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Tailored Collaboration

Planning and Implementing CIS and AMR/AMI Projects

PDF Report #4583

Subject Area: Management and Customer Relations




Planning and Implementing CIS and AMR/AMI Projects

About the Water Research Foundation

The Water Research Foundation (WRF) is a member-supported, international, 501(c)3 nonprofit organization that sponsors research that enables water utilities, public health agencies, and other professionals to provide safe and affordable drinking water to consumers.

WRF's mission is to advance the science of water to improve the quality of life. To achieve this mission, WRF sponsors studies on all aspects of drinking water, including resources, treatment, and distribution. Nearly 1,000 water utilities, consulting firms, and manufacturers in North America and abroad contribute subscription payments to support WRF's work. Additional funding comes from collaborative partnerships with other national and international organizations and the U.S. federal government, allowing for resources to be leveraged, expertise to be shared, and broad-based knowledge to be developed and disseminated.

From its headquarters in Denver, Colorado, WRF's staff directs and supports the efforts of more than 800 volunteers who serve on the board of trustees and various committees. These volunteers represent many facets of the water industry, and contribute their expertise to select and monitor research studies that benefit the entire drinking water community.

Research results are disseminated through a number of channels, including reports, the Website, Webcasts, workshops, and periodicals.

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Planning and Implementing CIS and AMR/AMI Projects

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FOREWORD

The Water Research Foundation (WRF) is a nonprofit corporation dedicated to the development and implementation of scientifically sound research designed to help drinking water utilities respond to regulatory requirements and address high-priority concerns. WRF's research agenda is developed through a process of consultation with WRF subscribers and other drinking water professionals. WRF's Board of Trustees and other professional volunteers help prioritize and select research projects for funding based upon current and future industry needs, applicability, and past work. WRF sponsors research projects through the Focus Area, Emerging Opportunities, and Tailored Collaboration programs, as well as various joint research efforts with organizations such as the U.S. Environmental Protection Agency and the U.S. Bureau of Reclamation.

This publication is a result of a research project fully funded or funded in part by WRF subscribers. WRF's subscription program provides a cost-effective and collaborative method for funding research in the public interest. The research investment that underpins this report will intrinsically increase in value as the findings are applied in communities throughout the world. WRF research projects are managed closely from their inception to the final report by the staff and a large cadre of volunteers who willingly contribute their time and expertise. WRF provides planning, management, and technical oversight and awards contracts to other institutions such as water utilities, universities, and engineering firms to conduct the research.

A broad spectrum of water supply issues is addressed by WRF's research agenda, including resources, treatment and operations, distribution and storage, water quality and analysis, toxicology, economics, and management. The ultimate purpose of the coordinated effort is to assist water suppliers to provide a reliable supply of safe and affordable drinking water to consumers. The true benefits of WRF's research are realized when the results are implemented at the utility level. WRF's staff and Board of Trustees are pleased to offer this publication as a contribution toward that end.

Charles M. Murray
Chair, Board of Directors
Water Research Foundation

Robert C. Renner, P.E.
Chief Executive Officer
Water Research Foundation

ACKNOWLEDGEMENTS

A project of this nature is heavily dependent on quality utility participation. The direct involvement by so many utilities contributed greatly to the relevance and usefulness of this research report.

The authors of this report give their gratitude and thanks to the utilities and their representatives and associates over the duration of this research project for their project commitment, high quality participation, and funding:

- Greater Cincinnati Water Works, Cincinnati, OH (Sponsor) – Gary Wiest, Paul Vonder Meulen, Verna Arnette and Cathy Bailey
- City of Baltimore, Baltimore, MD – Rudy Chow and staff
- City of Regina, Saskatchewan, Canada – Debbi McCaig-Paisig, Brent Knaus and Amir Agha
- City of Winnipeg, Manitoba, Canada – Wanda Burns
- El Paso Water Utilities, El Paso, TX – Mark Bolduc

Almost 100 utilities provided data via an electronic survey related to CIS and AMS projects. The survey took a substantial effort to complete – we value the industry commitment demonstrated by these utilities. In addition, four utilities agreed to be interviewed as case studies and provided additional perspective beyond the survey. We acknowledge and appreciate their input, the time they took to talk with us and their subsequent review of the case study write-up.

We thank Water Research Foundation Project Manager, Linda Reekie, and the Project Advisory Committee – Esteban Azagra, Arcadis, Phoenix, AZ; Andrew Levine, East Bay Municipal Utility District, Oakland, CA; Bob Day, San Jose Water Company, San Jose, CA; and Doug Groce, Charlotte Water Company, Charlotte, NC. Their commitment was inspiring and their input has been invaluable.

The EMA research team included Melanie Rettie, Principal Investigator; Lynne Powers, Co-Principal Investigator; Alan Williams, Claude Williams, Leslie Willett Black, Loren Walberg, Mark Germscheid, and Mark Malinak, Subject Matter Experts; Kayla Vogel, Tara Turch, and Stacie Valencia, Project Support.

It is our hope that this manual will provide insights and advice for water utilities as they strive to apply best practices when selecting, implementing, upgrading and managing an Automated Meter Reading (AMR), Advanced Meter Infrastructure (AMI), and/or Customer Information System (CIS) environment.

EXECUTIVE SUMMARY

This report addresses the selection, implementation and support of Customer Information Systems (CIS), Automatic Meter Reading (AMR) systems, and Advanced Meter Infrastructure (AMI) systems in the water sector. These systems are virtually the cash register for a water utility, ensuring that customers are appropriately billed, payments are collected, and accounts properly managed. This enables the utility to collect the necessary revenue to provide safe water and maintain their operations and infrastructure.

The supporting technologies (AMR, AMI, and CIS) are complex technologies that require significant preparation, planning, and experience to implement. The consequences of failure can be severe, with symptoms sometimes not being apparent until months after errors are made.

A CIS implementation or upgrade project has multiple phases over the course of the project. It is a large undertaking for any utility. Such a project directly impacts revenue and every customer. CISs have many interfaces, so replacement projects have many moving parts. Very often there are substantial issues with converting data from the old system to a new system. If that weren't enough, often the people who use the CIS or legacy billing system day-in and day-out have used the old system for ten or more years, making it very difficult for them to become as skilled with a new system that has different business rules and a completely different user interface. As a result, CIS implementation or major upgrade projects are complex and risky, with severe consequences of failure.

Advanced Metering Infrastructure (AMI) and Advanced Meter Reading (AMR) automate the process of reading meters. Instead of reading a meter once every month or every quarter, the AMI/AMR systems provide many more readings and additional metering data (such as time-stamped consumption, battery status, tamper detection, etc.). This reduces estimated reads, customer complaints, and other issues, and increases customer satisfaction. Sometimes these systems require replacing meters, which are sometimes located inside the customer's premises. New systems called Meter Data Management Systems (MDMS) are beginning to be deployed to manage the massive amounts of newly available metering data. In addition, customer outreach must be conducted; the new hardware, software, and telecommunications capabilities supported; and staff and customers must learn how to use all of this newly available data. These projects have lots of moving parts and directly touch the customers.

The water industry is still in the technology adoption phase for AMR and AMI. Utilities are seeking advice on how to most successfully prepare for and carry out CIS and/or AMR/AMI projects.

The purpose of this report is to:

- Update 10-year-old research related to selecting and implementing a water utility CIS, summarized in *Effective Practices to Select, Acquire, and Implement a Utility CIS* (WRF project #3007, Rettie et al. 2005) (the "2005 Report")
- Conduct new research about how utilities maintain and upgrade their CIS
- Conduct new research related to implementing or upgrading AMR or AMI systems and related benefits

This Tailored Collaboration project provides useful advice for any water utility desiring to select or implement an AMR system, AMI system, or CIS. It also provides useful information for

any water utility about to do a major CIS upgrade. The report provides advice regardless of where the utility is in the technology life cycle: selecting, implementing, maintaining, or upgrading the system.

PROJECT APPROACH

The project consisted of the following:

- Conducting secondary research (summarizing existing research)
- Conducting new research via a "State of the Industry" survey sent out to more than 600 water utilities in North America
- Carrying out two multi-day workshops (attended by the participating utilities and the Project Advisory Committee)
- Conducting five case studies. Four of the case studies are based on data provided by the utilities, supplemented by follow-up telephone calls. The utilities reviewed the final case study write-up. A fifth case study was developed based on publicly available documentation from the utility's website.

Relationship to the 2005 Report

Table ES.1 summarizes the relationship between the 2005 Report and the current report. While some parts of the 2005 Report have been updated and replaced, there are some other sections that are still very relevant to water utilities, which remain in the new document. Finally, new sections have been developed to address topics not included in the original report.

Table ES.1
Relationship of this report to 2005 Report

2005 Report	2016 Report
Water utility CIS project framework and other CIS background	This framework has been replaced by the Meter-to-Cash cycle and overview. Additional sections were developed related to CIS trends, CIS organizational considerations, and typical project phases.
State of the water industry relative to CIS and secondary research findings	This has been replaced by new findings. Material was added related to AMS, MDMS, and vendor management.
Water utility CIS benchmarking survey results	Not addressed. A different approach was used to select case study utilities.
Vendor input on water CIS practices	Not addressed; 2005 findings are still relevant.
Case study methodology and findings	The 2005 case studies are still highly relevant and provide valuable utility perspective. The current report contains five additional case studies, with four of them including AMI projects.
Conclusions and recommendations	Incorporated into updated report.

(continued)

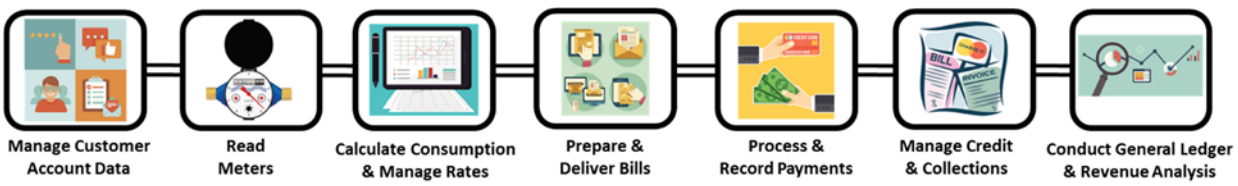
Table ES.1 (Continued)

2005 Report	2016 Report
Application to the industry and future research	Replaced.
Participant CIS challenges and recommendations	The 2005 Report section is still highly relevant and useful. These reflected the experience of the participating utilities.
	Added data related to AMS, MDMS, and vendor management.
CIS	Additional material: • Preparing for a CIS project • CIS project readiness assessment • Preparing for a CIS go-live • CIS challenges and potential remediation tactics • Warning signs of a CIS project in trouble • CIS checklist to enhance chances of success • CIS project health assessment
AMS	New material including • Secondary research findings for the water sector and the electric sector • Current and emerging trends • Organizational considerations • Typical project phases • Preparing for an AMS project • AMS challenges and potential remediation tactics • Warning signs of an AMS project in trouble • AMS checklist to enhance chances of success • AMS project health assessment

OVERVIEW OF METER-TO-CASH CYCLE, CIS, AND AMR/AMI

In aggregate, the processes of enrolling customers and maintaining appropriate account data, reading meters, billing customers, receiving payments, addressing collections issues, providing refunds, and applying the payments to the proper accounting ledger are known as the "Meter-to-Cash" cycle.

An explanation of the Meter-to-Cash cycle from both a business process point of view and a technology point-of-view is provided, also depicted below in Figure ES.1.



Source: EMA, Inc. 2016. All rights reserved

Figure ES.1 Overall Meter-to-Cash cycle

The key technologies that support the Meter-to-Cash cycle that are the focus of this Tailored Collaboration project are a CIS and AMR/AMI. Overviews of these technologies are provided. For the purposes of this report we have used the generic term Advanced Metering System (AMS) to refer to either AMR or AMI.

OVERALL FINDINGS

The findings of this Tailored Collaboration project greatly supported the findings of the 2005 Report. Although there has been substantial development and change in terms of the specific technologies and the vendor market, the core best practices to select and implement a CIS have not changed. The findings from that project continue to be highly relevant (including the project participant recommendations, case study findings, and other recommendations throughout the report). What also has not changed is that, at least anecdotally, many utilities continue to struggle with implementing those best practices.

Rather than contradicting the previous findings, our research supported and extended the findings. Some new findings are as follows:

1. Preparation for CIS or AMS project is vital. This involves not only planning for the project itself, but first conducting an analysis regarding the readiness of the utility to carry out the project. This should include looking at all aspects of the project (e.g., workforce, data, business processes, physical environment, and rules and regulations). Sometimes the extent of preparation required is sufficient to warrant one or more separate projects to increase the utility's readiness before starting the actual CIS or AMS project. Only after effective preparation should the utility undertake the implementation project
2. There are many similarities between the best practices for carrying out an AMR, AMI, and a CIS project
3. Particularly for AMI, there are project benefits that can be achieved that go beyond the Meter-to-Cash cycle. Limiting the business case (if conducted) to only meter-reading substantially reduces the possible benefits

STATE OF THE INDUSTRY REGARDING CIS AND AMS

As a part of this project, a survey of North American water utilities was conducted. The objective of the survey was to learn from utilities' experiences with their CIS and AMS in order to provide advice to other utilities. A related goal was to understand if the CIS findings from the previous 2005 survey were still relevant today.

The survey included several parts:

- Overall utility information (e.g., governance, services offered, etc.)
- Information about their customer service and their CIS experiences. This included asking questions about how the utility has maintained their CIS, and satisfaction with the CIS.
- Information about their meter reading environment, and about their AMR and AMI implementation experiences

Each section was independent in order to enable ease of survey completion. The survey was distributed to 623 utilities using an electronic survey. Ninety-nine (99) utilities responded to the customer service/CIS survey and 85 utilities responded to the metering sections. In aggregate, the respondents produce over 125,000,000 bills and over 1,193,000,000 meter readings annually. Figure ES.2 shows the size of the responding utilities by number of accounts served.

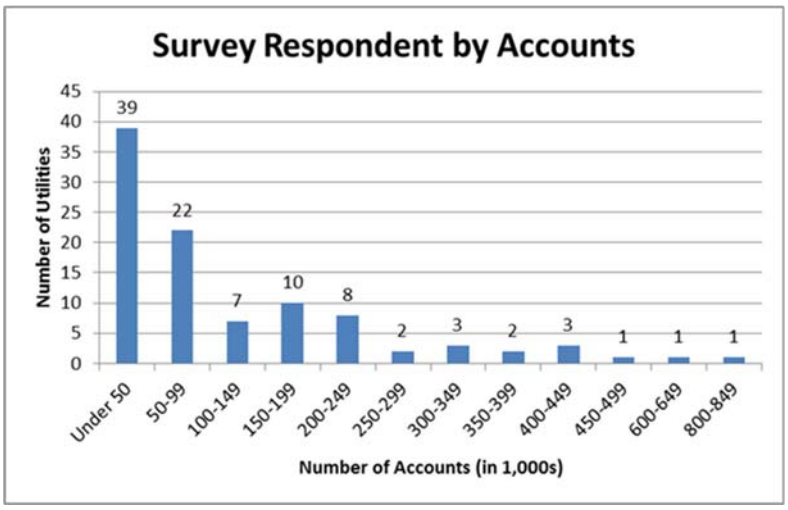


Figure ES.2 Survey respondent by number of accounts

General CIS themes from the survey include the following:

1. There appears to be a trend toward moving to monthly billing.
2. The number of new CIS implementation projects seems to be consistent. Over time, every year about 5 percent of responding utilities move to a new CIS product.
3. There may be a mild trend toward more successful projects, but in general, the findings are similar to the findings from 2005. Most projects are still "tough but ok," and approximately the same number of the projects are complete failures (nearly cancelled, cancelled, or resulted in litigation), from 11% in 2005 to 8% in 2015.
4. Factors contributing to successful CIS projects were strikingly similar to those in 2005 (the project had the right expertise and experience on the implementation team; CIS project business goals were developed and compared for results at the end of the project; vendor proposals addressed the utility's needs; all or nearly all business requirements were met by the commercial-off-the-shelf (COTS) products; and there was an effective and positive internal project team).
5. There is a trend toward COTS products (i.e., products purchased from vendors), and away from CISs developed specifically for one utility (custom CISs).
6. There is a substantial trend toward more interfaces between the CIS and other systems.
7. Utilities have a wide range of custom modifications to COTS products. Eighteen (18) percent of utilities have three or fewer modifications; 14% have between 4 and 9 modifications, and 51% have 10 or more modifications. There does not appear to be a correlation between the number of modifications and the success of the CIS project.
8. Utilities are increasing customer self-service offerings.

9. Forty-four (44) percent of utilities responding already provide near real-time updates to field staff. Another 31% of respondents plan to deploy this capability within the next two years.
10. Utilities are moving toward outsourcing selected parts of the Meter-to-Cash cycle. More than 60% of utilities currently outsource bill printing, and another 20% are planning to outsource it. About one-third of utilities outsource payments and collections activities. An additional 12% of utilities responding said they were interested in outsourcing payments, and 9% of respondents indicated interest in outsourcing collections to an outside collections agency.
11. Utilities are engaged in some type of social media. Sixty-four percent of respondents already have a Facebook presence and 47% are engaged on Twitter.

General AMS themes from the survey are as follows:

1. In general, the respondents are quite satisfied with both AMR and AMI projects.
2. While more AMR projects have been implemented, there appears to be a shift toward AMI technologies.
3. There has been a decline in AMS implementations. However, many water utilities are now either piloting or planning to implement an AMI in the next two years.
4. The level of public outreach carried out by utilities tends to be substantially greater for AMI projects than AMR projects.
5. When utilities do an AMI project, they usually also do an MDMS project. It appears a number of utilities are doing MDMS projects in preparation for an AMS project. Of the 32 utilities with an MDMS, 18 of them indicated that they read manually today. Those utilities are all either in the process of implementing an AMS, or plan to within two years.
6. Implementing an AMS project often results in shifting staff to different positions, and in new staff roles or responsibilities.
7. While 60% of utilities did carry out a business case for their AMS project, a large number (40%) did not.
8. AMS's are often integrated with the utility's Geographic Information System (GIS) (49%). Forty-four (44) percent of utilities have integrated their AMS with their Computer Maintenance Management System (CMMS).
9. Typically, the utility staff (whether Information Technology [IT] or Operations & Maintenance [O&M]) are responsible for maintaining the AMS data communications network.
10. Utilities are starting to set goals beyond reliable meter readings for AMS projects. AMI projects in particular have goals related to non-revenue water analysis.
11. Utilities are starting to use more advanced features of an AMS (both AMR and AMI).

VENDOR MANAGEMENT

A CIS or AMS is a significant investment, so productive relationships with vendors are important. It is in the utility's interest to have an effective, long-term, mutually agreeable relationship with the vendor. The heart of such a relationship revolves around contracts, service levels, and communications.

Chapter 6 provides best practices from the Information Technology Infrastructure Library (ITIL), a globally recognized collection of best practices for managing Information Technology (IT). An area of particular interest from a CIS and AMS point of view involves what is called Supplier Management. In ITIL language, a supplier is a vendor. Supplier Management is part of the Service Design process which integrates into the Service Lifecycle. Best practices from three key areas of those relationships are addressed (modified from ITIL objectives): new contracts and renewals, contract reviews, and vendor reviews during the total lifecycle of the product. Typical utility challenges working with vendors are provided. Applying the best practices from ITIL provides one way to start addressing these challenges. This chapter also contains a summary of the State of the Industry survey regarding CIS maintenance practices. Highlights are as follows:

- Most survey respondents (83%) have an ongoing maintenance and support contract with their CIS vendor.
- Nearly 20% of those with ongoing contracts are fairly unsatisfied or very unsatisfied with their vendors.
- Of the utilities with no ongoing contract, 35% feel their vendor is usually very responsive.
- Most utilities regularly patch or upgrade their CIS (about two-thirds of utilities).

CASE STUDIES

Case studies from a total of five water utilities are provided. Each case study includes that utility's experience with either an AMS implementation or a CIS implementation; in some cases, both AMS and CIS are addressed. Case studies were selected based on the desire to illustrate large and small utilities and different governance structures, a desire on the part of the utility to share their story, and lessons learned that would be of interest to others. The utilities are:

- Albuquerque Bernalillo County Water Utility Authority, NM (ABCWUA) (AMI and CIS)
- City of Baltimore, MD (AMI/R and CIS)
- City of Bismarck, ND (AMI and CIS)
- Los Angeles Department of Water and Power, CA (LADWP) (CIS)
- New York City Department of Environmental Protection NY (NYC DEP) (AMI)

SUPPLEMENTAL MATERIALS

The following Appendices are posted on the WRF website, on the #4583 project page under "Project Papers:"

- Appendix B: Survey Questions
- Appendix C: Sample Job Description
- Appendix D: Bismarck, North Dakota Case Study Supplemental Information
- Appendix E: Related Reports

RESEARCH PARTNERS

- Greater Cincinnati Water Works
- Baltimore City Department of Public Works
- City of Regina
- City of Winnipeg
- El Paso Water Utilities

CHAPTER 1
INTRODUCTION AND PROJECT APPROACH

This chapter provides background information about CIS and AMS projects. It also lists the research objectives, presents the project approach, describes how utilities were involved in the project, and describes the contents of this report.

BACKGROUND

Selecting and implementing a new CIS and AMS is complex and risky. The "Meter-to-Cash" process is a vital business process for water utilities. It includes managing customer data, getting meter reads, billing customers, handling payments and customer calls, managing the delinquency cycle, and applying payments to the proper accounts. Some technologies are critical to accomplishing this work, in particular, CIS and the meter reading technology/process.

A CIS implementation or upgrade project has multiple phases over the course of the entire project and is a large undertaking for any utility. As a result, CIS implementation or major upgrade projects are complex and risky, with severe consequences of failure. Implementations often take substantially longer than intended and cost substantially more than budgeted. Post-implementation issues such as longer phone waits and inaccurate bills are routinely experienced. In addition to a negative impact on customer billing and potentially revenues, CIS projects can become publically visible and highly political. CISs have many interfaces (sometimes 30 or more), so replacement projects can be extremely complex. Very often there are substantial issues with converting data from the old system to a new system. Additionally, a CIS implementation or upgrade will require a major change in business processes and operations, requiring focused change management efforts throughout the project. As a result, many utility managers approach major CIS projects with trepidation.

All utilities have some version of a meter reading system. AMR and AMI technologies (generically referred to as AMS in this report), continue to mature. These technologies also directly touch every customer. As an example, when the meter must be replaced, these projects can require going inside the customers' premises. Depending on the specific changes, the meter replacement can even require substantial plumbing changes to support the new meter. If the old meter was under-registering the amount of water passing through the meter the customer's bill may be higher as a result of more accurate readings. AMS systems sometimes enable new capabilities such as improved leak detection and providing customers direct access to their accounts. As a result, AMS implementation and upgrade projects can become very high profile and politically sensitive.

Many utilities have put in their first or second generation AMS. These systems fail over time due to battery life, mechanical slowing of the meters, or meter failure. Many utilities struggle with the question of what to do as their current system ages. The cost to maintain existing technologies can increase over time and accessing vendor support can become increasingly challenging as technologies age. Meters directly affect every customer the utility serves. This means that any change can be very sensitive to both the customers and the governing body of the utility.

Even when utilities have systems that are working well, they often question the cost of maintaining the systems and struggle with managing vendors to get the support they desire in the

timeframe they desire. A major upgrade project requires extensive resources, often similar to the initial implementation.

As a result, many utilities delay upgrade or replacement decisions, doing nothing in the hope that a "silver bullet" solution will emerge. Others are moving to replace their metering system or CIS, but are searching for additional information to support the success of the project. Meanwhile, the pressure to address increasing customer needs and add value to business operations increases.

In 2005, the Water Research Foundation published a report on how water utilities could maximize their chances of success when selecting and implementing a CIS (Rettie et al. 2005). The 2005 Report focused on identifying effective business practices that increase a utility's chances of success throughout the entire replacement process, from start to finish. The findings from that study provided information about how to successfully select and implement a CIS, as well as areas to watch out for in order to avoid failures.

PROJECT OBJECTIVES

The goal of the current project "Planning and Implementing CIS and AMR/AMI Projects" is to provide advice to utility managers, building from the base created by the 2005 Report and expanding the analysis to include AMS projects. The research objectives were to:

- Update 10-year-old research related to selecting and implementing a water utility CIS
- Conduct new research regarding maintaining and upgrading a CIS
- Conduct new research related to implementing or upgrading AMR or AMI systems and the total organizational benefits of an implementation or major upgrade
- Explore other important or emerging focus areas in the Meter-to-Cash cycle as desired by participating utilities and supported by the project budget

PROJECT APPROACH

The project had two phases: Phase I – Mobilize and Collect Research, and Phase II – Analyze and Document Findings. The phases and steps are shown in Figure 1.1.

Phase I involved mobilizing the project. The researcher solicited and received commitments of involvement and support from several participating utilities. A webcast was held to communicate with project participants and to give a brief synopsis of the project and its goals. Multiple sources were used in order to conduct secondary research such as general web searches, previously published reports, conference presentations, general water industry sources, and related industries (gas and electric). Also during this step, a draft industry survey was reviewed by the participating utilities and PAC members and then sent out to utilities across the United States and Canada.

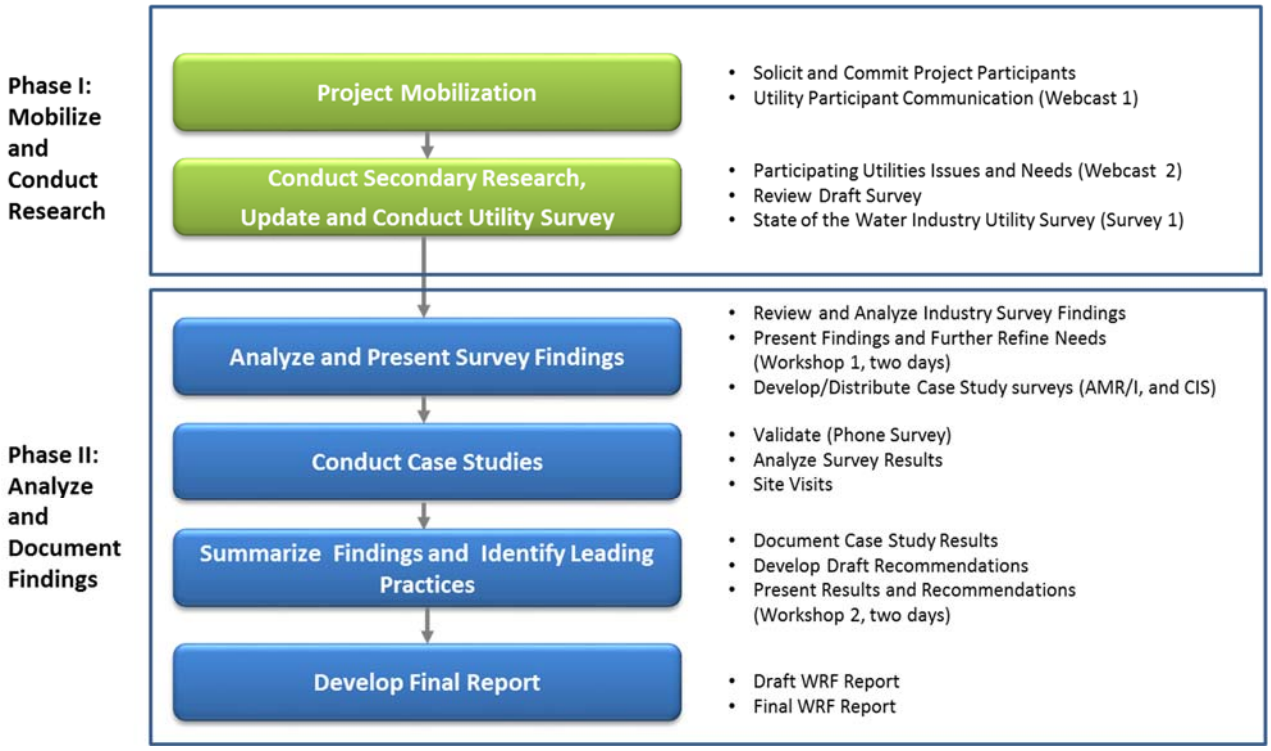


Figure 1.1 Research project phases

Phase II involved analyzing the data and developing recommendations. This included reviewing survey responses and presenting initial findings to the participating utilities and some PAC members at a workshop in Baltimore, Maryland. Case studies were also conducted. The case studies were selected from utilities who responded to the survey and were willing to provide more detail about their projects, and whose experience added value to the study overall. The case studies were presented at a second workshop, in Cincinnati, Ohio. During this workshop, the participants felt it would be valuable to expand the final report to include typical project phases, advice on preparing for a CIS or AMS project or a CIS go-live, CIS and AMS challenges and potential remediation tactics, warning signs of a project in trouble, and a checklist to enhance the chances of success. Those items were incorporated into this report. The remaining two steps in Phase II involved summarizing the findings, identifying leading practices and developing the final report.

INDUSTRY INVOLVEMENT

The project had extensive utility participation and was sponsored by Greater Cincinnati Water Works. Additional participating utilities were the City of Baltimore (MD), the City of Regina (Saskatchewan, Canada), the City of Winnipeg (Manitoba, Canada), and El Paso Water Utilities (TX). Four organizations served on the PAC: Arcadis, Charlotte Water, East Bay Municipal Utility District, and San Jose Water Company. The participating utilities and the PAC were very active in providing input and feedback to the research team in order to help shape and refine the project. They tested the survey and provided invaluable feedback that led to collecting more useful and valuable data. The two workshops were highly participative and provided a venue for the participating utilities and PAC members to share their experiences and perspectives, as well

as offer suggestions and recommendations to the research team. An added benefit to participants was the strong networking/collaborative environment that was created during this project.

The survey was distributed to 623 water utilities all across the United States and Canada. Ninety-nine (99) utilities responded to the CIS section, and 85 utilities responded to the metering section. The responses were analyzed and compared to the findings in the 2005 Report.

Case studies from five utilities were included:

- Albuquerque Bernalillo County Water Utility Authority (ABCWUA) (AMI and CIS)
- City of Baltimore (AMI/R and CIS)
- City of Bismarck (AMI and CIS)
- Los Angeles Department of Water and Power (LADWP) (CIS)
- New York City Department of Environmental Protection (NYC DEP) (AMI)

REPORT PROVIDES CONSOLIDATED RECOMMENDATIONS AND ADVICE TO UTILITIES

This report consolidates the key project findings. It includes a summary of themes from the secondary research, experience and perspective from those attending the workshops, survey results that summarize appropriate "state of the industry" comparisons to the 2005 findings, and learnings from the case studies.

While there is some comparison to the 2005 findings, as the project evolved the participating utilities felt it was more valuable to focus on recommendations and guidance to utilities than on changes between 2005 and 2015. Consequently, there is some comparison between the two surveys, but more effort was put into providing advice than on comparing the survey data. The advice and suggestions in this report are based on the secondary research, survey data, and the extensive experience of the utilities involved in the project, the research team, and the case studies.

Report Overview

Chapter 2 provides an overview the Meter-to-Cash cycle and related technologies. This chapter also includes the key drivers for utilities to make a major change in either of these systems, a general description of a CIS, a general description of AMS's, and an overview of organizational considerations related to both a CIS project and an AMS project. It creates a foundation for the remaining chapters.

Chapter 3 focuses more deeply on CIS. A summary of the secondary research is provided, as well as current and emerging CIS trends. Because a CIS project requires substantial organizational resources and because the human element is so critical to a successful project, there is also a section on the organization considerations specific to a CIS project. Other sections in this chapter are:

- Typical CIS project phases
- Preparing for a CIS project
- Preparing for a CIS go-live (an entire process in and of itself)
- CIS challenges and potential remediation tactics
- CIS warning signs of a project in trouble
- CIS checklist to enhance chance of success

- CIS project health assessment

Chapter 4 focuses more deeply on AMS projects. A summary of the secondary research related to the water sector is provided, as well a summary of experiences in the electric sector. It also provides a summary of current and emerging trends based on the literature review. Other sections in this chapter are:

- Organization considerations for an AMS project
- Typical AMS project phases
- Preparing for an AMS project
- AMS challenges and potential remediation tactics
- AMS warning signs of an AMS project in trouble
- AMS checklist to enhance chases of success
- AMS project health assessment

Chapter 5 provides a summary of the State of the Industry survey findings. A detailed survey was sent to approximately 600 utilities. The survey included several parts:

- Overall utility information (for example, governance, services offered, etc.)
- Information about their CIS selection and implementation experiences
- Information about their AMS selection and implementation experiences (including AMR, AMI, and MDMS)
- Information about managing their CIS vendors

The summary describes overall themes and survey results.

Chapter 6 provides best practices related to vendor management as summarized by the Information Technology Infrastructure Library (ITIL), a globally recognized collection of best practices for managing Information Technology (IT). An area of particular interest from a CIS and AMS point of view involves what is called Supplier Management. In ITIL language, a supplier is a vendor. Supplier Management is part of the Service Design process which integrates into the Service Lifecycle. Best practices from three key areas of those relationships are addressed: (modified from ITIL objectives) new contracts and renewals, contract reviews, and vendor reviews during the total lifecycle of the product. Applying the best practices from ITIL provides one way to start addressing these challenges.

Chapter 7 presents case studies from a total of five water utilities. Each case study includes that utility's experience with either an AMS implementation or a CIS implementation; in some cases, both AMS and CIS are addressed. Case studies were selected based on the desire of the utility to share their story, a wish to illustrate a variety of large and small utilities and governance structures, and some lessons learned that would be of interest to others.

CHAPTER 2
OVERVIEW OF METER-TO-CASH CYCLE, CIS, AND AMS

This chapter provides an overview of the Meter-to-Cash cycle from a business process and technology perspective, as well as drivers for utilities to change a CIS or AMS. It also includes an overview of a CIS and an AMS. Lastly, it provides a brief discussion of overall organization considerations for CIS and AMS projects.

OVERVIEW OF METER-TO-CASH CYCLE

The Meter-to-Cash cycle is greatly impacted by a CIS or an AMS. In order to understand this impact, a general understanding of the Meter-to-Cash cycle is required. This section provides an overview of the Meter-to-Cash cycle.

The cycle begins with initiating service to customers and installing a water meter; it ends with recording revenue for the service(s) provided. This cycle repeats on a regular basis as water is consumed, customers are notified and billed, payments are received, and ledger accounts are updated. There are many details, related policies, and systems that help ensure the business processes are properly carried out. There are also a number of variations due to state laws, local conditions, and governing bodies policies. A general cycle is shown in Figure 2.1.

An overview of each of these major business processes is provided briefly below.

Manage Customer Account Data

Each new account should have complete and accurate records. This includes all steps from identifying the correct premises at which the meter is installed, to capturing the correct meter (and meter interface unit) serial number when the meter is installed, to verifying the customer's identification and contact information. For some utilities, this step also includes credit analysis, deposit collection, dispatching, and the process to turn on or off the water service at the premises.

Read Meters

Most utilities bill customers based on the amount of water that has passed through the water meter. Wastewater charges are also typically based on water consumption. The collection of the water meter readings can be accomplished in many ways, but having an accurate reading is always vital to accurately billing the customer. After readings are collected, they are sent to the CIS for validation and processing. In most cases there is a process to identify readings that indicate higher or lower consumption than expected. Readings that are higher or lower than a set threshold should be read a second time to verify accuracy. The method of determining the high/low threshold varies by utility.

Calculate Consumption and Manage Rates

Once there is confidence that the meter readings are correct, the consumption for each account is used to create a bill based on the approved rates. Utilities can have multiple rates and varying rate structures used for calculating the amount owed to the utility. The Environmental

Finance Center (EFC) of the University of North Carolina (UNC), whose mission is to "enhance the ability of governments and other organizations to provide environmental programs and services in fair, effective, and financially sustainable ways," provides resources related to the impacts of different rate structures.

Prepare and Deliver Bills

In addition to water consumption, the bill typically includes a variety of other items such as fees, taxes, personalized messages, and a consumption graph. The bill may also include other services (wastewater, stormwater, solid waste, etc.). Once prepared, the bill is printed and mailed or sent electronically to the person responsible for paying the bill. A clear bill can prevent calls from customers. With the development of online bills, as well as printers that are capable of more advanced graphics for hard copies, bill design and delivery has become a specialized topic with its own set of leading practices.

Process and Record Payments

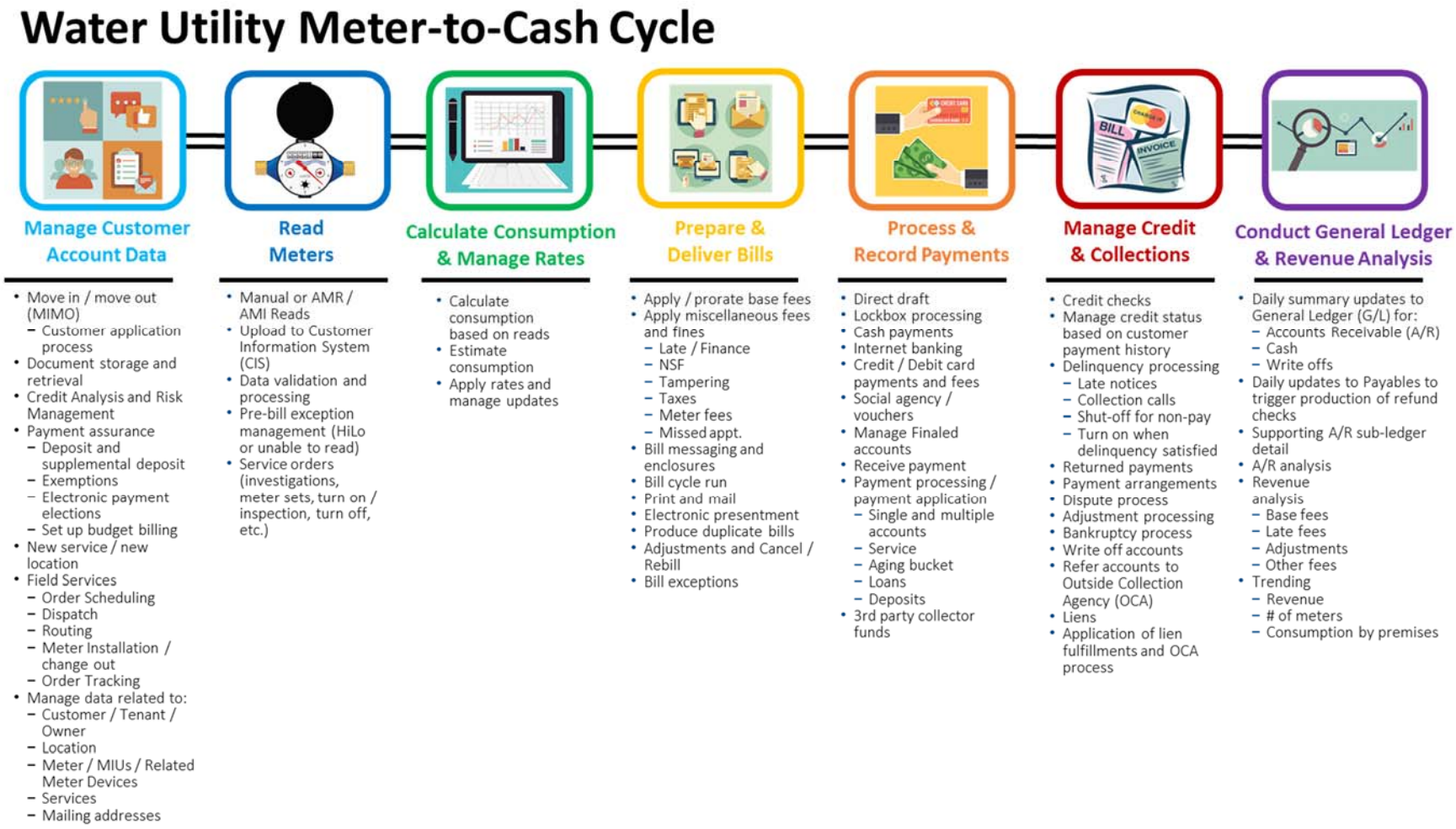
Payments are processed so that credit is applied to the correct account. Payments may be made in person or through other channels (direct draft, Internet banking, credit/debit card, smart phone, check, or a lock box). Sometimes payments are made via a third party such as a social agency. Other payments that may be processed through the CIS include loans, deposits, and payment of miscellaneous bills.

Manage Credit and Collections

When customers don't pay their bill in a timely fashion, a collections process must be initiated and implemented. Typically, this involves sending reminder notices, reminder phone calls, and ultimately, disconnecting the water service. Often, in order to assist customers, payment arrangements are made. The collections process also includes the bankruptcy process, account write offs, outside collection agencies, and, sometimes, liens on the tax bill or on the property itself.

Conduct General Ledger and Revenue Analysis

The final step is posting the money received to the proper general ledger account (e.g., water, wastewater, stormwater, or solid waste). Sometimes one payment is split across two or more accounts; the utility will have rules about how the payments are allocated, and in what order they are applied to the accounts. Regardless, the payments must be posted to the proper general ledger account in the financial system. If refunds or payments (such as returning a deposit) are required, the appropriate general ledger account is debited and the appropriate customer account is updated in the CIS.



Source: EMA, Inc. 2016. All rights reserved.

Figure 2.1 Water utility Meter-to-Cash cycle business process overview

MAJOR TECHNOLOGIES SUPPORTING THE METER-TO-CASH CYCLE

Most processes that are part of the Meter-to-Cash cycle rely heavily on technologies to make the process more efficient. The larger a utility is, the more benefit the utility receives from automating parts of the Meter-to-Cash cycle. Because some of these processes can be almost completely automated, they are outsourcing candidates (for example, prepare and deliver bills).

Many technologies can be integrated to provide additional automation to processes within the Meter-to-Cash cycle. Figure 2.2 provides a listing of the key technologies that may be used in each step of the Meter-to-Cash cycle.

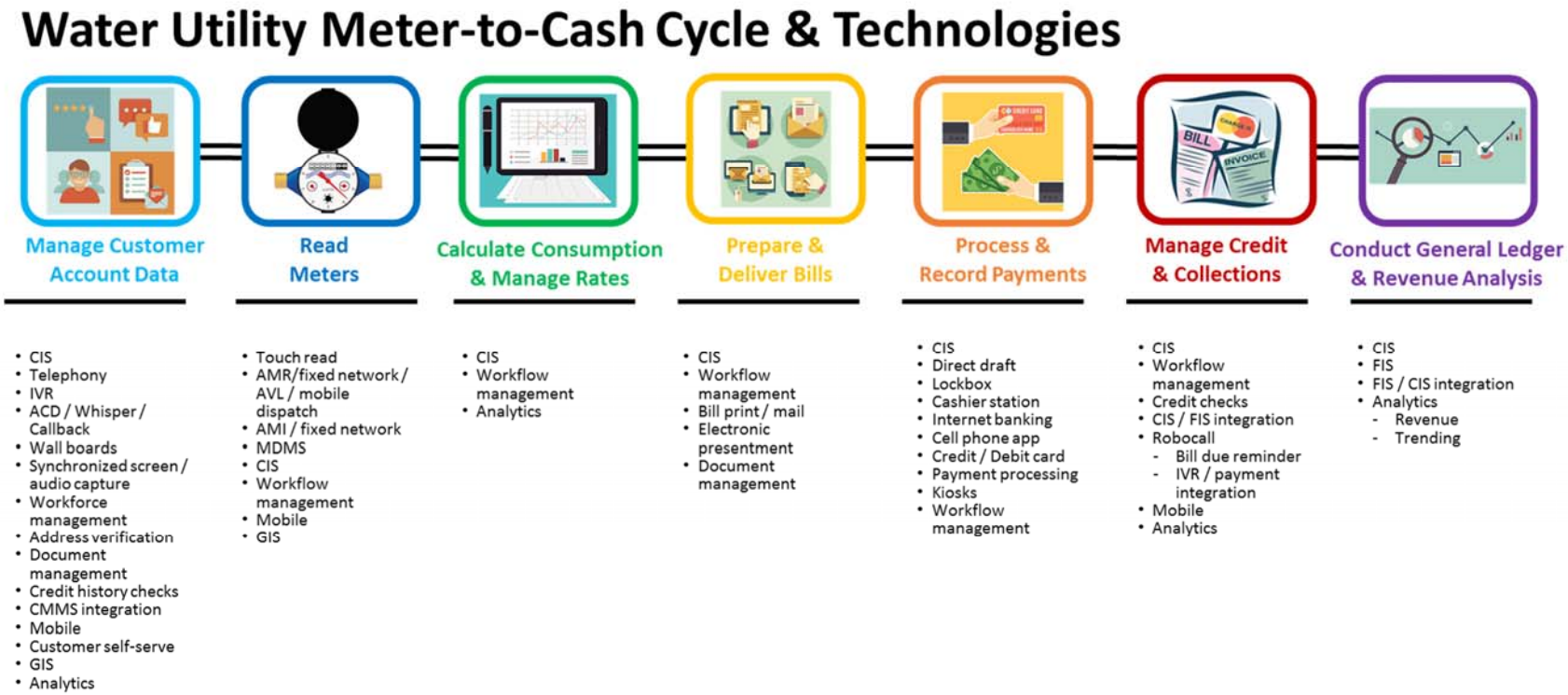


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Figure 2.2 Water utility Meter-to-Cash cycle technologies

AMS AND CIS DRIVERS FOR CHANGE

AMS projects can cost millions of dollars and often have a high public profile. CIS projects are risky projects due to the complex challenges caused by many interfaces, issues related to "dirty data" in the legacy billing system, interdependent business processes across the Meter-to-Cash cycle, and, often, poor utility understanding of current business processes. Both the AMS and CIS directly impact customers. Combined, the two systems are the utility's cash register. If either system fails, there is an immediate and highly visible negative impact.

As a result, utilities require compelling reasons to take on AMS or CIS implementations or major upgrades. Such reasons include:

1. Obsolete hardware, causing system instability, an inability to acquire hardware replacements, or excessive maintenance costs
2. Loss of ability to support the system due to retirements leading to loss of knowledge about the underlying software, or due to changing vendor strategies
3. Desire for performance improvement including improved response time, ability to support work regardless of location, and improved customer perceptions regarding utility responsiveness
4. Demand for additional customer service capabilities including additional payment channels, ability to select payment due dates, ability to pre-schedule turn-ons/turn-offs, ability to commit to service appointments, etc.
5. Addressing conservation issues and the need for near real-time data including items such as water consumption, payment status, customer visits, and other operational status
6. Providing economic benefit by more effectively collecting on delinquent accounts, or more accurately registering consumption
7. Providing support for analytics including consumption and location mapping and key performance indicators

CIS OVERVIEW

General Description

A CIS is the software application that provides an integrated environment with which utilities enroll new customers, generate billings, manage credit and collections, track water consumption, track and manage meters, handle customer inquiries, complaints, and service orders, and provide call center support. A CIS must support multiple billing structures, rates, frequencies and entities. Utilities often integrate their CIS with other enterprise systems such as Geographic Information Systems (GIS), Work Management Systems (WMS) and enterprise decision-support systems.

A CIS is at the heart of the Meter-to-Cash cycle. Many different operational areas of the utility will use the CIS on a daily basis. The meter reading and field service staff also rely heavily on this system, although they may not directly interact with it. Utilities may offer some level of self-service to customers through a managed interface.

The world of CIS products has evolved from in-house developed utility billing systems that were focused specifically on calculating bills and handling associated payments. Often these systems are referred to as legacy systems. Today, many utilities use products provided by a vendor,

often called commercial off-the-shelf (COTS) products. There are dozens of vendors providing these products, ranging from fairly small local vendors to large multi-national companies. Most CIS vendor products provide services for multiple industries (for example, electric, gas, and water).

Typical CIS Functionality

The level of CIS functionality varies, with some vendors providing multiple modules or additional functionality. At a minimum, typical CIS functionality for water services includes:

1. Customer account management (for example, enrolling new customers, handling move-in/move-outs, and maintaining contact information)
2. Revenue management (for example, managing rates, calculating bills based on consumption, creating and delivering bills, taking payments across multiple payment channels [cash, check, money order, lock box, Automated Clearing House (ACH), credit/debit, etc.], and managing delinquent accounts)
3. Related infrastructure management (for example, handling meter inventory including AMR and AMI devices, service/premises location data, and service orders related to field customer service)
4. Interfacing with one or more banks
5. Interfacing with a metering system

Optional CIS Functionality

Additional CIS functionality can include support for:

1. Additional services including wastewater, stormwater, gas, electric, and solid waste
2. Miscellaneous billing (one time or repetitive bills for items such as lab tests, testing and chlorination, property damage, boat slip rentals, etc.)
3. Managing backflow/cross-connection programs
4. Budget or levelized billing
5. More complex rate structures
6. Customer self-service (ranging from simply viewing account/payment status to starting services, entering a service order, or initiating a payment plan)

CIS Interfaces

A CIS typically is interfaced or integrated with several other systems. It is not unusual for a CIS to be connected to 20 or more other systems, and many more in larger utilities. The interfaces or integration can be near real-time or less often (e.g., daily or weekly), and uni-directional or bi-directional. There are a number of methods and technology approaches by which the integration can be accomplished. Each integration can impact a different set of users.

