The Next Era for Water Utilities-- Smart Metering Optimization

Presentation for the US Public Health Service

Presented by:
Dale Pennington, Managing Director
UtiliWorks Consulting, LLC.

November 20, 2012
Experience

UtiliWorks

- Nationally recognized client projects
- AMI, smart metering, Smart Grid experts
- National network of partners
- Critical regulatory relationships
- AMI business process improvement
- Expert cost modeling
Agenda

● What is the current state of technology for water systems?
● How do we manage the data?
● What can be done with the information?
● Cost vs. benefits
● How to get started
● Q&A
What is the current state of technology for water systems?
Key Considerations

● 60-70% of the value of past AMI projects was left on the table
  • Primarily used for simple meter reading
  • Much valuable data lost in the shuffle
● Today, AMI projects are oriented toward a data centric model
  • No more vendor sales/install model (2-3 days training)
  • Complex data management and analysis systems are being designed to maximize benefits and enable more complex functionality.
  • 10-15% of project costs are now focused on system integration due to the complexity of the system
Current state of technology

- Deployments have been going on for a long time, and we are in 3-5\textsuperscript{th} generation of technology
- Systems are moving way beyond billing information into utility management
- Cost versus benefits in most cases supports moving to the new systems
- Product constraints/environmental issues require better management of utility systems
- Advanced metering improves customer relationships
Technology Drivers

- Advanced metering should be an asset management tool in the utility segment

- Become a state of the art manufacturer and distributor

- A significant cost reduction in data collection and customer service

- It offers a significant change in the ability to utilize utility staff and capital based on data driven events (engineering design issues, capital budgets outlays)

- It is a network that is expandable for other city services, or can connect to existing networks
Typical Business Objectives

- Improve and protect revenue
- Reduce customer service calls
- Reduce distribution losses
- Reduce overall account management costs
- Reduce operational costs
Better Business Objectives

- Reduce theft of service by 90% by 2014
- Reduce distribution losses by 50% by 2014
- Reduce customer service OPEX by 20% by 2013
- Reduce customer service costs by 15% per account by 2015
- Reduce meter services OPEX by 25% by 2015
Each Utility Project is Unique

- *Your* needs are not the same as other utilities’ needs
- *Your* business drivers determine the final output
- Systems engineering provides perspective to utility projects
- Look at operations holistically to identify challenges and opportunities
- Consider requirements and constraints
What does the system consist of?

- Advanced meters
- Data transmitters
- Data collectors
- Meter data management systems (MDMS)
- Leak detection tool kits
- Customer information portals
- Analytical packages
Water Meters

Residential Mag meters
Life Cycle 18 years
99%+ accuracy

Residential flow meters
Life Cycle 8-18 years
Variable accuracy
Data Transmitters

Sensus

Aclara
Network

Badger System
Data, Networking and Communications

Communications Design:
- Broadband Point-to-Point Backbone Network
- Designed to facilitate multi-departmental/application use including; SCADA, AMI, Mobile Dispatch, Security, etc.
How to Choose a System
Example - Clear Value Propositions from Managing/Using the Data Correctly

- State of the art 24/7 monitoring of accounts worth over $65 million in revenue per year and 700+ Million in fixed asset replacement value
- Reduction in customer service costs and service issues by up to 75% within 3 years
- Real time emergency response to account issues
- Elimination of safety issues in reading meters
- Daily sales revenue from key accounts
- Continual improvement on asset performance
- Proactive customer service
So You Want to Move Forward?

- Understand what you want to build
- Business objectives are key to definition
- Don't build what you can buy
- Don't buy what you don't need
# Smart Grid Technology Assessment

## AMR/AMI Solutions

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## Summary Ratings

| Company Experience Water | ⚫           | ⚫             | ⚫               | ⚫                | ⚫            | ⚫            | 2006            | 2008              | 2008                   | ⚫        | ⚫   | ⚫            | ⚫             |
| Company Experience Electric | ⚫           | ⚫             | ⚫               | ⚫                | ⚫            | ⚫            | 2006            | 2008              | 2008                   | ⚫        | ⚫   | ⚫            | ⚫             |
| Proposed Product Maturity | ⚫           | ⚫             | ⚫               | ⚫                | ⚫            | ⚫            | 2006            | 2008              | 2008                   | ⚫        | ⚫   | ⚫            | ⚫             |
| Applicability to local environment | ⚫           | ⚫             | ⚫               | ⚫                | ⚫            | ⚫            | 2006            | 2008              | 2008                   | ⚫        | ⚫   | ⚫            | ⚫             |

