | Data | TV Observation | Summary | Rehab | Custom | Comment |
---|---|---|---|---|---|---|---|
| Overall Condition | | | | | | | |
| Structural | Total | Remaining | Rating |
| Flow | 0.000 | 0.000 | 0.000 |
| Cleaning | 630 | 630 | 366.9 |

| Quick Rating Struct | | | | | | |
| Quick Rating OM | | | | | | |
| Quick Rating Total | | | | | | |
| Pipe Rating Struct | | | | | | |
| Pipe Rating OM | | | | | | |
| Pipe Rating Total | | | | | | |

### Additional Work Needed

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<th>Additional Task Text</th>
<th>Assigned To Text</th>
<th>Completed Text</th>
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</table>

- Record 1 of 25
- View Mode
- Ready...
Condition Assessment

• CCTV Data Simplified Based on Score

= Failing: Imminent failure
= Poor: Monitor, proactive repairs
= Good: No concerns
Asset Assessment
Asset Risk
Asset Risk

• Integrating Criticality & Condition
  • Criticality – Consequence of Failure
    • Score 1, 2, or 3
  • Condition – Risk of Failure
    • Score Red, Yellow, Green
    • Extra point, or fraction of a point added for hot spots.

Asset Risk = Criticality + Condition
Asset Risk

| Red | Watch/Fix Medium Priority 7,584 ft | Fix High Priority 1,651 ft | Fix Now 4,820 ft |
| Yellow | Watch Low Priority 10,329 ft | Watch Medium Priority 4,494 ft | Watch High Priority 6,357 ft |
| Green | Standard Maintenance | Watch Low Priority | Watch Medium Priority |
Asset Risk

Sewer Lines Identified
Asset Risk

Project Zones Identified
Project Scoring
Project Scoring

Asset Risk = Criticality + Condition
Next Steps
Lucity Rehab module

- Expand on our use of the rehab module.
Next Steps

- Project Priority Array
- Capital Project component
- Pump Stations
- Force Mains
- Rework codes/weights to work with PACP
Lessons Learned

• You have more data collected than you realize even before implementation
• Staff support and Management buy in is crucial to any systems success
• CMMS systems, once populated, save time, money.
• Adds quantifiable data to back rehab needs and cost allocation.
• Provides an easily searchable data base to provide history on work/assets, customer issues and inquires, and any other data you may want to “gather”
CMMS systems - What does a utility need to get started?
AM programs – agency specific, one size does not fit all – CMMS systems are just one component

Small
- Consequence of Failure (COF) and Probability of Failure (POF)
- Focus on a critical asset class to collect additional data
  - Update CMMS
  - Update financial

Medium
- COF and POF
- Asset Management Program Evaluation (AMPE)
- Business Process Analysis (BPA)
- Collect additional data
  - Update CMMS
  - Update financial

Large
- COF+ and POF+
- BRE
- AMPE
- Teams
- BPA
- BCE
- SAMPs
- Resiliency
- ISO
- IIMM
- ISI
- CMMS
- Financial
Getting started – CMMS implementations are journeys............not destinations

- **Identify & Evaluate**
  - Existing data sources and inventories
  - Existing work practices
  - Look for gaps (e.g. collections, vertical, work history etc.)
  - How are you currently reporting (communicating with decision makers)?

- **1st round goals for system**
  - Consolidated asset database
  - Basic work management
  - Basic reporting

**Starting slowly and simply is the key to success!**
Choose a CMMS system that meets your agencies needs/goals now........but is expandable

**Evaluation considerations**
- Flexible reporting
- Modular (can add assets/users)
- Ease of use
- Vendor support
- Mobile applications
- Cost

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Learn from others.......and find a champion

• **Benchmark**
  • What systems are neighboring/similar agencies using?
  • How is it working for them?
  • Information sharing/user group potential

• **Identify an internal “champion(s)”**
  • Day jobs will continuously get in the way
  • One or more individuals needs to be focused on the effort and own it
  • Other departments (e.g. IT) will need to be on board
  • *Business processes needed to support the tools*
CMMS systems – Benefits
Recap
Benefits to Small Agencies

• Collect **reliable data** to **measure performance**
  • Workload backlog
  • Productivity
  • Effectiveness of preventative maintenance
  • Improves focus on critical assets
  • True O&M costs

• **Standardize** O&M practices
  • Extend useful life and reduce O&M-related equipment failures
  • Facilitates continual improvement
  • Captures system O&M knowledge
  • Streamline work practices
Benefits to Small Agencies (cont.)

• **Quantify needs** to decision makers
  • demonstrate the need for more resources
  • prove warranty compliance or regulatory compliance
  • Support rate adjustments to decision makers

• Provides **visibility and transparency**
  • Management understands what is happening in the field
  • Field crews understand what is important for effective utility management
Questions