Examples of interfaces or integrations with other systems include phone systems, GIS, payment processors, field mobile solutions, property/tax appraisal systems, permitting systems, 311/Customer Relationship Management (CRM) systems, document management, and Computerized Maintenance Management Systems (CMMSs). The level of integration can be

limited or extensive. As a result, replacing or upgrading these systems requires an understanding of the impact of the change on the other systems. This understanding must include both the technologies involved, as well as how the systems are used.

Other Considerations Related to a CIS

In addition to the CISs ability to address business needs and functional capabilities, there are several other aspects to consider.

A key consideration is whether additional or different functionality is enabled by configuring the software or by programming additional capabilities (modifying the software). To modify with custom code or to use the product out of the box is a key consideration and something that the organization should address. In situations where the software is modified, an important factor is how the vendor will address the modification in future software releases (e.g., will it become part of the base code, or will it need to be an add-on that must addressed for every upgrade?). This is important because it has an impact on the complexity of implementing future product upgrades from the vendor and will impact the level of support required from IT and the business area.

For some utilities an important consideration is whether the CIS provides a premises-centric view (data stays with the premises), a customer/account centric view (data moves with the customer regardless of the premises/service location), or a combination of these.

The utility should consider developing a long-term strategy for the CIS and how it relates to other major products used by the utility. Some CIS products are a component of a vendor's suite of offerings. For example, the vendor may offer modules including core finance capabilities (accounts receivables, accounts payables, general ledger, treasury, etc.) as well as modules for human resources, permitting, and other typical public sector oriented modules, and utility billing. These are often referred to ERP (Enterprise Resource Planning) packages. Other CIS products focus particularly on CIS functionality. These are often referred to as "Best of Breed" products because they tend to offer more in-depth functionality in their selected area (CIS). Selecting an ERP or a Best of Breed strategy is a strategic decision for the utility and is an important decision.

A related consideration is that of maintenance. Vendors regularly release "patches" which enable specific new functionality or fix programming issues. These may be issued on a monthly or quarterly basis and are usually optional releases. Additionally, there are major upgrade releases, generally occurring every few years. A part of the CIS strategy must address how these maintenance releases will be handled and what level of access the utility desires to provide to the CIS vendor's staff.

CIS Trends

As with all software, the capabilities of CISs continue to evolve. Noticeable trends today include:

1. Offering near real-time integration with other packages
2. Including an advanced analytics platform to provide better insights that enable improved operations management, as well as to support analytics related to items such as customer segmentation, consumption patterns, payment patterns, and location-based analyses
3. Using data generated by AMS applications

4. Providing support for multi-channel customer interfaces. This includes contact channels such as in-person, voice, on-line, chat, and phone interfaces. It also includes multiple billing and payment channels
5. Incorporating other contact center technologies such as Computer Telephony Integration (CTI), Interactive Voice Response (IVR), speech recognition, integrated call/screen recording, and workforce management software, particularly for larger utilities. These products enable larger contact centers to provide increased self-service opportunities to customers, in addition to better developing and managing contact center staff
6. Providing more flexible user interfaces. More vendors are offering the capability for end users to configure the software to reflect the user's typical needs. They may offer templates based on typical roles such as a biller or a contact center agent
7. Issues related to the System of Record and which integrating technologies to use. As vendor's products become more powerful and include more functionality, the line between what data is in what system is becoming less clear. As an example, metering data is used by a MDMS, a CIS, and a CMMS. Each one of these systems will have their own definition of a "meter." Those definitions must be synchronized with the other systems, including which system is the authoritative source of "correctness." Additionally, in larger utilities it is likely that several systems that have been implemented will offer their own reporting environment, as well as workflow and business intelligence solutions to provide analytics. It is important to have clarity on how the various systems will be integrated, what data is reported by what system, and which integrating technologies will be used

AMS OVERVIEW

General Description

More and more utilities are moving from manual meter reading to automated methods of reading meters. This is because:

- The cost to physically send a person to each and every meter location to collect the reading can be expensive and inefficient, and has the potential for human error
- Working in the field is a somewhat uncontrolled work environment, which exposes workers to potential safety problems
- Automated technologies can provide more information and enable improved business process and customer benefits

There are two types of automated meter reading systems: AMR and AMI. Defined more fully below, AMR is a set of technologies to provide meter readings through an automated system. AMR generally involves meter readers walking near or by the meter or trucks driving by the meter, with the readings being collected by a device as it is carried or driven by the meter. AMI takes the automation to the next level. It involves using a communications network to automatically collect the readings, sometimes generating hourly or more readings per day per meter. For this report, we will use the generic term of AMS to refer to either an AMR or an AMI system.

Many larger utilities have more than one type of meter reading system. A blended strategy can address different meter reading situations, for example using AMI for commercial meters, unsafe areas, or rural areas with few meters, while using AMR for the remainder of their service area.

Meter Registers

The register on the meter records the volume of water that has passed through the meter and displays the amount on its face. It is the authoritative indication of consumption. The meter itself is not different in an AMS; however, the meter register must be able to electronically transmit the water volume. There are two basic technologies for this: using a pulse generating register or an encoder register.

Pulse registers have been used for many years, and generally they work well. The greatest drawback of a pulse register is that if the wire is cut, damaged, or shorted due to moisture, the meter continues to record consumption but the remote receptacle or AMS endpoint does not. Water consumption that is not read due to lost pulses can only be determined by someone reading the meter register. Reconciling bills with customers for lost pulses is often contentious and labor intensive.

With encoder registers, which are generally more expensive than pulse registers, if the wire between the register and the remote receptacle is cut or comes loose, simply reconnecting the wire restores the next reading to a true value.

Advanced Metering System Endpoint

The endpoint of an AMS is an electronic device that typically takes readings and in some cases statuses for such conditions as leakage or backflow from the meter register and sends them onward to be collected. Endpoints can also take readings from other instruments such as pressure or level meters. Some endpoints can output signals to remotely control a valve.

Automated Meter Reading (AMR)

Automated Meter Reading or AMR is the automated collection of readings from customers' meters to a remote central location. As a utility representative walks or drives near the meter, the data from the endpoint (sometimes known as a Meter Interface Unit (MIU), Meter Transmitting Unit (MTU) or Encoder Receiver Transmitter (ERT)) is collected with either a hand-held or vehicle-mounted data collector. Vehicle mounted units have more power and storage capacity, and are used for normal on-cycle meter reading. In the one-way mode, the endpoint simply transmits the latest reading when the vehicle mounted unit or handheld unit requests the data. Data is retrieved from the handheld unit either by placing it in a data cradle or removing a memory card (Schlenger, Hughes, and Green 2011).

In a drive-by system, a vehicle drives slowly through a neighborhood collecting meter readings via a radio signal sent from each meter. Early AMR systems transmitted only the current reading, but newer technology collects a reading at a specified time (for instance, hourly) and holds the readings until the collection device interrogates the device for the readings. This data can then be used to provide profiles of customer consumption, and be reviewed for high bill complaints and to find past readings for move-in/move-out processes.

Advanced Metering Infrastructure (AMI)

AMI is a system that collects time-differentiated consumption information and is capable of providing that information to the utility on at least a daily basis. This will typically be over a fixed radio network. The fixed network can have multiple configurations; the recommended configuration varies by vendor. AMI includes all the networking, communications, and data management hardware and software between the meters and ancillary devices and the utility's business systems (Schlenger, Hughes, and Green 2011).

An AMI system is configurable to take meter data multiple times each day. Rather than getting one reading each month, it is possible to collect metering data every day or even more often. The metering data is not limited to just readings, but depending on the endpoint capabilities can also include event alerts such as tamper, low battery, and reverse flow. While readings can be made every hour or more often, data is sent less frequently to conserve battery life. This much information can and should change a number of ways the utility does business. The benefits of an AMI system include:

1. Reduced estimated reads, because the meter data is available for every day and the billing meter read no longer needs to be estimated
2. Reduced truck rolls to obtain reads, as there is no longer a need to roll a truck to obtain a "special" read for move-in/move-out customer requests, or to investigate high reads or high bill complaints
3. Improved leak detection, where a utility or customer can monitor usage and identify abnormal patterns. This could indicate a possible leak
4. Reduced theft, where an alert can be sent when there is water use in a meter that is supposed to be turned off or when a wire is cut at the meter
5. Backflow monitoring because an AMI system can provide information about water flowing backward through the meter when the volume of backflow exceeds the volume of forward flow in the measurement period, e.g., one hour
6. Increased employee safety due to the reduced number of employees needed in the field resulting in a decreased chance of injuries. This translates into lower insurance costs
7. Improved water loss and distribution determination can be made by calculating the total volume of water being consumed in a defined area and then comparing it to the water delivered to that same area via the water distribution system. AMI can provide simultaneous hourly readings from all meters in a particular area to provide dynamic mass-balances
8. Conservation awareness due to customers viewing their own daily consumption, thus becoming more aware of their usage and supporting conservation efforts. Additionally, the utility can monitor conservation mandate compliance remotely, rather than having employees drive the service area looking for violators
9. Availability of AMI data changes how the utility addresses customer inquiries and complaints. AMI data allow the utility to discuss the customer concerns using detailed data that shows actual water usage for the time period in question. This can allow for a more detailed discussion on the customer's specific situation

Transmitting Data

Fixed network AMR systems collect readings and then transmit the readings to a data collection device before backhauling (transmitting) the data to a central location. These systems are similar to AMI systems in that there is a fixed network collecting the data (thus no need for vehicles to collect the data); however, the data transmission is one-way only, from the endpoint back to the central repository. For many AMS vendors the one-way system was an intermediate step to two-way systems that are usually referred to as advanced metering infrastructure.

In an AMI system, there are multiple options to transmit the data from the endpoint. These include Radio Frequency (RF), power line, and cellular transmission. In the water industry, radio frequency is the most common transmission method.

Depending on the chosen vendor's solution, the data may be transmitted from the endpoint directly back to the utility or it may be sent to a mounted collection device or to a series of collection devices. These collection devices may be mounted on a specially built tower, telephone and electric poles, or tall structures such as water towers and buildings. When the data is sent through a series of collectors/transmitters it is best to have redundancy so if one collector cannot receive the data, another one can. The vendor is usually responsible for determining how many collectors are needed and generally, where they should be placed. Collector placement can become challenging due to the need to work through issues such as providing electric power, right-of-way, aesthetics, and security.

Meter Data Management System (MDMS)

A utility with 50,000 connections (meters) and an AMI that reads every four hours would receive 2,190 reads per connection per year, or 109,575,000 reads annually. This amount of data can be stored in the AMI headend system and readings needed for billing sent to the billing system as needed.

Storing readings longer than a year on the AMI headend could reduce its performance and is therefore not recommended. If reading data is needed by the utility for longer time periods, then an alternative means of storage is required. The CIS could also suffer from degraded performance and might require modification to store all readings. Therefore, an alternative method of data storage is needed. Many utilities with an AMI system have also installed an MDMS to store the readings and other metering data received from the AMI system. The MDMS can also be a data source for the utility's CIS and various other information systems and users. The integration of systems needing meter readings is a design issue heavily dependent on the information system environment and is not covered in this report.

AMI headend software will provide reports on metering data including meter reading success rates, cut wires, endpoint battery strength, endpoints with low battery strength, meters with no flow, meters with backwards flow, meters showing potential leakage at customer sites, data collector conditions and more. In recent years, "analytics" is the term applied to analyzing AMI information. Although provided by the AMS headend software, analytics are more likely to be performed in the MDMS because data covering longer time periods can be analyzed and because the information can be made available to individual customers. The MDMS enables utilities to use metering data for more strategic purposes in addition to just the billing read. Some features of MDMS for water utility users include:

1. Water conservation program monitoring to see how well programs are performing
2. Water meter problem detection to help direct maintenance efforts
3. Water loss analysis for the distribution system

The analysis supported by the MDMS can be applied at the individual customer level as well as across the customer base. Some features offered by MDMS to customers are:

1. Historical water usage profiles with comparison to other similar water users and sometimes with weather data
2. Alert messages to be sent via email, phone, or social media for consumption intervals (for example, every 1,000 gallons), nearing or reaching specific monthly water usage limits or cost break points and potential leakage
3. Alert messages for water conservation, water supply reductions or outages
4. Viewing and paying water utility bills
5. Reporting problems, requesting service and getting status updates on service delivery

MDMSs are relatively new. Many utilities do not yet have the systems in place to manage these large amounts of data, nor do they have existing business processes, staff, or the analytic mindset to support analyzing and using this data.

AMS Water Industry Trends

AMI technology and related applications in the water industry continue to improve and expand. Some developments in products, features and services were requested by water utilities, some are being applied from the electric industry, and some represent entrepreneurial developments by vendors. It is difficult to predict the direction of the market with such a rapidly developing market. Presented here is a short list of industry trends that are currently being used and explored:

1. Using the existing citywide communication systems for the AMI fixed infrastructure. A citywide communications system can provide bandwidth for emergency services (police and fire) and mobile dispatch. It can also provide hot spots for public Internet access
2. Making use of the extensive data provided by an AMI system. Comparing daily consumption of similar customer classes (example, car washes, laundromats, or fast food restaurants) can provide insights into conservation practices or potentially fraudulent activities
3. Sharing the cost of data collectors and the backhaul system with other utilities such as electric or gas. Benefits include increased usage of the infrastructure (better leverage for an asset), additional “free” sites for data collectors, improved reliability, and off-loading of fixed infrastructure maintenance responsibilities
4. Using remote turn-off/turn-on capabilities. AMI remote turn-off/turn-on is something commonly used in the electric industry. A few manufacturers have introduced products with this capability for water meters; they have not yet been adopted for a large scale water system as of this report
5. Using cellular communications, thus eliminating the need to implement a separate fixed network. Alternatively, remote locations or particular trouble spots can send meter data

using cell phone technology. This can be used even if no other automated meters are used in the system

6. Storing metering data in the cloud. This opens up opportunities and creates challenges around ownership, confidentiality and security.
7. Detecting leaks using acoustic leak detectors. AMI technology can be used to monitor these detectors and report on leaks
8. Monitoring pressure by adding pressure transducers into the AMI system

AMS OR CIS PROJECT ORGANIZATIONAL CONSIDERATIONS

Typical business units responsible for some part of the Meter-to-Cash cycle are: new services, meter reading, billing, credit and collections, payments, and finance. These business units are often split across one, two, or even more departments in the utility or agency. For example, often payment-related and general ledger activities are under the domain of a financial unit such as the Finance Department or the Treasurer's Office. Meter reading might be in Field Services. The call center might be part of a citywide call center (sometimes called a 311) or a stand-alone unit in the water utility.

Typical Project Organization and Roles

A typical high-level project organization is shown in Figure 2.3. Depending on the complexity and size of the utility, the project organization may have additional units (for example, a Project Management Office). The structure shown in Figure 2.3 is the minimum project organization required.

The Steering Team (sometimes called a Steering Committee) provides overall project direction and executive leadership. The Steering Team makes key project decisions, provides funding and other resources, and ensures risks are appropriately addressed. Members of the Steering Team include the Project Sponsor and other senior management level decision-makers with a strong vested interest in the positive outcome of the project.

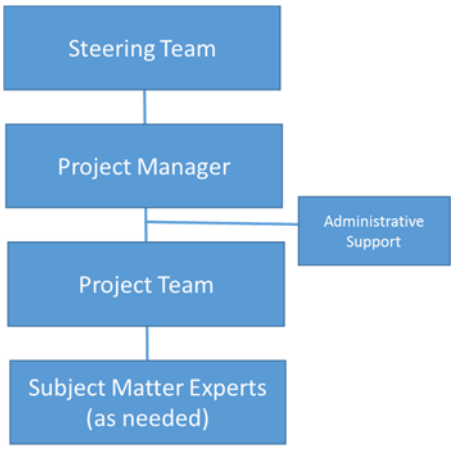

Figure 2.3 Typical CIS or AMS Project Structure

The Project Sponsor is responsible for identifying other members of the Steering Team and the Project Manager. The Sponsor has the ultimate responsibility for the project, including building commitment at the senior management level. The sponsor "is the person or group who provides resources and support for the project and is accountable for enabling success" (A Guide to the Project Management Body of Knowledge, Fifth Edition, 2013 Project Management Institute). This should be someone who has sufficient authority, influence, power, enthusiasm, and time to ensure that conflicts that could impede the change are resolved in a timely and appropriate fashion (Managing Change in Organizations: A Practice Guide. 2013. Newtown Square, PA: Project Management Institute, Inc.). An actively engaged sponsor is the top driver of project success (PMI 2014).

The Project Manager is responsible for managing the project scope, budget, schedule, quality, and project team. He or she is responsible for coordinating and managing overall project related activities. This coordination includes coordinating internally within the utility as well as

with all vendors, consultants, and other external entities related to the project. The Project Manager escalates project issues to the Steering Team that the Project Manager is not able to resolve. The Project Manager will need administrative support for tasks such as reserving meeting rooms, sending invitations to meetings, tracking tasks, etc.

The Project Team actually carries out the work. They are responsible for carrying out day-to-day project activities, making decisions within the scope of their expertise and roles, providing input regarding risks, developing solutions, and communicating about the project. The team should include functional knowledge about how key processes are carried out (account set-up and management, meter reading, billing, payments, credit and collections, and general ledger/revenue) and related policies. The team should include people with operational knowledge of how the current system and processes support the Meter-to-Cash cycle. It is also important to have someone with a deep understanding of the many interface issues that will come up. The team should include people from the contact/call center, metering/field service, dispatch, and IT. There should be some continuity between team members across the selection and implementation phases, but sometimes there are somewhat different members between the selection project team members and the implementation team members. The project team members' involvement will fluctuate during different project phases. Depending on the size of the project and the utility, they will often be dedicated to the project full-time during implementation.

Project Team members will be creating new institutional knowledge and developing new skills that will be of great value to the utility in the future. Team membership should be determined based on the person's understanding of the current system, ability, interest and aptitude, not on seniority. The organization should ensure that they are prepared to allocate resources to the project based on the project plan, ensuring successful completion of each phase of the project.

Subject Matter Experts (SMEs) are brought in as needed to provide specific knowledge required by the project. It is important to know who the SMEs are, to engage them as needed over the course of the project, and to be aware of timing constraints they may have or cause as a result of other responsibilities. Typical SME content areas include procurement, human resources, public communications, and other areas in the agency that are responsible for communicating with the public, issuing bills, reading meters, and collecting payments. This will vary based on the utility's specific situation.

Coordination Across Organizational Units

Because the Meter-to-Cash cycle is often split across organizational units, it is important to ensure clear communications and coordination across every impacted organizational unit. This includes business process changes and changes to policies. The cross-functional and interdependent business processes mean that project leadership, project team members, and operations management should be aware of impacts and take particular care to communicate changes across organizational boundaries. The more impacted a business unit is, the greater the need for proactive communications.

Staffing Levels

A CIS or AMS implementation project requires substantial organization resources (management attention, staff, and budget), and requires staff from across the entire Meter-to-Cash process. The utility should assess its ability to support the project in context of other major projects

requiring the same resources. There is an additional workload during an AMS and a CIS project. As a result, it is necessary to provide additional staff capacity.

A variety of mechanisms can be used to address this including: bringing back retirees on a part time basis, training temporary workers to take the place of people who are now fulfilling project responsibilities, shifting people from other positions, or hiring new employees on a temporary basis. Because new institutional knowledge is created as a byproduct of these projects, it is desirable to include people on the team who could share this knowledge in the future.

Job Responsibilities

Often staff is asked to carry out duties that are broader than their typical day-to-day responsibilities. Post-implementation, new responsibilities, and often shifts in responsibilities, will be required of utility staff. For an AMS project this may include providing support and maintenance for a communications network (whether cell or radio) that is put in place to support the meter reading, troubleshooting the metering technologies, and analyzing/using the large amount of metering data from the system. For a CIS project, often there is a shift in responsibility to assume business analysis and operational responsibilities previously handled by IT organizations.

Policies/Rules and Regulations

Adopting new technologies enables utilities to adopt new business processes, which often creates a need to update or create new policies. Current policies and regulations should be well understood by the project team members. Potential new policies and regulations should be researched and discussed in advance of the time they are required by the project, so as not to negatively impact the project schedule. The operational staff needs to be trained in the new rules and regulations prior to go-live, and at the same time, support the current rules and regulations.

Incentives/Rewards

During CIS or AMS projects, staff is often asked or required to work substantial amounts of overtime and to defer vacations. When these requirements last for months or years, it often becomes an issue for project team members (including supervisors and managers) due to the impact on their personal lives. However, in the public sector, there are often organizational constraints that limit the use of monetary incentives or social activities that when viewed out of context, may seem to be inappropriate (for example, spending “the public’s money” on a dinner to thank people for their extra effort). The utility should identify ways to motivate and recognize the extra efforts of staff and managers on the project.

Union Considerations

In a union environment, concerns need to be addressed related to the impact of automation on the number of positions, job descriptions, training, and compensation.

External Stakeholder Communication

There are often special stakeholder groups that have particular communications needs because of the project (distinct from customers that will be directly impacted). In particular, needs of other entities or departments for whom the utility is providing meter reading or billing services, and who are directly paying for the project, should be considered.

Change Management

Change management continues to be a challenge for many organizations. Although it is often recognized as being a major element of these projects, it continues to be a pain point. Only one in five organizations report highly effective change management (PMI 2014). As stated in *"Effective Practices to Select, Acquire, and Implement a Utility CIS,"*

> *Change management involves understanding and helping people deal with change. A major change in technology imposes a major change on the people who use that technology, and can have ripple effects throughout the organization. Effective change management proactively develops strategies and action plans to manage the impact of the change. Involving people in the process and preparing them for the changes is key to a successful change process. Leadership is also key to working through change. Leaders need the skills and attributes to guide the organization while attending to the needs of employees. Most projects that an organization undertakes, regardless of whether the project includes a technology component, will result in changes to the organization and the way in which its people work. A successful project devotes significant attention to managing the impact of these changes* (Rettie et al. 2005).

There are two major areas that require attention in any change project: the mechanics of change, and the people who are impacted by the changes. The mechanics of change are the practical and measurable components such as timelines, objectives, gap analysis, documentation, training plans, and the adoption of the desired new behavior. Addressing the people impacted by change includes how the project team is created and initiated, SME input, backfilling, and project team dynamics. A great plan without motivated and competent people to implement it does not happen. Both the mechanics and people aspects of change require a lot of coordination and involve many moving parts.

Change projects fall into one of three states:

1. Balanced change focus
2. Underdeveloped people focus
3. Underdeveloped mechanics of change focus

They can vacillate between these states based on the effectiveness of the change management program. These states are described below.

Figure 2.4 Balanced change focus

Balanced Mechanics and People Aspects

In this scenario (see Figure 2.4) there is a balance between having the empirically measurable mechanics and the management of the human change impact. There is a plan that considers all the technical aspects of a change project with a timeline to keep the project on track. The mechanics define the "why" for the project and outcomes.

The people aspects of change take into consideration the fear factors, resistance to change, respect for people's skills and talents, inspires participation and builds enthusiasm. Ultimately it will answer everyone's question "What does it mean for me, where do I fit in all this and what does it mean for our customers?"

Figure 2.5 Underdeveloped people focus

Lack of Attention to People Aspects

This state of change is depicted in Figure 2.5, where the mechanics are in place, but the people aspect of change is not developed. When this occurs the project will technically appear to be on track to succeed; however, there will not be any power or momentum behind it because the people are the drivers that implement the mechanics. This scenario has the mechanics in place, but nothing really gets done because the people side has no motivation.

Figure 2.6 Underdeveloped mechanics of change

Lack of Attention to Mechanics of Change

On the contrary, if the people aspect is more developed than the mechanics, there will be enthusiasm to implement the change, yet the tools to implement the project will be missing. The project will spin its wheels which impacts timing, quality, and, eventually, enthusiasm. Refer to Figure 2.6.

When developing and carrying out a change management plan it is important to ensure there is a balanced approach to change. Effective change management addresses both the mechanics and the people. One without the other is guaranteed to experience delays and roadblocks and often fails to achieve sustainable change. The utility might have a new system, but the old way of doing things is still practiced.

An effective change management program includes workshops and learning opportunities with specific activities and outcomes for leadership, management and supervisors, the project team and staff or end users in both areas of mechanics and people (Figure 2.7).

Figure 2.7 Effective change management program builds upon goals and addresses key stakeholders

CHAPTER 3
WATER UTILITY CUSTOMER INFORMATION SYSTEMS

This chapter provides a summary of secondary research findings, addresses organizational considerations specific to a CIS project, defines typical CIS project phases, and provides advice for how to prepare for a CIS project. Because the CIS go-live process is highly detailed it also provides a section on how to prepare for the go-live. Additionally, it addresses CIS challenges and potential remediation tactics, provides a list of warning signs to detect a CIS project in trouble, and includes a checklist to enhance chances of a successful CIS project. Lastly, an exercise to assess the health of a CIS project is provided.

CIS SECONDARY RESEARCH FINDINGS

Secondary research was conducted through reviewing information available in the public domain including conference presentations, industry publications and the Internet. The result of this research is summarized in this section. More research and industry data is available on customer service, effective IT implementations, and IT service management in general since the previous study. However, there is not much data specifically related to *water* utility CIS implementations.

Previous CIS Study Findings Are Still Highly Relevant Today

In the 2005 publication by Rettie et al., *Effective Practices to Select, Acquire and Implement a Utility CIS,* several common themes for successful CIS projects were identified. These themes have been validated and continue to be relevant today:

1. Project drivers define the opportunity. In other words, for those CIS projects that were successful, the reason for conducting the project were clearly defined before defining the CIS project itself
2. Defining the strategy determines the course of the project. For successful projects, after defining the project drivers, the utilities deliberately evaluated the best course of action to address the project drivers (upgrade, move to a new CIS, etc.)
3. Following proven project methodologies ensures that requirements are clearly defined. Successful CIS projects consistently used proven methodologies such as including cross-functional teams, and evaluating and redesigning business processes
4. Thorough evaluation drives vendor selection. Successful projects defined the entire vendor selection process in advance of issuing the RFP. This includes defining vendor selection criteria, and scoring criteria for use during evaluation and selection
5. Jointly constructing the work plan and contract results in realistic, thorough project plan. Once the CIS vendor was selected, the successful utilities worked with all parties (CIS vendor, consultant, IT, other third parties) to develop a contract that was realistic and well understood. Once the contract was in place, they then developed a detailed work plan that reflected their respective roles and commitments
6. The basics must be addressed during implementation. This includes conducting a gap analysis, business process analysis, testing, training, reporting, data conversion and

account migration, rolling out the system, and maintaining the system. These basics continue to hold true today

As that study states, utilities reporting successful CIS projects were not the only ones that did many things well. It continues to be true that utilities with failed CIS projects also did a number of things right, such as having a vendor payment schedule that was clearly tied to performance milestones and formally identifying and managing risk factors as part of the project plan. Carrying out only some of these practices very well is not enough to ensure the success of a complex high risk project such as a CIS replacement. Refer to the 2005 Report for additional information on each theme.

Additional analysis related to the 2005 survey data showed clear differences between successful and failed CIS projects, as depicted in Table 3.1.

Table 3.1
Practices associated with successful CIS projects in 2005

Practice	Successes Did This	Failures Did This
Identified and quantified CIS project business goals, and compared at end of project	93 %	0 %
Met all or nearly all business requirements by off-the-shelf vendor solutions	64 %	0 %
Received vendor responses that addressed utility needs	83 %	0 %
Created detailed "go-live" plans jointly with vendor and consultant	86 %	0 %
Had right expertise and experience on CIS implementation team (utility, vendor, consultant)	100 %	0 %

Additional Secondary Research Findings for CIS Projects

For utilities that are currently selecting and implementing a replacement for a legacy water billing system, execution of generally accepted project management practices continues to be critically important.

Implementation of a CIS is a large, complex project that touches every customer of the utility and requires cross functional participation for execution of the project. According to a December 2013 Cognizant white paper by Tripathy and Kumar, "…the complex nature of CIS initiatives has resulted in many failed or underperforming CIS implementation projects." Potential issues include ineffective project management, inexperienced project managers and/or weak management of consulting firms providing implementation assistance. The result is failed implementations, significant revenue loss, severe damage to customer trust and relations, and sometimes, time consuming, distracting legal issues.

The research also indicated that when water utility CIS implementation projects failed, the cost of failure was dramatically higher than the original project budget, about three to six times higher. The failed projects also often involve time-consuming and distracting litigation (Rettie and Wiest 2015).

Additional Water Research Foundation reports of interest have been included in Appendix E: Related Reports.

Current and Emerging CIS Trends

Several current and emerging trends specific to CIS were identified through the secondary research. They are presented below.

New Capabilities Continue to be Offered

Examples of new capabilities include increased flexibility in billing and payment due dates, improved phone systems and capabilities (e.g., chat, improved real-time speech analysis and escalation protocols), customer self-serve, and analytics.

Mobile Applications and e-Billing

Adoption rates of mobile applications continue and will continue to grow with the adoption of smart phones, tablets and future electronic devices. According to a Fiserv, Inc. survey in 2013 (Leiserson 2013), the percent of mobile bill payers doubled between 2012 and 2013, with the greatest growth occurring in payments to utilities. In 2013, 30 percent of the respondents paid their utility bill using mobile phones. Customers expect to have the ability to pay and view bills and conduct basic account management via mobile applications. Some utilities (including water utilities) are providing smart phone apps with which customers can check their bill, pay for service, and carry out other basic related activities.

Cross-Platform Application Integration

Cross-platform application integrations enable field and customer service personnel to have near-real-time data related to both field status and back-office status. Many water utilities now have near-real-time integration between their CIS, payment status, dispatching, and service orders in the field.

Cloud Computing

Cloud computing allows utilities to move CIS and supporting systems such as IVR/Automatic Call Distribution (ACD), payment processing and MDMS off-site, often to the cloud. These solutions are maturing and there are many more choices available. Many vendors now offer off-premises solutions.

Customer Experience

Increasingly utilities are evolving customer operations and as a result are focusing more and more on the customers' experience. New channels of customer service have developed.

Particularly for gas and electric utilities, walk-in support for customer service is diminishing and being substituted with alternative self-service channels such as IVR, web portals and mobile applications. As a result, utilities are focusing on the customer experience for each channel. According to J.D. Power and Associates, about 30 percent of inbound calls are related to billing. As utilities strive to "do more with less" they will begin to focus more on reducing call center calls by offering simple and consistent bills (Grant 2011). Utilities are moving from billing customers ("rate payers") to engaging their customers. Performance measures are expanding from phone system metrics (Average Speed of Answer (ASA), Average Handle Time (AHT), etc.) to include analysis of the customer experience.

Change and Continuous Improvement

Everything is happening faster. Change cycles are becoming shorter. Instead of replacing a CIS every 20 to 30 years, they will be upgraded or replaced in much shorter cycles in the future. This is due to advancement in technologies such as AMS and continued improvement by CIS software vendors. Utilities will begin to view customers more as partners, not as "rate payers" or "billers." The customer service event (such as starting service, or receiving a bill) will become part of overall customer relationship management.

Customer Analytics

With more data being collected and available to both utilities and customers, analysis tools are becoming more readily available and sophisticated. These tools can analyze data stored in the CIS, IVR/phone systems, AMS, and MDMSs. Affecting behavioral changes of customers through the use of data analytics is still elusive, however.

Security

With more online transactions happening, and numerous high profile security breaches involving payments, protecting the security of customer data is increasingly important and beginning to receive legislative attention.

Failed CIS Projects Give Warning Signs

There are still failed CIS projects. The warning signs have not changed, with typical examples being inadequate project management, vendor inexperience with the level of systems complexity, and missing/ineffective critical decision-making.

Outsourcing is Becoming More Accepted

Water utilities are more open to outsourcing segments of the Meter-to-Cash cycle, for example, bill delivery, payment processing, and technical support. However, outsourcing the entire contact center or CIS function (sometimes called Business Process Outsourcing (BPO)) is still somewhat unusual in the water sector.

CIS Market is Going More Global

As international vendors are moving into the U.S., growth in U.S. and Europe is slowing, and developing country water markets are starting to emerge.

Ownership of Data is Being Questioned

Data related to the customer is being increasingly used for analytics. As a result, ownership of data (e.g., meter data) and the System of Record for various data sets, is becoming blurry as software systems and vendor offerings become more complex. Metering and customer data may be part of multiple systems, including the CIS, CMMS or Enterprise Asset Management System (EAMS), MDMS, and GIS. At the same time, concern for data confidentiality and security is increasing.

IT System Ownership is Becoming More Diffused

IT is shifting responsibilities from IT owning the system, to involving customer service/operations. Many utility customer service organizations do not have the skill set to meet these responsibilities and struggle to deal with the new responsibilities.

Emerging Disconnect Between Utility Needs and Vendor Ability to Provide Support

Utilities struggle with vendors' ability, or lack thereof, to provide maintenance and support during the operational lifecycle. Particularly when political bodies identify required functionality during a certain timeframe, even when utilities are willing to pay for it, vendors are often not able to meet the utility's request for service due to a lack of available, trained vendor staff.

Implementing or upgrading a CIS represents an area of significant change for utilities. Implementation requires major planning, investment and careful implementation, and represents a significant project for the utility. The impacts of implementation are wide and far reaching, and touch every customer of the utility and cross-functionally within the utility. While technology and software continue to improve, executing the fundamentals of project management minimizes the risks associated with a CIS implementation or upgrade.

ORGANIZATIONAL CONSIDERATIONS FOR A CIS PROJECT

General organizational impacts of AMS and CIS projects are identified in Chapter 2. In addition to these general considerations, there are specific considerations for CIS projects. The information presented in this section is a synthesis of experience from the participating utilities and the research team.

Backfilling

Due to the depletion of daily operations personnel (because people are full-time on the CIS project), it is important to backfill the temporary vacancies. A number of tactics can be used including temporary staff, hiring contractors, bringing back retirees, and shifting people from other parts of the utility.

Impact on Daily Operations During the Project

Be aware that the people who are continuing to support the daily operations will be curious about the project and potentially feel left out of a special opportunity. Recognize that there will be fewer readily available skilled staff to support daily operations analysis and problem solving needs so some tasks may take longer. Communicate regularly with the supervisors and staff. Provide them a chance to ask questions, see the project status, and have input into decisions during the course of the project.

Preparing Daily Operations Staff to Use the New System

Developing an effective and detailed training strategy is critical to the success of a project. Not only can an effective training strategy ensure that daily operational staff are fully prepared to use the new system once implemented, but it can support change management activities (e.g., increased buy-in, provide feedback on processes, etc.). Allowing sufficient time to learn and practice using the new system will support an effective go-live process.

Project Team Location

During implementation, project team members should be co-located in a working area dedicated to the project team. They should report to this work location every day and not to their "regular" work location. The workspace should include a printer, space to display the computer screens on a wall, and a small area for ad hoc meetings.

Project Team Dynamics

Working in a team requires different skills from individually working at a specific task. Particularly during the implementation phase, this can be wearing on the project team members. Provide them with training initially, and refresher training, on how to work in a team. Examples of skills to improve with training include: listening, questioning, persuading, sharing, coordinating, respecting, handling conflict, facilitating meetings, giving feedback, problem solving, and being flexible.

Project Team Work Schedule

Project team participants should be fully aware of the critical tasks in the project plan and need an understanding of the impact it can have on vacations, especially if the implementation go-live is deferred. Additionally, the project schedule should identify times when overtime may become mandatory to ensure that critical tasks are completed on schedule.

TYPICAL CIS PROJECT PHASES

The research team and the participating utilities recommend a multi-phased approach to selecting and implementing a new CIS. In particular, they recommend placing a specific focus on the preparation phase, and splitting the implementation of core functionality from implementing additional functionality. The phases shown in Figure 3.1 are appropriate for both a major upgrade of an existing CIS as well as an implementation of a CIS project.

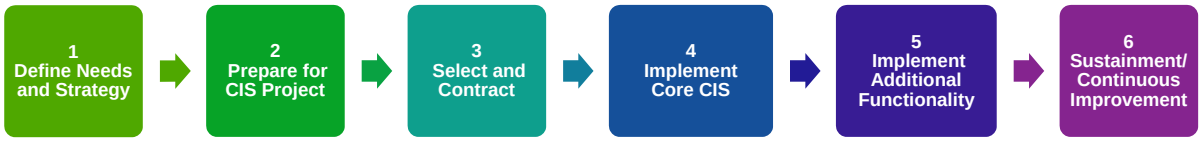

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Figure 3.1 CIS project life cycle

Broadly speaking, a CIS project is composed of six phases. Sometimes the phases are "packaged" differently by utilities due to procurement processes or funding cycles; however, each phase must be carried out. Each phase builds on the previous phase. Struggles or issues that are present in one phase will not be resolved simply by moving on; in fact, ignoring them may jeopardize the overall project.

Each phase is described further below with suggestions and advice from the research team and participating utilities.

Phase 1: Define Needs and Strategy

During this phase, the utility recognizes the need to take action and defines the strategy (upgrade to a more current version, move to a different system, enhance with another package or custom development, or defer). Important activities during this phase are:

1. Clearly define the issues and opportunities related to the potential replacement or upgrade project
2. Develop alignment about the need for a project at the leadership level
3. Clearly define the business goals, risks, and constraints
4. Develop an initial budget and schedule estimate

Sometimes this step includes an assessment of the current system's capabilities and viability.

Phase 2: Prepare for the CIS Project

This phase is often trivialized or entirely skipped but it is an essential step for a successful CIS project (on time, on budget, with the desired outcomes). Important activities during this phase are:

1. Educate key staff about what the CIS project will entail
2. Establish the project leadership team (Sponsor, Steering Team, and Project Manager)
3. Develop a project charter that defines what the project is, including assumptions, risks, constraints, and what the project will not address
4. Assess organizational readiness to undertake the project, and take steps to increase readiness if needed
5. Conduct a gap/fit analysis of the current system and business needs
6. Understand and prepare for the additional workload the project will create

7. Identify and address issues related to data in the current billing system, what data should be brought into the new system, and related clean-up efforts. Do not expect that all historical data should be brought into the new system
8. Analyze and document policies, business rules, and related automated workflows
9. Develop the Project Team's readiness and capabilities
10. Develop a quality project schedule that includes contingency time, and that addresses time required for the procurement process and the hiring process
11. Refine the project budget to include all associated project costs

Refer to the "Preparing for a CIS Project" section in this Chapter for more details and a self-rating sheet. Some utilities have the resources and knowledge to carry out this phase independently; others should acquire assistance from a consultant with relevant experience in the water sector.

If the outcome of the readiness rating is that the utility is not ready, specific steps should be taken to increase readiness. Depending on the utility's current situation, an outcome of the readiness assessment could be to carry out one or more preliminary projects (for example, a project to define current business rules).

Phase 3: Select and Contract With Vendor

This phase involves defining requirements and selecting a product. It may also involve selecting a system integrator to implement the product. Important activities during this phase are:

1. Define technical and functional requirements. This is a critical activity. If requirements are not gathered appropriately and articulated well, the entire project is at risk. The Project Team must be involved in this activity. Often this activity involves a substantial amount of discovery to define current business rules. Suggestions include:

    a. Ensure there is a clear understanding of the business requirements
    b. Use each area of the Meter-to-Cash cycle as applicable
    c. Address core business processes first, and then add enhancements
    d. Focus on the desired outcomes of the business processes, not on how the business process is actually carried out (that will vary by CIS product)
    e. Be prepared to change existing business processes and potentially business rules to get the desired outcomes
    f. Keep staff open to changing how work is accomplished once the new CIS is implemented

2. Develop RFP. Sometimes it is helpful to release a Request for Information (RFI) or Request for Qualifications (RFQ) before the RFP, so as to develop a better understanding of the market. It is helpful to notify vendors in advance of the RFP being released. This ensures they are aware of the desired project schedule and can plan to have the needed resources available to develop a quality response. The RFP and the vendor's response should become a part of the contract. Areas that should be addressed in the RFP include:

    a. Utility and project background
    b. Description of the current utility customer service environment

c. Project goals and desired outcomes
d. Project timeline
e. Vendor (or system integrator) evaluation process
f. Services to be provided (gap/fit analysis, data conversion, interfaces, training, reports, testing, documentation, stabilization support, future desired functionality and project phases)
g. Technical requirements
h. Functional requirements. This includes business rules and rates
i. Interface requirements
j. Number and type of users of the selected system
k. Maintenance requirements
l. Vendor's staffing
m. Cost estimate
n. Payment schedule spreadsheets (to enable an apples-to-apples comparison of vendor responses)
o. Utility contract boilerplate (consider including a maintenance agreement)
p. Vendor's boilerplate maintenance agreement and support agreement

3. Define the selection process; include procurement staff in defining the process
4. Develop a scoring methodology and rating sheet and review them with the selection team
5. Develop demonstration scripts and demonstration data
6. Conduct on-site vendor demonstrations using demonstration scripts and demonstration data
7. Review proposers' responses
8. Negotiate and establish the contract

Phase 4: Implement Core CIS

This phase should focus on ***replacing*** the core functionality of the existing system. Implement additional functionality only after the core CIS product has been implemented. Once the core product is in place and stable, then move to the next phase (implement additional functionality). This mitigates risks associated with huge learning curves, project delays, testing challenges, and project funding needs. Every vendor/system integrator has an implementation methodology specific to their system. Use it, but be sure to add other implementation activities. Important activities during this phase are:

1. Update the project plan to include the CIS vendor/system integrator activities as well as those of other vendors (to be interfaced with), related projects, and responsibilities of the utility
2. Establish and maintain a project document repository
3. Support the vendor during discovery activities
4. Assess the Project Team's health and address issues early
5. Redesign business processes to take advantage of functionality in the new system
6. Understand what data and reports will be needed by an auditor to validate that the system conversion complies with their audit requirements
7. Manage related contracts (hardware, interfaces, etc.)

8. Convert and clean data
9. Communicate with customers and other key stakeholders
10. Develop, maintain, and carry out the test plan
11. Train staff
12. Engage operations management at appropriate levels throughout the project
13. Conduct mock go-lives
14. Prepare for go-live and assess go-live readiness
15. Go live and manage the resulting issues list (sometimes called a "punch list")
16. Transition to ongoing operations (both on the part of the vendor/system integrator and the utility's service desk)
17. Final acceptance
18. Review and document lessons learned during the implementation for use during the next phases

Phase 5: Implement Additional Functionality

This phase (or potentially multiple phases) addresses adding additional functionality. When starting this phase, carry out the steps above in the context of adding selected additional functionality. For example, assess the needs, define the goals, analyze alternatives, etc. All activities and advice from the core implementation phase also apply to this phase. Consider establishing an overall Customer Service Improvements Roadmap to include additional technical functionality, as well as addressing other newly presented opportunities.

Note that this phase may be carried out in parallel with Phase 6: Sustainment and Continuous Improvement.

Phase 6: Sustainment and Continuous Improvement

This phase starts when the system has been implemented and customer service operations is becoming capable and confident with the new system. Important activities during this phase are:

1. Provide continuous coaching and reinforcement to the operations staff in terms of how they are using the new system and applying business rules/policies
2. Engage the vendor or system integrator to assess/coach staff on an annual basis regarding their use of the system
3. Establish a process to ensure vendor contract requirements are anticipated with enough time to respond appropriately (for example, contract renewal timelines)
4. Establish a process to assess patch releases, communicate the value and issues to key stakeholders, and make a decision to implement or not

PREPARING FOR A CIS PROJECT

Properly preparing for a CIS selection and implementation (or major upgrade) project has a beneficial impact on project success. It can be necessary to execute specific tasks (or sometimes change readiness projects) to enhance the utility's readiness to begin the CIS project. This effort, in particular, can be substantial.

Below in Table 3.2 is a list of items to consider to help determine a utility's readiness to take on a CIS project. As part of Phase 2 (Prepare for a CIS Project), this assessment should be

completed by the Project Manager. Use a scoring of Fully Prepared, Mostly Prepared, Somewhat Prepared, or Not At All Prepared. Address all areas that are not rated at least Mostly Prepared prior to starting the next phase.

Table 3.2
CIS project readiness assessment list

Item	Level of Readiness
1. Key staff is knowledgeable about what the CIS project will involve	
2. Project leadership has been established. There is a clear Project Sponsor, the Steering Team membership has been mostly defined, and a strong Project Manager has been identified	
3. The project purpose and expected outcomes have been clearly defined. This involves clearly defining and documenting the business goals the project will accomplish, and what is not in the project	
4. A sufficient budget has been established. Items to consider are: a. Consulting costs (to develop the RFP, support or manage the implementation, quality assurance, change management support, and/or staff development) b. CIS vendor's solution (licensing, professional services, travel/expenses, and maintenance) c. Other vendor services (for example, outsourced IT services, and vendors providing existing or new integrations) d. Staffing (overtime, backfilling). Allocate some budget to compensate the core project staff for the extensive amount of overtime work they will perform e. Staffing (skills development). Identify what remedial training or supplemental training will be required to enable operational readiness when the selected system is ready for go-live. For example, employees might need training in core Windows or Microsoft® Office applications f. Hardware/software for the new CIS platform (for example, additional database licenses, reporting tools, additional servers, backup tools, and so on) g. Facilities for the team during implementation. The project team should have a dedicated space for the duration of the implementation phase. Training facilities will be required	

(continued)

Table 3.2 (Continued)

5. Staffing needs and readiness have been clearly defined and assessed. Items to consider include: a. Defining project roles and participation (Project Sponsor, Steering Team, Project Manager, Project Team, SMEs, and IT support). If there are not clear candidates to carry out these roles, they should be developed, acquired through careful hiring, or acquired by outsourcing for the project duration b. Preparing the Project Team for the project. In addition to being familiar with how the CIS project will be done, team members should have the appropriate technical and "soft skills" necessary to support the project Assessing staff and leadership capabilities. Augment staff as needed with consultants, contractors or vendors. Ensure the right skills are available when needed. Understand the agency's needs and limitations	
6. The workload impact of the CIS project is understood and resources are available to address it. The workload will increase as a result of this project. Identify capacity constraints. In addition to adding resources, capacity constraints can be mitigated by improving inefficient work processes prior to the project and redeploying the resources to benefit the project. Potential pre-project activities include: a. Reducing estimated reads as much as possible b. Redesigning the bill to reduce calls c. Promoting electronic payment adoption d. Implementing an IVR so that simple, high-volume calls are automated e. Preparing management and customers to accept lower service levels during the project f. Acquiring additional resources (staff augmentation, hiring). Ensure sufficient time is allowed to recruit, onboard, and train new resources	
7. Operations management is prepared to support the project, understands the impacts and opportunities, and is prepared to participate in key decisions	

(continued)

Table 3.2 (Continued)

8. Start to address data issues. Discuss and make preliminary decisions about data to be converted to the new system. Once this is complete, assess the quality of the data and determine required actions to meet determined quality standards. Underestimating the extent of data issues is a major issue for many CIS projects. Estimate the level of effort to resolve the issues and start as early as possible so data cleanup is not a huge issue during the implementation and conversion. Potential issues include: a. Having "dirty data" (missing, duplicate, inconsistent or incorrect data) b. Using fields inconsistently c. Having poorly defined or enforced business processes that create dirty data d. Verifying that accounts are properly coded (commercial, residential, active, inactive, meter size, etc.) e. Establishing consistency in how data fields will be used (even if the legacy system does not programmatically enforce it), and training staff to use the data standards f. Ensuring reports are developed to identify data exceptions and resolve the exceptions as part of normal operational processes (daily, weekly, monthly) As the data is cleaned up, expect to find customer accounts with billing discrepancies due to historical errors. Be prepared to address these discrepancies	
9. Current automated workflows are understood and documented. As utilities have automated workflows over the years, there has often been a loss of institutional knowledge related to the automation embedded within the systems. Discovering the automated flows of work and data transformations takes time. It is useful to do this discovery in advance of having the vendor request this data	
10. Policies have been reviewed and updated. This involves developing a common understanding of published policies (or rules and regulations) and if/how they are enforced. If new capabilities are going to be implemented as part of the CIS, related policies have been researched and developed. Understand choices the utility will likely be presented with, and explore how related utilities or organizations have implemented those items. Once implementation starts it may be too late for thoughtful consideration and research related to potential policies	
11. Procurement processes are understood so that they can be accurately incorporated into the project schedule. This includes acquiring facilities for the project team, hardware, software, outside consultants and contract negotiations	
12. An initial project schedule has been established. The schedule will be successively refined during the course of the project, as more information becomes available	

PREPARING FOR CIS GO-LIVE

Use a highly structured process for go-live. Develop a detailed checklist for the go-live process with the project team (including all key members: utility, vendors, and consultants). This should be a step-by-step list of who will do what, approximately how long each task will last, a formal hand-off step from one task (person) to another, and how the hand-off and status will be logged/communicated. General items to consider are described below.