## Water MIU’s (radio)

<table>
<thead>
<tr>
<th>OEM vs Third Party</th>
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<td>MIU Freq (MHz)</td>
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<td>MIU Power (mW)</td>
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<td>10mW</td>
<td>1W</td>
<td>250mW</td>
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<td>Battery/MIU Warranty (years)</td>
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<tr>
<td>Sealed (non-replaceable) Battery</td>
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<tr>
<td>Notes: Mobile, FN-RF, FN-PLC, BPL</td>
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<td>FN-RF</td>
<td>Mobile</td>
<td>FN-RF</td>
<td>FN-RF</td>
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<td>FN-RF</td>
<td>FN-RF</td>
<td>FN-RF</td>
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</tr>
</tbody>
</table>

## Electric MIU’s (radio)

| 1-way, 2-way       |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| Licensed           | Y   | N   | N   | N   | N   | N   | Y   | N   |     |     |     |     |     |     |     |     |     |
| Transmissions (data rate) |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| MIU Freq (MHz)     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| MIU Power Output (mW) |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| RF Type (mesh, p2p, combo) |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
Defining Goals

Key Questions
Existing Program
Desired Future Program/System
Funding Available
Goal

Functional Areas
Billing
Customer Service
Meter Reading
Field Services
Operations
IT & Communications
Project Planning & Cost Estimate

**Topic Area**

<table>
<thead>
<tr>
<th>Topic Area</th>
<th>Cost</th>
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</thead>
<tbody>
<tr>
<td>AMI Pilot/Production</td>
<td>$4,659,800</td>
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<tr>
<td>MDM, IWMS, CIS</td>
<td>$3,584,500</td>
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<tr>
<td>TOU Billing</td>
<td>$434,600</td>
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<tr>
<td>Servers</td>
<td>$47,300</td>
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<tr>
<td>Changes to Staff</td>
<td>$220,000</td>
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<tr>
<td>Project Management</td>
<td>$350,000</td>
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</tbody>
</table>

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Example of a Project Team

Example City Project Sponsor

Bob Russ
Project Manager

Dale Pennington
Managing Director
Executive Project Sponsor

Kalin Fuller
Business Analyst

Tim Patterson SD
Manager IT/Integration Solutions Architect

Ranea White
Project Admin/Accounting

As needed resources

Todd Barlow VP Operations Executive Sponsor

Kody Salem Principal Consultant Communications

EXPERIENCED PROFESSIONALS WORKING TOGETHER
Building a Successful System

- Consider a 3-legged stool:
  - The stool needs all 3 legs to function as designed

- Smart Meters
  - Very straightforward and easy to procure
  - Essentially a commodity product

- Smart Systems
  - Thoughtful and thorough design provides the system foundation
  - Enables new functionality within the enterprise through data and automation

- Smart Processes
  - Very difficult to accomplish internally in a compartmented organization
  - This is the critical phase. If processes are not designed to manage and utilize the technology, the entire project will be perceived as a failure
Project Life Cycle

<table>
<thead>
<tr>
<th>Project Initiation</th>
<th>Preliminary Engineering</th>
<th>Plans, Specs &amp; Estimates</th>
<th>Construction</th>
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<tbody>
<tr>
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<td>Project Closeout</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Operations &amp; Maintenance</td>
</tr>
</tbody>
</table>

- Concept of Operations
- System Requirements
- High-Level Design
- Detailed Design
- Software / Hardware Development
- Field Installation
- Implementation
- Unit / Device Testing
- Integration and Decomposition
- System Verification & Deployment
- Subsystem Verification
- System Validation

UtiliWorks
Building Smart Utility Solutions

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How do We Manage the Data?
What Do We Manage?

AMI and Smart Metering/Grid Utility Impacts

Application Layer

- Customer Service
  - Marketing
  - Problem Resolution
  - Prepay
  - Customer web Portal
  - IVR

- Finance & Billing
  - Cash Management
  - Revenue Protection
  - Rate Design
  - Electron Billing

- Meter Data Analytics
  - Conservation
  - Enforcement
  - Incentive tracking
  - Meter Aggregation

- Utility/RF System
  - Data Collection
  - Troubleshooting
  - Exception reports
  - Firmware updates

System Operations

- System Operations
  - DR
  - GIS
  - SCADA
  - OMS
  - Volt/VAR

Maintenance

- Maintenance
  - Work Order Management
  - Mobile Data/Dispatch
  - Preventative Maintenance
  - Performance Monitoring