1) Ensure audit requirements have been addressed and required reports/logs are collected. Involve the person who will be responsible for signing off on the conversion to the new system from an accounting practices point of view early in the project. They can provide guidelines for reports and data verification requirements to sign-off on the conversion. Knowing these requirements in advance will prevent a last minute delay and alleviate concerns about the auditability of the conversion.
2) Conduct mock go-live exercises. This tabletop exercise allows rehearsal of the final go/no-go decision process so people will be prepared to consider all issues and alternatives when making the final go/no-go decision. Additionally, this process points out areas that either have not been thought about, or that need attention before the actual go-live. This process should include walking through a go/no-go decision, followed by walking the team through the cut-over steps using a well-developed checklist of activities, handoffs, and timelines. The timeline should include from a few weeks prior to the cutover to a few weeks after the cutover.
3) Reduce workload. Consider pausing transactions that would be disrupted during the cutover, including:

    - Delay or temporarily stop the disconnect for non-pay process
    - Reduce open service orders (close out all those possible, defer as possible)
    - Process refunds early, defer others until after conversion
    - Disable Electric Bill Presentment and Payment (EBPP) sign-up one billing cycle before go-live until after go-live

4) Run reports detailing account exceptions. It will be important to understand discrepancies between the legacy system and new system, and to ensure that everything has been, or will be, properly billed. Examples include:

    - New services that have not yet been billed
    - New meter installs or recent change outs

5) Run standard Key Performance Indicator (KPI) reports. This enables a before/after comparison, post go-live. Think through in advance how reports from the new system will relate to reports from the old system.
6) Review external communications. Review and update the external communications plan. Consider signage in the cashiering area to explain the enhanced capabilities that will be available after the new system has been implemented. Review the IVR flow for effectiveness and efficiencies.

7) Prepare staff. Communicate to all staff members about expectations during the project start-up (for example, they won't be as quick on the new system as they are on the old system; it will feel strange to them and calls will take longer), and about how they will be supported by the project team (for example, floaters in their work areas to help with questions).
8) Review internal communications plan and update for go-live. Ensure that a mechanism has been established to communicate information as needed. This should include communications within work groups, across work groups, between the project team and work groups, with senior management, and with other key stakeholders. Do not assume that normal communications channels will be sufficient.

CIS CHALLENGES AND POTENTIAL REMEDIATION TACTICS

Project challenges come in many forms, from many directions. Project participants of the previous study (Rettie et al. 2005), identified challenges they had experienced. These were grouped into six categories. These challenges are still relevant today and are listed below:

1) Understanding and addressing business needs. This includes balancing the new CIS functions and cost with a goal of improved customer service. Utilities have struggled with finding the right balance of cost and functionality. It also includes defining true requirements and ensuring the selected product meets those requirements
2) Changing and standardizing business processes. This is a key tactic to limiting or eliminating modifications to a COTS product
3) Addressing change management issues
4) Delivering effective IT support. The involvement of knowledgeable IT resources is critical. However, often there is little available IT capacity due to retirements or overcommitted staff
5) Managing and executing the project plan. Often utilities do not have skilled and experienced project management resources available
6) Providing effective long-term training. Training is not a one-time requirement. A method of providing training beyond the implementation period must be developed

Additional challenges were identified by the participants of the current research project:

1. Effectively communicating with customers and the public regarding the project. These projects directly impact every single customer of the utility. Effective and timely project communications require multiple communications channels and clear messaging
2. Sustaining project vision and focus during the project. The project can take multiple years, thus spanning election cycles. Strong executive leadership support and involvement in the project is required to sustain the vision and project focus
3. Loss of key project team members during the project. Due to the long project timelines it is likely there will be some turnover during the project, thus potentially losing key project knowledge and perspective
4. Challenges caused due to the involvement of multiple stakeholders and competing organizational responsibilities. Because these projects often span organizational boundaries they require strong leadership and communication to ensure resources are

available as needed, risks are mitigated, and changes to business processes/rules and regulations are well understood

Management and Remediation Tactics for CIS Project Challenges

Many project challenges can be addressed by good, proactive project management:

1. Regularly monitor the schedule, scope, budget and staff
2. Manage scope proactively
3. Focus on addressing the issues that impact the project schedule critical path
4. Do not hide or ignore problems. Consult with the Project Sponsor and with the Project Team (including vendors) to identify issues, develop risk mitigation steps, and get organizational advice. Solicit feedback and ideas. Listen to staff if/when they raise issues
5. Establish and use a risk management process. Identify risks, and rate them regarding the likelihood of occurring, and the impact if the risk does occur. Review this regularly at project review meetings. An issue is a risk that has come to fruition - address issues proactively based on the review outcomes
6. Re-baseline the project, consider contractual changes, or stop the project
7. Maintain good documentation. This is useful for reminding people about decisions and background, and for referring to when it is clear there is an issue to be addressed
8. If the Project Manager is not effective, change the Project Manager

Table 3.3 below provides a more detailed list of challenges and possible remediation tactics.

Table 3.3
CIS challenges and possible remediation tactics

Challenge	Possible Remediation Tactics
1. Unclear vision, goals, and measures	☐ Develop a project charter (a good reference is the Project Management Institute's (PMI) Project Management Book of Knowledge (PMBOK)) ☐ Document the project vision, goals, and desired results (measures). Revisit/update them at key project milestones ☐ Use the Project Sponsor and Steering Team to clarify the business and technical vision, goals, and desired outcomes of the project ☐ Hang a large poster of the vision, goals, and desired results in the project team room
2. Lack of management capability	☐ Hire a qualified management consulting company to help manage requirements, the RFP, vendor selection and the implementation ☐ Hire an internal Project Manager with related experience ☐ Identify shortcomings; carry out actions to address them ☐ Focus on what people say, not their rank or position

(continued)

Table 3.3 (Continued)

3. Lack of alignment	☐ Define the area/issues causing the lack of alignment. Assess the consequences of not addressing the lack of alignment. Do not try to hide major issues – address them. They will not disappear. If necessary, escalate the issue to the Project Manager, Project Sponsor, or Steering Team
4. Untimely or vacillating decisions	☐ Empower the Project Team to make decisions. Define clear guidelines for making and communicating the decisions, and for developing recommendations for a higher authority to consider ☐ Assign dates for decisions and owners of the decision ☐ Keep a decision log, review status regularly
5. Lack of funding	☐ Formalize the project with stakeholders and develop a detailed cost estimate and schedule to determine the budget for the project ☐ Get approval and allocate funds prior to project ☐ Defer the project or parts of the project until sufficient funding is available ☐ Acknowledge that a failed project is far more expensive than an over-budget project ☐ Revise the budget as the project progresses through phases and additional information is available ☐ Plan to upgrade customer service staff monitors (large monitors are a huge productivity enabler) ☐ Set aside an appropriate project contingency
6. Unrealistic schedule	☐ Identify key schedule drivers. Understand and factor in delays due to utility or local governance processes (procurement schedules and process, hiring timelines, requirements to update job descriptions, election cycles, etc.) ☐ Listen to vendors and consultants, as they have experience ☐ Explore changing project activities to address a key driver and show results, enabling increased funds as a result of the different budget cycle or timing ☐ Plan for problems; do not plan for perfection
7. Workload/lack of staff availability	☐ Assign project staff full time to the project during implementation ☐ Promote staff into project roles and backfill from less experienced staff. This supports developmental opportunities ☐ Hire local minority business enterprise, female business enterprise staff, etc. to backfill or provide project support ☐ Review resourcing needs monthly (both current and forward looking) to identify constraints and hard to get resources ☐ Increase the project duration

(continued)

Table 3.3 (Continued)

8. Poorly run meetings	☐ Provide training on effective meetings ☐ Send out an agenda prior to meetings. The agenda should define the purpose of the meeting and the meeting topics ☐ Be respectful of individual schedules and constraints. Schedule routine meetings in advance ☐ Invite only those needed ☐ Avoid isolated conversations ☐ Assign a facilitator and a note taker ☐ Table items that are not a part of the meeting agenda ☐ Assign issues and action items for follow up ☐ Publish minutes and solicit feedback
9. Poor project communications	☐ Develop and use a communication plan, for both internal and external communications. For an internal plan, a good reference is the PMI's PMBOK. ☐ The Project Manager should meet regularly (monthly or as relevant) with key stakeholders to ensure their project communications needs are being met ☐ Plan for both proactive communications (upcoming decisions, key project activities) as well as status updates (decisions that have been made, outcomes of project activities) ☐ Communicate appropriate information to all impacted levels within the organization. Recognize that communications needs and frequencies will vary during different project phases
10. Non-responsive third party vendors	☐ Inform related vendors about the CIS implementation project and establish a (contractual) mechanism for them to carry out their part of the work ☐ Develop and maintain a consolidated project schedule that shows **all** activities (not just the CIS vendor or system integrator activities) ☐ Ensure the contract contains penalties for missed deadlines, sub-standard deliverables, and not meeting service level standards. ☐ During implementation include third party vendors in meetings as appropriate ☐ Define an appropriate mitigation strategy; including triggers to deploy the strategy
11. Undocumented processes; lack of process documentation	☐ Document as-is processes during the project preparation phase ☐ Develop process swim lanes (a diagram that shows key processes, decisions, and handoffs) ☐ Review processes with key staff; agree on the desired procedure, document it, communicate it to others, and provide training/coaching to enforce compliance

(continued)

Table 3.3 (Continued)

12. Lack of analytic skills	☐ Identify skill gaps and address them as part of the project preparation phase ☐ Provide training ☐ Change team members to strengthen the team's ability ☐ Adjust the project schedule to reflect a more realistic pace ☐ Engage consultants and subcontractors to support project ☐ Use the project as an opportunity for employees to learn skills needed to support the system post go live
13. Difficulty visualizing "a new way of doing things"	☐ Provide training; educate staff and expose them to other ideas. Talk with other utilities – consider site visits. Attend conferences ☐ Keep an open mind ☐ Embrace the vendor and consultant's views ☐ Solicit best practice advice ☐ Develop to-be process swim lanes and document ☐ Get involved in testing of the solution
14. Staff lack a comprehensive systems understanding	☐ Have staff take the implementer's functional and technical training ☐ Embrace vendor and consultant support ☐ Select team members who have a desire to learn and will keep an open mind (honor skills and attitude, not seniority or position) ☐ "Walk" the process, so that team members understand the entire process ☐ Have team members visit operational areas they are not familiar with to increase operational understanding
15. Decisions based on opinions, not data	☐ Ensure decisions are based on the objectives outlined in the business case ☐ Review best practices to support effective decision making ☐ Adhere to the defined business requirements for the project ☐ Analyze internal data to support decisions ☐ Utilize vendor/consultant experience ☐ Consider multiple alternatives; use a comparative analysis ☐ Ensure the right people are involved in making the decisions
16. Desire to go into greater detail than required	☐ Bring people back to the goal and purpose being discussed – keep them on track ☐ Table discussions and assign for follow up. Review the "Parking Lot" to ensure people have confidence their concerns will not be ignored ☐ Use quantitative data to support deeper analysis as needed
17. Lack of attention to detail	☐ Use standard templates and methods to enforce detail ☐ Provide feedback as soon as the error is discovered ☐ Address chronic issues

(continued)

Table 3.3 (Continued)

18. Poor quality of data in current system	☐ Work with the vendor, project team and consultants to identify where data quality is an issue ☐ Address inconsistent use of fields through training and feedback for people using the current system so that additional data issues are not created ☐ Develop a list of data issues and reports that can be used to identify them. Consider converting only data that is *required* for effective implementation of the new CIS
19. Maintaining momentum and focus	☐ Structure the project plan with detail and communicate plan to entire team. Update the plan and re-communicate the status on a monthly basis ☐ Structure the project to be deliverable and milestone based ☐ Have project deliverables and milestones early in the project ☐ Celebrate accomplishing every milestone
20. Internal process delays	☐ Identify likely delay issues when planning the project and incorporate schedule contingencies into the project ☐ Identify the cause of the delays and resolve the issues ☐ Communicate project activities and deadlines well in advance of the deadline ☐ Establish intermediate tasks and check-ins to confirm progress is being made ☐ Delays should be escalated to the appropriate stakeholder when the Project Manager cannot resolve them ☐ Assess the impact of a delay to the critical path ☐ Look for opportunities to remove items from the critical path
21. Achieving true consensus	☐ Provide training on what consensus is ☐ Work to achieve consensus through open communications, recognizing that consensus is not always possible ☐ Clearly document who is responsible for decisions when consensus cannot be reached ☐ Establish ground rules for making decisions
22. Lack of documented decisions	☐ Establish and use a method to document and communicate issues, action items and decisions ☐ Assess impact of decisions on time, resources and budgets ☐ Maintain a decision log. The log should include the decision to be made, issues around the decision, person responsible to "work" the decision, timeline for decision being made, and status of the decision ☐ Hold weekly meetings to monitor and report on decisions ☐ Implement a project document library that can be accessed by all team members

(continued)

Table 3.3 (Continued)

23. Unwillingness to change policies or administrative regulations	☐ Clarify if the policies are legal, regulatory, or historical ☐ Discuss the impact the policies might have on the customer, the workload, and the project budget/schedule ☐ Raise concerns to the Steering Team for decision
24. Timely acquisition of hardware	☐ Look at project plan and assess when hardware will be needed. Work with IT, procurement and vendors to make sure it is available as needed and complies with required standards
25. Team fatigue	☐ Structure the project with enough time and resources ☐ Monitor effort during the project. If there is a lot of overtime early in the project this is a red flag ☐ Celebrate success early and often ☐ Develop a graphic showing project progress so people can see they are moving forward ☐ Acknowledge that project life is different from the "normal" day-to-day life the team members are used to
26. Scope creep	☐ Allocate contingency budget and schedule to handle unforeseen items ☐ Enforce a strict change control process to evaluate all changes once deliverables have been approved ☐ Adhere to requirements ☐ Identify the impact of proposed changes to the schedule and budget ☐ Defer until the next phase if possible
27. Numerous software modifications	☐ Enforce a policy to use the products as designed and change the business processes ☐ Assess the proposed modification to understand the reasons, impact on software functionality and business process ☐ Work with the vendor to get the modification included into their core product ☐ Require advance approval by a change control board (often the Steering Team) ☐ Allocate resources for approved modifications. They may not work as desired initially, so often require additional testing time
28. Project complexity exceeds vendor's skill and experience	☐ Vendors with a good track record, but inexperience with the complexity of work required, can get in over their head. Examine the vendor's project portfolio for projects of similar complexity ☐ Supplement the team with additional highly experienced project leadership and/or resources

(continued)

Table 3.3 (Continued)

29. Poor definition of interface requirements	☐ Use a cross-functional team to define and review the requirements ☐ Walk through the interface functionality with the Project Team several times. Develop flow charts, swim lanes, and other graphics to support an understanding of the work flow. Do not assume the workflow will always result in the desired outcome – make sure the interface requirements include all variations ☐ Use standard templates to define interfaces
30. Configuration change control	☐ Develop and enforce a clear configuration management plan ☐ Communicate and train staff on using and enforcing the plan ☐ Communicate expectations with the vendor ☐ Escalate as required
31. Staff does not understand core product architecture	☐ Send core staff to vendor training ☐ Have additional training material for review ☐ Have project specific training ☐ Plan for remedial ("supplemental") training as part of the contract ☐ Include ongoing training and support as part of the vendor contract
32. Staff is unable to achieve desired competency	☐ Hold working sessions to explain topics with supporting handouts ☐ Train project staff and end users as these items are identified; maintain a log of new concepts and incorporate them in the organizational change management plan ☐ Monitor adoption of new ideas early and often in the project ☐ Plan for remedial ("supplemental") training as part of the contract ☐ Repeat training for complex ideas until desired competency is achieved ☐ Involve operations in testing of the solution
33. Public not informed about payment channel changes	☐ Incorporate outreach to changes to the public through the external communication plan ☐ Have a multi-channel strategy to communicate changes to the public
34. New problems continually discovered after cut-over	☐ TEST, TEST, TEST and TEST prior to go-live. Tests should include all scenarios, account types, rate variants and billing cycles ☐ Use test management software, including automated testing as possible ☐ Plan for ongoing vendor and consultant support during stabilization. Include this in the RFP ☐ Revisit testing procedures and test data; confirm results. Analyze every anomaly to understand the root cause ☐ Confirm new operational process flows are being followed properly, and that jobs are being run in the required sequence ☐ Confirm that change control procedures are being followed

(continued)

Table 3.3 (Continued)

35. Post go-live operational challenges - call volume spike and call duration increase	☐ Expect and plan for this to happen; add staff temporarily (with enough time to receive training) to support the desired response times ☐ Examine business processes to minimize the impact to customers around go-live ☐ Consider turning off the collections stream short-term ☐ Phase in new customer channels post go-live ☐ Set up scripting for common customer inquiries ☐ Identify call types taking the longest time to resolve – provide additional training or explore additional workflow automation ☐ Defer or minimize bill image changes in conjunction with go-live

WARNING SIGNS OF A CIS PROJECT IN TROUBLE

Projects do not suddenly go from successful state to a failed state. There are many indications of trouble along the way. Below is a list of items that serve as warning indicators that a project might be in trouble.

1. A project that starts out troubled because goals, schedule, budget, and staffing are unrealistic, or a because the selected solution does not meet many required core functions
2. Governance of the project has been inadequately discussed, defined or documented, as indicated by:
   a. Lack of an effective project sponsor or champion
   b. Lack of a project charter
   c. Undocumented or informal change requests/change orders
   d. Project goals are not clearly understood
   e. Ineffective or inconsistent decision making
   f. Risks are not being appropriately addressed
   g. Steering Team does not address issues they have been presented
   h. Lack of, or inconsistent, project direction regarding tasks, priorities, timelines, or quality requirements
3. Inadequate budget as indicated by:
   a. Several unpaid invoices from vendor/consultants. This can also indicate an issue regarding performance of the vendor/consultant
   b. A lack of spending analysis against the budget
   c. Project forecasting continually shows the project will be overspent
   d. Scope is being reduced or deferred to stay within budget
4. Schedule slippage in meeting milestone dates
5. Unclear scope including lack of clarity about what items are in scope or out of scope.
6. Quality indicators including:
   a. Poorly defined functional requirements
   b. A configuration that does not reflect agreed-to functionality
   c. Numerous tests that fail to complete
   d. Large numbers of data sets that were not correctly converted

7. Project management issues, including:
    a. A lack of clarity around status
    b. Poor communication with the Project Team, Steering Team, and vendors
    c. Project Team does not know what to do
    d. Meetings are unproductive
    e. People are consistently surprised by requests (for data, decisions, resources)
    f. Issues are known but not addressed
8. Project team issues include:
    a. Not having essential knowledge on the team
    b. The Project Team is not listened to (by the Project Manager, vendors, or staff)
    c. Key project resources are not available as needed
    d. Project Team members have knowledge but do not speak up
    e. Project Team member is often and consistently pulled from the project to work on other projects or to address operational requirements
    f. Project Team member routinely skips meetings
    g. Project Team member consistently asks questions about material that has been previously addressed
    h. Passive resistance, as indicated by staff or supervisors not engaging in making the project successful through their leadership and active participation
9. Ineffective team communications, as indicated by:
    a. Personal issues get in the way of an effective business relationship
    b. The team members are not working in a collaborative manner
    c. The team members are not working in a manner that is solutions focused
10. Vendor performance issues, as indicated by:
    a. Ineffective communications
    b. Lack of pre-planning regarding meeting times, attendees, and desired outcomes
    c. Unclear contract requirements, standards and penalties
    d. Delayed deliverables
    e. Poor quality work products
    f. Unprepared or lack of staff, vendor changes key staff members
    g. Lack of understanding by vendor staff of the scope of work and the contractual requirements
11. Operational staff is not engaged. Potential signs include:
    a. Key operations staff and management do not understand the product architecture, project status, or key decisions and implications
    b. Operational staff do not attend key meetings
    c. Passive resistance, such as the operational staff members repeatedly make commitments and consistently fail to deliver on their commitments

CIS CHECKLIST TO ENHANCE CHANCES OF SUCCESS

The following areas are vital to a successful project:

1. Develop and maintain strong governance
2. Prepare thoroughly for the project
3. Understand staffing impacts and provide additional resources as needed
4. Provide effective project management

5. Provide effective risk management
6. Carefully select and nurture the project team
7. Have a clear project methodology
8. Ensure ongoing, meaningful, operational involvement

Each of these areas is described below. An assessment exercise is provided at the end of this section.

Develop and Maintain Strong Governance

Carefully establish strong project governance. This includes a good executive sponsor, strong Steering Team, and strong Project Manager. If the utility already has a good project governance process in place, leverage that process. Additional recommendations:

1. The Steering Team should include all key stakeholders from a management perspective
2. Monitor and continuously build and strengthen alignment of the utility's governing board, senior managers, middle managers, Project Manager(s), Project Team, and other key stakeholders
3. Establish a fair contract, and refer to the contract regularly. The contract is a business agreement to achieve certain goals. Varying from the contract without detailed documentation and a contract amendment carries high risk
4. Define and enforce clear change control procedures. Every change in the scope, schedule or budget should be documented and go through an approval process. Define this process early, and stick to it. Note that some changes might be no-cost changes; they should still go through the approval process
5. Obtain written approval of key project documents (for example, the project charter, functional requirements, go-live checklist)
6. Educate the Steering Team about their role and responsibilities:
    a. Communicate the vision for the project, which is aligned with the organization and customer service direction
    b. Secure resources and funding for the project, including budgets and resources for contingencies that arise during these types of projects.
    c. Ensure there is an effective and competent Project Manager to lead the project
    d. Empower, trust and support the Project Manager and Project Team that they will execute the executive vision of the project
    e. Accept overall responsibility and accountability for the actions of the Project Team
    f. Make sure that the right people are involved at the right time, in the right role
    g. Make sure that policy issues are addressed as needed. This includes updating polices, creating new policies, or enforcing compliance with existing policies
    h. Lead and support effective change management and organizational communication
    i. Continuously reinforce to the team the desired business outcomes to be achieved as a result of this project
    j. Use the project as a strategy for succession management and skills development
    k. Recognize those in daily operations who are enabling their teammate to participate full-time on the project. They can feel left out

7. Make timely decisions; do not have a pattern of reversing or waffling. Understand the implications of the decisions. Ensure there is enough information to be able to make prudent decisions when needed
8. Engage external stakeholders throughout the project (including unions, and entities and organizations for which the utility provides billing and customer services). Identify key decision points requiring their input, in advance. Educate them on alternatives and implications of decisions
9. Ensure the project receives regular, high quality oversight (from the Project Manager, Steering Team, and consultant)
10. Be clear about the project goals and what the desired business results of the project are. Document them and review them frequently. If the goals change, review the project plan, staffing, timeline, and budget to ensure they are aligned
11. Minimize customizations; instead, change business processes to be in alignment with the new system's capabilities. Be open to changing business rules (and sometimes regulations or ordinances) to simplify complex business processes or to avoid customizations. Focus on the desired outcomes, not the current process for how work is done
12. CIS projects can span multiple years. During this time, key personnel will change, business issues will evolve, and goals may be altered. It is important to develop alignment in the beginning of the project and to continuously maintain and/or recalibrate during the project. Be aware of "project fatigue;" take steps to keep the team fresh. Plan for changes to key staff during this time; do not have a "single point of failure"

Prepare Thoroughly for the Project

Complete the "CIS project readiness assessment list." Address all items that are rated as Somewhat Prepared or Not At All Prepared.

Understand Staffing Impacts and Provide Additional Resources as Needed

Each project phase requires different levels of staffing support. All phases require a cross-functional perspective so that the full Meter-to-Cash cycle is represented from a systems point of view. The level of time required will vary based on the size of the utility. Larger utilities tend to have more complex business rules, which requires more time.

The Steering Team members should spend approximately 5 to 10 percent of their time on the project. The Project Sponsor may spend 15 to 20 percent of their time on the project.

Plan for the Project Manager to spend 75 to 80 percent of their time on the project during the Prepare for CIS Project Phase. The Project Manager should be 100 percent dedicated to the project during implementation.

General project team staffing requirements are shown below:

- The Define Needs and Strategy phase is a short phase (typically one to four months), requiring about 10 to 20 percent of the team's time

- The Prepare for CIS Project phase is highly situational and will vary significantly depending on the specific situation and activities that need to be carried out. The level of involvement could range from minor to being a full-fledged project in its own right
- The Select and Contract phase may last from six to twelve months, sometimes longer. During this phase, up to contracting, some members of the project team will be required for an average of 40 to 50 percent of their time. The time requirement is not steady state. There will be some times when the team must be nearly full-time on the project; other times there will be little for the team to do
- During Implement Core CIS, from the time the selected vendor comes on-site, the project team should plan for 90 percent of their time to be dedicated to the project

The Sustainment and Continuous Improvement phase is really about normal, ongoing operational improvement. The level of effort will vary depending on the specific activities.

Other staffing considerations include:

1. Augment operational staff or have lowered service levels during the project. Augmentation alternatives include using full-time, part-time, retirees, temporaries, and consultants
2. Consider the utility hiring process and timeline; begin hiring well in advance of the actual need for skilled staff
3. Sometimes job descriptions need to be updated as part of this process; ensure enough time in the process to support updating or creating new job descriptions

Provide Effective Project Management

Commit to good project management. Do not start the implementation phase until a good Project Manager is in place. Suggestions include:

1. Select Project Managers who can communicate very well (status, timelines, good news, bad news, etc.) and who both respect, and are respected by, the functional areas. The Project Manager should be directly engaged with the team members (not managed from the office or by electronic communications). This is true for the utility Project Manager, and any vendor Project Managers. The CIS project requires effective, professional working relationships. An effective Project Manager is critical to establishing and maintaining a good team dynamic
2. Bad news does not get better over time. Promptly communicate important news, good and bad
3. Make sure the plan includes contingencies for problems; include time, budget and resources to address the inevitable problems that will occur during the project
4. Get ahead of the impact of this project on related work units and/or agencies (for example, increased work load). Establish relationships up-front. Prepare the leaders of those work units for the impact. Develop tools to discover and communicate status "in the moment" to catch issues as soon as possible, before resolving the issue requires extensive rework
5. Be aware of related and competing projects that might influence the schedule, budget, and resources available for the CIS project. Examples include metering projects,

acquiring other utilities, contract expirations/changes of vendors for supporting technologies, new rate models, and new conservation policies
6. Address issues with the performance of the Project Manager. If the issues are not resolved, do not be afraid to change the Project Manager

Provide Effective Risk Management

Manage risks. Identify them, assess the likelihood and impact of the risks identified, and take proactive steps to minimize or prepare for selected risks. Risk management strategies include mitigation, avoiding, accepting, or transferring the risk. Areas to consider include scope, quality, schedule, cost, contracting/procurement, human resources (including the hiring process, and job descriptions), communications, and integration of the project with other projects. Adjust the project plan to support identified risks that need action. Make small corrections early.

Carefully Select and Nurture the Project Team

Continuously educate and support the Project Team. This should be done as part of project preparation and continue during implementation steps. Developmental areas are often:

1. Systems thinking and business process analysis
2. Streamlining business processes
3. Interpersonal differences and team dynamics, working in groups, handling conflict, making decisions, persuasion, and other "soft" skills
4. Capabilities of current CIS platforms. Opportunities to learn about other systems can include attending related conferences, networking with other utilities, talking with vendors and/or consultants, and using online sources
5. Challenging the status quo

Other recommendations include:

1. Ensure technical resources with familiarity of the current system are available to support the project. They will provide essential knowledge about the functional requirements, and are very important during data migration
2. During implementation, have the Project Team located in a common space that is dedicated to the project. Physically separate the Project Team from daily operations. Expect the Project Team members to report to this dedicated team room, not their "normal" job location
3. Select consultants and vendors with substantial depth in the water industry. While there are many similarities to the electric industry, it is vital that consultants and vendors bring experience in the *water* sector
4. New institutional knowledge is developed as part of the project. Plan for staff to acquire this through operationalizing the project during implementation and post-implementation stabilization; leverage it during the continuous improvement phase
5. Develop one or more customer service "super-users" (or analysts) in the system who are in-house experts on how the system works, and who can carry out minor configuration changes. They will be an embedded coach for the rest of the team. They can identify problems before they become issues, solve problems quickly, and

provide on-the-spot coaching for users. They are a force multiplier for the project and post go-live

Have a Clear Project Methodology

Develop and understand the project methodology in advance. This includes consultant and vendor selection, contract negotiation, data migration, testing, the go-live process, and post go-live transition to the vendor's support team. Recommendations include:

1. Make small corrections early
2. Ensure fundamentals such as business rules, policies, rates, and organizational constraints (which become translated into user permissions) are well understood
3. Consistently refer back to the project goals and desired results
4. Refer back to the RFP, vendor's response, and the negotiated Scope of Work during the implementation. The Scope of Work, incorporated into the executed contract, should directly trace its lineage back through the demonstrations and the RFP to the statement of project goals. If needed, remind the vendors about contractual commitments from the RFP and their proposal, in addition to the negotiated scope
5. Require, and manage to, a detailed implementation plan with the selected vendor and the overall project
6. Consider converting only data that is required for running the new system and for meeting regulatory requirements
7. Phase the project implementation. Focus on core capabilities for Phase 1 and ensure added/new functionality is prioritized for a later phase
8. Test all account types, across the full account life cycle, billing life cycle, and payment life cycle. Test based on scenarios. Use a test management tool to track the status. Consider automating some parts of the testing
9. Carry out some form of parallel testing. A variety of methods can be used to simulate parallel testing, but the key point is to run every transaction from the live system for some period of time, in the to-be system. Compare results and understand every discrepancy
10. Develop a detailed go-live plan that incorporates all aspects of the go-live (CIS cutover, other vendor activities, facilities changes, communications protocols and timing, etc.)
11. Execute a dry run of the go-live plan, and resolve issues that were found. It is imperative that key stakeholders and management understand the specific steps that are their responsibility
12. Plan for a post go-live stabilization period during which employees will continue to gain skills. Ensure the plan includes post go-live support for employees
13. Use a continuous improvement mindset post go-live. Phase in functionality that was deferred as part of the core go-live project and rigorously manage the follow-on phases using the advice above. Have the vendor assess how the system is being used approximately one year after implementation

Ensure Ongoing, Meaningful, Operational Involvement

Have strong, continuous engagement from the functional areas (call center, metering, billing, adjustments, printing, payments, and accounting/finance) as well as IT. Other recommendations:

1. Define a formal communication plan that identifies stakeholder groups with associated frequency, type, and depth of communication. Once defined, work the plan; adjust it so that it stays current and effective
2. Communicate about the project status to the operational staff that is not directly involved in the project. Provide monthly updates; inform people about major decisions as they are made, update them regarding the schedule, answer their questions, and provide them information for questions they get asked
3. Ensure the line staff is very familiar with the system prior to go-live. Just doing formal training prior to go-live is not enough. This may be accomplished by having line staff work in the system for 30 to 60 minutes/day (in addition to their "day job") during configuration and testing, and providing scripts to follow. Another idea is to have simulated calls, using actual call data, and carry them out on the new system in a practice environment. Staff will need substantial time to become very familiar with the system prior to go-live. *One or two weeks of training is not enough*
4. Do not underestimate the shock to the functional staff in terms of new capabilities and responsibilities; make sure the change management plan addresses this. Often the legacy system has been enhanced over the years in a manner that insulates the customer service staff from needing to understand core workflow issues related to the Meter-to-Cash function. As a result, they often do not have the skills or discipline required to manage a system with many timing interdependencies, yet the new CIS and redefined roles and responsibilities will likely require this capability
5. When daily processing errors occur, it is vital to recognize them before many bills are sent to customers. Understanding the business process flow, and how the system architecture accomplishes that flow, is vital when implementing a new CIS. This is sometimes a threatening and stressful new responsibility to the customer service staff. Provide training on recognizing issues, analyzing the root cause, and reversing the processing errors. Ensure the vendor is available to provide timely and quality support

CIS PROJECT HEALTH ASSESSMENT

This assessment should be reviewed during the initial activities of Phase 2 (Prepare for CIS Project), Phase 3 (Select and Contract) and Phase 4 (Implement Core CIS). In addition, consider conducting the assessment at key points during the implementation. The assessment is most effective when multiple perspectives are incorporated. Consider conducting the assessment in a workshop with people who have a good working knowledge of the status of the project. At a minimum, the Project Manager should carry out the assessment with one or more people who are very involved in the project. In some organizations, it might be most effective to conduct it anonymously with a trusted third party assembling the results for further discussion by a larger group.

Those involved in the assessment should review and discuss each area using the description provided in this Chapter to trigger discussion. Once the group has discussed each area, each person

should rate the areas using Table 3.4 as a guide. They should also document comments that support their assessment.

For each area, rate the following items:

- Strong. This area is doing well and needs no special attention
- Acceptable. We could improve here and there, but there are no overriding concerns that will jeopardize the project
- Weak. We are lacking in a number of areas. If there is a plan in place to address the weaknesses, they have not yet been effective
- Seriously lacking. One or more areas are seriously deficient, with no plan to address the issues

After each item has been rated by each person, the group should have a discussion of the ratings. For those areas that are not deemed to be "Strong" or "Acceptable," develop remedial steps that will strengthen areas needing attention.

Table 3.4
CIS project health assessment

Area	Strong	Acceptable	Weak	Seriously Lacking
1. Develop and maintain strong governance				
2. Prepare thoroughly for the project				
3. Understand staffing impacts and provide additional resources as needed				
4. Provide effective project management				
5. Provide effective risk management				
6. Carefully select and nurture the project team				
7. Have a clear project methodology				
8. Ensure ongoing, meaningful, operational involvement				
9. Review "Warning Signs of a CIS Project in Trouble"				

CHAPTER 4
WATER UTILITY ADVANCED METERING SYSTEMS

This chapter provides a summary of secondary research findings from the water sector, includes a summary of experiences from the electric sector, provides current and emerging trends related to water AMS, addresses organization considerations for an AMS project, discusses typical AMS project phases, and provides advice on preparing for an AMS project. Additionally, it addresses AMS challenges and potential remediation tactics, provides a list of warning signs to detect an AMS project in trouble, and includes a checklist to enhance chances of a successful AMS project. Lastly, an exercise to assess the health of an AMS project is provided.

AMS SECONDARY RESEARCH FINDINGS – WATER

Secondary research was conducted through information available in the public domain, including conference presentations, industry publications and the Internet. The result of this research is summarized in this section.

Water Sector AMR and AMI Adoption

The water sector is still in the early phases of adopting advanced metering systems. About 14 percent of North American water utility customers have AMI or fixed-network systems (Stocker 2015). Estimates of adoption in the North American water market vary. It is clear that the fixed-network AMI market is growing, as shipments of smart meters to North American water utilities have grown from less than 500,000 per year in 2005 to nearly 3,000,000 per year in 2014 (Stocker 2015). Another estimate stated that by 2015 there would be 65,000,000 smart meters operating in the U.S. (Mohassel, Fung, Mohammadi, and Raahemifar, 2014).

A number of utilities are purchasing meters with AMR or AMI capabilities, but not necessarily implementing AMR or AMI at the time of the purchase. This will enable them to use their installed meter base when they do actually implement AMR/AMI. In the Water Research Foundation publication, *Advanced Metering Infrastructure: Best Practices for Water Utilities* (Schlenger, Hughes, and Green 2011), it was reported that "almost half of all North American water meters were *equipped* with AMR or AMI devices, under contract for conversion, with many large and small projects underway (italics added)." IDC Energy Insights reported on April 24, 2013 (Muallem 2013) that "Badger Meter estimates over 70 percent of [water] utilities have yet to convert to AMR/AMI providing an untapped market opportunity. As such, the company expects that water meter replacement and the adoption and deployment of new technology will compose a growing share of water meter product sales." The U.S. provides the largest market for fixed network AMR systems. While more utilities have implemented AMR in the past, there is a shift underway toward AMI.

As conservation issues become more urgent, advanced metering systems will become more attractive to utilities striving to better manage water demand and meet conservation regulations.

A recent study indicated that water utilities are changing their meter reading system at an average age of 8.2 years, more frequently than the commonly referred to 20-year life expectancy (Vollrath 2015). This implies that utilities are beginning to adopt newer meter reading communications technology and analytics more rapidly, as new capabilities and benefits develop.

Additional reports of interest are listed in Appendix E: Related Reports.

Potential Benefits to Water Utilities Adopting an AMS

Early adopters have more experience with modern AMI/AMR systems and are obtaining benefits beyond simply automating the reading of meters. Benefits will vary based on the specific utility situation, as well as the specific technology adopted. Utilities who have implemented AMI/AMR typically start with basic data collection related to billing. Over time they hope to realize the proposed benefit of advanced data analytics that results in behavioral change and transformation of customer relationships. However, these benefits are often difficult to quantify.

Potential benefits of implementing an AMS include:

1. Eliminating the great majority of estimated reads, customer leak investigations, and truck rolls for move-in/move-out reads
2. Eliminating meter reading errors
3. Changing the nature of conversations with customers. For example, utilities can respond to customer complaints about high bills with data showing actual consumption patterns and spikes. This leads to faster resolutions, fewer bill adjustments, and increased speed-to-revenue
4. Enabling more frequent readings with little incremental cost
5. Enabling custom billing dates
6. Enhancing customer service through providing automated alerts regarding consumption levels
7. Aiding in rate design, and enabling more sophisticated rates that closely track conservation program participation
8. Reducing meter reader injuries and injury-related costs
9. Proactively identifying on-premises leaks, as well as leaks in the distribution system
10. Creating "virtual meters" and understanding the distribution system health
11. Enabling improved demand forecasting
12. Reducing customer demand for water as they become more aware of their consumption, particularly in water-constrained areas
13. Identifying meters that are not recording properly (due to equipment failures or unauthorized bypassing)
14. Analyzing consumption across similar industries (for example, laundromats) to identify wrong-sized meters or other metering issues
15. Identifying flow rates that exceed the meter warranty
16. Identifying over-irrigation situations
17. Identifying meters that are early in the failure process
18. Reducing carbon footprint due to fewer miles driven
19. Increasing revenue due to better meter registration and the ability to detect leaks, at the same time that operating costs are reduced

Potential Challenges to Water Utilities Adopting an AMS

While there are a number of potential benefits to implementing an AMS, there are also many challenges, including:

1. Struggling to show a positive cost/benefit justification based purely on reduced meter reading costs. Depending on the size of the utility, a fully deployed and functional AMI system can take years and tens of millions of dollars to complete. Developing a positive return on investment or other purely financial cost/benefit analysis can be challenging
2. Depreciation rules that mean some obsolete meters may need to be replaced before they are fully depreciated
3. Managing contractors, and ensuring that all aspects of every installation are correctly configured (e.g., notifying customers in advance of the AMS work to be carried out on their account, the old meter reading is collected and applied to the right address, and the new meter is configured with the proper unit of measure)
4. Ensuring an effective procurement process is used, including thorough specifications and expectations in the RFP
5. Developing and implementing a process to monitor battery status and replace failing or dead batteries
6. Replacing physical observations of deteriorating meter environment by meter readers as they did their routes with some other method
7. Lack of interoperability on the part of meter and AMS vendors, as well as the technologies being used. This leads to an extremely high cost of switching vendors
8. Effectively using the increased data for more than just billing
9. Preparing for the technology and business process changes
10. Educating customers and addressing their resistance to installing radio frequency (RF)-based communications on their premises, which negatively impacts the business case because it means the data cannot be collected automatically
11. Preparing for the workforce changes (potentially fewer jobs, different skills)

Water Utilities Desire AMS Standardization

There are currently no AWWA standards for AMR or AMI although there is a strong desire on the part of many water utilities for standardization. The WRF report *AMR/AMI Standardization for Drinking Water Utilities* (2016), provides an overview of AMR and AMI systems, identifies requirements or specifications for AMR/AMI standards preferred by water utilities, and provides recommendations to develop standards that map to these requirements. The AMR/AMI standardization project has identified that interoperability of metering equipment is a significant driver for standardization, particularly between transmitters to data collection devices from various vendors. High priorities include a focus on the data transmitter (endpoint) robustness; wireless spectrum availability, data collection reliability and speed; and data management related to using the data generated by the utility and the customer, during and after the contract. A group of utilities is continuing to explore opportunities within the water industry, including developing standards, further developing relationships with water industry organizations, and working with vendors.

Implementing an AMS Has Impacts Beyond Simply Metering

Successful AMS implementations (particularly AMI implementations) create new roles and responsibilities. Data collection, storage, and advanced data analysis is driving the creation of new companies and new industries. Organizations are hiring data scientists and in the electric sector, terms like behavioral science and data science are becoming part of the nomenclature.

Additionally, network management, leak detection and water theft management all require skills that may not have been previously utilized in a water utility.

Implementation of AMS represents an area of significant change for water utilities. These systems require significant planning, careful implementation, and significant investment. The implementation will touch every customer of the utility as well as a number of cross-functional areas within the utility. While technology and software continues to improve, executing the fundamentals of project management minimizes the risk of AMS implementations.

AMS SECONDARY RESEARCH FINDINGS – ELECTRIC

There is a tremendous amount of material available related to the smart grid and AMI as they relate to the electric utility industry that can be applied to the water industry. Electric utilities have made, and are continuing to make, major investments in the smart grid. Under the American Recovery and Reinvestment Act of 2009 (ARRA), the U.S. Department of Energy (DOE) and the electricity industry have jointly invested over $7.9 billion in 99 cost-shared Smart Grid Investment Grant (SGIG) projects.

The definition of a smart grid is still evolving, however AMI is a key component (Mohassel, Fung, Mohammadi, and Raahemifar, 2014). In a smart grid, AMI establishes communications with the "load" or customer, and provides time stamped system information related to consumption. This information is used to improve distribution operations, which in turn then enables utilities to improve operations and provide customers with choices. These are all inputs into advanced asset management in terms of operating efficiency and asset utilization (Mohassel, Fung, Mohammadi, and Raahemifar, 2014). Applying this concept to the water sector, AMI can be a key input into advanced asset management for water.

AMI is a configured infrastructure that integrates a number of technologies to achieve its goals. The infrastructure includes smart meters, communications networks, meter data management systems, and a number of other software applications (Mohassel, Fung, Mohammadi, and Raahemifar, 2014). However, the single largest category of cost to deploy AMI is labor. According to Mohassel et al., overall costs for deploying and electric AMI system were:

- 45% for end-user equipment cost
- 20% for network hardware
- 15% for installation
- 11% for management
- 9% for IT

In 2012, the Department of Energy (DOE) conducted an analysis of initial results of investments in the SGIG Program, funded as part of ARRA. The analysis summarized operations and maintenance savings from AMI projects at 15 of the 99 funded electric utilities. These projects represented more than 3,500,000 smart meters. Results are shown in Table 4.1 below.

Table 4.1
Initial Results from AMI Projects (U.S. DOE 2010)

Meter O&M Savings Metrics	Range of percent Improvements
Change in meter operations cost	-13 % to -77 %
Change in vehicle miles driven, fuel consumption, and CO_2 emissions	-12 % to -59 %

Adapted from: U.S. DOE 2012

Other findings included:

- Cost reductions and productivity improvements observed to date are primarily related to reductions in labor and vehicle costs from remote meter reading, and automation of other billing-related services
- Projects that have completed deployment of their AMI systems generally observed larger cost reductions than those that have not yet completed deployment
- Of the projects that have completed deployment, the ones with lower customer densities per distribution line-mile observed larger savings per customer service than those with higher customer densities
- Several of the projects had prior experience with the deployment of AMI and its integration with legacy systems. Having previous experience has been beneficial for these projects in getting AMI to operate properly and with a minimum amount of delay, including having fewer customer and systems integration issues (U. S. DOE 2012)

Electric Industry AMI Adoption Barriers

Another analysis of AMI was conducted for the U.S. DOE by the National Energy Technology Laboratory in 2008. They found several barriers to successful AMI deployment, including:

- Business case requirements. Limiting the AMI benefits analysis to just electric utility operations biased the business case against deployment. A more complete societal business case often provides a different conclusion
- Depreciation rules. The accounting treatment of the value of in-service meters is a barrier. In most cases it will be necessary to replace obsolete meters before they have been fully depreciated
- Standards. There is a lack of interoperability among many AMI offerings. This can cause stranded investments if a selected vendor fails, or can force being locked into a particular vendor due to the installed base
- Education. Consumer education continues to be needed
- Technical resources. Utility and vendor technical staffs have been cut over the past decade; their skills are required in order to fully realize AMI's potential (U.S. DOE 2008)

Customer Participation Lessons Learned

Another 2014 SGIG analysis for the U.S. DOE documented lessons learned from customer participation in the smart grid (U.S. DOE 2014). Key findings were:

1. Customer education strategies are vital. These projects are complicated, and present a substantial learning curve to customers. Utilities must dedicate sufficient resources to the trial-and-error of the education process. It is essential to clearly notify customers of billing status if they are on pre-payment plans or when critical peak events occur. The most popular and effective means of notification is cell phone text messaging. There is no one-size-fits-all strategy for customer education. Methods include text messages, emails, mobile applications, web portals, telephone calls, bill inserts, and social media
2. Community outreach and public meetings are important. Particularly in the early stages of smart metering deployment, it is important to educate local officials about the utility's plans, and to hear feedback from the general public on issues and concerns. Early outreach improved overall community approval and meter adoption
3. Call centers, web portals and customer devices provide customers quick access to information about consumption and costs. Customers want rapid and often self-guided access to the information they desire. Customers generally like their in-home devices, and manufacturers are rapidly making changes as the industry learns more about what features are desired

CURRENT AND EMERGING TRENDS RELATED TO AMS

Several current and emerging trends specific to AMS (both water and electric) were identified through secondary research.

Customer Experience and Engagement

Some utilities and vendors are developing phone-based applications that enable customers to directly monitor their own consumption. The customers can configure alerts, receive notifications, see how their usage compares to others "like them," and get feedback on conservation efforts. As Todd Arnold states, *"…consumers increasingly want it all – and they want it now. … On a mobile application, they expect an A[verage] S[peed of] A[nswer] of immediately, an average handle time of a few swipes of the finger, and a first-contact resolution of 100 percent." (Arnold 2015)*

Off-Premises or Cloud Computing

Cloud computing allows utilities to move CIS and supporting systems such as IVR/ACD, payment processing and MDMS off-site, often to the cloud. These solutions are maturing and there are many more choices available. Many vendors now offer off-premise solutions, often using Software as a Service (SaaS) solutions. This transfers some technology system administration activities from the utility to the vendor's solution provider.

Home Area Networks/Home Automation Network (HANs)

A HAN includes the communication network from the meter to devices inside the home. Most HAN traffic occurs between the meter and the display inside the home, and the devices that are being monitored or controlled. The relationship of a HAN with other smart devices is still developing. Examples include the ability to monitor garage door openings and closings, lights, security cameras, keyless locks, temperature controls and more. These systems are starting to include water-related devices such as sprinkling systems, dishwasher usage, and showerheads. As consumers become more comfortable with such concepts they will become more aware of their real-time water consumption. This could expand into increased expectations for real-time leak detection and timely communications on the part of water utilities.

Internet of Things (IoT)

Smart meter and networking vendors are moving to the interconnected world. They are starting to use communications networks to connect other objects such as street lights, thermostats, HANs, pool pumps, water heaters, and so on. As sensor costs are reduced and more sensors are deployed on more devices, the fabric of interconnected devices will become more complex and more pervasive. This also means that vendors are starting to merge and acquire additional capabilities (for example, advanced analytics, predictive data sciences, and customer portals).

This leads to the concept of the "smart water network," a vision in which the status of the water grid is known in near real-time, and actions are taken to proactively address emerging issues – analogous to the smart grid of the electric industry.

Metering Analytics

Vendor-based analytics products are becoming more common. These products allow utility staff to analyze metering information, and may also provide a customer portal enabling customers to monitor their water consumption patterns. The advantage of these systems is that they can be enabled to notify customers of water consumption exceptions (as predefined). This presents great opportunity but also requires analysis and planning regarding system integration issues as well as business processes. Often these solutions include automated workflow and scripting components, introducing further complexities into the overall utility information technology architecture. Utilities are still struggling with how to use the vast amounts of data provided by AMS.

Security

There is increasing concern over privacy, particularly as it relates to consumer profiling. This could be used to estimate how many people live in the house, the time they are home, the type of appliances they have, and other personal patterns.

More Complex Information Technology and Operational Environment

In a smart grid environment, the complexity of operations increases dramatically across a utility organization. To obtain many of the potential benefits, AMI requires a multi-disciplined and cross-trained workforce including field crews, customer service representatives, distribution and

production staff, IT, and engineering. Utilities are struggling to acquire staff with deep experience and increasingly complex analytical capabilities.

Time-of-Use Water Metering

There is a desire on the part of water and energy utilities to work together to reduce water demand during peak electricity demand times. A study prepared for the California Energy Commission (House 2010) found promising results on the part of residential customers when they were provided time-of-use water data during peak electric demand periods, and asked to minimize their water consumption during these periods. Residential customers reduced their on-peak water usage by more than 50 percent compared to a control group. However, business groups and irrigation customers did not change their consumption patterns.

ORGANIZATIONAL CONSIDERATIONS FOR AN AMS PROJECT

Some general organizational impacts of AMS and CIS projects are identified in Chapter 2. In addition to these considerations, there are specific considerations for AMS projects. They are addressed in this section.

Typical AMS Project Staff Involvement

While the bulk of the selection and implementation work relates directly to the AMS itself, AMS projects (particularly AMI) can provide very large amounts of data that will impact more than just meter reading, bill calculation and customer service. The new data provided by these systems will enable other areas of the organization (e.g., engineering, distribution) to carry out new analyses to support capital investment decisions and required maintenance work. As a result, during the project it is beneficial to involve employees in sections/departments beyond meter reading (or field service) in order to educate them about benefits and opportunities the new system will provide, and to plan proactively to address challenges. Utility sections that should have some level of staff involvement during the project are:

- Meter reading/field service. They will use the new system and must be very familiar with it. This includes the maintenance of the meters, MIUs and related gear
- Billing. High/low exceptions will be analyzed differently; the billers need to understand this
- Information Technology (IT). They are typically responsible for planning and implementing the technical infrastructure including data communications, security, and integration to other systems
- Contact/call center. This section will have very different and effective tools for addressing customer complaints
- Facilities. This section will be involved in identifying locations where the data communications devices (collectors) and ancillary equipment might be located
- Conservation. An AMS provides new tools to analyze water consumption and enforce conservation measures
- Public Communications. Educating customers about the benefits of the new system and the project impacts is important

- Human Resources. The workload, job descriptions, and training requirements will change
- Procurement. The process for selecting and implementing the systems and the associated construction and project management services must be determined
- Engineering. Hourly data will be available for use in various engineering models, enabling far more precision
- Distribution. Targeted analyses of water leakage will be possible on a more ad hoc basis
- Production. Seeing consumption on a more near-time basis will allow Production to be more responsive when there are sudden unexpected changes

Some utilities implement the AMS with existing staff; others contract with implementation contractors. Regardless, members of the implementation team should include representatives with a solid understanding of:

- The current meter reading process
- Meter installation and repair (both residential and commercial)
- Billing
- IT
- The work order system

Team membership should be determined based on the person's understanding of the current situation, ability, interest and aptitude, not on seniority.

External Project Communications

Public communications should also be involved during the first phase of the project. It is important to develop proactive communications messages for customers who will be receiving the new metering system. It is also important to monitor ongoing communications from the public to ensure the utility meets and exceeds customer expectations.

Every customer will be affected by this project. It is essential for utility management to meet with public officials (City Council members, Commissioners, etc.) once the project has been approved. This provides them with the opportunity to be publically supportive of the project, and prevents them from being caught unaware of the project. One-on-one meetings will help in:

- Demonstrating how the system works
- Walking through the meter reading process and AMS implementation
- Explaining why leaks might happen and how they will be handled
- Providing important contact information

It is also beneficial to meet with Home Owner Associations, community and business leaders, civic organizations, and other groups that may lend support to the project and can help inform the community.

Customers should be notified of the project, both how it will benefit them and what they might experience with the meter change-out. Many utilities mail a letter to each customer at the beginning of the project and then again just before work begins in their neighborhood. Some

utilities also create a door tag to be placed after the installation is complete. There should also be information available on the utility website including where to obtain additional information. Providing abundant information can help reduce phone calls throughout the project.

Workforce Impacts

An AMS will change some duties and eliminate other duties, in some cases eliminating an entire position. Although there will still be a need to obtain readings that fail to transmit or where there is damaged equipment, a full staff of meter readers will no longer be needed as there will be far fewer service orders to obtain meter readings. Some utilities have found that the number of telephone calls decreased considerably after an AMS is installed, resulting in a need for fewer call center positions.

New skills such as testing, configuring, and installing meter interface units will be needed. For an AMI, the fixed network infrastructure must be maintained and will require occasional troubleshooting. Human Resources should be aware of the changes so they can prepare accordingly.

Recommendations to prepare for the upcoming changes include:

- Where a vacant position will be eliminated following the project, fill it with a temporary employee. The temporary employee would not have the expectation that the job was permanent
- Involve Human Resources early. This includes analyzing employees' skills to help match them to a new position, addressing changes in position descriptions, addressing union issues, and addressing compensation issues
- Develop training classes to help employees develop or enhance skills so their talent and knowledge can be used in other areas of the company
- In order to reduce employee fears, some utilities commit to employees that no one will be laid off due to the new technology and that anyone who wants a job, will have a job. Communicate with employees frequently. This will help reduce job loss fears and help employees understand transition plans

TYPICAL AMS PROJECT PHASES

There are several key phases that compose an AMS project (Figure 4.1).

Source: EMA, Inc. 2016. All rights reserved.

Figure 4.1 Typical AMS project life cycle

The phases described here are typical although they can vary depending on the utility's situation. Each phase is described more fully below.

Phase 1: Define Needs and Strategy

Clearly identify the business issues to be addressed and the desired outcome. This includes stating the problems that need to be solved and determining the business goals to be achieved. It might include becoming more educated about the possibilities and implications. Some methods to do this are attending industry conferences; talking with other utilities, vendors, contractors and consultants; releasing a RFI to understand the state of the market; and potentially conducting a small-scale pilot. At the outcome of this phase there should be a business case and metering strategy. The business case should address not just meter reading costs, but other benefits to be expected (conservation, customer service improvement, improved understanding of the water distribution system, etc.). At the end of this phase the project should have identified:

1. Clear business goals to be achieved
2. A high-level business case with estimated costs
3. A procurement approach and resources required
4. A roadmap for the project including timeline and key project milestones
5. A strategy for meter replacement as part of the AMS project
6. An understanding of the AMS strategy (e.g., drive-by AMR, fixed AMR, or AMI)

Phase 2: Prepare for the AMS Project

This step is vital, and often ignored, thus causing project delays or rework later. Key activities are to:

1. Establish alignment around the AMS project including what it will and will not include and how it will be phased and funded. Part of this usually involves developing a project charter that includes assumptions, risks, constraints and resource requirements
2. Establish the project leadership team (Project Sponsor, governance structure (Steering Team), Project Manager, Project Team) and if a consultant will be required
3. Understand the meter population. Physically inspect the meters and pits, and validate that data in the system(s) is accurate. Consider:
    a. Total flow through the meter
    b. Age
    c. Type (positive displacement, turbine, etc.)
    d. Sizes
    e. Register type and number of dials
    f. Location
    g. Potential reuse of existing wiring for older technology: remotes or touchpads
    h. Inspecting meters for plumbing issues that will need to be addressed as part of the AMI or AMR project. For example, inspect commercial meters to verify that the valves are in good working order and there is sufficient space to install a new meter
    i. Identify related infrastructure issues/repairs that will be required (e.g., lack of shut off values, collapsing meter vault walls, vault opening too small for meter change, etc.)
4. Resolve issues discovered as part of the previous activities

5. Develop policies for handling issues that will occur as part of the project (customer opt-outs, claims of leakage as a result of the installation, handling meters attached to the incorrect account, discovering accounts with billing errors, etc.)
6. Understand the ability of the current system(s) to handle data generated as a result of the project; develop a strategy to handle additional data requirements
7. Develop a list of facilities (including names and contacts) where field equipment such as the data collectors can be located. Inspect the facilities to validate the condition (power, space, access, etc.); update contact information and willingness to support the project
8. Work with other agencies or departments to develop an understanding of their resources and ability to support the project. This includes those responsible for providing IT and telecommunications system support, as well as Human Resources and external Communications support
9. Refine the project schedule and budget. Include contingency and time required for the procurement process

Phase 3: Select and Contract

Typically, this involves one or more RFPs. Many utilities release two RFPs; one for the AMI or AMR system and one for the meters. If the AMI or AMR system is procured first, then later procure meters that will work with the chosen AMI or AMR.

1. If needed, select a consultant. Depending on the utility's procurement requirements, this may involve an RFP process
2. Put together a cross-functional selection team and provide training. Typical members include the meter shop, field services, customer service, communications and IT
3. Develop a detailed Request for Proposal
    a. Include a propagation study to determine the number of needed data collectors and in what areas of town. Note that a propagation study is only a prediction of needed collector locations
    b. Include the Read Success Rate (RSR) calculation. Develop a scoring methodology and rating sheet; review them with the selection team
4. Evaluate proposals; develop a short-list, conduct reference checks and if feasible, site visits where the proposed system has been successfully implemented
5. Select the solution and negotiate the contract
6. Include a very detailed work plan in the contract negotiations
7. Establish a mechanism for project information control procedures

Phase 4: Implement

This phase involves making sure all of the hardware and software is effectively converted from the old system to the new system, providing proper oversight of all contractors, ensuring that operational changes are in place to use the new system, and appropriately involving the customer base.

1. Test the AMS in a test environment to verify software functions and interfaces are operational, performance is satisfactory and users are trained. The test environment should include data collectors, endpoints and meters as well as servers and networks
2. Carry out a small scale rollout to review and reinforce required procedures prior to beginning the full-scale rollout
3. Carry out and continuously update the communications plan to announce and explain the project to the community, including local officials
4. Work with the contractor to develop an installation schedule, including ordering of equipment
5. Assign one or more staff members to perform quality assurance on work done by the contractor
6. Move into full-scale rollout when all procedures are determined to be fully operational
7. Train the contractor on policies, processes and communications procedures
8. Require the contractor to use digital data management of each installation and to ensure data integrity. Ensure there are checks and balances in place. Common data quality errors include: manual data entry, manual data transmission, manual data validation, missing meter information, incorrect meter information, CIS not being updated correctly
9. Update procedures to reflect the new processes
10. Full-scale rollout. Rigorously validate data related to installations and contractor payments
11. Be prepared to stop the project until new issues that have occurred are addressed. It is less expensive to stop the project than to revisit customer sites and redo the work
12. Be very familiar with the contract; enforce it
13. Carry out a comprehensive communication plan that includes staff, customers, and other stakeholders. Monitor avenues of feedback (e.g., social media, call center, writing correspondence, and other communications channels) to determine where adjustments should be made
14. As sections of the service area are completed and transmitted readings are working correctly, appoint one team member to work with other areas of the utility and "operationalize" the system. Examples include:
    a. Work with customer service staff in the contact center to obtain reads on demand and to interpret the consumption profile
    b. Work with finance and accounting to use the system for rates analysis
    c. Work with the supervisors to provide training and develop customer communication scripts
    d. Work with engineering to ensure they understand the new capabilities of the system and start to use it
    e. Establish a process to meet with non-meter-reading staff regularly to answer questions and reinforce new capabilities
    f. Review routes to pick up readings that have not yet been converted to the AMS. Consider redesigning routes for the short-term
    g. Create a training plan for field technicians to understand how to program endpoints and repair broken or cut wires
    h. Ensure key reports are reviewed daily, weekly and monthly, and appropriate actions are taken

15. Carry out the plan to begin transitioning meter readers to other job duties as the system is installed and the workload justifies the change

Phase 5: Sustainment/Continuous Improvement

Carry out additional phases (for example, advanced analytics, customer self-service, etc.) as planned. Continue to promote new uses of the data.

PREPARING FOR AN AMS PROJECT

Properly preparing for an AMS selection and implementation project has a substantial impact on project success by preventing unanticipated project delays to obtain needed hardware and ensuring timely access to facilities.

It is usually necessary to perform specific tasks (and sometimes projects) to enhance the utility's readiness to undertake the AMS project. This effort can be substantial, and often should be a project in and of itself. An AMS project unlike most others will go live over time, as AMS capable meters are installed and data collectors are mounted and the account transitions from manual read to automated status.

Below, in Table 4.2, is a list of items to consider for readiness. As part of Phase 2 (Prepare for the AMS Project), this assessment should be completed by the Project Manager. Rate each item, with a score of Fully Prepared, Mostly Prepared, Somewhat Prepared, or Not At All Prepared. Address all areas that are not rated at least Mostly Prepared prior to starting the next phase.

Table 4.2
AMS project readiness assessment list

Item	Level of Readiness
1. Key staff is knowledgeable about what the AMS project will involve. This will include IT, billing, Customer Service Representatives, field services, meter services, conservation, communications, and finance. If an AMI system is being installed and data collectors placed on utility structures, facility maintenance should also be included	
2. Project leadership has been established. There is a clear Project Sponsor, the Steering Team membership has been mostly defined, and a strong Project Manager has been identified	
3. The project purpose and expected outcomes have been clearly defined. This involves clearly defining and documenting the business goals of the project, and what is not in the project	
4. Identify meter locations with infrastructure issues and repair. When the AMS contractor finds multiple issues that either slow down or prevent a meter change out, the project timeline and cost could be impacted. Repairing and preparing these locations in advance may be a preparatory project	

(continued)

Table 4.2 (Continued)

Item	Level of Readiness
5. AMS radio signals do not transmit well when in a pit location with a metal meter box cover. If replacing meter box covers with another material, ensure there is a good understanding of the number of lids and lid sizes. This information will have an impact on pricing and the project schedule	
6. Ensure that meter locations are recorded and if necessary marked. This is especially important when there is more than one meter in a pit and when meter boxes are grouped together. It is not always obvious which customer or account the meter belongs to	
7. If large, commercial meters will be replaced, determine in advance if extra plumbing will be required and if the meter vault has sufficient space for the work to be completed	
8. Consider the ability of the CIS system to handle the additional information that AMS requires such as a field to store the endpoint number, installation data, existing field status information, ability to manage inventory by meter serial number, and lack of billing codes and billing multipliers for high resolution meters (meters with dials displaying usage as low as one cubic foot)	
9. A sufficient budget has been established. Items to consider are: a. Consulting costs (to develop the RFP, support or manage the implementation, quality assurance, change management support, and/or staff development) b. AMS vendor's solution (licensing, professional services, travel/expenses, and maintenance) c. Other vendor services (for example, meter change out and temporary meter reading services) d. Staff resources dedicated to the project e. Staff skills development and training to support operational readiness f. Hardware/software for the new AMS system, including items such additional database licenses, reporting tools, additional servers, backup tools, and so on g. Facilities for the team during implementation. The project team should have a dedicated space for the duration of the project. If a mass meter change out is warranted, additional warehouse space may be necessary. Training facilities will also be required	
10. Staffing needs and readiness have been clearly defined and assessed. Items to consider include: a. Defining project roles and participation (Project Sponsor, Steering Team, Project Manager, Project Team, SMEs, and IT support). If there are not clear candidates to carry out these roles, they should be developed, acquired through careful hiring, or by outsourcing for the project duration	

(continued)

Table 4.2 (Continued)

Item	Level of Readiness
b. Preparing the project team for the project. In addition to being familiar with how the AMS project will be done, team members should have the appropriate technical and "soft skills" necessary to support the project c. Assessing staff and leadership capabilities. Augment staff as needed with consultants, contractors or vendors. Ensure the right skills are available when needed. Understand the agency's needs and limitations d. It is vital that all key Meter-to-Cash functions be meaningfully represented during the course of the project, especially during the planning phase. Without input, it is possible to miss valuable benefits. To ensure benefits will be realized, take the time to update and document key Meter-to-Cash processes	
11. The workload impact of the AMS project is understood and resources are available to address it. The workload will increase because of this project. The project will have a major impact on the call center (additional calls), billing (multiple meter change outs), and IT. Additional SMEs will be required from dispatch (leaks and damages during the meter change out), public communications, and sometimes human resources. Choices for addressing this are: a. If a large number of meters are being replaced, consider automating the process in the CIS. Meter change outs can be a time-consuming an error-prone process. Automating that process will save time and avoid errors b. Add project contact information on the bill to reduce calls to the call center c. Add an information page on the utility website d. Implement an IVR so that project information can be automated	
12. Operations management is prepared to support the project, understands the impacts and opportunities, and is prepared to participate in key decisions	
13. It is not unusual to find meters in the field that were unknown and not being billed, or that were not properly configured in the CIS. Create a policy on how to handle these situations	
14. There is a sound understanding of the Meter-to-Cash business processes on the part of the staff that will become the Project Team	
15. Procurement processes are understood so that they can be correctly incorporated into the project schedule. Understand the options, requirements, and timeline required to carry out the various contracts needed by the project	

(continued)

Table 4.2 (Continued)

Item	Level of Readiness
16. Develop a plan to dispose of the old meters. Depending on the planned speed of the meter change out, there may be hundreds of meters removed each day. Salvaged meters have value. There should be a well-developed plan to account for each meter and secure them until disposal can take place	
17. An initial project schedule has been established. The schedule will be successively refined during the course of the project as more information becomes available	

AMS CHALLENGES AND POTENTIAL REMEDIATION TACTICS

AMS projects are challenging projects for a number of reasons. Rather than having one go-live date, an AMS goes live over time, as endpoints are activated. Below, in Table 4.3, is a list of potential challenges and potential remediation tactics.

Table 4.3
AMS challenges and potential remediation tactics

Challenge	Potential Remediation Tactics
1. Decision makers think AMS only replaces meter reading	☐ Ask a few AMS companies to demonstrate the capabilities of a system. Invite decision makers and areas of the utility that may also see benefits from a system ☐ Install a demonstration project that just covers the area near the utility office. Invite decision makers as well as local officials to witness how the system works ☐ Visit nearby communities with a working AMS ☐ Release an RFI ☐ Provide copies of this report and other industry publications to the decision makers ☐ Encourage decision makers to attend industry conferences and attend AMS presentations ☐ Conduct a business case. Document potential goals and business results
2. Lack of money	☐ Create a business case. Consider all benefits, not just metering costs ☐ Explore a variety of financing scenarios ☐ Consider a joint venture with the local electric or gas company
3. Selecting the appropriate technology for the utility needs	☐ The goals determined by the Steering Team and business requirements must guide the technology decisions. Make a chart showing the benefits of each technology compared to the goals ☐ Ensure that key stakeholders for using, supporting, and maintaining the technologies are involved in the decision ☐ Determine which requirements are critical, wanted, and not necessary

(continued)

Table 4.3 (Continued)

Challenge	Potential Remediation Tactics
4. Steering Team disagreements	☐ The Steering Team must have one vision and the same goals for the project. This should be defined and agreed to before proceeding to a project charter ☐ All members should sign the agreed upon charter and refer back to it during discussions ☐ Decisions should be documented and stored in a central "Decisions" log
5. Confusion regarding decisions	☐ Use project management tools to document issues, action items and communicate decisions (a good reference is the PMI's PMBOK ☐ Have one person responsible for maintaining the decision log. The log should include the decision to be made, issues around the decision, person responsible to "work" the decision, timeline for decision being made, and status of the decision ☐ Implement a project document library that can be accessed by all team members
6. Untimely or vacillating decisions	☐ Empower Project Manager to make decisions ☐ Define clear guidelines for making and communicating decisions, and for developing recommendations for a higher authority to consider ☐ Assign dates for decisions and owners of the decision
7. Selecting a Project Manager	☐ Ensure the Project Manager has the appropriate skills (both technical and "soft") to lead the project. Prior experience of a similar nature is valuable ☐ If the desired individual has some but not all of these skills, take time for training before project starts, or ensure someone else on the team can provide appropriate support or engage an external consultant as part of the project team ☐ The Project Manager needs to work well with the contractor but must be empowered to effectively represent the interests of the utility
8. Maintaining momentum and focus	☐ Create and maintain a detailed project plan. Communicate the plan to entire team. Update the plan and communicate the status regularly ☐ Assess impact of decisions on time, resources and budgets ☐ Structure the project to be deliverables and milestone based ☐ Have project deliverables and milestones identified early in the project
9. Poorly run and inefficient meetings	☐ Provide training on effective meetings ☐ Send out an agenda prior to meetings. The agenda should define the purpose of the meeting and the meeting topics ☐ Document decisions in the decisions log ☐ Invite only those needed

(continued)

Table 4.3 (Continued)

Challenge	Potential Remediation Tactics
	☐ Avoid isolated conversations ☐ Assign a facilitator and a note taker ☐ Table items that are not a part of the meeting agenda ☐ Publish minutes and solicit feedback ☐ Do not end the meeting without creating and reviewing an action items list
10. Achieving true consensus	☐ Refer to the project vision, goals, and desired outcomes ☐ Work to achieve consensus through effective communications ☐ Clearly document who is responsible for decisions when consensus cannot be reached ☐ Establish ground rules for making decisions
11. Team members get pulled away from project	☐ Ask Project Manager or the Project Sponsor to state the importance of the project to the team members' leaders from the beginning ☐ Temporarily promote others that can take over daily duties. This is a good practice to prepare others for future opportunities ☐ Backfill positions with temporary employees so daily work can continue ☐ Keep the employees that remain with their daily tasks appraised of the importance of the project and the project status. They are helping to make the project successful too
12. Emotional reactions as vendors are eliminated	☐ Use a qualified consultant to help the vendor selection process ☐ Use a scoring system for vendor selection to minimize emotional attachment ☐ Acknowledge the reactions – do not ignore them. Provide time for discussion. Ensure that logic underlying the emotion is heard and discussed
13. Contract issues	☐ Attach schedule and detailed work plan to contract and make it part of the contract ☐ Do not agree to the contract until it addresses every concern ☐ Include penalties missed deadlines and not meeting quality standards ☐ Contract should include a contractor managed phone number for complaints and scheduling ☐ Include an expected complaint response time and hold the contractor to meeting that time demand
14. Unexpected field conditions prevent AMS gear installation	☐ Investigate field conditions prior to starting the project ☐ Knowing the meter population ahead of time will help to get accurate pricing during contract negotiations ☐ If replacing meter pit lids will be part of the project, getting a count of numbers and sizes will also help control project costs

(continued)

Table 4.3 (Continued)

Challenge	Potential Remediation Tactics
	☐ Assign a field crew to make repairs to vaults and other meter locations so that system implementations can occur smoothly ☐ When more than one meter is in a pit or multiple meters are set next to each other, clearly mark what each meter serves ☐ Ensure other organizations who touch the metering equipment (for example, other Public Works organizations) are aware of the criticality of replacing meters exactly as they were (facing the right direction and returning the same meter to the same property)
15. The customers do not know about the project	☐ Develop a communications plan before starting the project ☐ Create a brand name and logo for the project. This will help make the public aware of it and it builds excitement ☐ Put the project name and logo on utility vehicles and write into the contract that contractor's vehicles must do the same ☐ Create a website for the project to provide information, updates, allow for complaints to be submitted, and if necessary provide a portal to schedule appointments for meter change outs ☐ Place temporary work signs in each neighborhood as work is being performed
16. Customers are wary of letting contractors onto property	☐ Require by contract that contractors must drive identifiable vehicles and wear uniforms ☐ Provide contractors with a project identification tag with a photo ☐ Create a letter on utility letterhead for contractors to give to the customer ☐ Consider showing contractor photographs on the project website
17. Customer high bill complaints	☐ Anticipate this will happen; address it proactively in the communications plan ☐ Make certain the customer service representatives (CSRs) understand that since older meters often under register consumption the new and accurate meter may cause customers to call with high bill complaints ☐ Consider adding information on the IVR explaining why consumption may be high ☐ If a customer portal is available encourage customers to look at their consumption profile ☐ Temporarily use displaced meter readers to proactively identify leaks and meet with the customer to explain the reason
18. Contractor is not following the agreed upon work tasks	☐ Define expectations of engagement with vendor prior to the project beginning ☐ Ensure contract contains penalties for not meeting deadlines or quality standards ☐ Immediately contact the contractor. Insist on immediate fix

(continued)

Table 4.3 (Continued)

Challenge	Potential Remediation Tactics
	☐ Do not hesitate to delay or halt the project. Document the halt and ensure it contains the specific reason(s) for the halt and the conditions that will allow the contractor to resume tasks ☐ Work out a process for the contractor to rework missed steps ☐ Instruct project quality assurance staff to closely check work until contractor has proven compliance ☐ Continue to regularly and randomly check quality assurance after compliance is achieved
19. Internal process delays	☐ Identify potential schedule issues when planning the project; address them through the risk management process ☐ Identify cause of the delay and resolve the issue ☐ Communicate project activities and deadlines well in advance of the deadline ☐ Escalate to the appropriate stakeholder when the PM cannot resolve them ☐ Assess impact of delay to critical path ☐ Look for opportunities to remove items from the critical path
20. Timely acquisition of hardware	☐ Look at project plan and assess when hardware will be needed. Work with IT, procurement and contractors to make sure it is available and complies with required standards ☐ Meter orders are sometimes delayed. Be sure to order them in plenty of time; include this in the contract
21. Manage the shift in meter reader workload	☐ As the AMS is installed, the need for meter readers will decrease. AMS installation is typically done on an area-by-area basis to increase the productivity of installers. If the areas align with meter reading routes, then the time to complete a route can be minimized, allowing staff reductions to be done as early as possible ☐ If doing a full deployment, a utility should expect to displace most of the meter readers as well as some customer service representatives and field service representatives. Human Resources should be involved early in the project to develop a plan for future job and staffing changes and to update job descriptions ☐ Notify unions of upcoming job changes ☐ Work across the organization to identify positions that may become open
22. Scheduling field implementation	☐ Identify sections of the service area to change out in groups. This is usually done by a defined geographical area such as routes Ensure there is a high level of coordination between the contractor and meter reading operations. Consider blackout dates in which meters are not changed out near scheduled reading dates

(continued)

Table 4.3 (Continued)

Challenge	Potential Remediation Tactics
23. Meter reads are not being received	☐ Work with the contractor to assure proper communications system coverage ☐ Determine ahead of time the acceptable RSR ☐ Accept contractor work by defined sections. Do not wait until the end of the project to accept the project in whole ☐ Do not accept the contractor's work until the agreed upon RSR is met

WARNING SIGNS OF AN AMS PROJECT IN TROUBLE

Projects do not suddenly go from a successful state to a failed state. There are many indications of trouble along the way. Below is a list of items that serve as warning indicators that a project might be in trouble.

1. A project starts out troubled. Goals, scope, schedule, budget, and staffing all must be realistic
2. Governance of the project has been inadequately discussed, defined, or documented as indicated by:
   a. Lack of an effective Project Sponsor or champion
   b. Lack of a project charter
   c. Undocumented or informal change requests/change orders
   d. Project goals are not clearly understood. Stakeholders must have a common understanding of the project, vision, goals, and scope
   e. Ineffective or inconsistent decision making
   f. Risks are not being addressed. A risk management plan must be established and managed throughout the project
   g. Lack of, or inconsistent, project direction regarding tasks, priorities, timelines, or quality requirements
3. Inadequate budget as indicated by:
   a. Several unpaid invoices from contractor/consultants. This can also indicate an issue regarding performance of the contractor/consultant
   b. A lack of spending analysis against the budget
   c. Project forecasting continually shows the project will be overspent
   d. Scope is being reduced or deferred to stay within budget
4. Schedule slippage in meeting milestone dates
5. Scope lacks clarity about what items are in scope or out of scope. Indicators include numerous questions about direction, or multiple change requests
6. Quality issues include:
   a. Poor communications
   b. Lack of regularly scheduled meetings
   c. Lack of proper tools and/or parts to complete numerous meter change outs
   d. Unable to read meters consistently
   e. Meter documentation is not accurate or complete
   f. Delayed deliverables
   g. Unqualified or lack of staff

h. Lack of understanding of the scope of work

7. Project management issues include:
   a. Lack of clarity around status
   b. Lack of a formal communication plan
   c. Poor communication with the Project Team, Steering Team, and contractors
   d. Project Team does not know what to do
   e. Meetings are unproductive. A lack of agenda and follow up minutes are an example
   f. People are consistently surprised by requests (for data, decisions, resources)
   g. Issues are known but not addressed
   h. A lack of honesty about the actual project status (covering up issues)
   i. Project Manager with no or limited leadership skills
8. Contractor performance issues, as indicated by:
   a. Contractor arrives at customer location without notice (this is especially important when the meter is located inside of the home or business)
   b. A large number of leaks occur after contractor has changed out meters
   c. Contractor is not following the agreed-upon work steps such as taking pictures or recording GPS location
   d. Meter serial numbers and endpoint numbers do not correspond to records
   e. There are consistent issues with the RSR as defined in the contract
9. Operations is not engaged. Potential signs include:
   a. Customer service representatives are not using data as system goes live
   b. Training sessions are missed

These are all issues that will happen on a project, but when they consistently happen with no improvement noted, it is a red flag. Do not be afraid to stop the project until these issues are resolved.

AMS CHECKLIST TO ENHANCE CHANCES OF SUCCESS

The following areas are vital to a successful project:

1. Develop and maintain strong governance
2. Prepare thoroughly for the project
3. Provide effective project management
4. Provide effective contractor oversight
5. Provide effective risk management
6. Have a clear project methodology
7. Ensure ongoing, meaningful, operational involvement

Each of these areas is described below. An assessment exercise is provided at the end of this section.

Develop and Maintain Strong Governance

Carefully establish strong project governance. This includes selecting a good executive sponsor, strong Steering Team, and strong Project Manager.

1. The Steering Team should include all key stakeholders from a management perspective
2. Monitor and continuously build and strengthen alignment of the utility's governing board, senior managers, middle managers, Project Manager(s), Project Team, and other key stakeholders
3. Establish a fair contract, and refer to the contract regularly. The contract is a business agreement to achieve certain goals. Varying from the contract without detailed documentation and a contract amendment carries high risk
4. Obtain written signoff of key project documents (for example, the project charter and functional requirements)
5. Educate the Steering Team about their role and responsibilities:
    a. Communicate a vision for the project that is aligned with the organization and customer service direction
    b. Secure resources and funding for the project, including budgets and resources for contingencies that arise during these types of projects
    c. Ensure there is an effective and competent Project Manager to lead the project
    d. Empower, trust and support the Project Manager and project team that they will execute the executive vision of the project
    e. Accept overall responsibility and accountability for the actions of the project team
    f. Make sure that the right people are involved at the right time, in the right role
    g. Make sure that policy issues are addressed as needed. This includes updating policies, creating new policies or enforcing compliance with existing policies. are not
    h. Use the project as a strategy for succession management and skills development
    i. Recognize those in daily operations who are enabling their teammates to participate full-time on the project. They can feel left out
6. Make timely decisions; do not have a pattern of reversing or waffling. Understand the implications of the decisions. Ensure there is enough data to be able to make prudent decisions when needed
7. Ensure the project receives regular, high quality oversight (from the Project Manager, Steering Team, and consultant)
8. Be clear about the project goals and the desired business results of the project. Document them. Review them frequently. If the goals change, review the project plan, staffing, timeline, and budget to ensure they are aligned
9. Be open to changing business rules (and sometimes regulations or ordinances) to simplify complex business processes. Focus on the desired outcomes, not the current process for how work is done
10. AMS projects could last several years. During this time, political leadership may change, key personnel will come and go, business issues will evolve, and goals may be altered. It is important to develop alignment in the beginning of the project and to continuously maintain and/or recalibrate during the project. Plan for changes to key staff during this time; do not have a "single point of failure"

Prepare Thoroughly for the Project

1. Complete the "AMS Project Readiness Assessment List." Address all items that are rated as Somewhat Prepared or Not At All Prepared. Allocate appropriate resources (budget, staff, supplemental positions/contracts, schedule, facilities, and management)

2. Engage Human Resources to plan for future changes and potential elimination of some positions. Training classes and skill assessments could be necessary
3. Carry out a pilot or proof of concept project to validate and refine the implementation process
4. Assess staff and leadership capabilities. Augment staff as needed with consultants, contractors or vendors. Ensure the right skills are available when needed. Understand the organization's needs and limitations
5. Document business rules, policies, and workflow in advance of the implementation project. Once implementation starts it is too late for thoughtful consideration and research related to potential policies. Be prepared in advance
6. Research new features and policies the utility plans to implement in advance. Understand choices that may need to be made, and how related utilities or organizations have implemented those items
7. Engage external stakeholders early and throughout the project (including unions, and entities and organizations to whom the utility provides meter reading services). Identify key decision points requiring their input, in advance. Educate them on alternatives and implications of decisions
8. Add basic project information on the bill directing customers of where to go to reduce phone calls

Provide Effective Project Management

Commit to good project management. Do not start the implementation phase until a good Project Manager is in place.

1. Select a Project Manager who can communicate very well (status, timelines, good news, bad news, etc.) and who both respects and is respected by the functional areas, the Steering Team and the contractor. The AMS project requires effective, professional working relationships. An effective Project Manager is critical to establishing and maintaining a good team dynamic
2. Make sure the plan includes contingencies for unexpected problems. Include time, budget and resources to address the inevitable problems that will occur during the project
3. Get ahead of the impact of this project on related work units and/or agencies (for example, increased meter change outs and changing meter numbers). Establish relationships up-front so good lines of communications are created. Discuss the impacts on operations with the leaders of those work units. Develop tools to discover and communicate status in the moment to catch issues as soon as possible, before resolving the issue requires extensive rework
4. Be aware of related and competing projects that might impact the schedule, budget, and resources available for the AMS project. Examples include acquiring other utilities, contract expirations/changes of contractors or vendors for supporting technologies and new conservation policies

Provide Effective Contractor Oversight

Be certain the contractor understands the project schedule and orders parts (and meters, if that is within their scope) early enough to stay on time.

1. Verify that the contractor's employees have passed a background check before working on the utility's behalf
2. Make sure that the contractor understands the agreed upon responsibility to make repairs and make changes to infrastructure
3. Make sure the contractor understands how to handle customers who oppose system implementation
4. Implement a process to ensure work is correctly completed before issuing payment
5. Ensure the contractor (and any sub-contractors) follows the agreed upon workflows
6. Include and use the ability for the utility to approve sub-contractors that the contractor proposes to use
7. Develop an easy process for the contractor to report problems and issues
8. As a last resort, issue a stop work notice to the contractor if there are contract compliance issues

Provide Effective Risk Management

Maintain a risk register. Identify risks, assess the likelihood and impact of the item identified, and take proactive steps to minimize or prepare for selected items. Risk management strategies include mitigation, avoiding, accepting, or transferring the risk.

1. Consider: scope, quality, schedule, cost, contracting/procurement, human resources (including the hiring process, and job descriptions), communications, and integration of the project with other projects
2. Adjust the project plan to support identified risks that need action

Have a Clear Project Methodology

Develop and understand the project methodology in advance. This includes consultant and contractor selection, contract negotiation, the implementation process, and testing.

1. Include carefully defined milestones in the contractors' contract(s). Also include an incentive for the contractor(s) to accomplish quality work. Include the RFP and the contractor's response to the RFP in the implementation contract
2. Ensure business rules, policies, and organizational constraints are well understood
3. Ensure there is a detailed implementation Scope of Work with the selected contractor

Ensure Ongoing, Meaningful, Operational Involvement

Have strong, continuous engagement from the functional areas (call center, metering, billing, adjustments, conservation, payments, public communications and accounting/finance, and IT).

1. Define a formal communication plan that identifies both internal and external stakeholder groups with associated frequency, type, and depth of communication. Once defined, work the plan; adjust it so that it stays current and effective
2. Communicate about the project status to the operational staff that is not directly involved in the project. Provide monthly updates; inform people about major decisions as they are made, update them regarding the schedule, answer their questions, and provide them information for questions they get asked. Remember, many customers will not take time to call but will stop employees they see in the field
3. Sometimes job descriptions need to be updated as part of this process; ensure enough time in the process to support updating or creating new job descriptions. Give HR advance notice; be sure to consider union or civil service requirements
4. Make sure that employees who repair and reset meters receive training to program the endpoints and repair cut wires, and understand the importance of capturing the correct endpoint identification number
5. Often meters that are replaced will register the water flowing through them more accurately. In many cases the old meters were under-registering. Be prepared to handle questions about higher bills
6. Work with the contact center/call center leadership to assure new "scripts" are developed as new capabilities become available for call takers. Keep them well informed regarding the status the AMS rollout and what geographic areas (or customer segments) have been converted

AMS PROJECT HEALTH ASSESSMENT

This assessment should be reviewed during the initial activities of Phase 2 (Prepare for AMS Project), Phase 3 (Select and Contract) and Phase 4 (Implement Core AMS). In addition, consider conducting the assessment at key points during the implementation. The assessment is most effective when multiple perspectives are incorporated. Consider conducting the assessment in a working session with people who have a good working knowledge of the status of the project. At a minimum, the Project Manager should carry out the assessment with one or more people who are very involved in the project. In some organizations, it might be most effective to conduct it anonymously with a trusted third party assembling the results for further discussion by a larger group.

Those involved in the assessment should review and discuss each topic using the description provided in this Chapter to trigger discussion. Once the group has discussed each area, each person should rate each area using Table 4.4 as a guide. They should also document comments that support and describe their assessment.

For each area, rate the following items:

- Strong. This area is doing well and needs no special attention
- Acceptable. We could improve here and there, but there are no overriding concerns that will jeopardize the project
- Weak. We are lacking in a number of areas. If there is a plan in place to address the weaknesses, they have not yet been effective
- Seriously lacking. One or more areas are seriously deficient, with no plan to address the issues

After each area has been rated by each person, the group should have a discussion of the ratings. For those areas that are not deemed to be "Strong," develop remedial steps that will strengthen areas needing attention.

Table 4.4
AMS project health assessment

Area	Strong	Acceptable	Weak	Seriously Lacking
Strong governance				
Proper preparation				
Effective project management				
Contractor oversight				
Effective risk management				
Have a clear project methodology				
Ensure ongoing, meaningful operational involvement				

CHAPTER 5
STATE OF THE INDUSTRY SURVEY FINDINGS

As a part of this project, a survey of North American water utilities was conducted. The objective of the survey was to learn from utilities' experiences with their CIS and with their AMS projects. A related goal was to understand if the CIS findings from the previous 2005 survey were still relevant today.

The survey included several parts:

- Overall utility information (for example governance, services offered, etc.)
- Information about their customer service, and CIS experiences, with the same or similar questions as in 2005. The survey was expanded to ask about utility maintenance of and satisfaction with the CIS
- Information about their meter reading environment, and about their AMR (drive-by and fixed network) and AMI implementation experiences. This section was completely new as the previous study did not address metering

Each section was independent to enable ease of survey completion. There were a total of 150 questions. Prior to implementing the survey, the participating utilities and the PAC members tested the survey for clarity and flow. After incorporating their recommended changes, the survey was distributed to 623 utilities across the U.S. and Canada, including large, medium, and small utilities, with a variety of governance models. Refer to Appendix B for the survey questions.

Not all utilities completed each section. Ninety-nine utilities responded to the customer service/CIS survey; and 85 utilities responded to the metering sections. Responding utilities ranged from small utilities (the smallest billed 618 accounts) to very large utilities, with the largest billing over 800,000 accounts. In aggregate, the respondents produce over 125,000,000 bills and over 1,193,000,000 meter readings annually. Figure 5.1 shows the size of the responding utilities by number of accounts served.

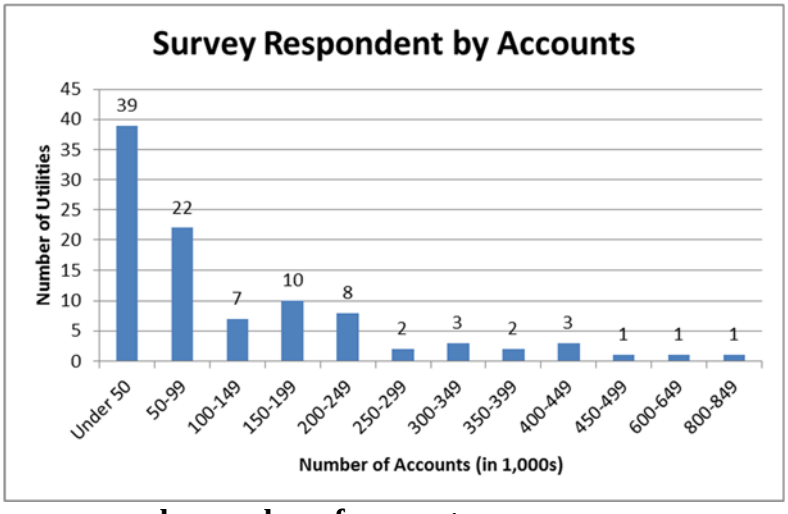


Figure 5.1 Survey responses by number of accounts

As with all surveys, this is a snapshot in time. The North American water sector is composed of thousands of water utilities with a variety of characteristics, so drawing conclusions and applying them to all water utilities must be done with caution. However, there appear to be some common themes that can be identified. The general research findings are presented below.

CIS GENERAL THEMES

General CIS themes from the survey include the following:

1. There appears to be a trend toward monthly billing
2. The number of new CIS implementation projects seems to be consistent. Over time, every year about 5 percent of responding utilities move to a new CIS product
3. There may be a mild trend toward more successful projects but in general, the findings are similar to the findings from 2005. Most projects are still "tough but ok" and approximately the same number of the projects are complete failures (nearly cancelled, cancelled, or resulted in litigation) (from 11 percent in 2005 to 8 percent in 2015)
4. Factors contributing to successful CIS projects were strikingly similar to those in 2005 (the project had the right expertise and experience on the implementation team; CIS project business goals were developed and compared for results at the end of the project; vendor proposals addressed the utility's needs; all or nearly all business requirements were met by the COTS products; and there was an effective and positive internal project team)
5. There is a trend toward commercial off-the-shelf (COTS) products, i.e., products purchased from vendors, and away from CISs developed specifically for one utility (custom CISs)
6. There is a substantial trend toward more interfaces between the CIS and other systems
7. Utilities have a wide range of custom modifications to COTS products. Eighteen percent of utilities have three or fewer modifications; 14 percent have between 4 and 9 modifications, and 51 percent have 10 or more modifications. There does not appear to be a correlation between the number of modifications and the success of the CIS project
8. Utilities are increasing customer self-service offerings
9. Forty-four percent of utilities responding already provide near real-time updates to field staff. Another 31 percent of respondents plan to deploy this capability within the next two years
10. Utilities are moving toward outsourcing selected parts of the Meter-to-Cash cycle. More than 60 percent of utilities currently outsource bill printing, and another 20 percent are planning to outsource it. About one-third of utilities outsource payment and collections activities. An additional 12 percent of utilities responding said they were interested in outsourcing payments, and 9 percent of respondents indicated interest in outsourcing collections to an outside collections agency
11. Utilities are engaged in some type of social media. Sixty-four percent of respondents already have a Facebook presence and 47 percent are engaged in Twitter

AMS GENERAL THEMES

General AMS themes from the survey are as follows:

1. In general, the respondents are quite satisfied with both AMR and AMI projects
2. While more AMR projects have been implemented, there appears to be a shift toward AMI technologies
3. There has been a decline in AMS implementations. However, many water utilities are now either piloting or planning to implement an AMI in the next two years
4. The level of public outreach carried out by utilities tends to be substantially greater for AMI projects compared to AMR projects
5. When utilities do an AMI project they usually also do an MDMS project. It appears a number of utilities are doing MDMS projects in preparation for an AMS project. Of the 32 utilities with an MDMS, 18 of them indicated that they read manually today. Those utilities are all either in the process of implementing an AMS, or plan to within two years
6. Implementing an AMS project often results in shifting staff to different positions, and in new staff roles or responsibilities
7. While 60 percent of utilities did carry out a business case for their AMS project, a large number (40 percent) did not
8. AMSs are often integrated with the utility's Geographic Information System (GIS) (49 percent). Forty-four percent of utilities have integrated their AMS with their Computer Maintenance Management System (CMMS)
9. Typically, the utility staff (whether IT or Operations & Maintenance (O&M)) is responsible for maintaining the AMS data communications network
10. Utilities are starting to set goals beyond reliable meter readings for AMS projects. AMI projects in particular have goals related to non-revenue water analysis
11. Utilities are starting to use more advanced features of an AMS (both AMR and AMI)

SNAPSHOT OF RESPONDENTS

Of the 99 utilities that responded, 54 are locally governed (55 percent), 37 are independently governed (37 percent), and 4 are independent (4 percent). As reflected in Figure 5.2, the survey respondents in 2015 included noticeably more independently governed utilities (and fewer local government respondents) than in 2005.

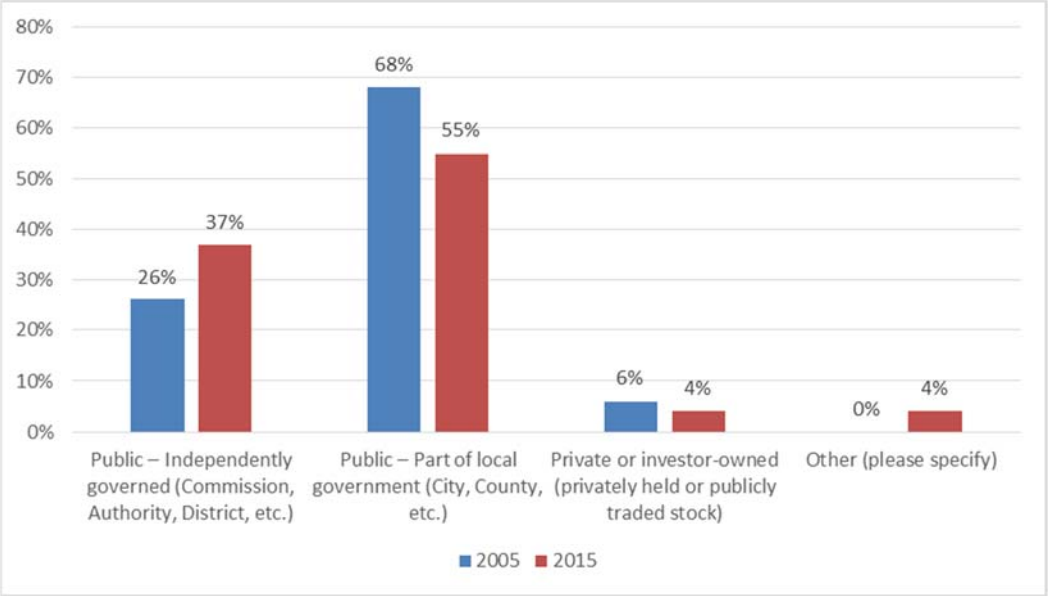


Figure 5.2 Governance of responding utilities

The services billed were very similar when we compare data from 2005 to 2015. Most utilities bill for water and wastewater, with fewer billing for stormwater and solid waste (Figure 5.3). Thirty-nine percent (39) of responding utilities bill on behalf of other agencies. Three responding utilities bill for only wastewater services. "Other" services billed included a combination of services such as industrial waste, broadband services, snow and ice removal, streetlights, chilled water, and recycling.