Data Flow

Enterprise Service Bus

Network and Communications Layer

- LAN
  - Utility Enterprise Networks
  - Copper/Fiber/Wireless

- WAN
  - Satellite
  - Cellular
  - WiMAX
  - Fiber ft RF Networks

FAN/AMI/Backhaul

- RF Mesh
- Point-to-Point
- Point-to-Multipoint

- WiMAX
- PLC

HAN/Customer Portal

- Energy conservation
- Prepay Notifications
- Rate notifications
- Mobile Text Alerts

Utility Infrastructure Layer

- Generation
  - Market Interfaces
  - Plant Control Systems
  - Generators

- Transmission
  - 115 kV to 765 kV AC
  - Load Balancing
  - Failure Protection

- Substation
  - LTCs
  - Regulators
  - IEDs
  - Substation LANs

- Distribution
  - Field Devices
  - Transformers
  - Cap Banks
  - Fault Indicators

- Homes/Buildings
  - Water Gas Electric Meters
  - Thermostats Smart
  - Appliances Load
  - Control devices

Utility Infrastructure Layer

- Solar panels
- Micro windmills
- Energy Storage Devices
Integrating Business and Data Models

Business Model Integration

- Business Model
- Process Model
  - Process I
  - Process II
  - Process III
- Data Model
  - Data I
  - Data II
  - Data III
- Application Prototypes
- User View Panels
- Application Programs
- Requirements Document
- Physical Model
- Database Generation
- 1/0 Data Structures

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Using the information
Manage leak alert events

- Map views restriction non-Compliance
- Conservation reporting
- Pressure analysis
# High Water Usage Report

This report lists meters with a high level of water consumption. The 'high consumption' threshold can be specified, and the report can be filtered to show high consumption only during restricted times, i.e. to identify lawn watering restriction violations.

<table>
<thead>
<tr>
<th>Hourly Consumption Threshold</th>
<th>Location Classes</th>
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<tr>
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<td>CJ</td>
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</tbody>
</table>

**Hourly Consumption Threshold**

- **Location Classes**: CJ

## Date Range (yyyyMMdd)

- **From**: 20110214 13
- **To**: 20110228 13

## Watering not permitted between the hours of

- **12AM** and **12AM**

## Communication

- **On odd days for even houses and vice versa**
- **On the following days of the week**

## Date and Days for Water Restrictions

- **From**: 20110214 13
- **To**: 20110228 13
Data Mining

High Water Usage Report

This report lists meters with a high level of water consumption. The high consumption can be filtered to show high consumption only during restricted times, i.e., to identify times when water restrictions are in place.

Hourly Consumption Threshold
Location Classes
Date Range (yyyy-MM-dd)
Date Range (yyyy-MM-dd)
Meter Group

Times and Dates for Water Restrictions
Watering not permitted between the hours of 10:00 and 04:00. Off 10:00 and 04:00. Off 10:00 and 04:00.

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Daily Water Consumption
Aggregate meters if required
Correlate with weather

Hourly Water Consumption
Mark conservation program starts
How Does Your MDMS System Communicate to the Customer and What Can’t it Do?

- What do I owe, when do I owe it, how do I pay?
- Why has my bill changed? What else should I know?
- How has my bill changed from last year?
- What did my appliances cost to run?
- How can I control costs?
- How does my home compare to similar homes?
Data Mining

Customer Benefits

• Daily water consumption

• Correlate with weather

• Hourly water consumption
Decide Where the Data Should Go

**Meter & AMI System**

<table>
<thead>
<tr>
<th>Water Meter Data: (Leak)</th>
<th>MIU</th>
<th>Gateway</th>
<th>AMI SERVER (MDM)</th>
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<tbody>
<tr>
<td><strong>Department</strong></td>
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<tr>
<td>Billing/CIS</td>
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<td><strong>User Functions</strong></td>
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<td>Customer Call</td>
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<th>MIU</th>
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<th>AMI SERVER (MDM)</th>
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<tr>
<td><strong>Department</strong></td>
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<td>Operations</td>
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<tr>
<td><strong>User Functions</strong></td>
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<td>Systems Demand Profile</td>
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<td>Bill Generation</td>
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<tr>
<th>Water Meter Data: (Tamper Alert)</th>
<th>MIU</th>
<th>Gateway</th>
<th>AMI SERVER (MDM)</th>
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<td><strong>Department</strong></td>
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<td><strong>User Functions</strong></td>
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<td>Security team</td>
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<td>Customer Call</td>
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Cost vs. Benefits
Cost vs. Benefits