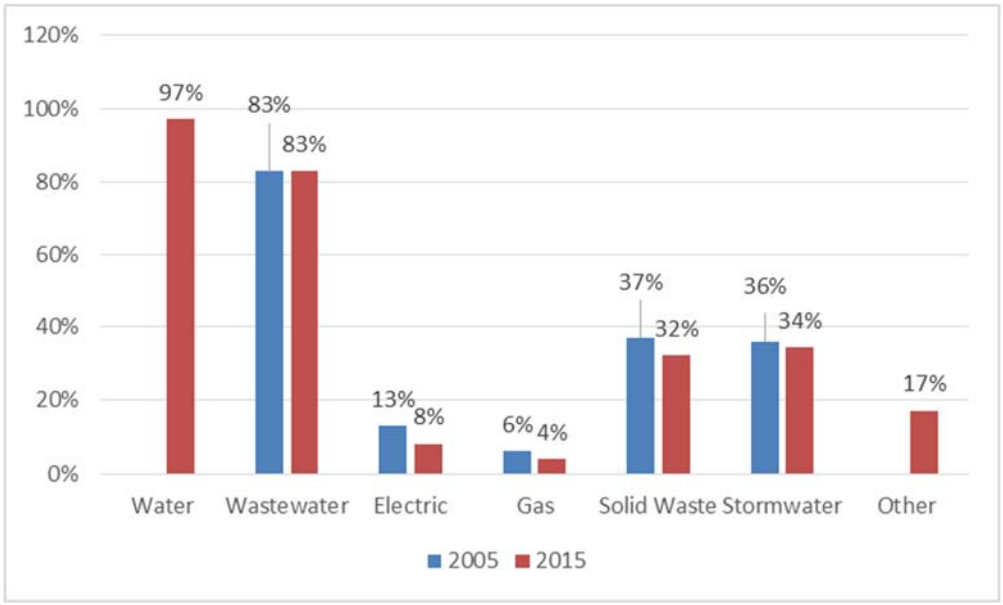


Figure 5.3 Services billed by responding utilities

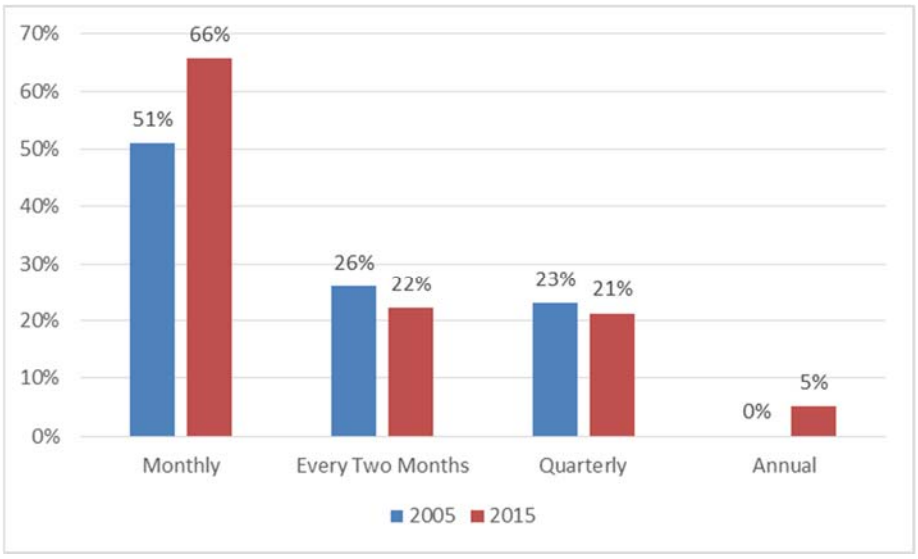


Figure 5.4 Frequency of billing by responding utilities

Sixty-six percent (65) of utilities bill monthly for residential customers, 22 percent (22) bill every two months, and 21 percent (21) bill quarterly. In 2015, more utilities billed monthly than in 2005 (Figure 5.4). The numbers add up to more than 100 percent as some utilities bill some of their residential customers every month, and other residential customers bi-monthly or quarterly.

OTHER GENERAL SURVEY RESPONSES

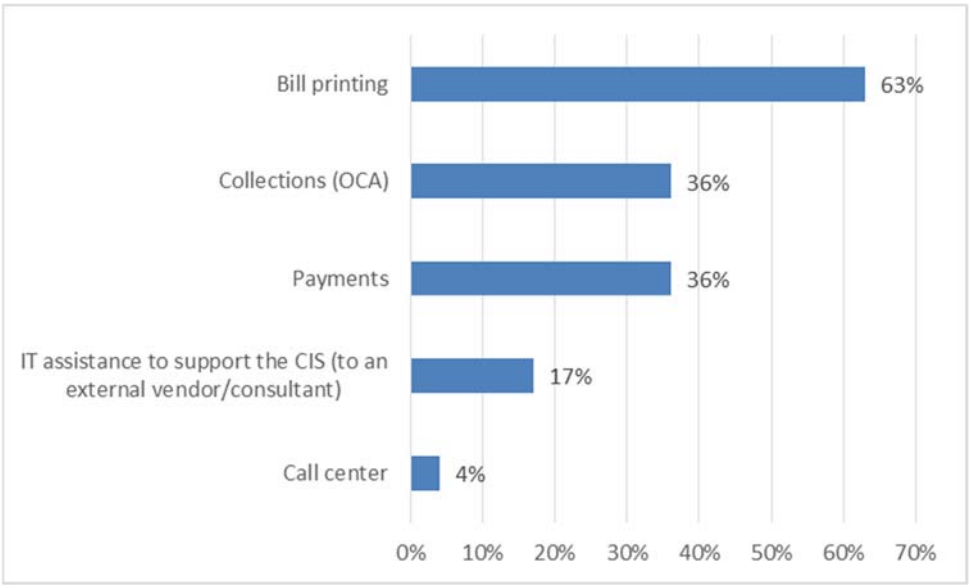


Figure 5.5 Currently outsourced Meter-to-Cash processes

A high percentage of utilities (75 of 97 responding utilities, or 77 percent) currently outsource some part of the Meter-to-Cash cycle, but only 4 percent (4) outsource their contact center (Figure 5.5).

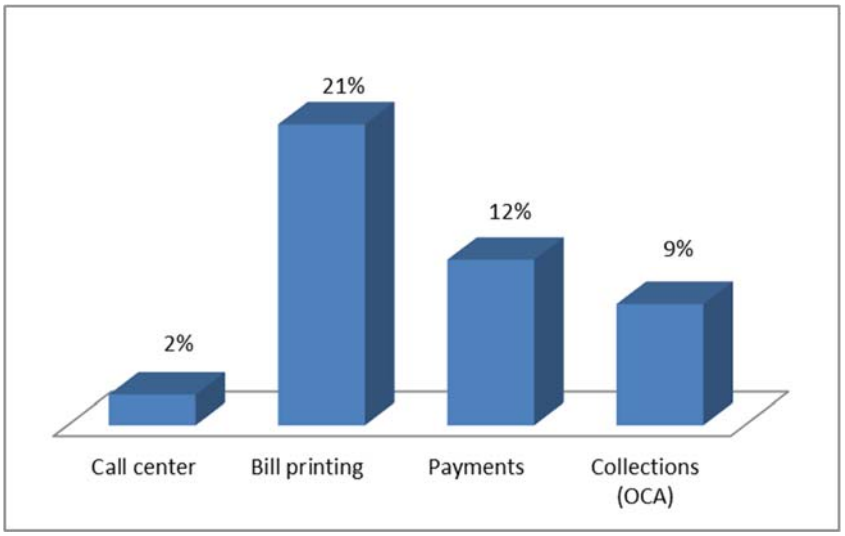


Figure 5.6 Interest in outsourcing selected Meter-to-Cash processes

Only 2 percent (2) of utilities are planning to outsource their contact center, but substantially more (24 of 97 responding utilities) are interested in outsourcing other services (Figure 5.6).

Many utilities already provide online customer service capabilities such as web portals, IVR and social media. Only a small number (11 utilities) currently have a mobile application, but 57 percent (57 utilities) are in the process of offering such an app, or are planning to within the next two years. (Figure 5.7).

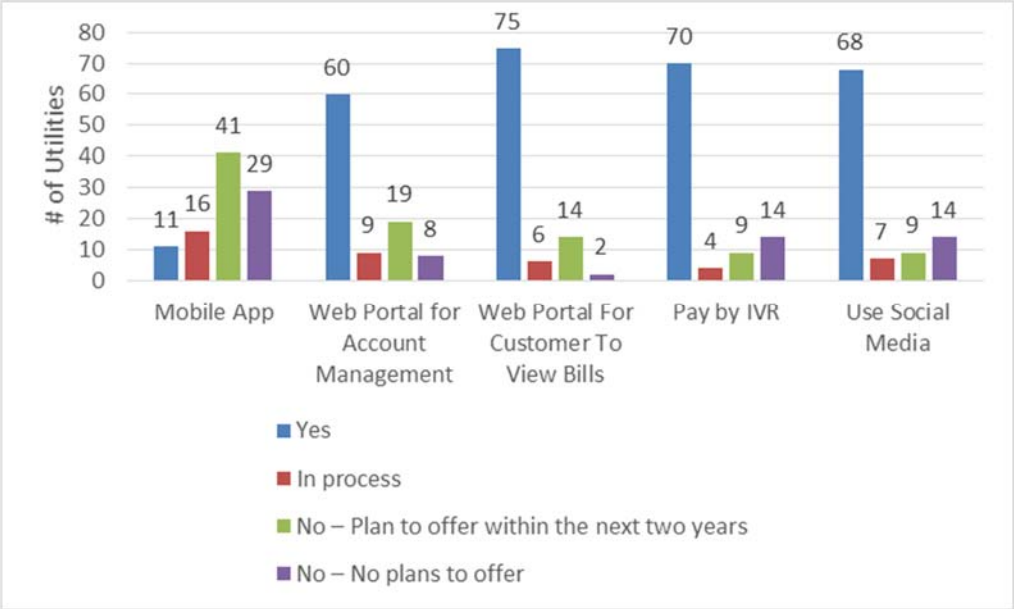


Figure 5.7 Customer access to online services

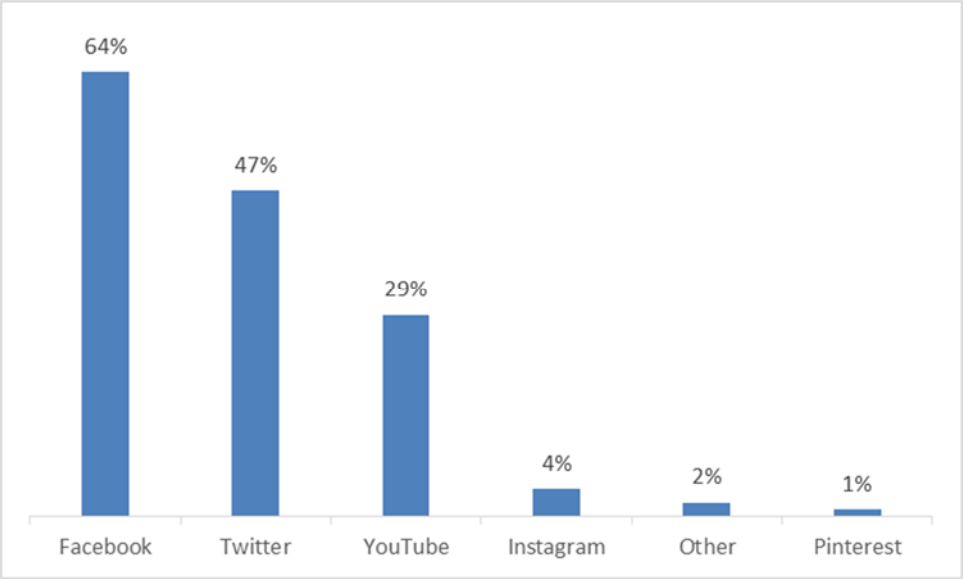


Figure 5.8 Social media channels used

Facebook and Twitter are the most commonly used social media channels (Figure 5.8).

CIS SURVEY RESULTS

A summary of responses related to CIS projects is provided below.

Top Reasons for CIS Projects

Reasons for replacing the current billing system were:

1. No longer supported by vendor – 43 percent (23 out of 54 responding utilities)
2. Poor inquiry, analysis, and reporting capabilities – 43 percent (23 out of 54)
3. Difficult to integrate with other applications – 37 percent (20 out of 54)
4. Limited or no customer self-service capabilities – 31 percent (17 out of 54)
5. Did not carry out a required business function – 24 percent (13 out of 54)
6. Expensive and time-consuming to enhance – 24 percent (13 out of 54)
7. System's technology was no longer supported – 19 percent (10 out of 54)
8. Difficult for employees to learn (high training curve) – 17 percent (9 out of 54)

CIS Replacement Project Activity

Over half of the responding utilities, 52 percent (49 utilities), have gone live with a new CIS in the last ten years (since 2005). These replacements then lead to upgrade projects. At the time of the survey, ten utilities were in the process of upgrading their CIS.

In general, it appears the number of CIS replacements per year has been fairly stable since 2005 (Figure 5.9).

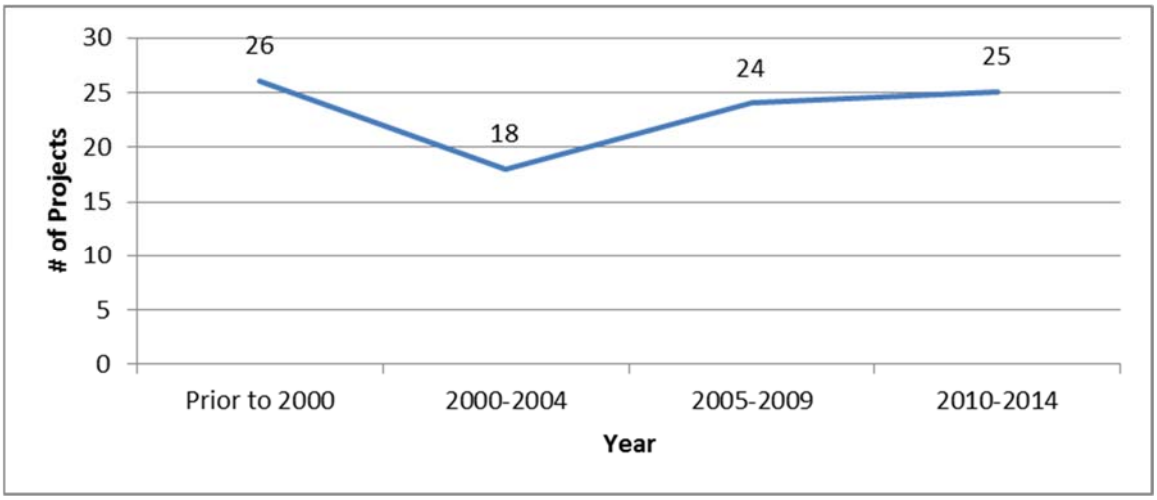


Figure 5.9 CIS replacements

CIS Project Experiences

Survey respondents were asked about their CIS projects. They were asked to characterize the project as having gone well, ok, or not well – using the following definitions:

- Went well – It went live generally as planned, within the budget originally allocated, and without any upsets during implementation or after go-live
- Okay – It was a tough project that was reasonably close to budget (within 20 percent) and schedule and had no fatal errors, but it was a struggle and brought us a lot of surprises along the way
- Not well – It was so stressful and problematic that we almost cancelled it (or we did, in fact, cancel it and went back to the drawing board). It was well over budget or beyond schedule, or both, or had other significant problems

This report categorized projects that were rated as "not well" as "failed" projects. Among responding utilities, there appears to be a mild trend toward having more successful projects, an increase from 35 percent in 2005 to 39 percent (39 utilities) (Figure 5.10), but in general, the findings are similar to the findings from 2005. A little over half of the projects were categorized as "Tough but ok" (from 54 percent to 53 percent (52 utilities)). There are still a number of failed projects (from 11 percent to 8 percent (8 utilities)).

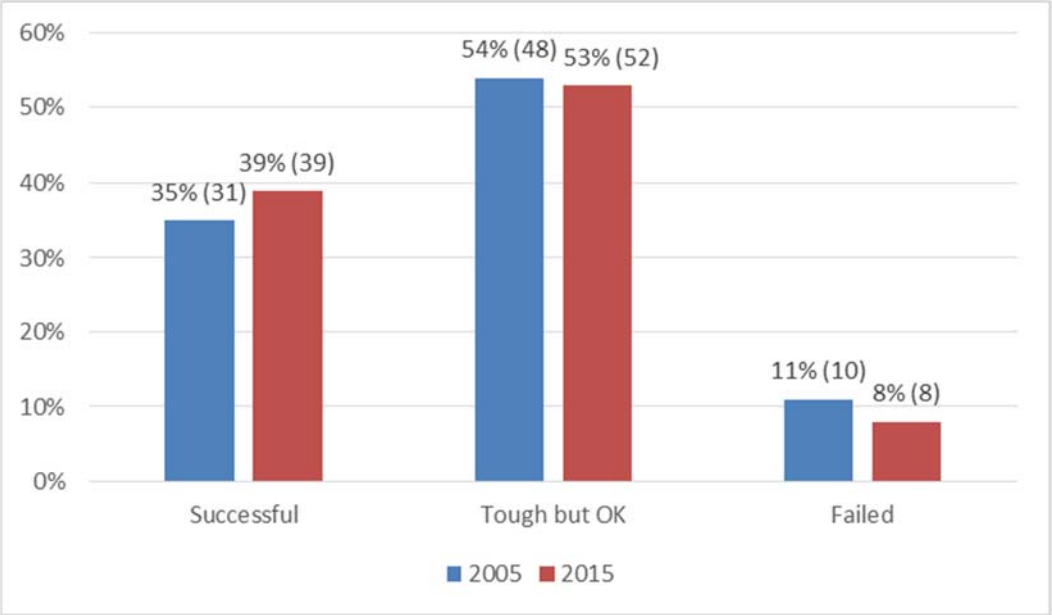


Figure 5.10 Utility self-rating of CIS implementation project

COTS Versus Custom Products

Most utilities implemented a COTS CIS. Twenty-nine utilities (31 percent) purchased an off-the-shelf package with nine or fewer modifications, 46 utilities (48 percent) purchased an off-the-shelf package with ten or more modifications, 16 utilities (18 percent) custom developed their CIS software, and 4 utilities (4 percent) obtained their CIS software in another manner. The survey results indicated a range in the extent to which software was modified (Table 5.1).

Table 5.1
Project experience compared to number of product modifications

	0 - 3 Mods	4 - 9 Mods	10 or More Mods	Custom Developed
Successful	5	5	16	7
Ok	10	6	26	8
Failed	1	2	4	1
Total	16	13	46	16

Of the failed projects, there did not seem to be a correlation with the type of CIS (e.g., whether it was a custom or COTS product), or with the number of modifications to the product.

Integration With Other Systems

Water utilities are interfacing the CIS with other key systems to create more robust and efficient workflows. There has been a clear trend for increased integration of CIS applications to other utility applications from 2005 to 2015 (Figure 5.11).

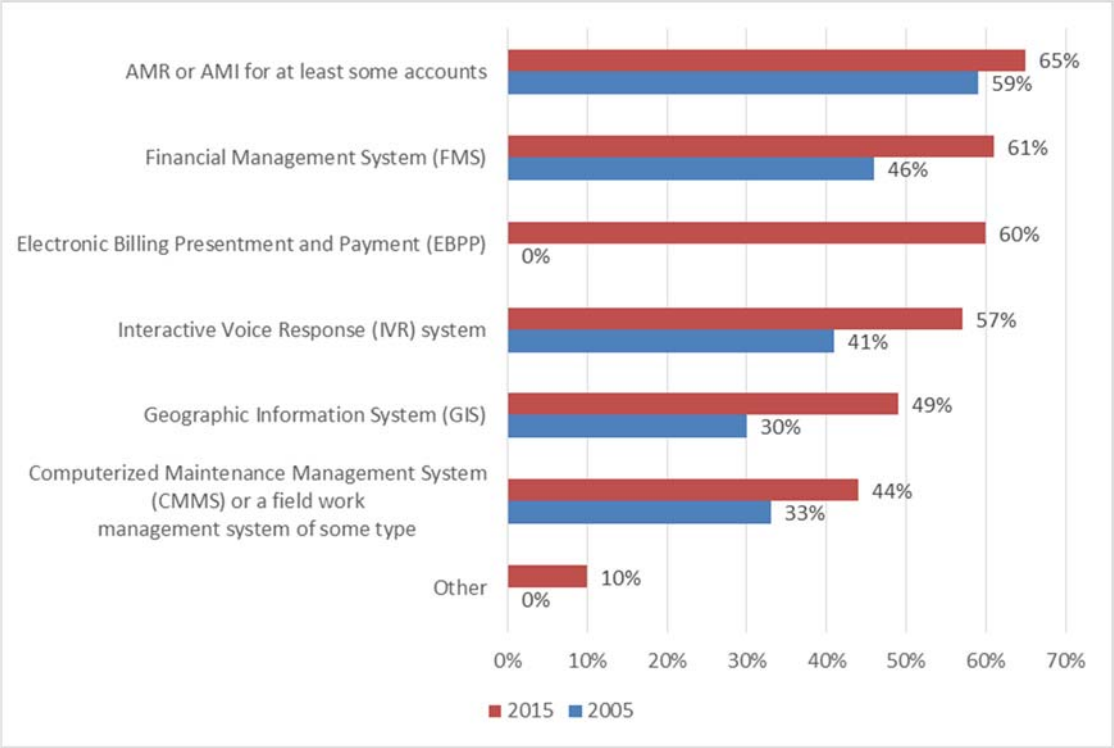


Figure 5.11 Applications linked to CIS

A high number of responding utilities report that they either have or plan to have the ability to provide near real-time data to field shut-off crews (Figure 5.12).

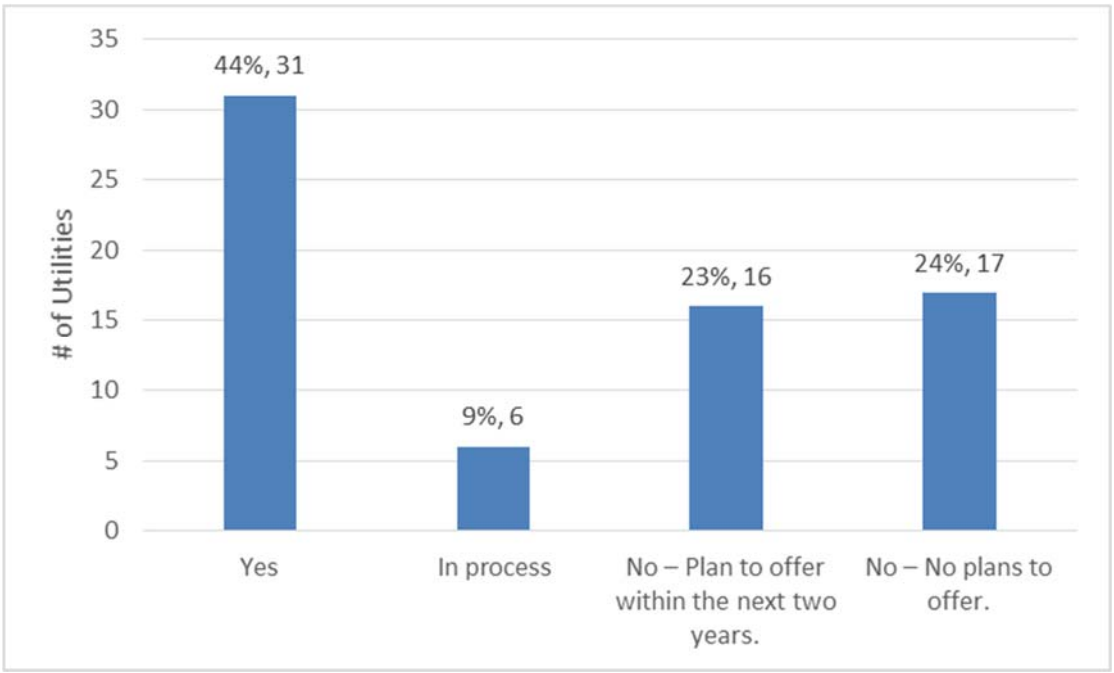


Figure 5.12 Utilities offering or planning to offer near real-time updates within two years

Factors Contributing to the CIS Project Outcome

Survey respondents were asked to rank the top five factors that contributed to their CIS project success. The responses of utilities with a successful implementation were as follows:

1. Had the right expertise and experience on the implementation team (from utility staff, vendor, and/or consultant) (25 utilities, or 64 percent of responding utilities)
2. Identified and quantified CIS project business goals, and compared them at the end of the project (17 utilities, or 43 percent of responding utilities)
3. An effective and positive internal project team (16 utilities, or 41 percent of responding utilities)
4. Vendor responses addressed the utility's needs (14 utilities, or 35 percent of responding utilities)
5. All or nearly all business requirements were met by off-the-shelf vendor solutions (12 utilities, or 30 percent of responding utilities)

Among utilities who stated they had a very difficult/failed implementation (8 of 99 utilities), the top five areas cited for improvement were:

1. Data conversion was a major problem (5 of 8 responding utilities)
2. The number and/or complexity of software modifications caused major problems (5 of 8 responding utilities)
3. Users were resistant to or unenthusiastic about the new CIS (4 of 8 responding utilities)
4. Insufficient or inadequate training (4 of 8 responding utilities)
5. We did not have a solid understanding of how the CIS fit into furthering our utility customer service strategy (3 of 8 responding utilities)

Survey Results Regarding Staff Understanding of the CIS

The majority of respondents indicate that their staff has a good understanding of the CIS system (Figure 5.13). In fact, 27 percent (25) of utilities felt they are highly skilled with their CIS. Fifty-nine percent (55) felt that staff members had a good understanding of their own area of expertise.

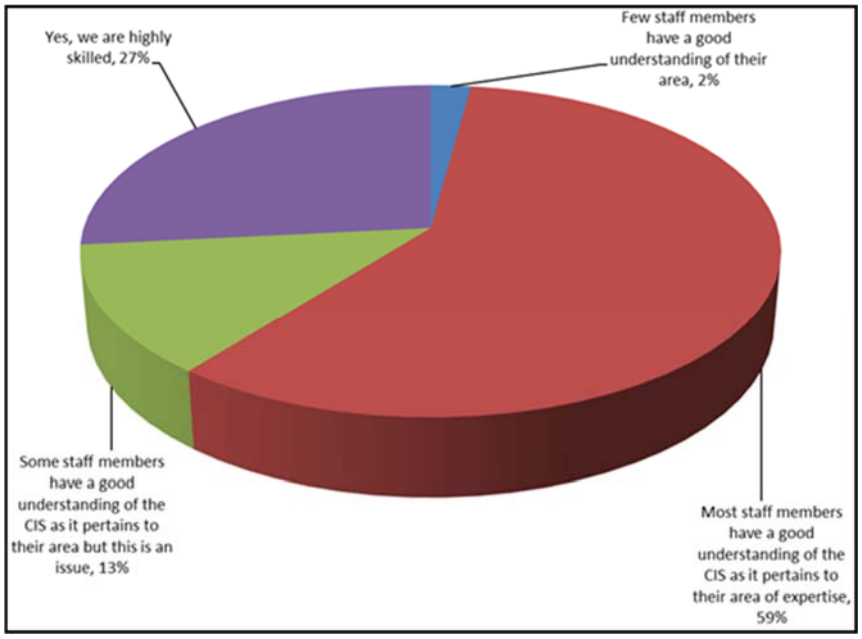


Figure 5.13 Staff understanding of CIS

CIS Upgrade Frequency

Most utilities regularly patch or upgrade their CIS (Figure 5.14). Forty-six percent of the respondents indicate that they perform CIS upgrades and patches one or two times per year, and 20 percent do so every few years. This means that about two-thirds of the utilities generally keep their CIS current. Comments from the utilities indicated that they have struggled in this area, and are moving toward a more managed or frequent patch process. A typical comment was "We have not updated adequately and struggle with this area. We now have to undergo a major upgrade at a high expense."

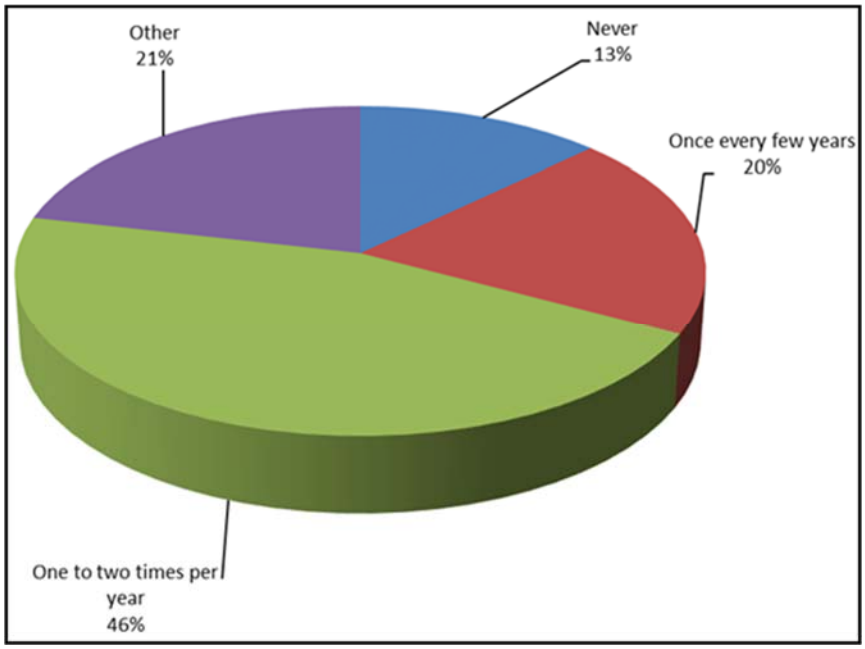


Figure 5.14 Frequency of utility upgrades to CIS

CIS Upgrade Support Practices

Most utilities used external support during the upgrade process. Forty-two percent (22 of 53) of utilities worked closely with their vendor, including on-site assistance and training. Forty-three percent (23 of 53) used the vendor to provide guidance and remote support on an as-needed basis (Figure 5.15).

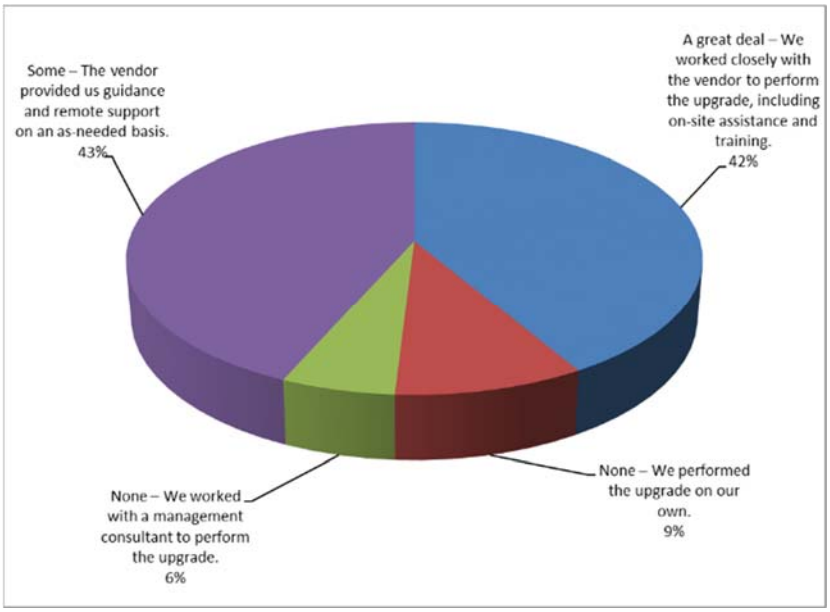


Figure 5.15 Support used during CIS upgrade

However, 9 percent stated they had never upgraded their CIS. In general, these utilities had a legacy billing system. Only 9 percent (5 of 53) performed the upgrade completely on their own. Most utility respondents applied "exhaustive testing" to their CIS upgrade project. 68 percent (36 of 53) of the utilities applied exhaustive testing; 28 percent (15 of 53) used moderate testing (Figure 5.16).

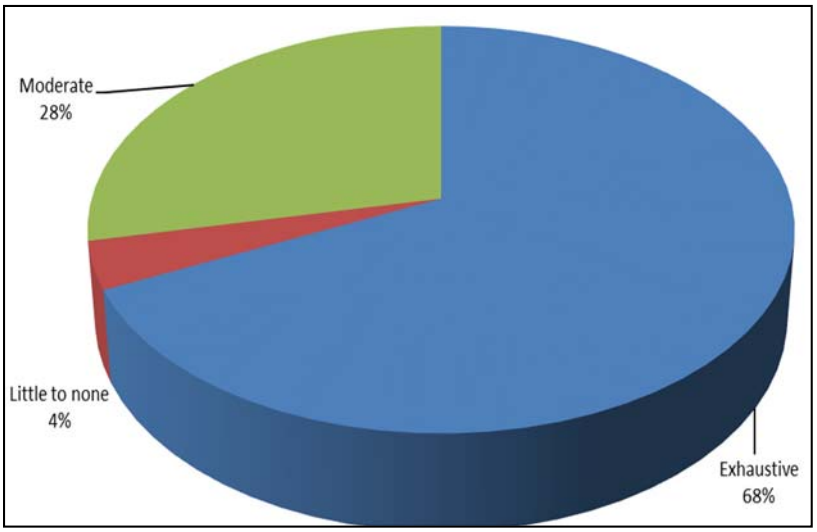


Figure 5.16 Extent of CIS upgrade testing

CIS Upgrade Satisfaction

Fifty-seven percent (31 of 54) of utilities felt only somewhat satisfied with the capabilities of the upgraded CIS. One-third of utilities (18 of 54) were very satisfied and felt it substantially improved their capabilities.

The remainder felt the upgrade either did not provide improvements in productivity or customer service levels, or there were a number of issues they experienced as a result of the upgrade.

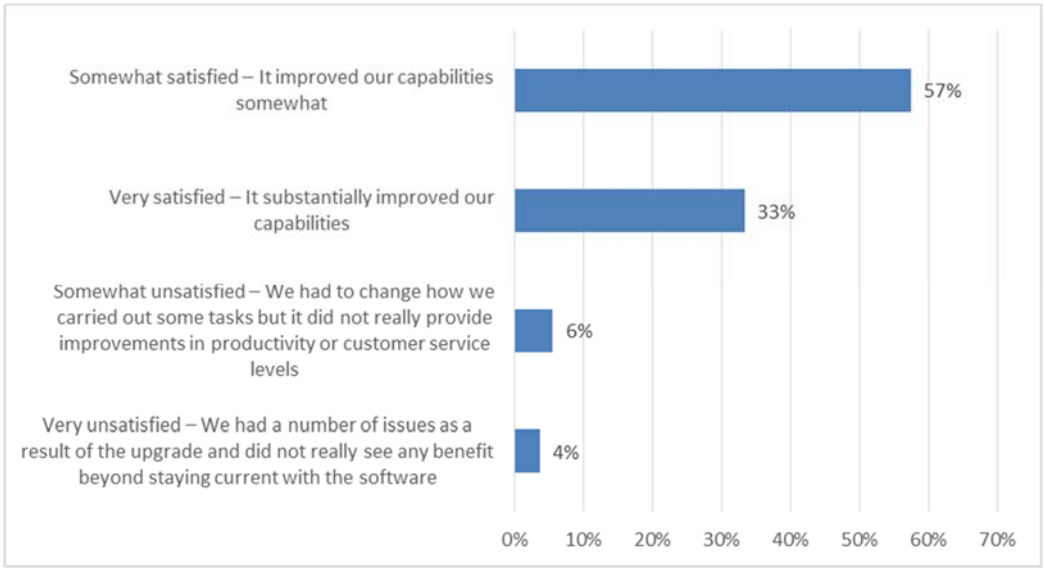


Figure 5.17 Utility satisfaction with upgraded CIS

AMS SURVEY RESULTS

The utilities were also surveyed regarding their AMS implementation status as of 2015. Depending on the context of the question, some questions distinguished between different AMS's – drive-by AMR, fixed AMR, AMI, and MDMS.

The survey in 2005 did not included meter reading systems, so there is no comparative data.

Overall AMS Technology Project Status

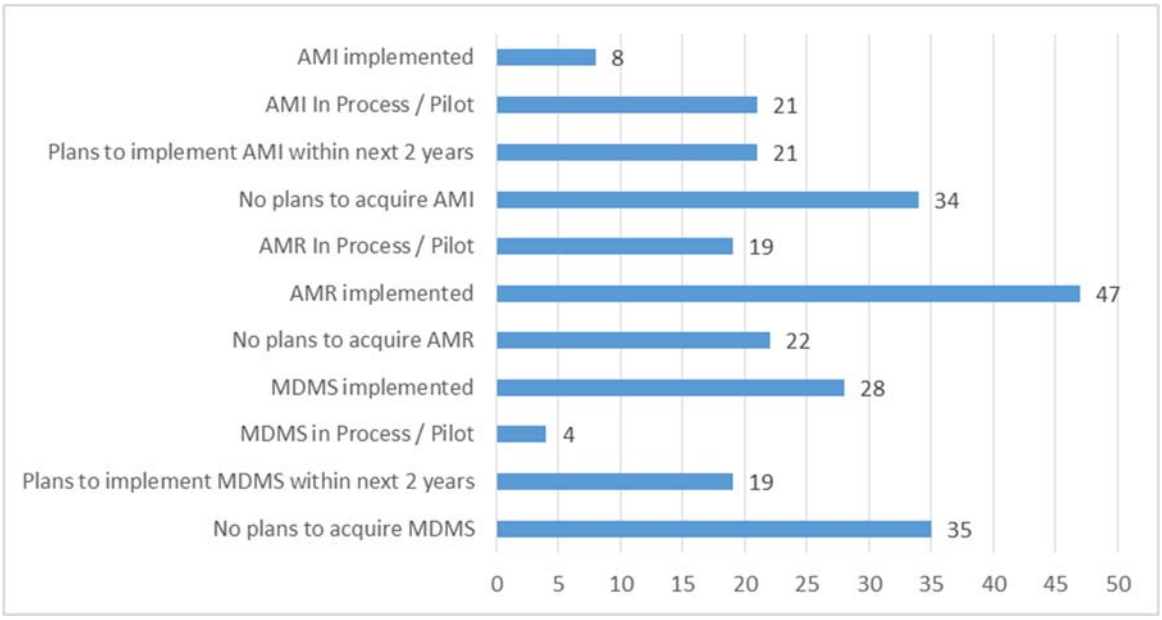


Figure 5.18 Responding utilities' AMS technology status

Figure 5.18 shows the number of responding utilities that have fully implemented drive-by or fixed AMR, AMI, and MDMS, have plans to implement it in the next two years, have a pilot or the technology that is in process, or if the utility does not plan to acquire the technology at all.

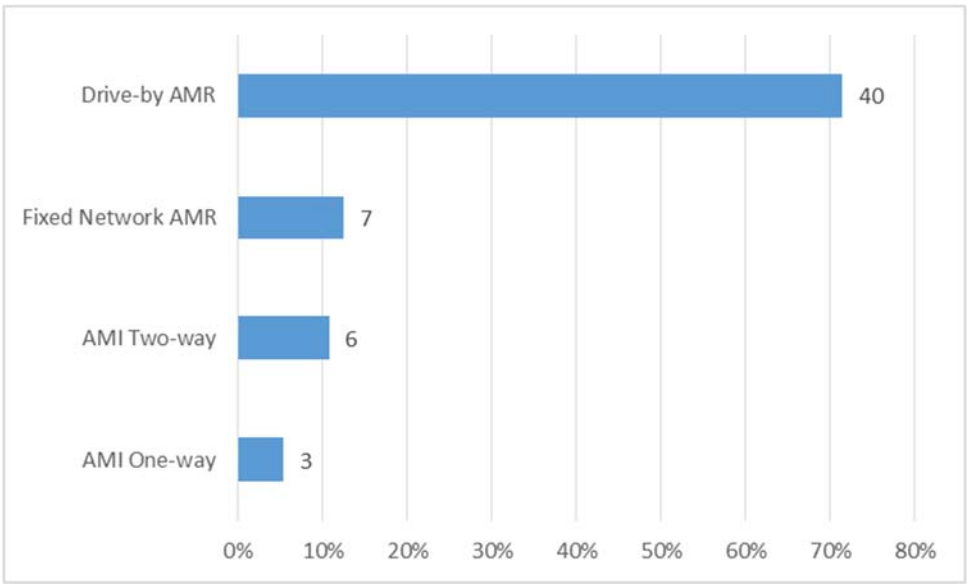


Figure 5.19 AMS technologies implemented

AMS Technologies Implemented

Figure 5.19 shows the number of respondents that have fully implemented each technology. More utilities have implemented drive-by AMR than other AMS technologies.

AMS Technologies Implemented by Year

The majority of AMS implementations were drive-by AMR during 2005 to 2009 (Figure 5.20). The number of implementations has declined strikingly since then.

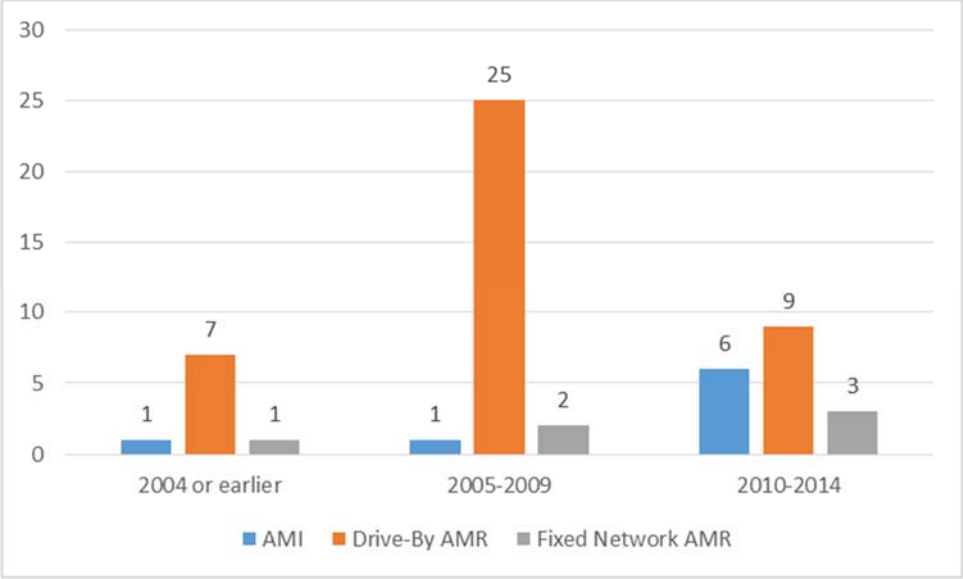


Figure 5.20 AMS implementations by year

AMS Satisfaction Levels

Figure 5.21 illustrates the number of the responding utilities and satisfaction with their AMS technology. Nearly all utilities are highly or mostly satisfied with their AMS.

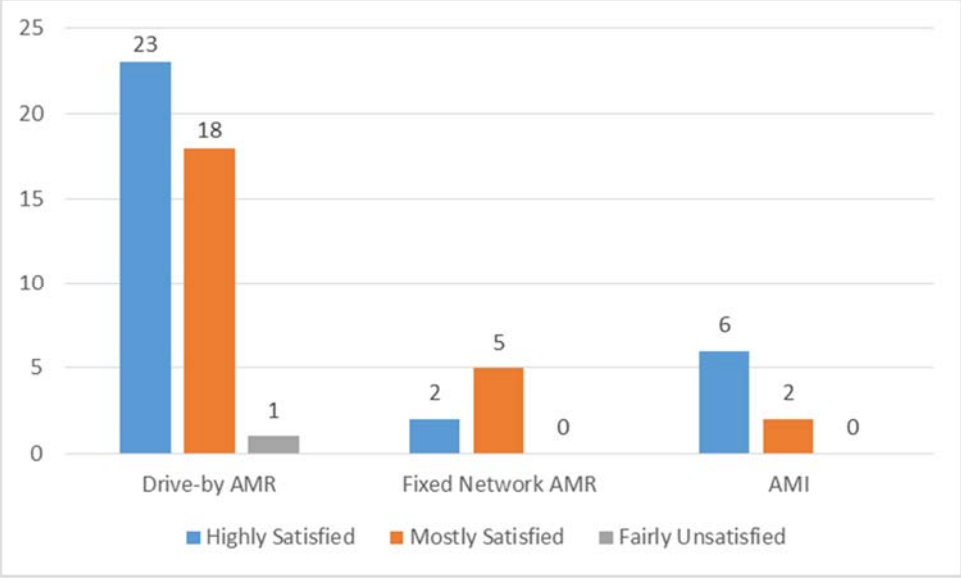


Figure 5.21 Utility satisfaction with AMS technology

AMS Business Case Frequency

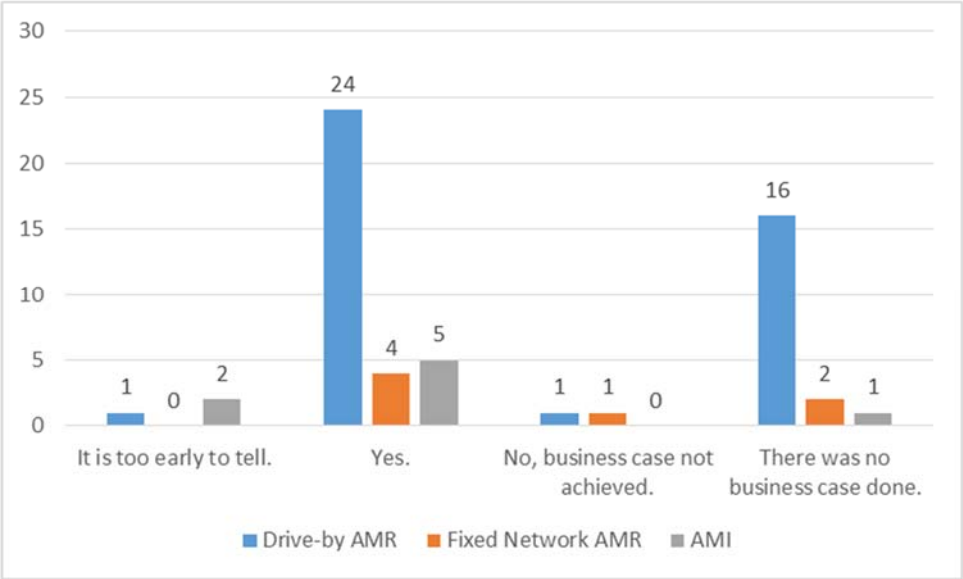


Figure 5.22 Business case achieved by AMS

For utilities that conducted business cases, the majority achieved their goals. Many of the responding utilities did not conduct a business case for their AMS projects (Figure 5.22).

AMS Integration with Other Systems

The CIS is the most frequent integration from responding utilities (48 percent, 48 utilities). The most typical integrations are with the CIS (48 utilities), GIS (15 utilities), and MDMS (21 utilities). Some utilities (6) have also integrated their CMMS with the AMS (Figure 5.23).

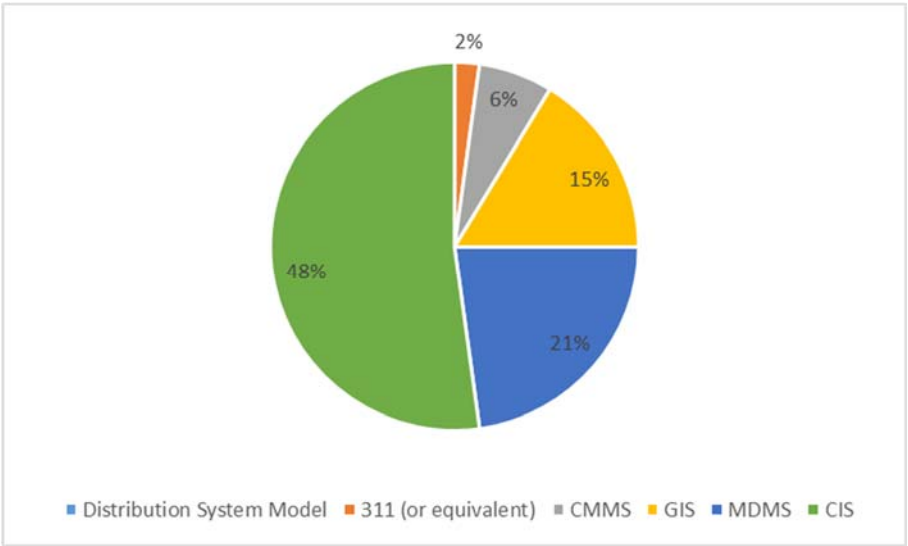


Figure 5.23 AMS integration with other systems

AMS Technologies Being Implemented or Piloted

Of utilities in the implementation phase, most are implementing either drive-by or AMI (Figure 5.24). Of utilities in the pilot phase, most are piloting AMI (Figure 5.25). This may indicate a trend toward adopting AMI technologies.

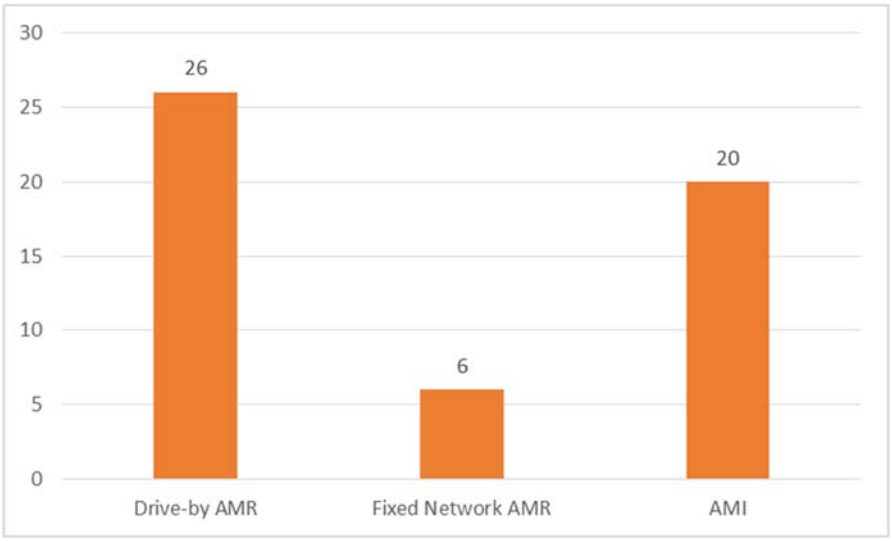


Figure 5.24 Of utilities in the implementation process, most are drive-by AMR or AMI

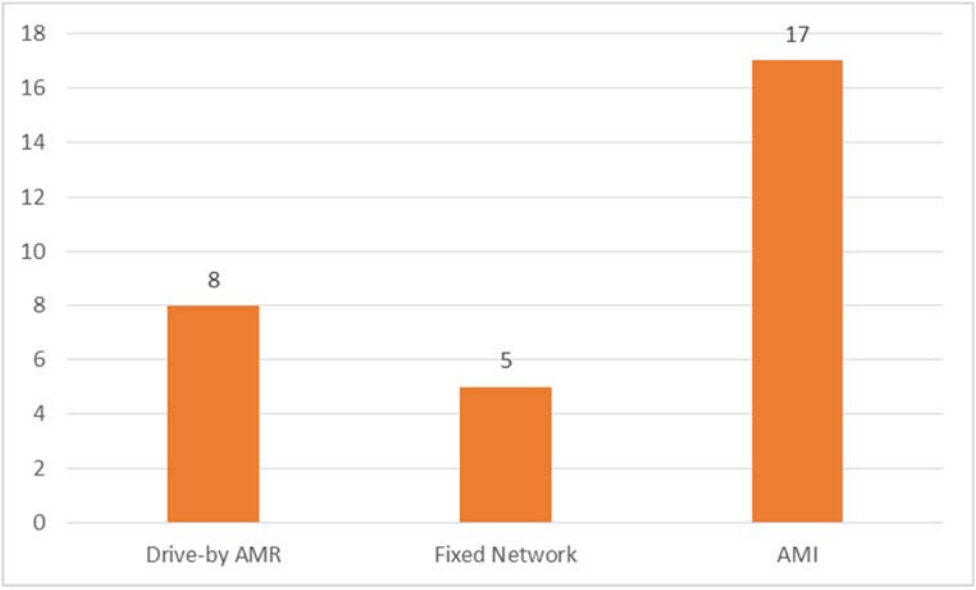


Figure 5.25 AMI is the most frequent technology being piloted

AMS Staffing Levels

Utilities were asked about the staffing impacts of the AMS project. In general, positions were either eliminated or employees were shifted to other positions (Figure 5.26).

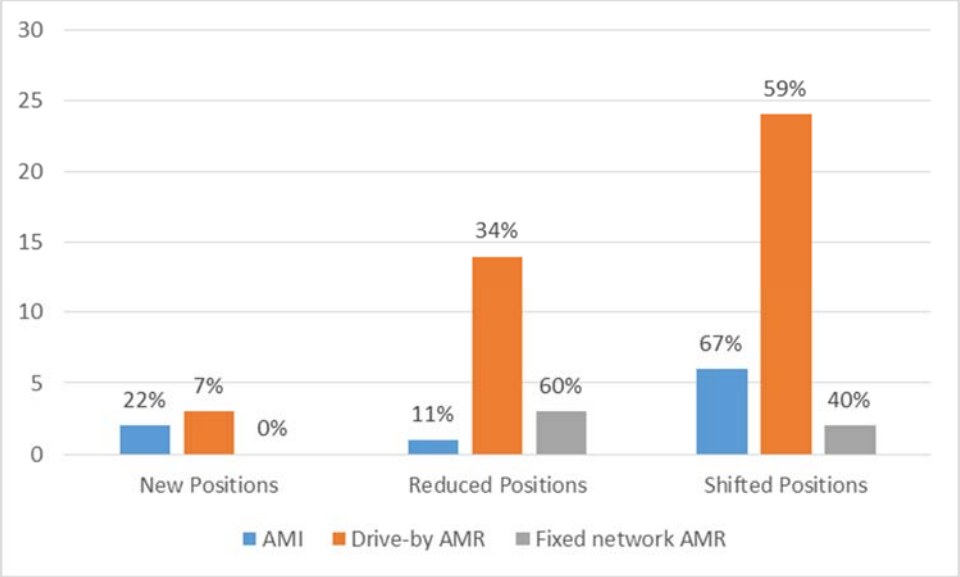


Figure 5.26 Staffing changes due to AMS

AMS Staff Responsibilities

The survey asked utilities to indicate if new staff roles or responsibilities were implemented after implementing the fixed network or drive-by AMR. Results are shown in Figure 5.27. It appears that implementing an AMS often, but not always, resulted in new roles and responsibilities.

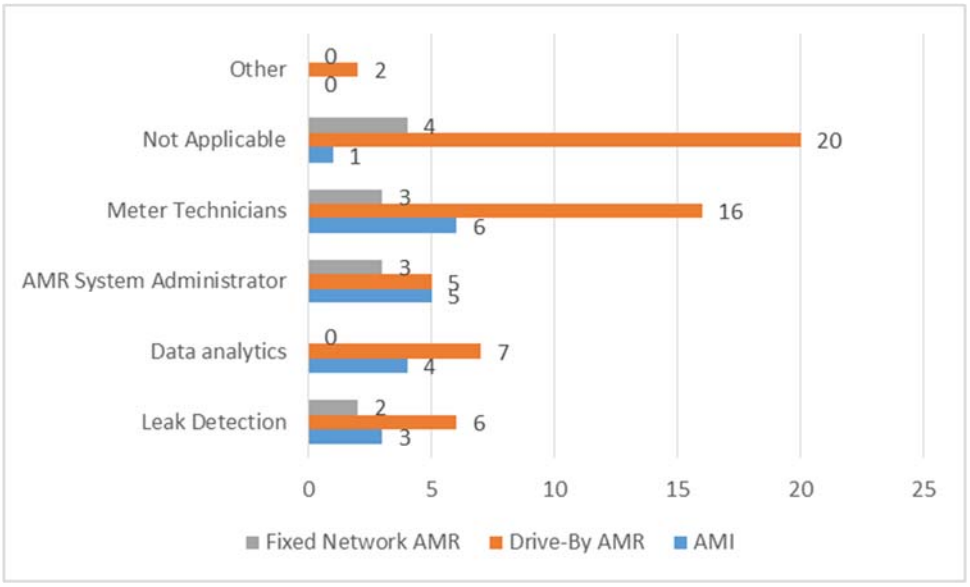


Figure 5.27 Role changes as a result of AMS projects

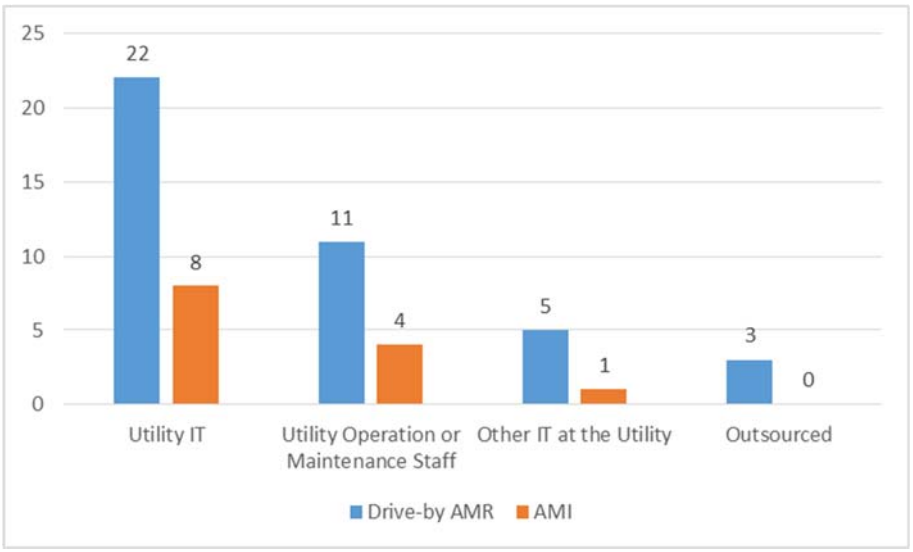


Figure 5.28 Responsibility for data communications network

Twenty-two responding utilities (54 percent) identified the utility IT staff as being responsible for maintaining the data communications network for drive-by AMR (Figure 5.28) and 11 utilities use O&M staff to maintain the system.

Timing and Extent of AMS Public Outreach

Utilities were asked to what extent customers were informed about the AMS project, and when in the project cycle customer outreach occurred. The level of outreach varied by AMS type and by the project phase. Over half of the utilities did no or minimal outreach before the AMS project was approved (Figure 5.29).

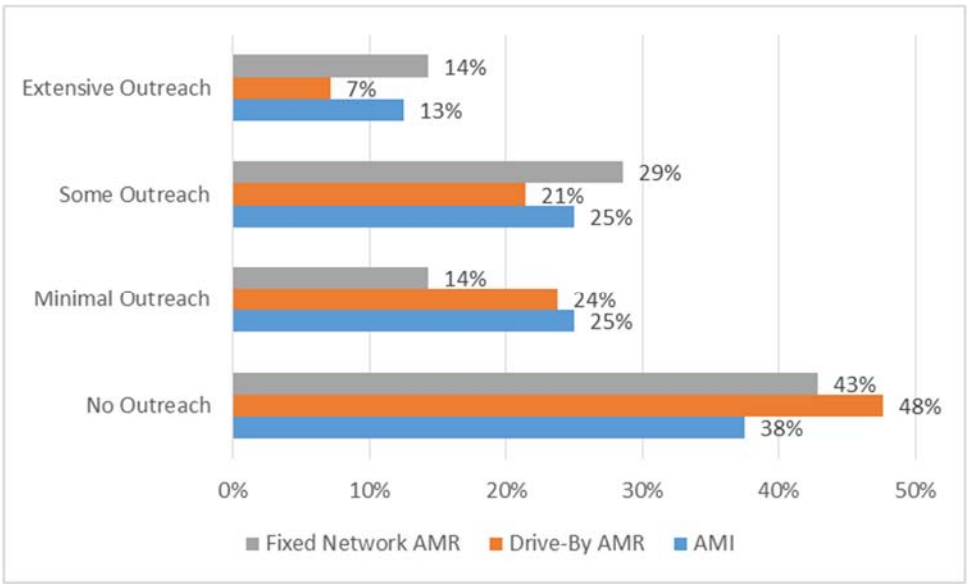


Figure 5.29 Public outreach before AMS project approval

AMI projects did substantially more outreach than AMR projects once the project was approved (Figure 5.30).

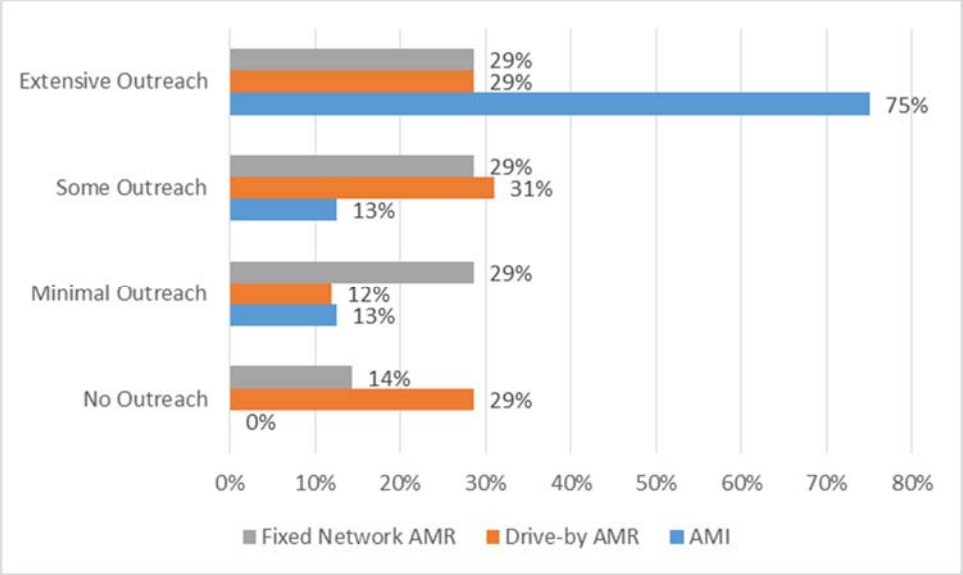


Figure 5.30 Public outreach during AMS project

AMI projects continued to have extensive outreach, and substantially more outreach than AMR projects, after the AMI project was rolled out (Figure 5.31).

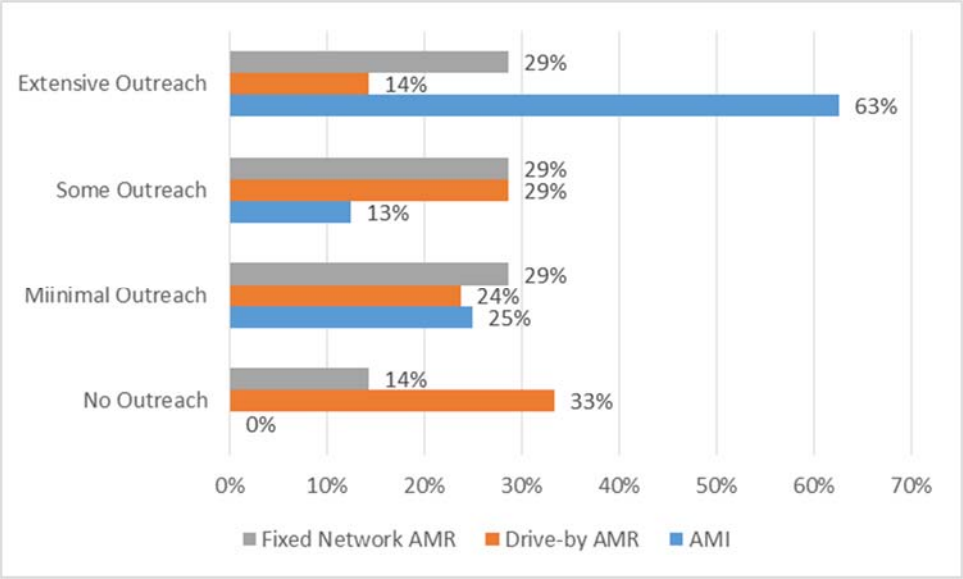


Figure 5.31 Public outreach after AMS rollout

Extent of Full-Time Project Managers for AMS Projects

Table 5.2 shows the number of responding utilities that had an internal and external full-time AMS project manager. Twelve (14%) responding utilities had both an internal and external AMS project manager.

Table 5.2
Utilities with a full-time AMS internal and external project manager

	Yes	No
Internal Project Manager	30 (35%)	24 (28%)
External Project Manager	17 (20%)	37 (44%)

Top Goals for Implementing AMS

Figure 5.32 shows the top four goals for utilities to implement an AMS system.

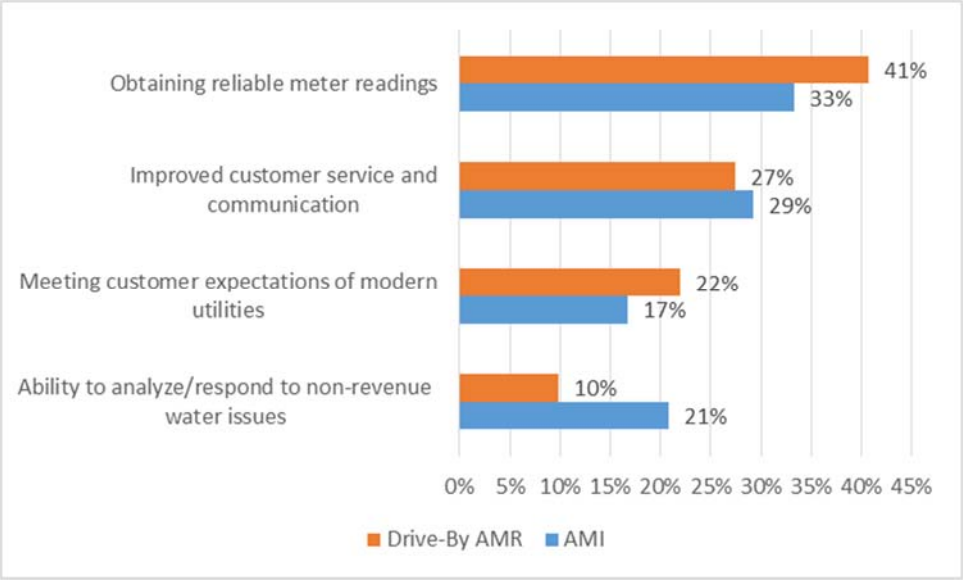


Figure 5.32 Utilities top goals for implementing AMS

Other reasons cited were to support moving to monthly billing and to reduce safety concerns related to confined space entry.

Table 5.3 shows primary daily uses of the AMS by number of utilities, after the system has been implemented. It appears that utilities responding to the survey are starting to use the data for more than just billing meter reads. The highest usage of this data is for final reads, identifying zero consumption, leak detection, bill dispute, and tamper monitoring. It appears that utilities still have significant opportunities to use the data for analytical purposes such as theft detection, district metering and demand forecasting.

Table 5.3
AMS technology daily uses – total number of utilities

AMS Data Use	AMI	Drive-By AMR	Fixed Network AMR	Total
Final Reads	7	19	6	32
Zero Consumption	5	20	6	31
Leak detection	5	20	4	29
Bill Dispute	7	16	5	28
Stopped Meters	3	17	1	21
Tamper Monitoring	4	14	2	20
Reverse Flow Detection	3	12	2	17
Customer Notifications	6	1	3	10
Theft Detection	4	2	3	9
Automated Workflows	1	4	0	5
District Metering	0	2	0	2
Demand Forecasting	0	1	0	1

SUCCESS FACTORS FOR CIS AND AMS PROJECTS

Table 5.4 below shows the success factors for the various projects. In general, the success factors for CIS and drive-by AMR project are very similar. Also, the success factors for AMI and fixed network AMR are very similar.

Table 5.4
Reasons that projects were successful

	CIS	AMI	Drive-By AMR	Fixed Network AMR
Had the right expertise and experience on the implementation team (from any of our utility, our vendor, and/or our consultant)	•		•	
All or nearly all business requirements were met by off-the-shelf vendor solutions	•		•	
Identified and quantified project business goals, and compared them at the end of the project	•		•	
Vendor responses addressed the utility's needs	•		•	
Created detailed go-live plans jointly with the vendor and the consultant	•			
A clear understanding of how the technology furthers the utility's strategies and goals			•	•
An effective, positive internal project team		•		•
A good project plan that provided adequate direction for each step and adequate time to complete each step		•		•
A highly-effective utility Project Manager		•		•
Field work was managed through digital work orders via mobile devices		•		
Effective customer communication		•		•
Effective senior executive involvement				•

MDMS

Utilities Using MDMS

Of the utility respondents, 28 utilities have already implemented an MDMS, rising to about sixty percent (60 percent) (47 of 68 utilities) within the next two years (Figure 5.33).

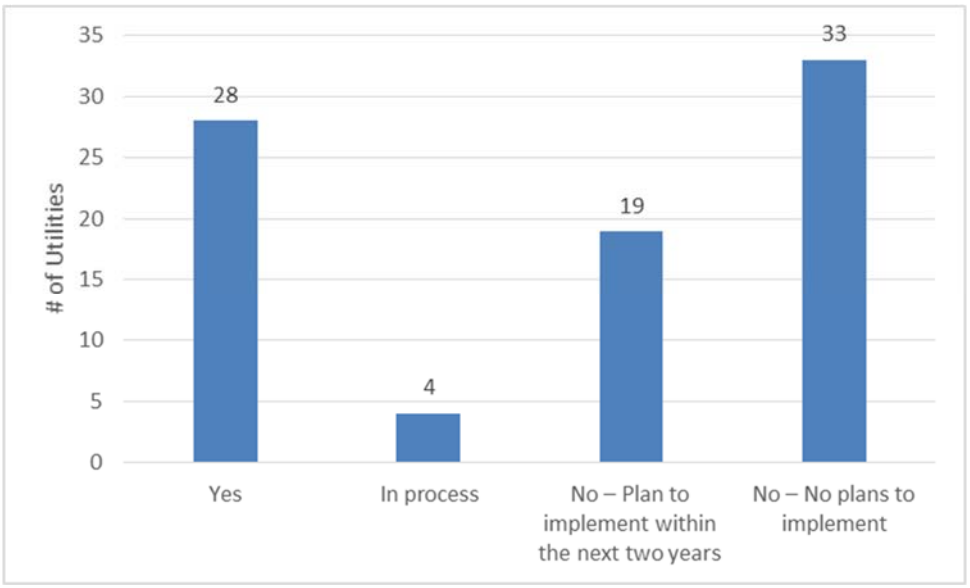


Figure 5.33 Number of utility respondents using MDMS

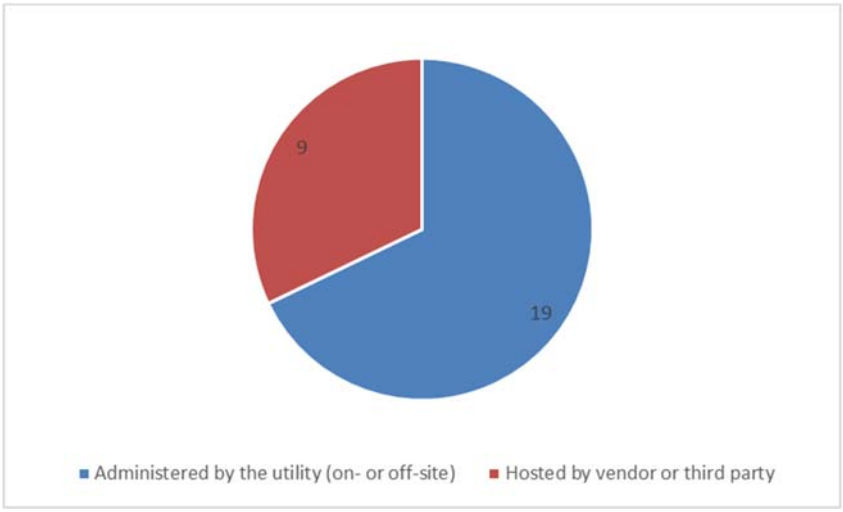


Figure 5.34 Number of utility respondents outsourcing the administration of the MDMS

Utilities Outsourcing MDMS

A significant number of utilities (9 of 28, or about 32 percent) have outsourced the MDMS administration (hosted by vendor or other third party) (Figure 5.34).

How MDMS Data is Used

Where utilities have implemented an MDMS, they are using the data in a variety of ways (Figure 5.35) including automated alerts to staff regarding items such as potential leaks, meter and battery issues, and questionable reads. Some utilities (10 of 28) have automated alerts to customers related to potential leaks.

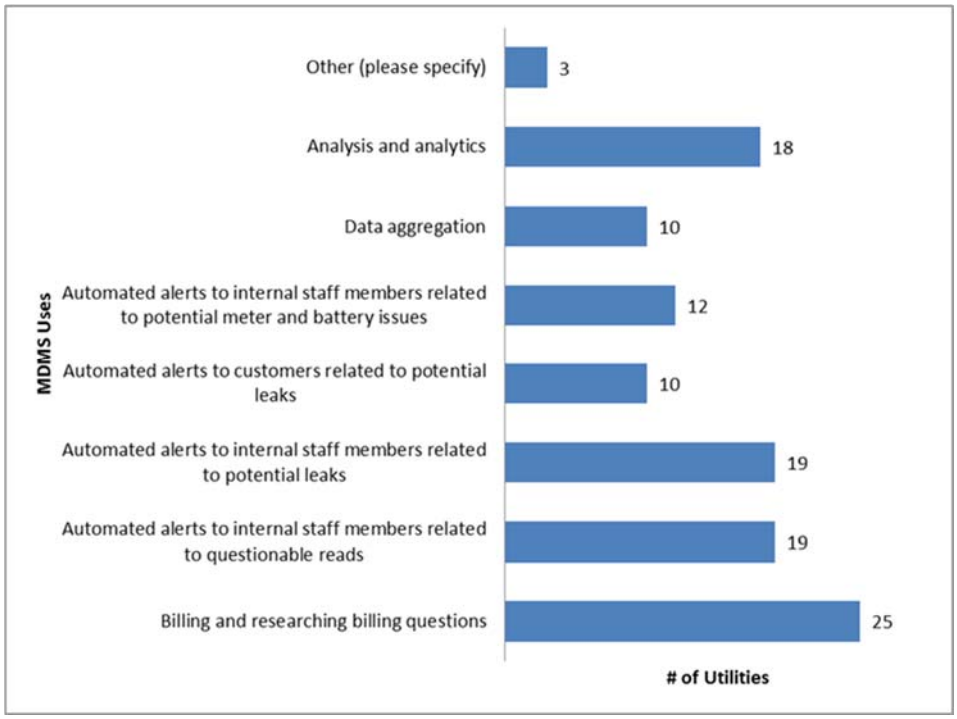


Figure 5.35 Benefits of MDMS data

CHAPTER 6
VENDOR (SUPPLIER) MANAGEMENT

A CIS or AMS is a significant investment, so productive long-term relationships with vendors are important. The heart of such a relationship revolves around contracts, service levels, and communications (on the part of both the utility and the vendor).

The ITIL provides a globally recognized collection of best practices for managing IT. An area of particular interest from a CIS and AMS point of view involves best practices related to Supplier Management. In ITIL language, a vendor is a supplier and the utility is a customer. Supplier Management is part of the Service Design process which integrates into the Service Lifecycle.

Three key areas of those relationships (modified from ITIL objectives to reflect the CIS and AMS context) include contract reviews, new contracts and renewals, and vendor reviews during the total lifecycle of the product. Each is discussed below.

CONTRACT REVIEWS

A contract review is a good practice for existing contracts. This means understanding at a high level what the current contract contains. It is an important first step toward developing a contract strategy for renewals that will occur later. In conducting a contract review there are three best practices that will help utilities understand what is contained in their current contracts and assist in planning for the future. They are:

1. Identify the vendor relationship owner, who is the person at the utility responsible for managing the vendor relationship
2. Analyze the contract for "customer" (i.e., utility) and "supplier" (i.e., vendor) responsibilities
3. Track key contract dates including renewals, product end of life, and product end of support

CONTRACTS: NEW AND APPROACHING RENEWAL

Whether the contract is for the purchase of professional services, licenses, or maintenance, contracts should be inclusive of the utility's goals. Before entering into a new contract or renewing an existing contract, clearly consider and define needs. Vendor contracts and Service Level Agreements (SLAs) should align with the utility's overall customer service goals and requirements.

The following recommendations are best practices for new contracts.

1. Include the RFP and vendor's proposal response in the contract
2. List and define local terminology or acronyms the vendor should understand to meet expectations
3. Determine and document the communications expected of the vendor (e.g., support tickets, monthly reports, quarterly reviews, contract renewals)
4. Define types of responses expected (ticket created, ticket being worked, ready for testing, resolved, patches available, patches applied, etc.)

5. Define appropriate timeframes for response types (SLAs)
6. Define what happens if the response timeframe is not met. Determine an appropriate penalty for nonperformance
7. Establish the process for nonperformance penalty processing. The default is the customer (utility) must request the penalty, but the vendor could automatically apply it if the process is properly documented
8. Assign the responsibility to track SLA-related items and document that the SLA was met or not met. The default is the customer (utility), but the vendor is better-equipped to report on SLA performance
9. Document the escalation path for unresolved issues
10. When customizations are created, the vendor should incorporate the customization into future releases to preserve the COTS nature of the product as much as possible
11. Identify the responsibility for applying patches or upgrading, and the responsibility for costs related to the patching or upgrade effort
12. Document how the costs and rates for services are calculated, e.g., per user, per license, site license, as a percent of the original purchase price, etc.
13. Document the vendor's source code escrow access procedures, conditions under which escrowed source code is released, and typical annual escrow costs
14. Establish rates for professional services
15. Establish rates for technical training
16. Establish rates for SaaS, cloud, or other hosting and/or system administration support options
17. Define whether the contract will auto-renew if no action is taken
18. Renewals are opportunities to revisit the contract to address these best practices. Ensure enough time is allowed during the pre-contract renewal phase to address concerns, negotiate new terms, or ultimately, select a different vendor

VENDOR REVIEWS

Vendor reviews are opportunities to establish and maintain planned and structured communication with the vendor. These reviews are important to maintaining a good relationship with the vendor. They also provide an opportunity to develop a common understanding of needs and solutions available to address them. Recommended best practices are:

1. Schedule quarterly vendor/contract reviews
2. Review SLA performance during the last period and over time
3. Review support issues
4. Review all work performed during the prior period
5. Review all upcoming work or anticipated needs
6. Review unapplied patches and upgrade options
7. Review SaaS and cloud options
8. Review contract dates
9. Discuss how service or performance could be improved

UTILITY CHALLENGES WITH MANAGING VENDORS AND CONTRACTS

Anecdotally (based on input from the research team as well as the participating utilities), utilities report a number of challenges working with vendors. They are summarized below.

1. Auto-renewal clauses being activated without a reminder note or in far too little time to work through the utility's procurement processes
2. Vendors paying close attention during the implementation of a large project, but being far less responsive to lingering or new issues/needs after the project has been completed (even when the utility has funds to pay for the service)
3. Utilities not enforcing contracts, and then getting frustrated by the vendor not complying with the contract terms. The Project Manager (or contract manager) must be extremely familiar with the contract and how it applies to the services being delivered. It is good business practice to regularly discuss the contract and status
4. Not documenting scope changes as they occur, including no-costs changes. As with any other contract change, these should go through a formal change control process

SURVEY RESULTS REGARDING CIS MAINTENANCE CONTRACTS

The survey included several questions related to how utilities manage their CIS vendor relationship. Ninety-nine utilities responded to these questions. Highlights are provided below.

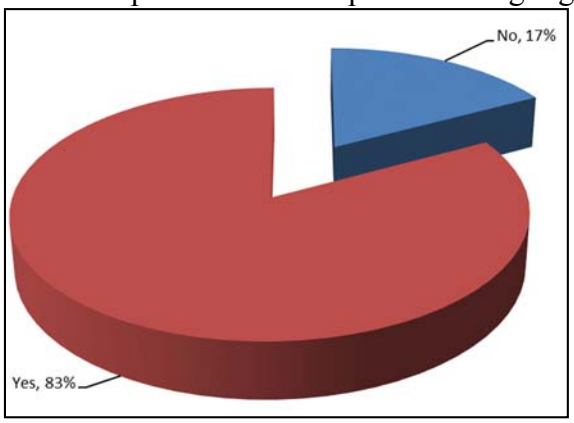


Figure 6.1 Utilities with CIS maintenance and support contracts

The majority of respondents (83 percent, or 82 utilities) indicate that they have an ongoing maintenance and support contract with their CIS vendor (Figure 6.1). Seventeen percent (17 utilities) of the respondents said they did not have such a support contract in place.

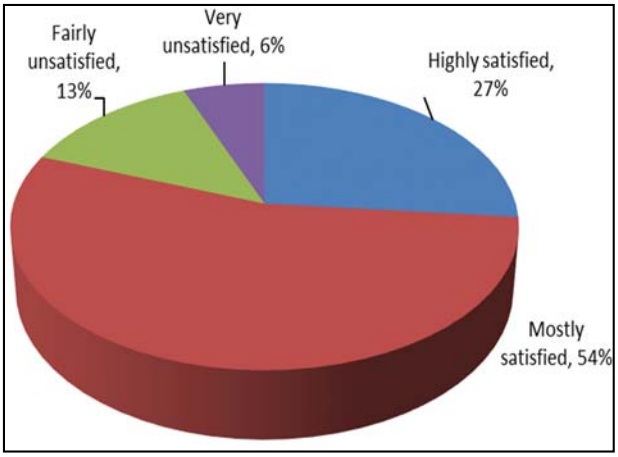


Figure 6.2 Utilities satisfaction with CIS vendor maintenance and support contract

Of respondents with ongoing maintenance and support contracts, 27 percent (22 utilities) are highly satisfied, and 54 percent (45) are mostly satisfied. Nineteen percent (11 utilities) are fairly unsatisfied or very unsatisfied (5 utilities) (Figure 6.2). The fairly unsatisfied and very unsatisfied utilities included a combination of large and small utilities, with a variety of vendors. Many of them had had the same vendor for a number of years. 10 of the 16 fairly unsatisfied or very unsatisfied utilities had 10 or more modifications to the CIS.

Most utilities with a maintenance/support contract also have a SLA in place (56 utilities). Of them, (73 percent) feel the CIS vendor generally meets the SLA timeframes (Figure 6.3).

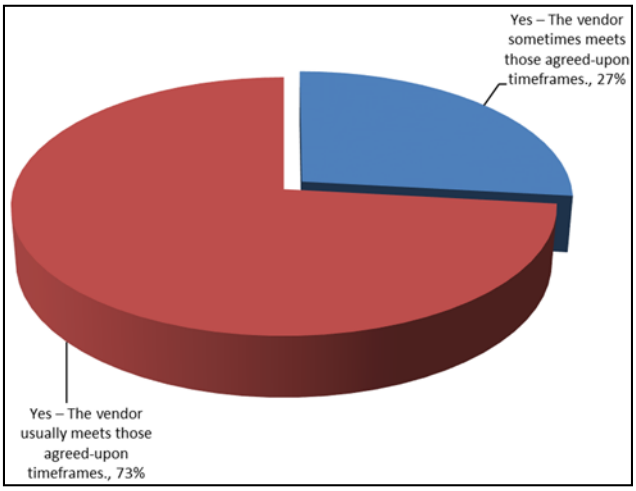


Figure 6.3 Vendor responsiveness when there is a maintenance contract

Twenty utilities said they do not have a SLA with the CIS vendor. Of those, 35 percent (7) of those said the CIS Vendor is usually very responsive. About half (55 percent, 11) felt the vendor is sometimes responsive, and 10 percent (2) felt their vendor is almost never responsive (Figure 6.4).

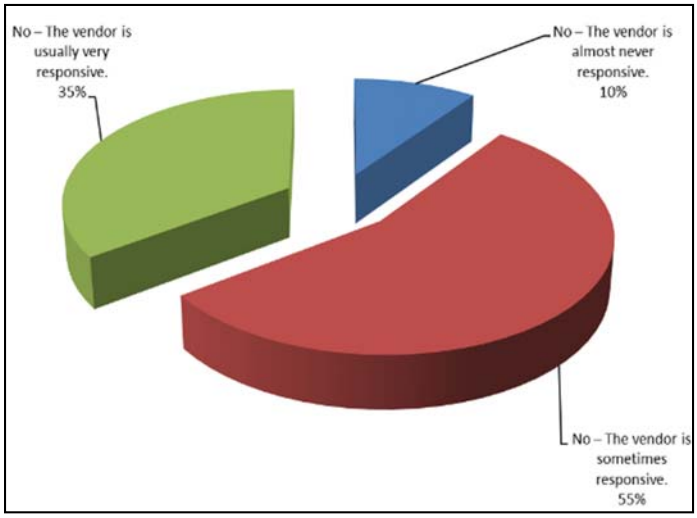


Figure 6.4 Vendor responsiveness without maintenance contracts

Reasons for dissatisfaction with the vendors are shown in Table 6.1.

Table 6.1
Reasons for dissatisfaction with CIS vendor's maintenance

Reasons for dissatisfaction with CIS vendor maintenance	% of Utilities
Sometimes new releases or patches break previous fixes	25 %
Low confidence the vendor's fixes will work the first time	25 %
The vendor is unable to respond to our service requests in a timely way, even when we are willing to pay more	22 %
The vendor charges too much for the services requested	19 %
Issues with the vendor's Project Manager(s)	6 %
They keep changing support staff	3 %

CHAPTER 7
CASE STUDIES

METHODOLOGY OVERVIEW

Case studies from a total of five water utilities are presented in this chapter. Each utility case study includes their experience with either an AMS implementation or a CIS implementation – in some cases both AMS and CIS are addressed. The selection criteria included having a variety of large and small utilities and governance structures, and a desire on the part of the utility to share their story and some lessons learned that would be of interest to others.

The utilities are:

- Albuquerque Bernalillo County Water Utility Authority, NM (ABCWUA) (AMI and CIS)
- City of Baltimore, MD (AMI/R and CIS)
- City of Bismarck, ND (AMI and CIS)
- Los Angeles Department of Water and Power, CA (LADWP) (CIS)
- New York City Department of Environmental Protection, NY (NYC DEP) (AMI)

With the exception of LADWP, the case study process involved reviewing the utility's response to the industry survey and analyzing their current situation and interest in being a case study; sending the utility a questionnaire; conducting one or more phone interviews to discuss their experiences; and incorporating the utility's comments into the final case study write-up.

The documentation regarding LADWP's CIS experience is taken directly from LADWP's website as of January 28, 2016.

ABCWUA AMI AND CIS CASE STUDY

General Background

Albuquerque Bernalillo County Water Utility Authority (ABCWUA) provides water and wastewater services to Bernalillo County and the greater Albuquerque, New Mexico metropolitan area. It is the largest water utility in the state of New Mexico. The Authority was formed in 2003 through a legislative action which transferred the municipal Water and Wastewater Utility from the City of Albuquerque to the Albuquerque Bernalillo County Water Utility Authority. Over the

ABCWUA Mission Statement

- Assure responsive Customer Service
- Provide reliable, high quality, affordable and sustainable water supply, wastewater collection treatment, and reuse systems
- Support healthy, environmentally-sustainable, and economically-viable community

next several years the Authority carried out a series of processes to separate from the City of Albuquerque.

The Authority serves the population of 656,000 through over 600 employees, supporting more than 3,300 miles of water supply pipeline and 2,700 miles of sewer collector pipeline. ABCWUA bills each of its 207,000 accounts monthly for water, wastewater, and solid waste. This includes 186,500 residential accounts and 19,000 commercial and multi-family accounts. ABCWUA relies on two sources for its drinking water: ground water from the Santa Fe Group Aquifer and San Juan-Chama surface water diverted from the Rio Grande River. Like many cities around the world, water conservation programs play a huge role in the area.

AMI

Meter Related Issues

In 1997 while still part of the City of Albuquerque, the Authority began a pilot program of installing AMR on 17,000 meters in one area of town that was hard to access. When they acquired a private utility in the same area the meters (about 20,000) were already on an AMR system.

When ABCWUA was formed in 2003, water conservation became a strategic focus. Conservation programs were so successful that they caused a major revenue shortfall. In fact, the Authority had two unscheduled rate increases due to the success of conservation.

The Authority required a better understanding of where their water production was going, the ability to reduce leaks sooner, and a way to make sure the water meters were measuring accurately.

Goals

When ABCWUA started the AMI project in 2010 they had four goals:

1. Encourage further water conservation among residents and businesses
2. Meet a state-mandated target of reducing daily-per-capita water consumption to 150 gallons by 2014
3. Streamline operations
4. Improve customer service

The Authority looked to AWWA for best practices and set their goals based on QualServe. As part of this process, they conducted a peer review (ABCWUA frequently benchmarks themselves against other utilities. The Authority also took part in the Effective Utility Management benchmarking process.).

Restructuring customer service and implementing AMI technology were identified as the best methods to meet their goals. Some key customer service functions were part of the operations group, including meter change-out technicians. Changing out non-working meters had not been a priority. Some meters had been estimated for more than a year, and about 9,000 – 10,000 meters were estimated each month. In addition, large meters were not tested, although a significant percentage of water (approximately 25 percent) was known to pass through them. An organizational change was made to move the meter change-out technicians to Customer Service. The Authority has since reduced estimated meter reads down to less than 300 per month. By setting a rigorous meter testing schedule in which all large meters were tested at least once every three

years and the top 25 users were tested annually, they became more confident in their meter accuracy.

AMI Project Leadership

The Authority determined AMI was the best solution to reach their goals. It would allow them to take readings multiple times per day (thus locating leaks sooner), reduce the number of estimated meter reads, and reduce staff safety issues such as falling, lifting vault lids, and other inherent outdoor safety issues.

Securing funding was very helpful. The Executive Director and Board supported the AMI program and earmarked $2 million per year for AMI as part of their Capital Improvement Program (CIP) known as the Decade Plan. Because it was part of this plan, the money could not be used for anything else.

The Authority then established a steering committee with the Chief Financial Officer as the Executive Sponsor and the Operations Manager as the Project Manager. They believe that projects like this one should not be owned by Information Technology (IT) but instead be functionally driven and managed by the group that is driving the technology. The rest of the team was made up of individuals from all areas of the organization. They believe it is better to make up a team that spans the organization, that way it eliminates the "who's the best salesman" issue of competing projects.

RFP Process

ABCWUA brought in a consultant to help with the RFP process. They also carried out site visits to some successful utilities and to several vendor sites. One requirement for selection was that the system had to work with multiple meter brands, because they wanted to be able to have meter manufacturers compete on price in order to get better prices. They also wanted a two-way system so that they could get on-demand reads when necessary and install necessary updates easily.

They released an RFP but did not get the responses they had hoped for. Rather than accept less than what they wanted, ABCWUA waited a bit for the technology to mature, then released another RFP. The vendor responses to the second RFP still did not result in the desired features. Again, ABCWUA declined to move forward, and waited for the technologies to mature. They released the RFP a third time and selected a vendor. The Project Manager stated that a major investment such as AMI is like a marriage: "You only want to do it once so you better make the right choice."

Solution

The system that ABCWUA selected supported two-way communication and a licensed network. It was important to the Authority that they own the frequency so they would not have issues with traffic interference. Through a separate RFP they selected meter data management software and customer engagement software. Antennas were installed only on the Authority's properties. They did not want to rent space and then have access issues, or face lease increases in the future. ABCWUA first set up the system with 900 meters. In 2011 they added another 40,000 accounts.

Benefits

They saw improvements in efficiency almost immediately by using leak reports. In one case they noticed a residential account showing water consumption every hour. A representative visited the property. After meeting with a neighbor who was taking care of the house, the representative found that the owner had to leave quickly due to a family emergency and would not be back for several weeks. The backyard water spigot was found fully open to refill a fountain. Had it not been for AMI it is likely the water would have continued running the entire time the customer was gone, creating a huge bill and wasting a lot of water.

Other benefits ABCWUA has experienced include eliminating manual meter reads, thus reducing data-collection costs and increasing billing accuracy.

Some of the biggest naysayers are now supporters of the program and using data to better analyze meter districts. By reading entire sections of accounts at one time, they create a "virtual" meter which provides an accurate way to look at consumption models and figure out detention time in pipes. It has also proven to be a great tool to help reduce non-revenue water loss.

In recognition of their success, ABCWUA was presented the 2013 CS Week Expanding Excellence Award for Best Smart Infrastructure Project among utilities that generate less than $400 million in annual revenue.

Future

ABCWUA now has about 64,000 AMI meters installed. They plan to have the remaining meters completed in the next two years. In the future they would like to include pressure monitoring through AMI to help identify leaks in the system

H. Warren, the Operations Manager states, "Our smart grid infrastructure has provided us with many new tools to enhance the way we run our operations and serve our customers. It will help us save money, deliver more accurate bills and encourage users to conserve water. It's also helping us improve customer service and make better long-term decisions."

CIS

CIS Related Issues

In 2003, when ABCWUA was being created by the New Mexico state legislature, the City of Albuquerque was in the process of installing an enterprise software solution. As part of that project, the City converted from a legacy billing system to a vendor provided solution. The City Information Technology department was in charge of the project. The project was very difficult. There were substantial schedule delays and multiple change orders. Minimal, if any, functional user feedback was provided by customer service and field service staff. The software was heavily customized.

When the system went live in 2005 there was poor user acceptance. It took the staff a long time to learn the system, and some previously simple processes became difficult. For instance, it took 20 minutes and changes to 5 screens to complete a meter change out. Not long after go-live, the software provider was purchased by another software vendor, who announced that they were no longer supporting the system, but were moving their customers to a newer CIS product offered by the company. ABCWUA was able to leverage a maintenance contract to move to the newer CIS product at a greatly reduced price.

Project Management

ABCWUA believes that having the right project manager is critical. It is important that the Authority's PM have a close relationship with the vendor PM. As a result, they changed the Authority's first CIS PM because he did not engage with users enough, and stayed in the office the majority of the time. The vendor's first PM was also released due to poor communication skills. This person tended to talk down to the employees and therefore they did not want to work with her. ABCWUA also believes that effective communication, and taking action when issues arise, is critical.

Many contractors who helped to install the first CIS also helped to implement the new product. Since they already had knowledge of the Authority's processes and resources, and the data was much cleaner, the installation was much easier. Perhaps some of the mistakes that had been made on the first implementation were still fresh on their minds so the new project went much more smoothly. Even so, there were issues.

Training and Service Level

During the entire process Customer Service employees were involved. Rather than have IT configure and clean the data, Customer Service employees did it. During implementation Customer Service Representatives (CSRs) worked in shifts to test and train. Instead of backfilling positions, the CSR's covered for each other so that while some employees were working on the implementation others continued to answer phones.

Albuquerque normally has a service level standard of answering 90 percent of all calls in two minutes or less. During implementation, the executive level and board members were alerted that the service level would be temporarily lowered to 30 percent of the calls answered in two minutes or less. Customers were notified through a recorded message that played when the office was called. The lower service standard did not become an issue for the Authority.

Super Users

One key to the success of this project was the creation of super users. Two employees with unique technical skill sets were trained to thoroughly understand the new CIS and were given the new job title of CS Administrator. They understood every aspect of the new software. They helped train others and were capable of answering most questions. They created new reports and changed billing rates in the system. Management initially opposed the idea of hiring new FTE's for the super user position but now realizes the value these positions bring. Refer to Appendix C for a copy of the CS Administrator Job Description.

Go-Live and Training

ABCWUA went live with the new system in April 2009 – 3 months early and $350,000 under budget. They had not planned to go live until June 30, but in April they acquired a new utility. They did not want to input all the new account information into the old system only to move it again two months later. Additionally, they felt ready to make the switch. Though they held training sessions for the CSR's, in the end they found that most employees did not need additional training since they had been so involved along the way. The super users were used to answer questions as they emerged.

Vendor Assistance

When there are issues with the product ABCWUA has easy access to support. An unusual situation is that one of the vendor consultants who helped to implement the system, now lives in Albuquerque and works from a desk inside the ABCWUA Customer Service area. He is still an employee of the vendor but Albuquerque benefits from him being so close. At first, the employees were so comfortable with him being there that they would immediately approach him with questions or issues. Management has since created a process so that issues go through the proper channels.

Benefits

Since going live in 2009, the system has worked well for them. The CSRs have a good understanding of how to use the system. New functionality, such as tracking liens, has been particularly important. Because ABCWUA bills for solid waste, they have been able to use the power of disconnecting the water service to encourage payment. Before solid waste was billed through the same system as water and wastewater they had a difficult time getting some citizens to pay.