Executive Summary

Project Description
Needs Assessment
Capital Cost
Schedule
Cost vs. Benefits

Project Description (example)

Deploy a “smart metering” or Advanced Meter Infrastructure (AMI) system for all water and electric meters serviced by the CUSTOMER Public Utility Board. The system will provide daily (or hourly) accurate measurement of all water and electricity that will provide financial benefit to residential and commercial customers and modern tools for city personnel to improve services, lower costs and improve the efficiency of our water and electric infrastructure assess owner by the CUSTOMER Public Utility Board.
Cost vs. Benefits

Needs Assessment (example)

In our analysis and in comparisons to similar-sized cities, CUSTOMER ranks favorably in its utilization of its current systems and personnel to manage the utility operations. At the same time, there are substantial improvement opportunities associated with this AMI project that greatly impact the consumer and the utility. Our study uncovered significant and specific value propositions that support the new tools provided in an AMI project. Without the tools provided by AMI, most of these improvement measures are not achievable.
Cost vs. Benefits

Needs Assessment – Estimated Benefits (example)

- Monitor daily and accurately report product sales
- Reduce unaccounted for product
- Recover 2.5% of electricity losses (lower customer cost $3,5000,000 per year after three years)
- Accurately meter and bill for water consumed (increase $448K per year by 2nd year), plus revenue increase of $538K for associated sewer charges
- Recover $2.8M in lost water production
- Improve customer service and billing productivity by 30%
Cost vs. Benefits

Needs Assessment – Estimated Benefits (example)

- Estimated potential annual savings in excess of 10 Million per year after year three
- Empower customers to monitor and lower their utility bills
- Use ‘time of use’ data to negotiate lower electricity purchases

Additionally, a well designed AMI system will directly and indirectly facilitate attainment of many of the customer’s goals and objectives.
**Cost vs. Benefits**

**Capital Cost (example)**

While there are several acceptable options for technology selection and deployment methodologies with a range of costs, the recommended base case scenario assumes upon a complete meter change-out for water and electric meters using a design procedure, pilot and deploy approach to maximize the project benefits. It also assumes outside resources for installation labor. In this scenario, the budgetary project cost estimate for the entire project is between a 17-22 Million with a 10% contingency.
Cost vs. Benefits

Schedule

A 24 month schedule is proposed in the base case. The recommended schedule includes a three month design process to effectively review all project variables and develop procurement strategy and documentation, a four month procurement process to solicit, review, evaluate and award component and installation contracts, a four month pilot and deployment preparation program with a small group of meters, a 10 month full-scale deployment of new meters and AMI devices, and three months of post installation support, training, business process re-design and system turnover.
# Cost vs. Benefits

## Summary Matrix of Estimated Potential Savings

<table>
<thead>
<tr>
<th>Department No.</th>
<th>Department</th>
<th>ROI Number</th>
<th>2009 Costs or Savings Achieved</th>
<th>Proposed Solution</th>
<th>Year-1 Savings</th>
<th>Year-2 Savings</th>
<th>Year-3 Savings</th>
<th>Notes</th>
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<tr>
<td>1153</td>
<td>Electric Meter Read</td>
<td>R1</td>
<td>$41,313</td>
<td>AMI system, tamper detection</td>
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<td>2410</td>
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<td>$14,016,025</td>
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- **Potential savings calculated over three years from current state**
- **Organized by AMI-impacted Department**
- **Year 1 Savings = $1,478,017**
- **Year 2 Savings = $6,625,605**
- **Year 3 Savings = $10,640,025** (Level out and reoccurring Year 3 and beyond)
- **Total after Year 3 = $18,743,647**

*March 4, 2010*
While the city of Monroe's $6.8 million automated water meter project is roughly 91 percent complete, city officials say they've already seen a better reading of water consumption leading to increased revenue.

Director of Administration David Barnes said water consumption is up in the city of Monroe over last year, according to readings from the new meters. Consumption is up around 10 percent to 15 percent just on the residential meters. Consumption is about 150,000 gallons more a month, according to the new meter readings.

"That means our revenue is up 10 percent to 15 percent. Over the whole process, we anticipated it would be up around 10 percent, but it's a lot better than what we thought it would be," Barnes said. The additional revenue is around $1 million over last year because of the more accurate readings of water consumption.

"Before we put these new meters in, I'd say 70 percent of our meters were under-reading, and a lot of residents were getting a minimum bill," Barnes said. "We knew we were losing water and we knew we had problems, but we didn't know it was this big of a problem."
Thank You!

Any Questions?