Key Success Factors

ABCWUA believes the key factors to their success are:

1. Make certain you have the right project manager
2. Configure the system, do not customize it
3. Super users are an invaluable resource
4. Communicate service level drop to management and customers
5. Communicate with the vendor frequently to make sure you are on the same page

CITY OF BALTIMORE CIS AND AMI CASE STUDY

General Background

Baltimore City's Department of Public Works (DPW), through the Bureau of Water and Wastewater, operates three Reservoir Watersheds, three Water Filtration Plants, and two Wastewater Treatment Plants. The Bureau employs 1,700 employees and is responsible for the following in the Baltimore Metropolitan Area:

- Supplying 250 million gallons of drinking water daily to 1.8 million people
- Maintaining 3,400 miles of water mains through Baltimore City and Baltimore County, which also includes over 22,000 fire hydrants
- Collecting and treating on average over 210 million gallons of wastewater each day through 3,100 miles of sanitary mains
- Maintaining a 1,000-mile separate storm water drain system through more than 52,000 inlets

- Metering and billing approximately 401,000 metered accounts (approximately 394,500 residential and 6,500 commercial meter greater than 3 inches) on a quarterly basis.
- Billing includes water and wastewater services and state mandated fees related to storm water remediation and Chesapeake Bay restoration

Baltimore's water and wastewater infrastructure was built over 100 years ago and, like many other utilities around the country, their original asset replacement program had a longer expectation of assets' useful life. As a result of a massive CIP to improve the infrastructure on a proactive rather than reactive basis, DPW's total budget for FY2015 was $1.15 billion with about $650 million of this being applied to capital improvement projects.

DPW Director Rudolph Chow, PE made the decision to simultaneously update Baltimore's manually read metering system and 30+ year old billing system. Neither system, as a result of their age, could support the customer experience transformation that both the Department of Public Works and Mayor Stephanie Rawlings-Blake wished to give citizens. Furthermore, the legacy billing system could not provide monthly billing which would allow residents to budget more effectively and provides more transparency into rate breakdown. Once the new CIS becomes operational, there will also be a change from quarterly to monthly billing. Collectively termed the "BaltiMeter Program," the AMI/R and CIS projects are independently very high risk projects. DPW leadership initiated both projects with an understanding of the challenges and level of risk to implement this amount of change all at once, but as each of the projects hinged so tightly to the other, it was critical they were undertaken at the same time.

AMI/R Project Background and Preparation

In 2008, the Bureau of Water and Wastewater hired a consultant to conduct a business case analysis regarding the benefits and estimated costs for an AMR or AMI system. The business case identified the following benefits that could be achieved by implementing an AMI/R program:

- Greater transparency of meter reading data and more predictable billing timeframes (reduction in manual reads)
- Reduce estimated bills as a result of access issues or environment-dependent restrictions
- Enhance customer service (quickly assist the customer in understanding their consumption and resolving questions/issues)
- Timely identify potential water loss
- Enhance operational efficiencies due to fewer meter field checks and billing adjustments

In 2012, a RFQ was released to identify the technology that the City would accept. Upon review of the RFQ, the City desired a radio-based, fixed area network AMI system within the City's geographic boundaries. Baltimore County desired a combination of a radio-based, fixed area network AMI system and a mobile collection AMR system. Additionally, in 2012, the City contracted with three meter vendors to provide meters to the City. The City intended to purchase the meters and provide them to the installation vendor.

A RFP for the installation was released in May 2013 with the bidders for the installation required to use the technologies that had been approved as a result of the RFQ process. Additional steps the Utility took to prepare for the AMI/R Installation project included:

- Providing for adequate funding in the CIP
- Contracting with an experienced consultant to provide a broad range of project oversight
- Hiring a project manager
- Initiating the development of an RFP for Urgent Needs work to address more significant infrastructure issues that would prevent meter installations

AMI/R Key Project Participants

The AMI/R key project participants included: DPW Director, DPW Project Manager, representatives from DPW Customer Support and Services, DPW Communications, and DPW Engineering and Construction, the Mayor's Office of Information Technology (MOIT), Baltimore City Legal, Baltimore City Purchasing, Baltimore County DPW, City Consultants, and the AMI/R Implementation vendor.

AMI/R Project Status

In November 2013, the AMI/R installation contract was awarded to upgrade or replace residential and commercial water meters in Baltimore City and Baltimore County in two phases. Phase 1 included meter replacements in Baltimore City with a first round scheduled completion by April 1, 2016. Phase 2 included meter replacements in Baltimore County with a scheduled completion date by April 1, 2017. It also included implementing a Meter Data Management System (MDMS) capable of importing, validating, processing, and reporting data, providing long-term data storage and management, and allowing water customers to view their water consumption behavior via a web portal.

The initial focus of the project was on the IT and telecommunications infrastructure needed to support the metering system and installation process. The City had to invest resources to upgrade their technology infrastructure to support the amount of consumption data it was preparing to receive. There was also focus on confirming business requirements, developing a communication strategy with customers, ensuring that the existing billing system was able to receive the meter change information, coordination between installation vendor and meter reading staff, meter installation training for the vendor, and installation of the AMI fixed network.

One of the first requirements that had to be met prior to allowing meter installations was for the installation vendor to test the AMI/R system in a very controlled environment at the Meter Shop. In the summer of 2014, meters with transmitters were placed on the meter test benches and a network device was installed at the Meter Shop. Water was run through the meters on the test bench, consumption data was transmitted to the network device, and the network device transmitted the information to the receiving system. When that proved successful, the next requirement was to conduct a "Proof of Concept" phase in the field. In the fall of 2014, approximately 10,000 meters were installed in areas of the City and the County to challenge the system. The City intentionally chose areas with very tall buildings and meter vaults that flooded often. When that phase proved successful, the vendor was permitted to move into full scale meter

installations in Baltimore City in January 2015. The majority of Baltimore City residential installations (approximately 199,000 accounts) were complete by October 2015. The remaining City meters awaiting replacement were primarily as a result of infrastructure issues related to the age of the current assets. At the time that this case study was written in April 2016, the vendor met the City's requirement to complete all City meter installations that were available to the vendor. The following tasks remain and are required to be complete by April 1, 2017:

- Complete the remaining City meter installations (7%) as the meter vault or account information issues are corrected
- Complete the remaining County meter installations (52%)
- Complete the remaining County fixed network installations (39%)
- Implement the analytics tool which would allow for a user-friendly and easier processing of head-end metering data
- Determine how much meter data will be collected on the AMR mobile read meters

AMI/R Project Challenges and Lessons Learned

1. For AMI Projects, assess the potential network device installation locations for viability and fit with the project prior to the start of the project:
   - The City discovered that some initially identified locations were no longer City-owned properties and the new owners were either unwilling or unable to provide access to the locations or they requested payment to provide a location for the device
   - Identify the City agency that occupies the property and obtain a contact name for installation coordination
   - Determine the condition of the building (e.g., is it structurally sound), accessibility, whether the property has a power source and if it is currently active, and any other issues that could hinder installation of the network device (e.g., the building has some historical or other status that would present difficulties or costs to access the building or mount something to the building)
   - For non-City locations, explore whether there would be a charge for the use of the location
2. Identify and correct meter locations which may prevent meter installations prior to the start of installation activities (e.g., vault opening size too small, inoperable shut off valves, etc.). Doing this can reduce the impact on the installation project and allow associated costs to be spread out over an extended period of time. However, for issues that are not resolved prior, have a process established to resolve issues quickly to minimize the impact to the installation schedule.
3. Use the project as an opportunity to check on account information associated with the meter for accuracy and that the system of record matches field findings. This validates the data during the mass replacement and will prevent any more substantial meter exceptions or risks to billing. This includes data related to the address of the service and to the meter manufacturer, identification number, and size.
4. Lay out business process and mitigation planning for the inevitable data or environmental issues that will appear in any project of this magnitude. Examples:

- Meter vaults that contain more than one meter. In twin meters, planning for some data errors that could appear when "sunsetting" a manual meter reading process, led to some erroneous switches at some point in time and the meter reading was no longer associated with the correct account
- "Community" meter groups. When there is a cul-de-sac with multiple meter vaults next to each other, it is not always clear which meter goes with which property. Take the time to contact the customer and confirm which meter goes to which account/address, and identify it on the meter ahead of vendor installations
- Joint planning between the meter replacement project and the operational meter reading schedule. Validating that meter replacements are scheduled to ensure minimal disruption to the regular read-bill cycle is critical to stakeholder buy-in.
- Communication: Ensure that all communications provided to customers and key stakeholders are clear, that there is an escalation point to request more information and understand the impact and basic operations of the new meters. This includes communications as a result of the discovery of leaks during the meter replacement project. *Refer to Appendix 2: Meter Installation Customer Communication for a more detailed description of Baltimore's communication with customers*.
- Identify accounts/addresses that would require main valve shut downs or traffic control in order to change the meter.

5. Increase operational staff prior to, or very early in, the meter installation project start. Do not underestimate the project's impact on operational staff. A dedicated project team that can escalate key decisions through the appropriate channels is best suited to a large-scale program such as a mass meter replacement project.
6. Create project executive sponsor escalation protocols, key decision points, and stakeholder assessment to define the best method of communication.
7. Identify an experienced program manager and break-up individual tracks to key project members for optimum follow-up and to reduce the chance of employee burn-out for the core project team.
8. In advance of the project, develop relationships with those that will either impact the project or be impacted by the project in order to facilitate resolution. Examples of another group impacting the AMI/R project relates to re-lining, or street widening projects. When external groups pull the meters to support their work, they often are not aware of the project impact. This can be problematic if the AMI/R contractor is in the middle of proving out their installation.
9. Ensure that project documentation is well managed. Dedicate a project site that provides one version of the truth and that all project members and key stakeholders can reference.
10. Hold the installation vendor to the contract terms and halt the project if significant contract terms are not being met. It is better to temporarily halt the project than to continue on and have significant re-work or quality issues.
11. As the project progresses, the project team will be focused on project completion and the operations staff will be provided the relevant training and begin to take over the management of the new meters. As the operational staff will have not yet developed the expertise to identify issues quickly and provide resolution, have dedicated resources that are responsible for assisting operations with the new capabilities and processes. It would be beneficial for these resources to have been involved in the project from the

start, be highly aware of the project status, and to participate in ongoing communications with both the project team and operations.

AMI/R Benefits Realized to Date

1. Improved ability to provide better consumption information with the ability to analyze issues and assist the customer in understanding consumption. *Refer to Customer Issue Resolution Example in Appendix 1.*
2. Improved efficiency in obtaining meter readings. The amount of time and staff required for meter reading has been reduced significantly. Reading staff has been shifted to address issues that are interfering with the automated reading process.
3. Fewer incidents or issues that delay or prevent meter readings (e.g., weather events, an animal in the yard, cars parked over vaults, etc.). Baltimore received approximately 2 feet of snow in February 2016 and there was very minimal impact to the ability to obtain meter readings.
4. Improved leak detection capabilities. The increased meter data assists in the determination of a leak with the ability to detect if consumption never drops to zero. Reports also indicate accounts that have had continuous consumption 24 hours per day for more than 7 days.
5. While the installation and maintenance for an AMI system is more complex and more expensive than an AMR system, staff is better able to respond to ongoing operations issues and customer inquiries in the AMI system. It also decreases the need for field visits. On demand reads, identification of continuous consumption, and the ability for office staff to conduct a turn off test are just a few examples of what can be performed by office staff.

CIS Project Background and Preparation

The other half of the BaltiMeter Program is the replacement of the 30+ year old legacy water billing system. The meter-to-cash water billing cycle is split over two primary agencies, the Bureau of Water and Wastewater under the Department of Public Works and the Bureau of Revenue Collection under the City's Finance Department. DPW and City Finance have different reporting structures into the Mayor's office. The Bureau of Water and Wastewater is responsible for processing applications for new service, meter reading, meter maintenance, billing, audits, customer service, discount programs, billing adjustments, and collections. The Bureau of Revenue Collection is responsible for payments and refunds. Both agencies have a shared responsibility for financial and operational reporting. Baltimore's goals for the new CIS include:

- Improvement of the predictable timing of bills
- Improvement on the standard management of billing exceptions
- Expansion of payment arrangement options for customers
- Automation of many repetitive and routine business processes
- System driven work flow management and ensuring maintainable business processes

All project participants agreed that there would be no customer code requested and this would remain a commercial off the shelf (COTS) product. To avoid heavy post go-live or

maintenance costs for the future, a commitment was made to change business processes, if necessary, to avoid custom development that would be unique to Baltimore. The new CIS is intended to interface with almost 20 other systems (e.g., banking/payment, financials, metering, work order management, GIS, etc.) An RFP for the new CIS was released in January 2014 with demos occurring in May 2014. Additional steps taken to prepare for the CIS project included:

- Providing for adequate funding in the Capital Improvement Program (CIP)
- Contracting with an experienced consultant to assist in identifying and verifying system requirements and to provide a broad range of project oversight and implementation support
- Attending a national conference focused on utility customer service that included viewing several CIS demonstrations
- Hiring an external project manager. Baltimore chose to have the CIS Project Manager be the same project manager on their AMI/R installation project
- Reviewing the Water Research Foundation report #91071, *Effective Practices to Select, Acquire, and Implement a Utility CIS* (Rettie et al. 2005). Baltimore made some decisions related to their new CIS based upon recommendations from this research, including the decision to limit the amount of history being brought into the new CIS
- Participating in a networking group focused specifically on water customer care executives of large utilities and their issues
- Implementing a data warehouse; building the content of the data warehouse provided a better way to query legacy system information and was particularly beneficial in the data cleansing and data migration processes of the CIS project

CIS Key Project Participants

The key CIS project participants included: DPW Director, DPW Project Manager, representatives from DPW Customer Support and Services, DPW Communications, DPW Engineering and Construction, the Mayor's Office of Information Technology (MOIT), Baltimore City Legal, Baltimore City Purchasing, Baltimore City Finance, Baltimore County DPW, City Consultants, and the CIS implementation vendor.

CIS Project Status

In October 2014, the CIS installation contract was awarded to replace the existing legacy billing system in Baltimore City and Baltimore County, with a system of the same technology as the City finance department's ERP. Phase 1 of the replacement project included conversion to the new CIS in Baltimore City with a first-round completion date by April 1, 2016. Phase 2 includes conversion to the new CIS in Baltimore County with a scheduled completion date by April 1, 2017. With each CIS go live, those accounts will also be converted to monthly billing and moved to the new billing rate structure. Analysis phase workshops started in January 2015 in order for the vendor to obtain more detail on current billing processes. The project then moved into the Design phase in March 2015 for the vendor to review new system capabilities and how processes should/could change in the new system. The Development phase began in June 2015 for the vendor and City to work through the details of system configuration. At the time that this case study was written in April 2016, the City had made the decision to move the City go-live from April 2016 to

October 2016 to avoid interference with other City agency activities and to allow more time for City system testing and staff training. To date, the City has maintained the commitment to not include any requirement that would need custom coding. In addition to carrying out the technical implementation of the selected CIS project, there are several other key activities planned that include:

- Increasing the readiness of the current workforce to operate in the new billing system. This will be a combination of providing additional support to the operations sections as they address current ongoing operational needs as well as preparing them to handle the new policies, technologies, and business processes.
- Assessing current job classifications and structures to adapt to a more responsive design to operations. This takes the form of both re-assigning current staff, in addition to hiring additional staff to support the conversion and future operational requirements.
- Preparing for future business processes. This includes developing detailed testing scenarios, identifying a set of accounts to monitor through the entire meter-to-cash process, determining expected results and entering them into the testing software.
- Preparing for bill print validation. This includes examining a subset of bills to confirm they contain the correct data and present the data as intended.
- Preparing for training. The current plan for training has three major components:
  - As the project has progressed, along with the desire of the City to keep all existing staff, the training plan had to include basic training on other key office applications Since the CIS system is built on top of the Microsoft architecture, the training is essential and will be provided through the City training resources.
  - The vendor will provide typical roles-based classroom training.
  - After classroom training, staff will receive simulation training at their workstations. For this training, the new system will be available in a dedicated training environment. Staff will be expected to perform duties using the new system to continue to enhance their knowledge of the system. For example, Call Center staff will receive simulated calls from other staff members and will need to use the new systems to carry out their tasks to address the customer's concerns. The goal of this training is to enable staff to be more confident and skilled when they have to deal with real customers having questions related to the meter readings, the bill design, the move from quarterly to monthly billing, and the new rate structure.
- Implementing a comprehensive stakeholder communications plan that will address the new bill design, the new billing rate structure, and the change in billing frequency.
- Continuing data cleansing activities to increase the data quality.
- Reviewing and updating water regulations and City code based upon final configuration of the system.

CIS Project Challenges and Lessons Learned to Date

1. Ensure that Standard Operating Procedures (SOPs) and/or business rules requiring updates as a result of the change in billing system or as a result of quarterly to monthly billing are identified, documented and confirmed prior to the completion of the system configuration phase of the project.

2. Identify related projects that impact the CIS project. Because of the typical long duration of these projects and the large number of interfaces, it is not unusual to have one or more of the key projects, interfaces, or stakeholders change during the CIS project implementation. Baltimore experienced this when their work order system was upgraded as part of a separate effort. The consequence was the CIS vendor had to update interface work they had already completed in order to work with the newer version of the work order management software.
3. Stay focused on core functions and responsibilities first, and then add additional capabilities and features in a phased manner. An impact matrix should be monitored throughout the project to determine if a requested change significantly increases the risk of the project.
4. Exposure to other utilities, utility conferences, new work flow ideas from experienced consultants, and an understanding of process redesign is critical to help other organizational leaders as they need to have the background to lead and sustain transformational change. Help other members who are not exposed to those project-related experiences to 'Know what they don't know.'
5. Secure a primarily dedicated project staff who can put aside daily operational jobs to focus on the project and be involved in the project from the start and on an ongoing basis to provide input, gain understanding, and to prepare to take ownership.
6. Evaluate staffing levels prior to the start of the selection process. Evaluate the current organization structure compared to the future needs after the new business processes and CIS have been implemented.
7. Plan to have time in advance of the project to carry out basic data cleansing and account cleanup activities to minimize the impact on the project. For example, identify and correct accounts that weren't coded properly (e.g., active/inactive). This should start approximately 6-12 months prior to project initiation.
8. Establish standards and enforce consistency in how data is input and in how data fields are used in the existing billing system to help with the data migration efforts.
9. Ensure that an experienced project manager is identified and that sub-track owners for areas such as training, legal, and regulatory plans are laid out.
10. Hire a consultant with experience in CIS implementations. It is particularly valuable for the consultant to be engaged from the start of the project when decisions with long term impacts and implications are being made. Specific benefits included identifying issues that the utility staff may not be aware of, understanding long term implications, providing operational insights and experience to predict potential challenges, and ensuring proper oversight of the CIS contractor.
11. Hold the CIS vendor to the contract terms and halt the project if significant contract terms are not being met.
12. Expect to discover additional information during the course of the project that may require additional time added the schedule and/or additional money to address an issue. Be prepared to review the impact analysis to determine whether the project schedule or scope should be updated to reflect the new and more accurate understanding.
13. Ensure that project documentation is well managed. Dedicate a project site that provides one version of the truth and that all project members and key stakeholders can reference.

14. Provide consistent, timely, clear, and highly credible communication to internal and external stakeholders. Doing so will help give them confidence in the project and the process and provide information that will assist them in responding to customer questions/concerns. This includes customers and the DPW departments or other City/County agencies that are likely to interact with customers (e.g., City Council, Mayor's Office, etc.)

CIS Benefits Realized to Date

The following benefits have been realized to date:

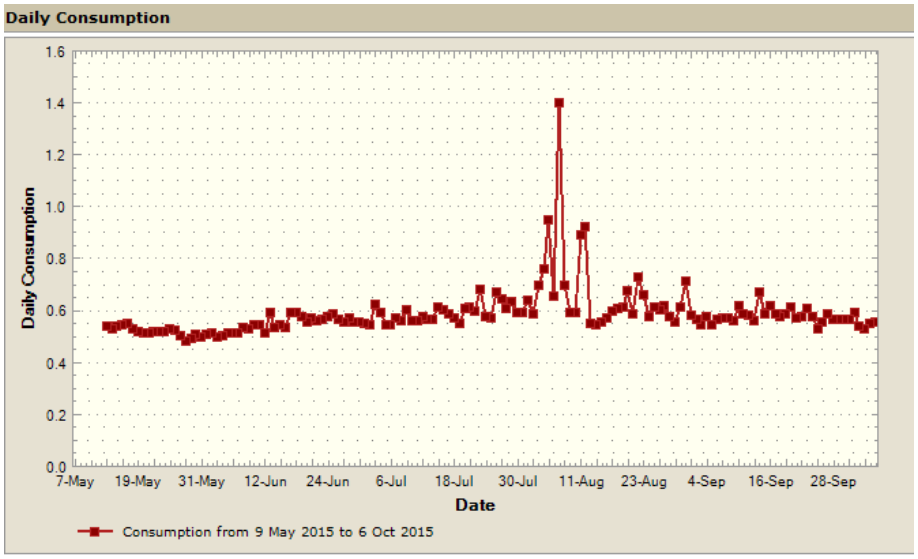
- A deeper understanding of current policies and identifying and addressing issues with current business processes
- Identification of process changes that can and should be changed in advance of system go-live
- More detailed documentation of current and future policies and procedures
- Increased quality of the existing billing data

Risks Doing Both Projects Simultaneously

The AMI/R and CIS projects are very high risk due to the complexity of the projects and the workload the projects impose on project and operational resources. To realize the rewards of a simultaneous project schedule, a proper understanding of the risks involved, planning and strong mitigation planning for when the inevitable issues arise, and good communication to necessary stakeholders is invaluable.

Appendix 1 – Customer Issue Resolution Example

A customer contacted Customer Care around 10/6/2015 to complain of ongoing high bills that started after the meter was changed in May 2015. The customer insisted they did not have a problem and that something must have happened during the meter change. Customer Support began an analysis of the customer's account. The customer's old meter was read 10 days prior to meter change for billing purposes. In those 10 days, 16 units of consumption registered on the old meter. This was very high consumption based on the household size and upon prior billing consumption. When the meter was changed, consumption remained consistently high. There was also a spike in consumption at the beginning of August 2015 that the customer could not recall (Figure 7.1). Customer Care could not identify a day in which the customer's consumption ever registered zero during the course of the day and the customer was advised that there appeared to be a leak at the property.

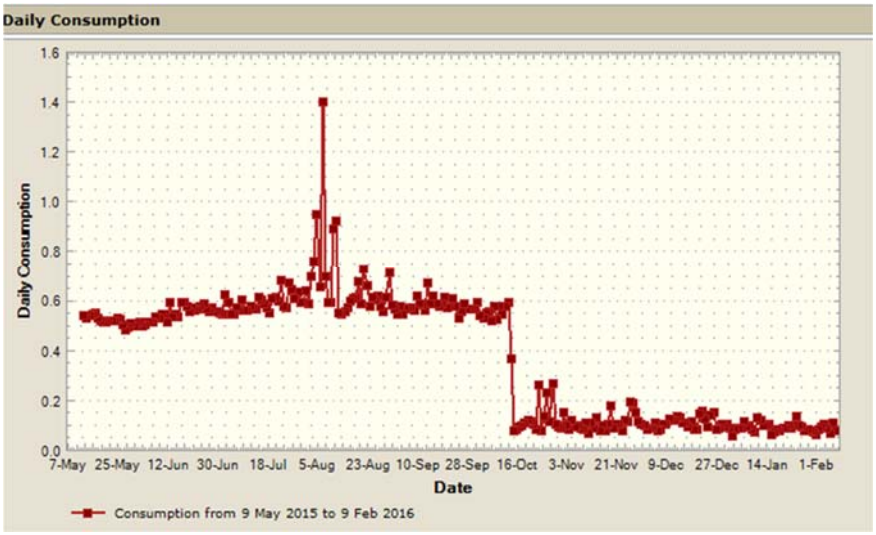


Source: Courtesy of City of Baltimore DPU

Figure 7.1 Daily consumption data indicates issue

The customer contacted Customer Care after the plumber had visited and reported that the plumber could not find any leaks or any other issue.

Customer Care analyzed meter reading information again. Figure 7.2 below indicated that, after the plumber visited the property, consumption dropped significantly and was consistent with prior billing consumption. The consumption has remained at this level.

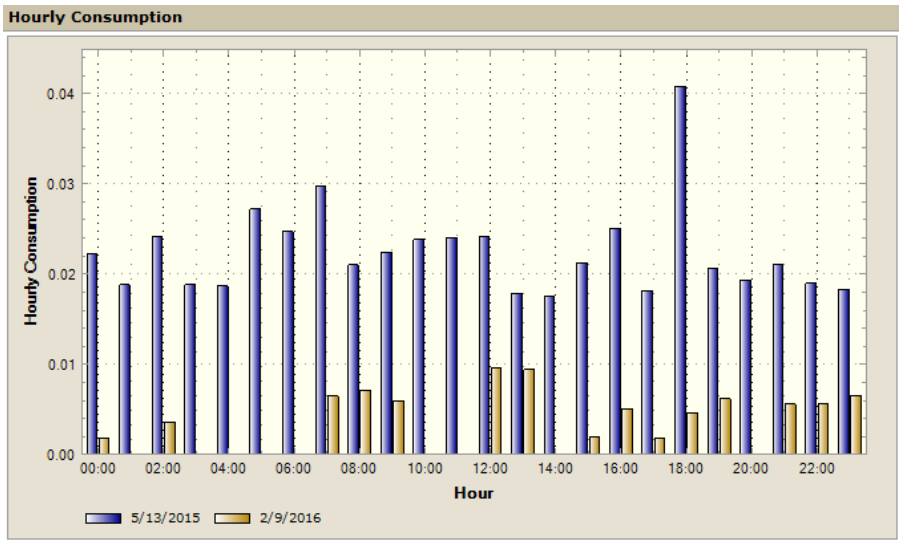


Source: Courtesy of City of Baltimore DPU

Figure 7.2 Consumption data confirms expected consumption

Figure 7.3 below shows hourly consumption on 5/13/2015 (blue) when consumption at the property was high and on 2/9/2016 (gold) when consumption was consistent with prior billing. On 5/13/2015, at no point did consumption go down to zero during that 24 hour period. On 2/9/2016,

as expected, there are many points during that 24 hour period when consumption went down to zero.



Source: Courtesy of City of Baltimore DPU

Figure 7.3 Hourly consumption

All consumption information was shared with the customer and the customer acknowledged that they must have had an issue.

Appendix 2 – Meter Installation Customer Communication

The program was branded as "BaltiMeter" and an extensive customer outreach program was developed by the DPW Communications Division, the Project Manager, the Consultant, and the Installation Contractor (Figure 7.4).

Source: Courtesy of City of Baltimore DPU

Figure 7.4 BaltiMeter customer outreach

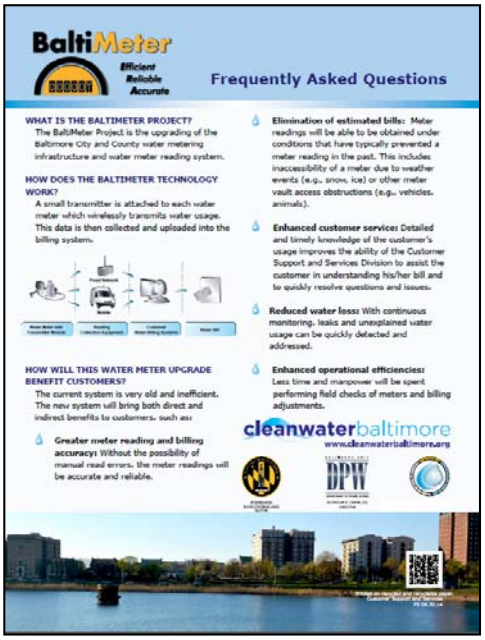
At the start of meter installation, a press conference was held for the Mayor and Director of Public Works to announce the official start of meter installations. The press conference also included a display and discussion of the equipment involved. DPW's Communications division released a variety of press releases as the project started and as various project milestones were accomplished.

Meter Installation Protocols for both Residential and Commercial Customers

- All project representatives (e.g., installers, quality inspectors, etc.) have identification from their employer. Additionally, all vehicles have BaltiMeter project identifiers
- Project representatives are instructed to advise the customer to contact the City's 311 if the customer is expressing concerns to the installation representative or their authority to perform work

Meter Installation Notification Process for Residential Customers

- As work begins in a new area, a letter and a Frequently Asked Question document is mailed to both the property address and the billing address (if they are different) (Figure 7.5). These notifications will explain what is going to happen and what the customer can expect as the water meter upgrades commence



Source: Courtesy of City of Baltimore DPU

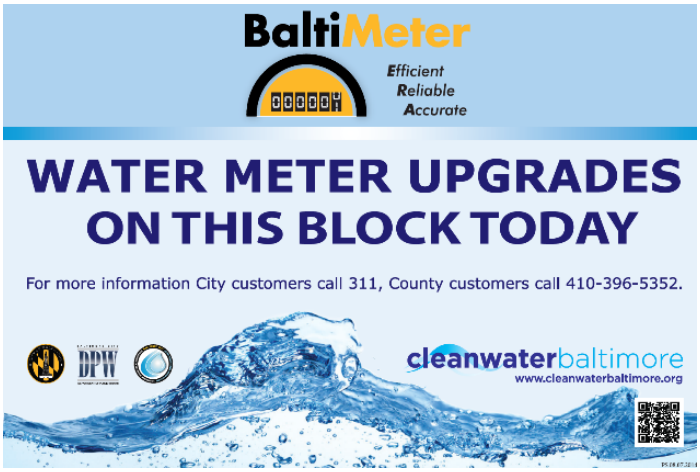
Figure 7.5 Meter notification letter

- As the installation vendor mobilizes in a new area, door hangers are placed at the property approximately two to three days in advance of the expected date of installation (Figure 7.6).

Source: Courtesy of City of Baltimore DPU

Figure 7.6 Door hangers

- On the day of meter installations, meter installers will place signs in the area alerting to meter installations being performed (Figure 7.7).



Source: Courtesy of City of Baltimore DPU

Figure 7.7 Meter installation sign

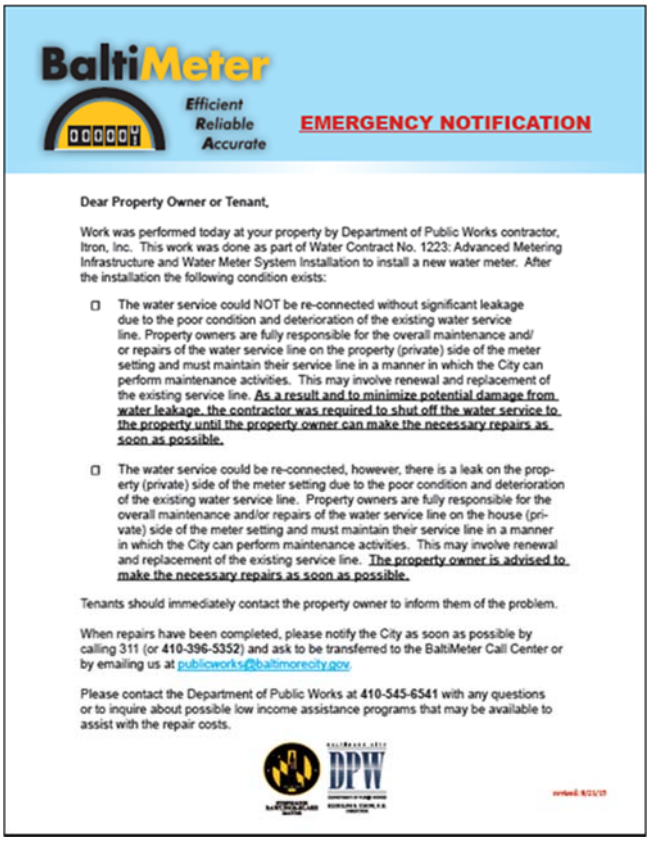
- Prior to starting the meter upgrade, the meter installer will knock on the door of the property as a courtesy to advise the customer that a brief water interruption is about to occur. Customers do not need to be present in order for the upgrade to occur.
- Installers will leave another door hanger after the meter installation is complete or if they were unable to complete the meter installation (Figure 7.8). If installers were unable to complete the installation (e.g., leak issue, account information correction required, something blocking the

meter vault, etc.), the door hanger will indicate if customer action is required to resolve the issue.

Source: Courtesy of City of Baltimore DPU

Figure 7.8 Door hangers communicate installation status

- If a situation occurred that required the water to be shut off and left off at the property (e.g., significant leak) or if there was a customer side problem, an Emergency Notification letter is left at the property (Figure 7.9).



BaltiMeter

Efficient
Reliable
Accurate

EMERGENCY NOTIFICATION

Dear Property Owner or Tenant,

Work was performed today at your property by Department of Public Works contractor, Itron, Inc. This work was done as part of Water Contract No. 1223: Advanced Metering Infrastructure and Water Meter System Installation to install a new water meter. After the installation the following condition exists:

- ☐ The water service could NOT be re-connected without significant leakage due to the poor condition and deterioration of the existing water service line. Property owners are fully responsible for the overall maintenance and/ or repairs of the water service line on the property (private) side of the meter setting and must maintain their service line in a manner in which the City can perform maintenance activities. This may involve renewal and replacement of the existing service line. As a result and to minimize potential damage from water leakage, the contractor was required to shut off the water service to the property until the property owner can make the necessary repairs as soon as possible.
- ☐ The water service could be re-connected, however, there is a leak on the property (private) side of the meter setting due to the poor condition and deterioration of the existing water service line. Property owners are fully responsible for the overall maintenance and/or repairs of the water service line on the house (private) side of the meter setting and must maintain their service line in a manner in which the City can perform maintenance activities. This may involve renewal and replacement of the existing service line. The property owner is advised to make the necessary repairs as soon as possible.

Tenants should immediately contact the property owner to inform them of the problem.

When repairs have been completed, please notify the City as soon as possible by calling 311 (or 410-396-5352) and ask to be transferred to the BaltiMeter Call Center or by emailing us at publicworks@baltimorecity.gov.

Please contact the Department of Public Works at 410-545-6541 with any questions or to inquire about possible low income assistance programs that may be available to assist with the repair costs.

DPW

Source: Courtesy of City of Baltimore DPU

Figure 7.9 Emergency notification letter

Meter Installation Notification Process for Commercial Customers

- Commercial customers are mailed a letter and a Frequently Asked Question document is mailed to both the property address and the billing address (if they are different) (Figure 7.10).
    - These notifications request that the customer make an appointment for their meter change/upgrade. Customers are informed that this is done to minimize the potential impact to the business. The letter also states that failure to schedule an appointment may result in their water being temporarily shut off without advance notice for the meter upgrade

Source: Courtesy of City of Baltimore DPU

Figure 7.10 Meter installation documents for commercial customers

- The initial appointment with the customer is to perform an assessment. The meter installer will assess if there are any issues that would prevent the meter installation, make contact with the customer's representatives that are knowledgeable about the property water maintenance, identify if traffic control or valve shutdown would be required for the meter installation, etc.
- After the assessment appointment, the meter installer will coordinate a date and time for the meter change/upgrade with the customer
- If the commercial customer does not call to schedule an appointment, a "Repeat Notice" postcard and a "Final Notice" postcard are mailed (Figure 7.11). Installers will also visit the property in an attempt to schedule an appointment. If all attempts fail to get a response from the customer, the account is returned to DPW for authorization to proceed with the meter installation.

Source: Courtesy of City of Baltimore DPU

Figure 7.11 Repeat and final notice cards for commercial customers

Quality Checks to Monitor Communication Protocols

- When the installation vendor imports customer accounts into their work order system, all accounts are immediately placed in "Black Out" status. This status prevents the account from being dispatched to be worked. Accounts must remain in "Black Out" status until communication protocols are confirmed by the City's consultant
- Every mailing includes a copy of the correspondence going to both DPW and consultant representatives. Each mailing has an identifier on the envelope to associate it with the intended routes to be worked
- Upon confirmation of receipt of the letter, consultant gives permission to place door hangers at the appropriate locations that notify customers of upcoming meter changes
- When door hangers are placed, installer must also take a variety of photos at a representative sample of locations showing door hangers were placed. House numbers and street signs must also be included in the photo report. Staff placing the door hangers also have a phone application that tracks their movement while placing door tags
- Consultant reviews photo report before giving permission for installations to occur
- Once permission to begin installations is granted, appropriate accounts are moved out of "Black Out" status so work can be dispatched. The consultant verifies in the installers work order system that only the approved accounts are removed from "Black Out" status
- The consultant also follows up on the actual installations to ensure they are occurring close to the timing of the door hangers being placed at the property
- To support the communication efforts, there are also on-going weekly communication meetings that focus on identifying and resolving new or changing communication issues

CITY OF BISMARCK CIS AND AMI CASE STUDY

General Background

The City of Bismarck, North Dakota is the state capital with a population of 72,000 and a Metropolitan Statistical Area of about 126,000. For the past several years the area has been one of the fastest growing small cities in the United States due to the energy boom.

Water and wastewater services are provided through the City's Department of Public Works - Utility Operations. Water for the City is taken from the Missouri River, treated, and then delivered to the citizens through an elaborate network of approximately 320 miles of water pipe ranging in diameter from 3 inches to 42 inches. The City's water system includes 2,900 hydrants, 5,900 valves and five pump stations. The treatment plant has the capacity to treat and produce about 30 million gallons per day (MGD). The City also supplies water to the South Central Regional Water District and the City of Lincoln, North Dakota.

Water use is measured through 18,944 residential and 2034 commercial water meters. In 2012, a staff of three people provided billing and call center functions, which were shared by the Public Works-Utility Operations and Public Works-Service Operations Departments. Meter installation, maintenance and reading, and customer service orders were performed by another work group within the Utility Operations Department.

The City's billing system was a 30-year-old in-house system written in DB/2, running on IBM's iSeries (AS/400) platform. Services billed included water, sewer, street lighting, storm water, and solid waste.

By 2012, the City had three key challenges regarding customer service: an aged landline, a phone based AMR system, a legacy billing system, and questions regarding the appropriate organization and staffing levels for Customer Service. Bismarck officials issued an RFP for assistance:

1. Selecting, procuring, and implementing a replacement for the existing AMR system
2. Selecting, procuring, and implementing a new CIS
3. Analyzing and providing recommendations regarding the organization of the Utility Customer Service organization (structure and staffing levels)

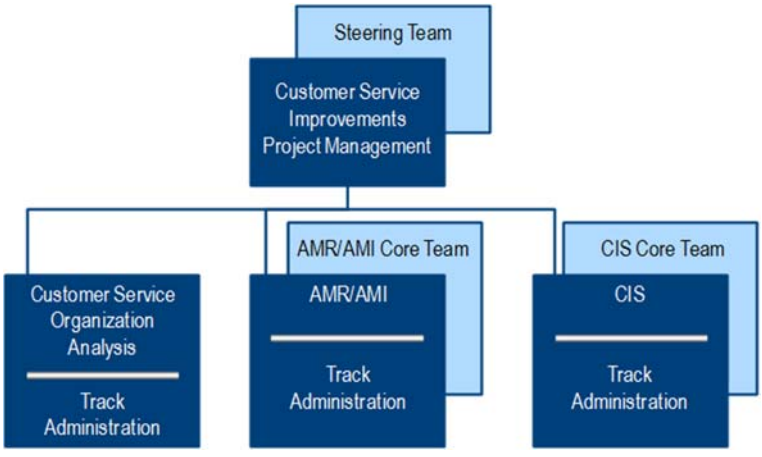
The project vision is shown below in Figure 7.12.

Source: Courtesy of City of Baltimore DPU

Figure 7.12 Customer service improvements project will provide clear roadmap and well-implemented solutions

One consulting company was hired to assist with all three tracks. Two Core Teams were formed – one for AMR/AMI and one for the CIS, with one Steering Team overseeing both Core Teams and the organizational analysis. The Steering Committee was composed of the Director of Finance, Director of Utility Operations, and the Assistant City Administrator (Figure 7.13).

The Organization Analysis was carried out in parallel with the CIS track, followed by the AMI/R track.



Source: City of Bismarck

Figure 7.13 City of Bismarck Project Structure

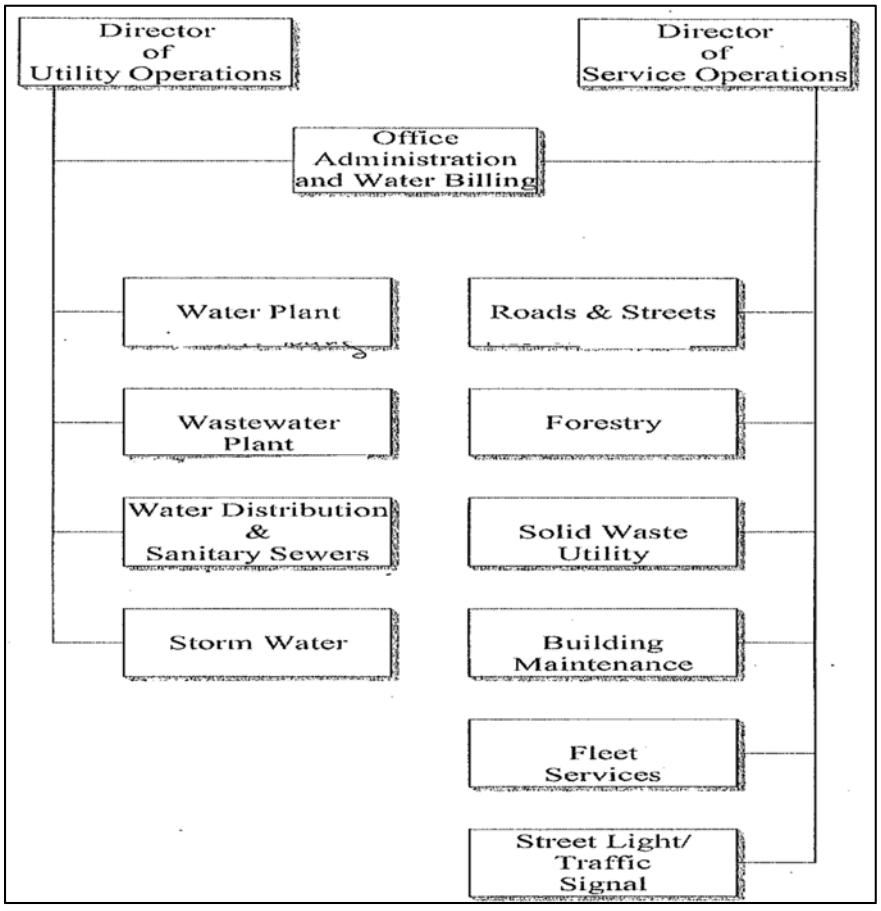
Organization Analysis Track

The organization analysis included looking at the existing structure, staffing levels, job duties, work load, and performance measures, and redesigning them in the current environment to be more effective. The redesign applied principles of best practices, and an eliminate/reduce/shift/redesign analysis process.

The analysis found that the organization was quite lean, and little work could be eliminated without carrying out the AMR/I and CIS projects. The analysis also included recommendations related to the expected impacts of the new AMR or AMI system and CIS, in terms of required skills, as well as the impact of these projects on staff levels while the projects were being carried out. The track included two checkpoints – one after the CIS was commissioned and stable, and one as the AMR/I project neared completion.

A new organization structure was recommended, as well as draft job descriptions for a Customer Service Manager, Customer Service Field Lead, Field Service Representative, Customer Service Representative II, and Customer Service Representative I.

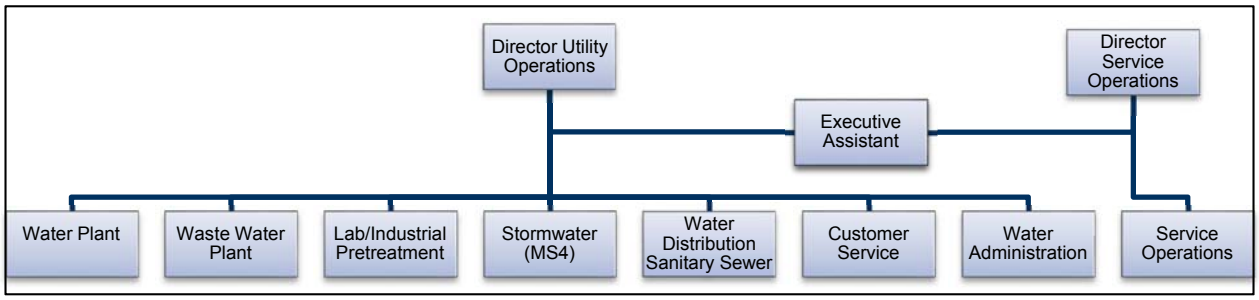
A new manager was hired to directly manage the department giving the employees more day-to-day guidance. Prior to the change the City was organized as shown in the following diagram below (Figure 7.14).



Source: City of Bismarck

Figure 7.14 Original City of Bismarck organization

The new organization chart shows Customer Service as its own section (Figure 7.15).



Source: City of Bismarck

Figure 7.15 Updated City of Bismarck organization related to customer service

The recommendations were intended to:

1. Provide greater emphasis on utility customer service by combining Utility Billing/Payment and Customer Service into a unit of its own reporting to the Director of Utility Operations.
2. Reduce the broad span of responsibilities of the Principal Office Assistant, permitting that individual to focus on Public Works Department responsibilities other than utilities work.
3. Create an Executive Assistant position to provide support to the Director of Utility Operations and the Director of Service Operations.

The recommendations were carried out. The new organization has been received very well, and has achieved the goals. It has provided a clear focus for customer service and a growth path for employees. The new Customer Service Manager was hired in December 2014.

CIS

Key activities of the CIS project were to:

1. Define business rules and business process improvement opportunities
2. Define the selection process, select the vendor, and conduct negotiations
3. Implement the selected solution

Once the City had defined the business rules and business process improvement opportunities related to the CIS, a strategic decision was made. The same vendor that supplied the City's HR and financial system also had a utility billing module. The City could go through a full-fledged RFP process for a "best of breed" CIS, or, alternatively, determine if the utility billing module could meet the City's business rules and achieve the desired business process improvement opportunities. If it was determined that the vendor could not meet the requirements, then the City intended to release an RFP to select a best of breed product. The City decided to investigate the utility billing module. Advantages were: they already had a positive relationship with the vendor

and built-in integration between the utility billing module and other financial modules. For example, staff would have visibility regarding a customer's payment status across the entire spectrum of City services.

The vendor was invited to demonstrate their product so the team could assess whether the vendor's modules could meet the requirements of the utility. Demonstration scripts were prepared, and the Core Team prepped for the selection decision. The demonstration schedule included time for the Core Team to have some hands-on exposure to the product. As part of the selection process the Core Team attended the vendor's annual conference to become more familiar with the product, and to answer remaining questions from the demonstration.

The Core Team decided that the vendor's utility billing module did meet their business rules and requirements. The vendor was asked for a Best and Final Offer, and ultimately selected.

Project Team

The Core Team represented multiple areas, including representatives from water billing, meter reading, information technology, and finance.

Training

As the new system was being installed, training was already being performed. A separate training room was created. The CSR's took turns training while the others continued taking care of business. The employees were very receptive to the new system. The old system functioned but was complicated and did not offer many of the features of a modern billing system.

External Communication

External communication was made about the new billing system related to billing cycle changes that resulted from the City's implementation of the new system. To avoid confusion, only minor changes were made to the bill format. Following the utility billing implementation, the City started to offer an online payment option with related external communications.

Project Schedule

Implementation started in December 2012, and the system went live in October 2013. The City and vendor took primary responsibility for the implementation, with little consultant involvement. Overall, the CIS project was on-schedule and under budget.

Benefits

Now that the new CIS is fully implemented the vendor has several programs that Bismarck finds valuable. The vendor holds an annual user conference that provides staff a chance to discuss various issues with other utilities using the same product, and to learn about new products being created. They also have an opportunity to meet and talk to vendor staff and make suggestions for software enhancements.

Issues

The system is working well. It is upgraded each December. But that is not to say that the system is perfect. The new manager has experienced some issues with the vendor's responsiveness. When there are issues, the vendor's responsiveness depends on the specific item needing attention.

Important institutional knowledge has been lost through some staff transitions at the City. The new manager has had to work hard to have the vendor come on-site to deliver additional training in-person. Additionally, she is still analyzing reports to understand what is available and how to interpret them. She recommends that the maintenance contract include an option for in-person visits for training and troubleshooting as needed.

Important project documentation (for example, user manuals) is not available. There is no effective training program for people who missed the original training provided during implementation.

Occasional conversion errors are still being discovered; this is made more tedious due to the lack of understanding of some system functionality. Also, additional functionality is desired (for example, data related to the premises needs to be keyed in again when a new customer moves in).

AMI

Meter Related Issues

In the late 1990's the City installed a land-line phone AMR system to gather monthly meter readings. The project, which cost about $2.2 million, worked fairly well at first, though the City was never able to collect more than about 90 percent of all the readings. From the beginning, about 10 percent of accounts still had to be read manually because some people did not have telephone service or the meter and the phone line were so far apart it was not practical to connect the two. In addition, some people objected to the idea of automated meter reading. Even with the 10 percent of accounts they could not read remotely, the City saved the cost of several meter readers who were moved to other jobs. The new system also improved the timeliness and accuracy of the City's meter reading and billing processes.

And then an unexpected change in lifestyle occurred. People began eliminating their home phone lines in favor of wireless phones. By 2010, around 50 percent of Bismarck customers no longer had landline telephones. As a result, the City no longer received monthly meter readings, and those readings had to be estimated. This issue caused difficulties for both the City's customers as well as an additional work load for staff. As a result, the City was forced to move to a new metering solution that took advantage of current technologies.

Goals

At the beginning of the project the goals were to:

1. Reduce estimates
2. Provide accurate billing
3. Provide regular meter reads
4. Improve customer service

Leadership and RFP Process

The Project Sponsor was the City's Director of Utility Operations. The Customer Service Manager served as Project Manager. She had recently joined the City after using an AMI system in a nearby rural water utility that spanned 6 1/2 counties.

The first step of the AMI project was to conduct a business case. As an outcome of the business case, the City determined that AMI was the best direction. Once the AMI was selected, the City would select their meter vendor.

To become more familiar with the choices, the City invited AMI vendors to make a presentation related to the features and functionality of their system to City staff. This helped the City understand the technologies, and provided input into the RFP.

Key project steps were:

1. Define the scope of the project and develop a plan. The primary objectives of the AMI system were defined as:
    a. Improve water meter accuracy – residential and commercial water meters that had reached the end of their useful life should be replaced
    b. Eliminate meter reading inaccuracies – install encoder water meters that would provide a solid and reliable foundation for future meter reading technology
    c. Deter water theft – tamper detection and a better meter design should be used to minimize the opportunity for water theft
    d. Improve customer service – the system should improve the City's ability to communicate leaks to its customers, thus minimizing the number of complaints received due to unexpectedly high water bills
    e. Deploy an efficient meter reading system – the system should provide better control of the time between meter readings
    f. Develop reliable support – build relationships with industry experts that can support the City's metering and meter reading needs over the long term
2. Draft RFPs. It was decided to release a Request for Bids (RFB) for meters, and a Request for Proposals (RFP) for the AMI system. The RFB required absolute encoder registers. The RFP for AMI was released in May 2013
3. Develop a public education plan. The City stated in the RFP that the City would send out a letter to all customers introducing the program prior to the start of installations. After the introductory letter, the contractor was required to assume full responsibility for customer notification and to make and schedule appointments. The contract also gave the contractor responsibility of developing a customer education program that, at a minimum, informed the customer of the metering program, explained how to detect leaks, and provided conservation information. The contractor was also required to provide a website dedicated to the work being done for Bismarck. The website was required to provide all public education information and allow customers to make an appointment, register a complaint, and request printed material such as the introductory and appointment letters
4. Finalize both the RFB for meters and the RFP for the AMI. Through the RFB for meters, the City selected one vendor to provide encoder registers. The RFP for the AMI system detailed the criteria including warranty aspects (20 years, 10 at full warranty

and 10 at a prorated rate), hourly readings, inclusion of a customer portal, and ability to interface with the utility's billing system

5. Select the contractors. Five companies' submitted proposals for the system and the top two were invited in to answer additional questions and provide a demonstration. They were scored based on the criteria in Table 7.1:

Table 7.1
City of Bismarck meter scoring criteria

Category	Weighted Average
Project Team Overview	19.20 %
Demonstration	25 %
Project Approach and Schedule Compliance	24.20 %
General Questions and Answers	14.10 %
Cost	17.50 %

6. Negotiate contracts. The City and the selected contractor spent several months working through the contract and agreed to terms in June 2014
7. Implementation. Actual installation of the reading system along with meter change outs began in November 2014 and was completed in February 2016

Solution

Through the RFP, the City received bids on a fixed network. However, after discussions with the local electric company, the City decided to go a different direction. Montana Dakota Utilities (MDU) provides gas and electricity to Bismarck and the surrounding area. Several years prior, MDU had installed a fixed network to gather their meter readings. Even though Montana Dakota is a private company the two utilities determined that sharing the network would benefit both of them and save money for the community. The AMI contractor selected by the City was the same contractor that had been serving MDU. MDU was at a point where they wanted to upgrade their network to provide full 2-way AMI capability. This project provided them an opportunity to accomplish this upgrade efficiently by placing transmitters on city assets at no charge. This also enabled MDU to increase their reliability through increased redundancy of the collectors.

Montana Dakota Utilities is responsible for installation, operation and maintenance of the network; in return they can recover some of the fees they charge to the City to collect their meter readings. It is a win-win situation.

Communication

After the meter RFP was closed and the AMI contractor selected, the City began communicating the plan to the public. Information was released both in the newspaper and on television. Letters were sent to every account holder describing the system and the upcoming need to change out the water meter. Since Bismarck experiences very cold weather, nearly all water meters are located inside homes and businesses, thus meter change outs require coordination. An additional letter was sent to each account holder as their route was released to the contractor for the scheduled meter change out. The City's website had an entire page describing why meters were being replaced and the process for completing the task. The website also had a place for customers

to schedule a convenient date and time. In addition, customers could look on the site to see a photograph of the installation contractors so they could feel more secure when letting the contractors into their home.

An example of the City's website information can be found in Appendix D.

Issues

The installation process has not gone without issues. The installation contractor hired a subcontractor who has not always followed the workflow (for example failing to take photographs of the removed meter and not capturing the GPS coordinates of each location). Though the project is nearing completion, the City of Bismarck is continuing to work through these issues and requiring the contractor to go back and complete the steps that were missed. The system takes hourly readings, which are transmitted to MDU and stored, then sent to the City the following day. For security reasons, only the meter transmitter number and the meter readings are transmitted. The data is then loaded to software that matches it to the correct customer account in CIS for billing. A spreadsheet of this data is available to the CSRs if they need to investigate billing issues. The process is a little difficult and the CSRs have had to learn the process. The City is in the process of installing analytical software which will make the process easier and provide much more functionality. CSRs were trained during implementation, though they are still learning how to look at the information. The Field staff was trained on handhelds so they can utilize the information while working on site. The handhelds enable field staff to get a meter reading, troubleshoot any error messages, and reprogram the transmitter if needed.

Benefits

The project is now about complete. At the beginning of the project the City had two full time meter readers on staff who were augmented by one part time employee and two readers hired through a temporary staffing agency. They are now down to one full time reader who spends most of his time on tasks other than meter reading. The others either voluntarily retired or transitioned to other jobs. The system is working well.

Because the RFP and contract for the system were very detailed, the City has been able to hold the contractor accountable for following the agreement. This has been valuable. One official with the City stated that she kept the RFP on her desk throughout the project so she could refer to it anytime an issue was raised. She stated that the details in the RFP were vital to the project running smoothly.

Conclusion

Overall, the City of Bismarck staff are happy with the system and with the implementation. Bismarck's Customer Service Manager stated, "We would not have done anything differently. We hired a good consultant and transformed meter reading, billing and customer service."

LADWP CIS PROJECT SUMMARY

Introduction

This section covers the recent and ongoing LADWP CIS implementation. The project has been highly visible to the public via the media. The project has resulted in litigation, cost overruns, and had a severe negative on the utility. The problems encountered impacted customer relations, Department perception and internal morale. While disappointing to the utility, the experience provides valuable lessons to be applied to future projects.

The documentation regarding LADWP's CIS experience is taken directly from LADWP's website as of February 21, 2016. The navigation is LADWP website → Residential → Customer Service → Bill & Payment → Billing System Problems and Progress (LADWP 2013). The following documents provide an overview of the LADWP CIS story through the end of 2015:

1. Billing System Presentation to LADWP Board: Customer Information System Implementation: Why the New System Had Problems…and What We're Doing About It. ("Billing System Presentation to LADWP Board", November 18, 2014.) The purpose of this presentation was to discuss lessons learned regarding the cause, outline steps taken, and provide an outlook for future activity.
2. Los Angeles Department of Water & Power Approach for CCB/MWM Stabilization Root Cause Analysis. This executive summary provides a root cause analysis of the system instability and recommendations as part of an overall remediation approach. ("Billing System Rood Cause Analysis", August 25, 2014)
3. LADWP Third-Party Analysis of Customer Information System Implementation Focused on "Root Causes" of Failures Leading to Significant Customer Service Problems ("Billing System Summary and LADWP Response", November 18, 2014)
4. LADWP Customer Service 2014 Year End ("CSD Statistics 2014 Recap", January 2015)
5. LADWP Customer Information and Billing System Class Action Litigation Settlement Summary ("LADWP Class Action Settlement Summary", February 2016)
6. LADWP Statement by LADWP General Manager Marcie Edwards Regarding Settlement of Customer Billing Class Action Litigation ("Statement by GM Marcie Edwards Re Class Action Litigation Settlement", August 17, 2015)
7. Mayor's Dashboard ("CSD Dashboard 1 22 16", January 22, 2016)
8. Putting Customers First, Customer Service Information Remediation Progress Report (Putting Customers First, Customer Service Information Remediation Progress Report" March 17, 2015)

Background

In September 2013, LADWP transitioned to a new business technology platform to replace an assortment of customer service technologies developed over the past 40 years. The multiple systems being replaced were highly inefficient and unstable. As the cutover date to the new systems approached, with stretched resources the LADWP project management team opted to push forward aggressively with implementing the new systems rather than continue to try to sustain operations with the legacy technology. This resulted in overlooking serious planning and

implementation challenges. It also reduced or eliminated much of the testing, and left inadequate time to properly prepare and train those needed to operate the system.

The problems were numerous and well documented in the press and social media. At the peak, 20 percent of the bills going out were estimated, resulting in customer confusion. Bills were delayed and revenues fell. Customers that were confused or received estimated bills called the Customer Service Center only to wait on hold for an average of 37 minutes. In some cases, the hold time was two hours or more. The City Council took action to relieve customers over concerns of paying inaccurate bills, including many who were billed appropriately and took advantage to delay their payment as well. The widespread criticism, heavy workload and customer wrath took its toll on Customer Service Representatives in particular, resulting in high absenteeism and morale problems that further undermined efforts to improve.

As of March 2015, the cumulative budget was $173,000,000, and costs were approximately $188,000,000. An additional $20,000,000 (estimated) was being requested to complete remaining critical system defects.

Root Causes Underlying Three Main Issues

LADWP had an external consultant conduct a root cause analysis of the problems related to the implementation. In August 2014, findings from this analysis identified three key issues.

Inadequate Project Management

Key indicators related to the two new key systems (CIS and mobile workforce management software) provided overwhelming evidence of non-readiness. The organization had a lack of preparedness for daily operations of the new systems. They lacked a detailed project plan to manage and track project status, and to monitor the implementation issues. Contract terms were not followed or managed. The project management approach was to use a project team instead of a single project manager, leading to poor decision making and a lack of accountability. Warning signs were ignored, including failing to heed the Quality Assurance contractor warnings and critical project deliverables not being available. The scope was overly ambitious, yet continued to grow as the implementation date approached. The project management team overlooked problems with the new system due to the increasing pressures related to the need to replace the expired existing system and to control spending to keep the existing system operational. At the time of cutover, there were several dozen Severity Level 1 defects identified. LADWP's contract with their Solution Integrator called for no Severity 1 or 2 defects at time of go-live.

Vendor Inexperience With Level of System Complexity

The vendors were selected as the lowest cost alternative. They were viewed as qualified and experienced, but this was the largest complex utility billing system replacement project they had ever managed. The Project Manager was not experienced or seasoned in the CIS product that was selected. The Solution Integrator failed to keep their team quality consistent throughout the project, and the Project Management Team did not adequately identify or address the Solution Integrator's gaps in experience.

Unprepared Workforce

Staffing constraints and Civil Service exam processes impeded the early implementation efforts to hire, train, and prepare staff for the new system. Late system integration resulted in a lack of testing the system for readiness, little time for staff training, and issues related to secure user access (user defined roles). When the system went live, there was insufficient staffing to handle overwhelming customer surge.

Other issues included lack of data conversion validation, not enforcing a mandatory code freeze, and minimal financial testing. For example, only one complete billing cycle (of 21 cycles) was tested prior to cutover. No month-, quarter- or year-end financial testing was performed. No balancing reports were produced to verify that accounts, customers, premises, service points, meters, etc. were correctly cutover. This was a major source of invalid or incomplete configuration of account, service point, and meter data issues, leading to high numbers of estimated bills.

Implementation Problems

As a consequence of the issues identified above, there were problems when the system went live. These were:

- High percentage of estimated bills (21 percent)
- High billing defects in dollars ($160,000,000) and accounts with delayed billing status (74,000 accounts)
- Billing issues delayed the orderly implementation of the collection process
- High average call wait times (33 minutes)

Nearly one year after the system went live, the number of defects remained virtually unchanged. Numerous Severity Level 1 defects hindered daily operations. Lingering conversion and configuration problems caused large revenue losses due to unbilled or incorrectly billed accounts. Sections of the organization remained unclear on how to effectively use the systems in their daily operations, thus causing erroneous or inconsistent application of business processes. Significant data security issues existed due to user defined roles not being fully implemented.

There were four class action lawsuits involving customer claims related to billing errors and overcharges that occurred following implementation. On June 29, 2015 LADWP announced that it reached an agreement to settle the lawsuits. The City and LADWP continue to pursue claims against the Solution Integrator.

Actions Taken to Address Implementation Problems

Following the root cause analysis LADWP took a number of actions to address the implementation problems:

- Leadership transition
- Increased transparency in communication. This included establishing a dashboard to report on the status and increased community outreach
- Refocused resources on the critical issues
- Hired additional customer service representatives and meter readers

- Developed formal training curriculums for new and existing employees
- Engaged supplemental technical analysis for root cause analysis, system stabilization, reporting functionality, customer enhancements, and data clean-up activities
- Addressed the issues related to collections including lenient payment arrangements

In addition to addressing the immediate implementation issues, LADWP also took other actions.

Management Changes

In February 2014, a new General Manager was appointed. She promptly tasked a senior manager to assume leadership over the implementation and customer service challenges. With great urgency a plan was put in place which included very public disclosure of key measurements. The new management team also made a commitment to provide more resources to project scoping at the early stages.

Project Management

LADWP is re-evaluating the team approach to project management versus having an experienced project manager for complex implementations. Other project management changes included identifying new project management talent in the organization, and implementing training for all internal project managers.

Customer Service Orientation

All employees are becoming highly focused on improving customer service. Management has proposed Department-wide customer service training and accountability. Customer service metrics and dashboards have been implemented.

Increased Transparency

The Mayor's Dashboard related to customer service now provides a model for the City and for customer accountability related to change initiatives. New metrics specific to the lessons learned and new project activities have been announced. More customer outreach is in place to address specific programs and changes.

Current Status

Great progress has been made since the go-live. During 2014, call wait times dropped dramatically, a Customer Service Division training academy for Customer Service Representatives was implemented, estimated bills decreased from 21 percent to 5 percent, timely billing improved from 95 percent to over 98.5 percent, and on-line self-service payment arrangements/options were implement, reflecting the impacts of many remediation activities (refer to Figure 7.16).

In March 2015 the Department issued a Customer Service Information Remediation Progress Report providing a summary of metrics and goals, with most of them on or near the target. Several thousand CIS system defects (at various defect priority levels) have been remediated.

Approximately 100 known critical defects remained, and several hundred total defects remained to be remediated at the time the report was issued. At that time, the vast majority of the Departments 1, 500,000 million customers were being billed correctly. Collections efforts remained a Department focus, with efforts ramping up to collect moneys rightfully owed and unpaid. The Department planned to provide Board updates every 30 days on the collections efforts.

Weekly Customer Service dashboard updates are posted on the LADWP website. Refer to Figure 7.17 and 7.18 for examples.

LADWP continues to publish a monthly customer service dashboard. Additional self-service options have been and are being deployed (start/stop service, payment arrangements, online access to billing data, and communications related to paperless billing and electronic payments). Monthly billing and "level pay" is being implemented, with a plan to transition all residential customers to monthly billing by the end of FY 2016/2017. Additional program offerings are being developed, including more access to conservation tools and launching a demand response program. LADWP is also proceeding with a back-up call center.

Summary

As of November 2014, LADWP reported:

1. The new billing system problems had harmed public and ratepayer trust
2. An independent analysis revealed the depth of project management and project scoping issues
3. Defects in the new systems still existed, were being prioritized, and fixed
4. A Customer Service culture change throughout all levels of the Department was of the highest priority
5. Strong leadership was being provided by the new General Manager and senior managers
6. Approaches to hiring, staffing and training were all being evaluated
7. There was a strong commitment from the General Manager and management team to use these lessons learned to improve customer service and for future complex technology projects such as the financial system
8. The recovery process and transparent communication were supporting long-term change

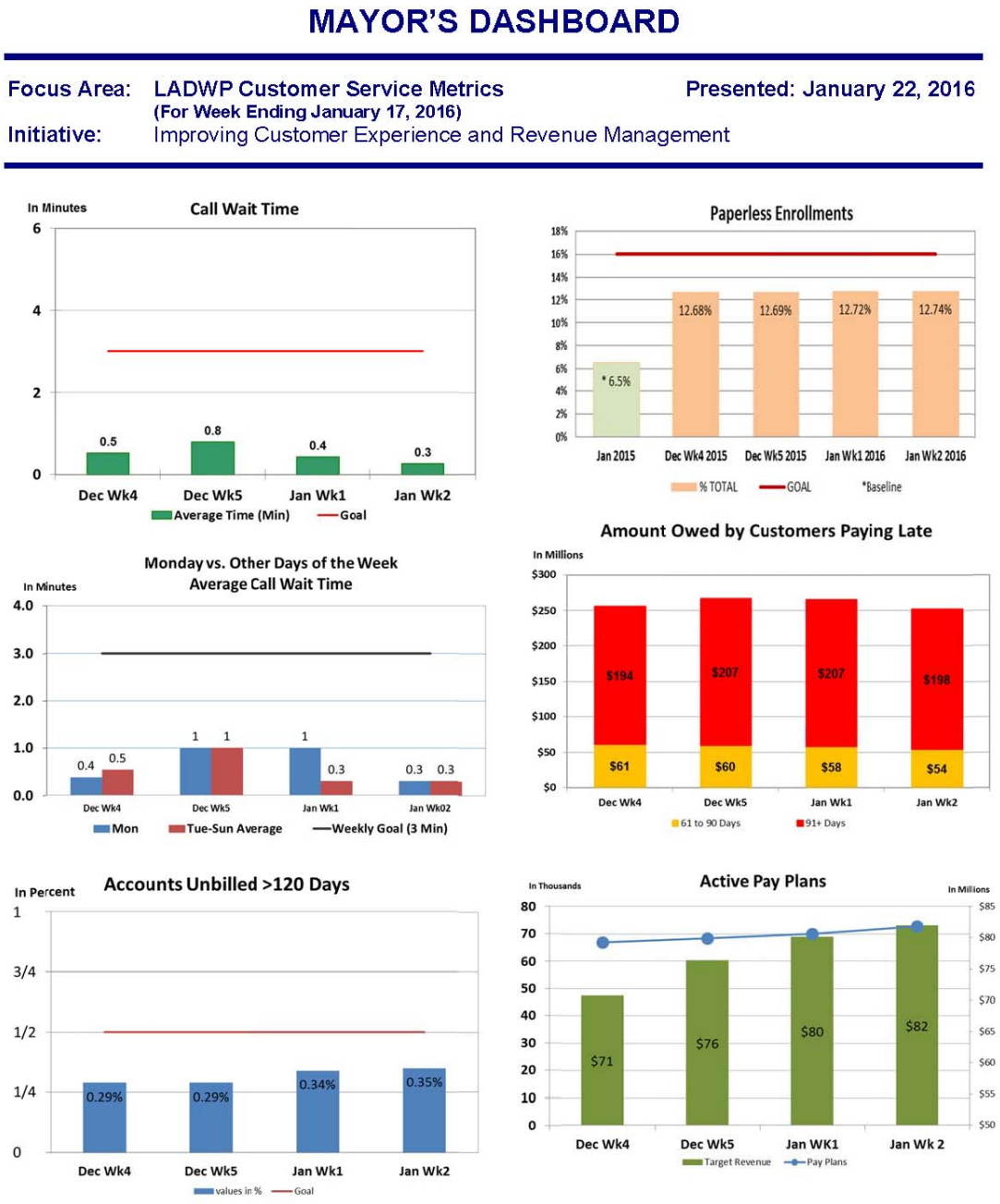
LADWP is in the final stretch of fixing the remaining problems with the new billing system. Tremendous progress has been made not only to fix the system, but to improve the overall customer experience. This progress includes:

1. Almost 99 percent (98.7 percent) of all bills are processed by the new billing system and mailed on time. Less than one-half of 1 percent of new bills require any adjustment by specialized billing team members prior to mailing to customers
2. Call hold times have dropped from an average of more than 30 minutes to an average of two to three minutes
3. Estimated bills have dropped from over 20 percent to under 5 percent and are now at industry standard levels
4. Ongoing internal audits are conducted to validate the accuracy of the billing formula used by the CIS

5. Over 250 new customer service representatives, meter readers and billers have been hired, with more being added and undergoing training
6. Billing metrics (such as percentage of meters read) now exceed industry standard levels
7. 88,000 customers have been enrolled in paperless billing since January 1, 2015, and now total 240,000 customers
8. Accounts receivables have been reduced by 33 percent since January 2015. Customers late on their bills have been offered payment plans with easy enrollment online or by phone. Over 64,000 customers have completed payment plans and another 58,000 are currently in active pay plans
9. Special office hours and Customer Service Saturdays have been held at branch offices normally closed to help customers resolve billing concerns
10. Responsiveness to email and online contact from customers has been significantly improved

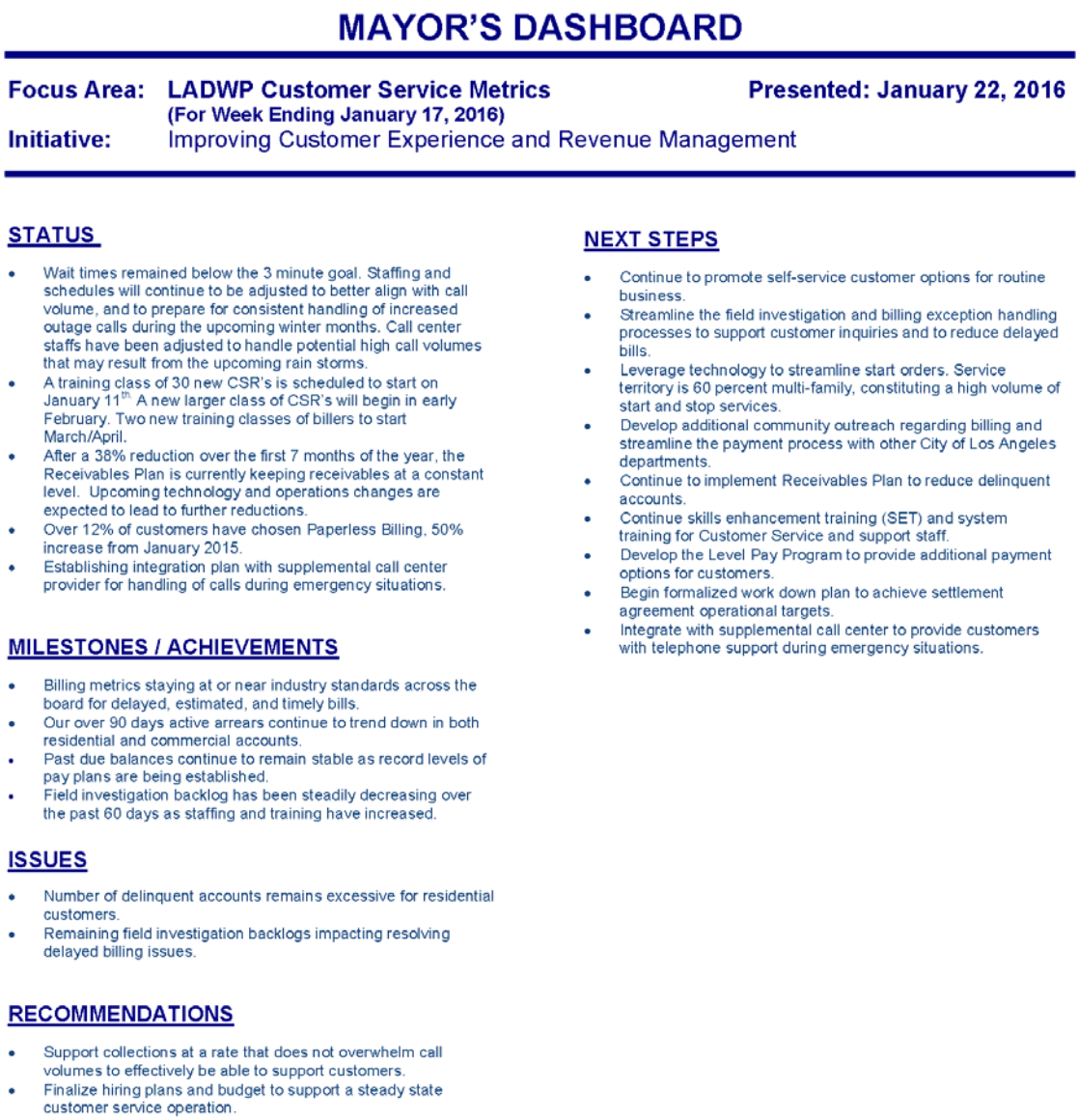
Source: LADWP CSD Statistics 2014 Recap

Figure 7.16 LADWP 2014 year end customer service call wait time snapshot



Source: LADWP website navigation: LADWP →Residential → Customer Service → Bill & Payment → Billing System Problems and Progress → Customer Service Dashboard Archive

Figure 7.17 LADWP weekly mayor's dashboard page 1



MAYOR'S DASHBOARD

Focus Area: LADWP Customer Service Metrics **Presented: January 22, 2016**
(For Week Ending January 17, 2016)
Initiative: Improving Customer Experience and Revenue Management

STATUS

- Wait times remained below the 3 minute goal. Staffing and schedules will continue to be adjusted to better align with call volume, and to prepare for consistent handling of increased outage calls during the upcoming winter months. Call center staffs have been adjusted to handle potential high call volumes that may result from the upcoming rain storms.
- A training class of 30 new CSR's is scheduled to start on January 11th. A new larger class of CSR's will begin in early February. Two new training classes of billers to start March/April.
- After a 38% reduction over the first 7 months of the year, the Receivables Plan is currently keeping receivables at a constant level. Upcoming technology and operations changes are expected to lead to further reductions.
- Over 12% of customers have chosen Paperless Billing, 50% increase from January 2015.
- Establishing integration plan with supplemental call center provider for handling of calls during emergency situations.

MILESTONES / ACHIEVEMENTS

- Billing metrics staying at or near industry standards across the board for delayed, estimated, and timely bills.
- Our over 90 days active arrears continue to trend down in both residential and commercial accounts.
- Past due balances continue to remain stable as record levels of pay plans are being established.
- Field investigation backlog has been steadily decreasing over the past 60 days as staffing and training have increased.

ISSUES

- Number of delinquent accounts remains excessive for residential customers.
- Remaining field investigation backlogs impacting resolving delayed billing issues.

RECOMMENDATIONS

- Support collections at a rate that does not overwhelm call volumes to effectively be able to support customers.
- Finalize hiring plans and budget to support a steady state customer service operation.

NEXT STEPS

- Continue to promote self-service customer options for routine business.
- Streamline the field investigation and billing exception handling processes to support customer inquiries and to reduce delayed bills.
- Leverage technology to streamline start orders. Service territory is 60 percent multi-family, constituting a high volume of start and stop services.
- Develop additional community outreach regarding billing and streamline the payment process with other City of Los Angeles departments.
- Continue to implement Receivables Plan to reduce delinquent accounts.
- Continue skills enhancement training (SET) and system training for Customer Service and support staff.
- Develop the Level Pay Program to provide additional payment options for customers.
- Begin formalized work down plan to achieve settlement agreement operational targets.
- Integrate with supplemental call center to provide customers with telephone support during emergency situations.

Source: LADWP website navigation: LADWP →Residential → Customer Service → Bill & Payment → Billing System Problems and Progress → Customer Service Dashboard Archive

Figure 7.18 LADWP weekly mayor's dashboard page 2

NYC DEP AMI CASE STUDY

General Background

The New York City Department of Environmental Protection (DEP) provides water, wastewater, and storm water services to approximately 10 million people in New York City and a portion of New York just north of the city. There are nearly 6,000 employees who assist DEP in fulfilling their mission statement. DEP has approximately 835,000 accounts, with 759,000 residential and 76,000 non-residential accounts. The total numbers of accounts that are billed on metered charges are 797,500 and 97 percent of these are connected to and billed on readings from AMI devices. In general accounts are billed on a quarterly basis, however customers can now choose to be billed on a monthly basis. Annual revenue is about $3.67B, and annual operating expenses are about $1,200,000,000.

> Mission Statement
>
> The New York City Department of Environmental Projection protects public health and the environment by supplying clean drinking water, collecting and treating wastewater, and reducing air, noise, and hazardous materials pollution.

AMI Project Background

Note: the installed system is a fixed network type, with one-way reads automatically transmitted four times per day. For the purposes of this case study, we will refer to it as an AMI system.

Prior to implementation of the AMI system, approximately 15 to 17 percent of the bills were estimated. This caused a number of issues, including:

- Billing accuracy challenges
- Increased expenses for reading meters and billing
- Collections issues (including appeals, delays paying, and increased accounts receivables)
- Lack of tools to help customers manage their water usage online

The primary AMI project driver was not a reduction in meter reading costs, but more to increase productivity as well as providing tools to allow customers to view their water consumption and better manage their water usage.

Current Status

DEP is currently in the maintenance and optimization phase of their fixed network AMI system. Meters two inches and larger are read hourly, while smaller meters are read four times a day. While there are 797,500 accounts billed on metered charges, there are 844,000 meters in our system and of these, approximately 820,000 meters are connected to Meter Interface Units (MIU), with a 97 percent saturation rate. The Data Collection Units (DCU) are almost all co-located with rooftop equipment from the Department of Information Technology and Telecommunications

(DoITT's) citywide wireless system (NYCWiN). The AMI DCUs are wired to the NYCWiN network with Ethernet cables. NYCWiN is used only for backhauling the AMI data from the DCU to the AMI Network Operating Center; this occurs every five minutes. There are two complete duplicate Network Operating Centers. Northrup Grumman currently supports the NYCWiN system. The AMI data transmission from the AMI device to the AMI database is accurate and secure across the transmission stream.

AMI Project Preparation

Before moving to a full-scale AMI project, NYC DEP built their knowledge base and skills with several smaller-scale projects. In 1999, NYC implemented an Automated Meter Reading (AMR) system for large customers tied to an inbound telephone system. Approximately 2,000 large customers signed up. The project resulted in a 95 percent read rate among participants, and allowed for monthly billing. While effective, the technology was based on shared phone lines, and DEP experienced the limitations of landline phone technologies.

In 2005, DEP partnered with Consolidated Edison (Con Ed) to pilot a mobile system in a Brooklyn neighborhood. In 2007, DEP installed another mobile system for about 700 hard to read or confined space accounts.

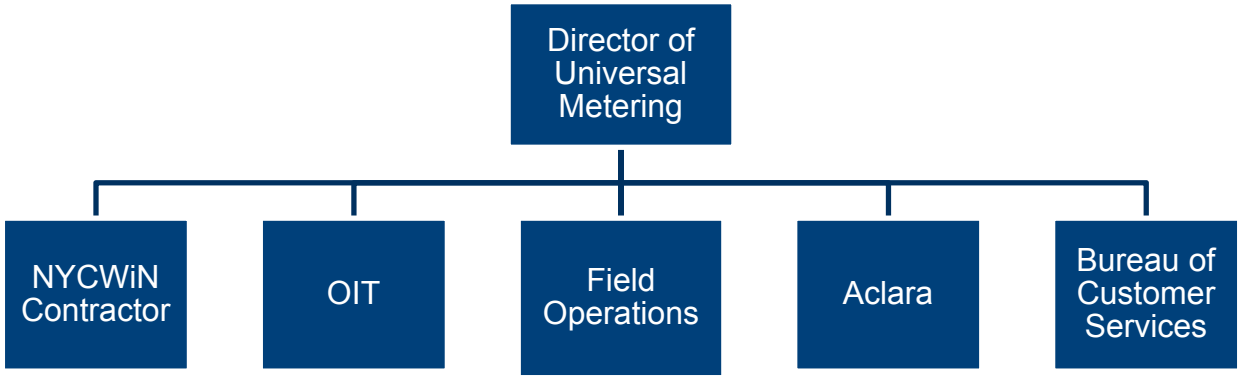
DEP views these earlier projects as essential to building their skills and readiness for the citywide AMI project.

AMI Project Team

The AMI project was spearheaded by the Bureau of Customer Services and was solely contained within the bureau. The Project Manager of the team had past experience with large scale meter replacement projects prior to implementation of the AMI project. He had led their universal metering project and was considered DEP's resident meter technology expert. There was a high-level program support for the AMI project because savings were expressed as increased productivity and reduced collections over time.

The team learned a great deal from the previous pilots. In addition, they had looked at other AMR/AMI systems for the previous several years and were able to use this information when implementing their own AMI project.

A depiction of the project team is below in Figure 7.19. There was no formal steering committee. However, senior department leadership met weekly with the project team and the software vendor to review and discuss the status of the project.



Source: NYC DEP

Figure 7.19 NYC DEP AMI implementation project team

Project Schedule and Approach

Key project milestone are noted below:

- February – May 2007: DEP released an RFP for a citywide AMI system and evaluated first round candidates
- July – September 2007: piloted the two finalist candidates
- May – July 2008: awarded contract, and developed contract for DCU with the citywide wireless system (NYCWiN) contractor
- August 2008: began DCU installation
- Summer/Fall 2008: bid installation contracts
- February 2009: began meter replacements and MIU installations
- March 2012: reached 95 percent (substantially complete)

DEP's AMI system uses DCUs on the same rooftops as the NYCWiN system. There were 450 possible rooftop locations available through the NYCWiN infrastructure. New York City used 350 of these sites for installation of the DCUs.

DCUs are connected to NYCWiN network cells using an Ethernet cable or if mounted on light poles use cell data modems. The NYCWiN system uses POTS (Plain Old Telephone Service) and microwave for backhaul to the NOC.

The implementation program was based on several key concepts:

- Contractor staff was provided with extensive training in the use of the handheld device as well as other trouble shooting techniques that they could employ in the field
- Installation contract areas were divided simply and clearly. There were twelve installation contract areas. The contracts were competitively bid unit price contracts. Each contract area was then further subdivided into zip codes. Each contractor started in on one or two zip codes, and then moved to the next zip codes when they were 80 percent complete with an assigned zip code

- Repeated and extensive communications. This included carrying out a combination of appointments and neighborhood canvassing with door hangers and large scale postcard mailings. A project website had maps, photos, FAQs, and contractor contact information. Contractors supported a combination of telephone and web-based appointments. After an area was 80 to 85 percent complete, a "Denial of Access Lite" letter was sent to sites that had not yet been converted. This usually resulted in another ten percentage points of completed installations
- Contractor performance requirements were clearly articulated and monitored
- Getting data to customers early in the program. Customers were placed on AMI billing immediately and DEP launched a customer presentment website months after installations began

In total, the project involved installing 820,000 MIUs and replacing 430,000 meters. As soon as accounts were converted, the Bureau of Customer Services started to use the system. Several months after an account was converted customers were provided with the ability to view their account status online.

Managing the installation data was critical because once the implementation was in full-gear more than one thousand installations were carried out per day.

To streamline and improve the implementation of the program, DEP worked with the AMI vendor to develop handheld device software improvements to:

- Minimize manual data input
- Provide data to all system interfaces. This included:
  - AMI system software, to associate an MIU with a meter and an account
  - DEP's billing system, to place the meter/account on AMI billing and change the read cycle to prevent continued download for semi-manual reading by Con Edison
  - Con Edison, to inform them of accounts they no longer needed to read
  - Tracking installations for contractor payment
  - Setting up a work queue of meter replacements in DEP's billing system
  - Creating a database of completed and incomplete jobs
  - Reports for a variety of project and operational purposes
- Set up a queue of information for the final manual step of the meter change-out process in the billing system

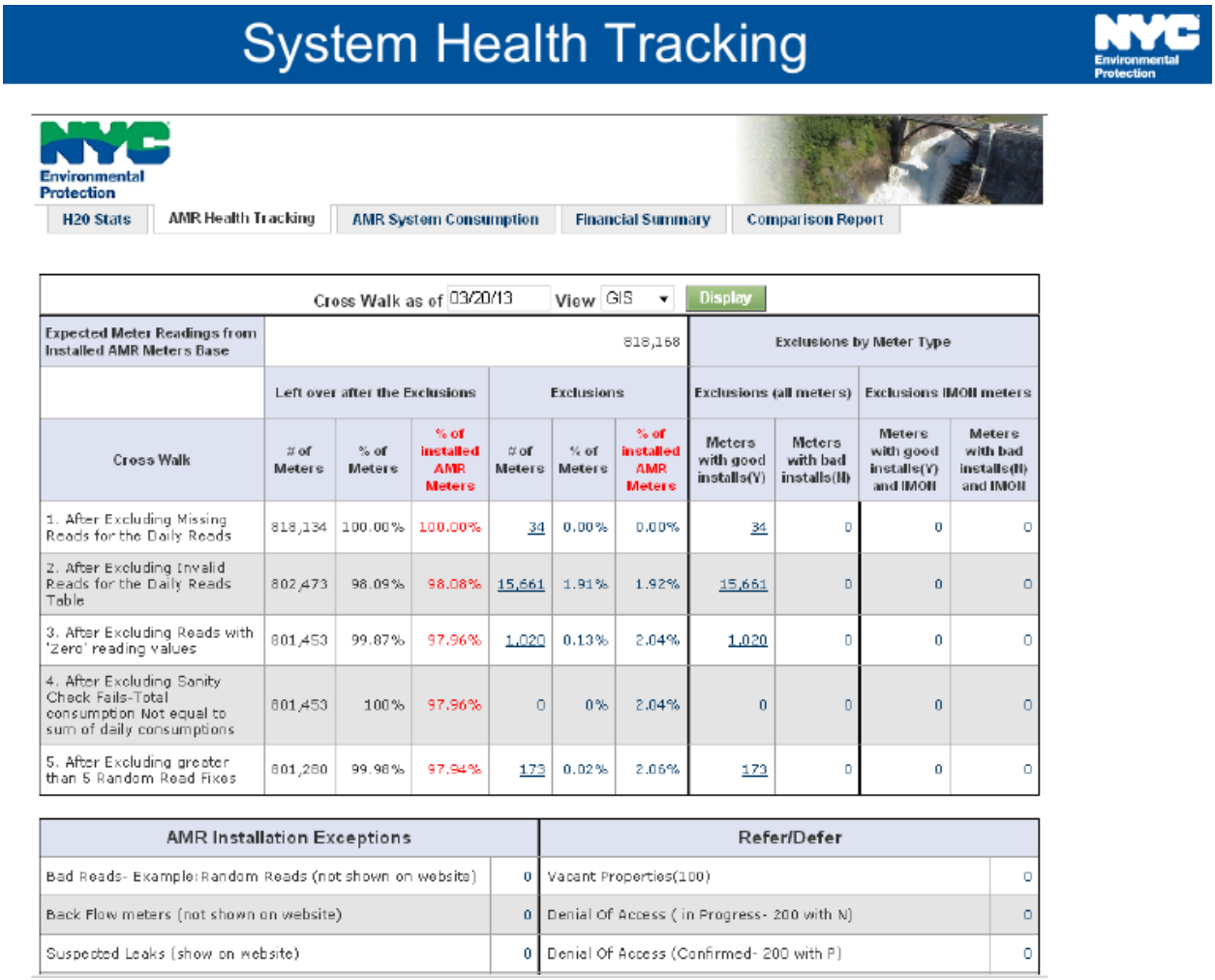
This upgraded handheld software included support for bar coding the meters, with the bar codes including all information required for the new meter set up in DEP's billing system. The bar codes also included all pertinent meter information needed for meter tracking.

During the installation, DEP also collected data related to:

- Updated contact information (for example, the building superintendent)
- Updated meter location
- Vacant buildings
- Plumbing problems
- Customer refusal

The project was substantially completed in less than 36 months. Installation rates started out slow during the pilot, then ramped up to about 1,500 a day over a period of two to three months.

The health of the system was checked daily; refer to the screen shot in Figure 7.20 below.



System Health Tracking

NYC Environmental Protection

NYC Environmental Protection

H20 Stats | AMR Health Tracking | AMR System Consumption | Financial Summary | Comparison Report

Cross Walk as of 03/20/13 View GIS Display

Expected Meter Readings from Installed AMR Meters Base							818,168		Exclusions by Meter Type	
	Left over after the Exclusions			Exclusions			Exclusions (all meters)		Exclusions IMOII meters	
Cross Walk	# of Meters	% of Meters	% of installed AMR Meters	# of Meters	% of Meters	% of installed AMR Meters	Meters with good installs(V)	Meters with bad installs(II)	Meters with good installs(V) and IMOII	Meters with bad installs(II) and IMOII
1. After Excluding Missing Reads for the Daily Reads	818,134	100.00%	100.00%	34	0.00%	0.00%	34	0	0	0
2. After Excluding Invalid Reads for the Daily Reads Table	802,473	98.09%	98.08%	15,661	1.91%	1.92%	15,661	0	0	0
3. After Excluding Reads with 'Zero' reading values	801,453	99.87%	97.96%	1,020	0.13%	2.04%	1,020	0	0	0
4. After Excluding Sanity Check Fails-Total consumption Not equal to sum of daily consumptions	801,453	100%	97.96%	0	0%	2.04%	0	0	0	0
5. After Excluding greater than 5 Random Read Fixes	801,280	99.98%	97.94%	173	0.02%	2.06%	173	0	0	0

AMR Installation Exceptions		Refer/Defer	
Bad Reads- Example: Random Reads (not shown on website)	0	Vacant Properties(100)	0
Back Flow meters (not shown on website)	0	Denial Of Access (in Progress- 200 with N)	0
Suspected Leaks (show on website)	0	Denial Of Access (Confirmed- 200 with P)	0

Source: NYC DEP

Figure 7.20 NYC DEP AMI System Health Tracking Screen Shot

In 2015, DEP moved from handheld devices to Panasonic ToughPad tablets. Prior to the tablets, the handhelds had to be brought into the office to download data. Now, field service workers can be deployed straight from their homes instead of having to come to the office to download the data before starting their day and they transmit completed job work back to the office as it is completed. The tablets allow for real-time updates and the ability to transmit jobs on an ad-hoc basis during the day. The tablet itself was also easier to handle than the earlier handheld devices. All account information is contained on the tablet thereby eliminating paper work orders and routing sheets. As a result, they get accurate reports on a job-by-job in near real-time basis. Staff also uses the tablets to take pictures when needed.

Training

The Project Manager believed there was no such thing as too much training. DEP used the initial pilot as a training period. Staff was involved in placing the AMI MIUs, and using the vendor's handheld devices for programming the MIUs. Part of the goal was to develop an initial core of inspectors who were trained on the system, understood how to use it and would be leaders in training others.

They used a "train the trainer" approach and also used manuals to train on the new system in the office. Staff who were struggling with learning the new processes and software were identified and instead of moving them off the project, DEP provided mentoring to the employees. DEP's IT staff were always one or two steps ahead of the vendor's IT staff and continuously pushing them to raise the bar.

During the training process, DEP identified six or seven people in the Call Center who had mastered AMI and assigned them to handle customer questions on AMI. This way the customer was able to speak with a representative who had the knowledge to answer the question in a more efficient time and manner. Again, a cadre of staff early adopters was developed as a training resource for other staff.

Change Management

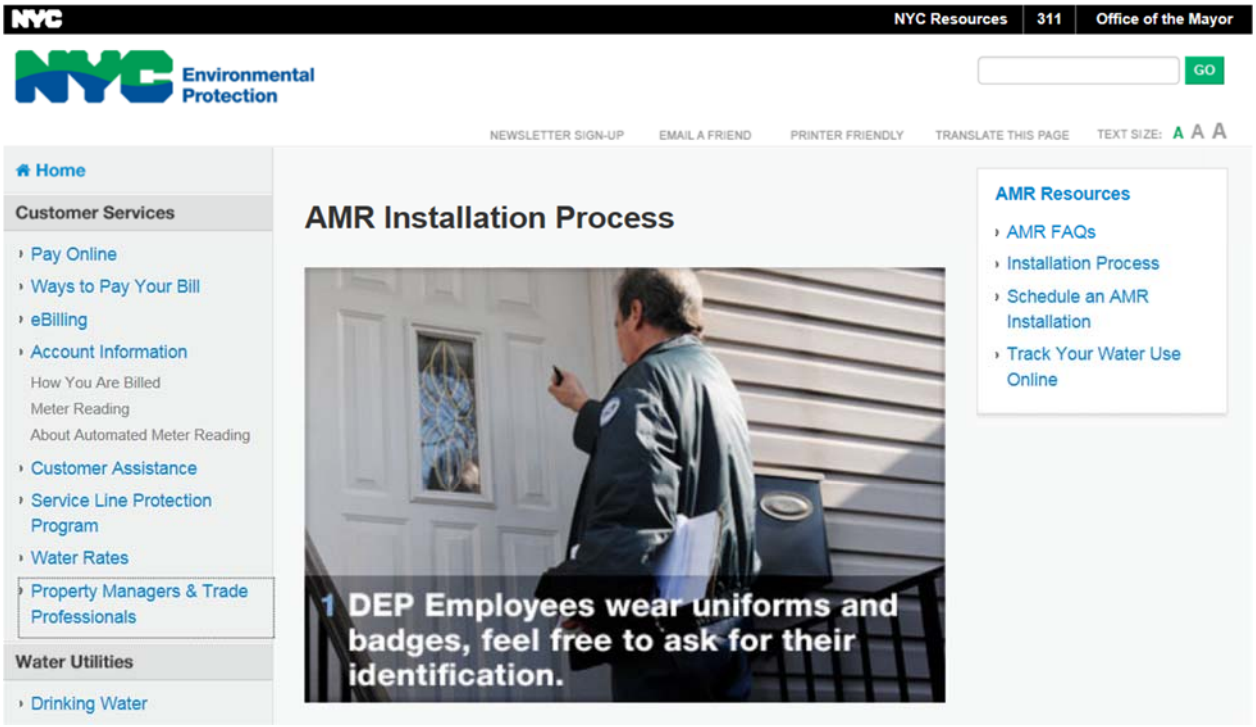
The pilot program introduced IT staff to data flows and introduced field staff to handheld computer software, as well as providing them with experience related to the mechanics of MIU installation and programming. The pilot program also prepared customer service staff in understanding how daily AMI readings could change their work process.

The new AMI system was easier for clerical staff to use and understand. The customer and the Customer Service Representative could look at the same information on the computer screen when the customer called in with questions.

In some cases, implementations of AMI systems eliminate meter reading jobs. In DEP's case, City employees were not let go, but were moved to different positions. This is partly because meter reading had previously been handled by Con Edison. Jobs evolved so that in addition to the meter maintenance and replacement, the maintenance of the MIUs was integrated into work assignments.

Communications Program

An extensive outreach program was conducted. DEP informed customers of the benefits of AMI through letters, bill inserts, postcard mailings, and door hangers in each zip code. DEP also held briefings for community organizations stating that customers will be able to view their water usage online and sign up for leak notifications through the My DEP Account application. A website was dedicated to notify customers about AMI installation through maps where installations were being performed, contact information for the contractors, as well as the step by step process involved in installing AMI devices (Figure 7.21). Customers were also informed that AMI installation would be provided at no cost to the customer.



Source: NYC DEP

Figure 7.21 NYC DEP AMI website

Vendor Management

There were four contractors selected to install MIU's and replace meters. The rejection rates varied by contractor, and ranged from 0.5 percent to 3 percent. The rejection rates were clearly correlated with high staff turnover and quality of the contractor's supervision. DEP provided contractors with timely feedback on their successes and errors.

Project Costs

The project costs for the AMI vendor (including design, installation, and modification of software), purchase of the MIU and DCU equipment, purchase of the replacement meters, the twelve contracts to install MIUs and replace meters, installation of the DCUs, and a few small consultant contracts totaled $250 million. The project was completed under budget.

Current Status

Ongoing care of the meters and AMI system is required. DEP performs daily diagnostic tests for invalid or missing transmissions. These tests identify MIUs that have wire damage, incorrect programming, and vandalism, as well as readings that decline over time (running backwards or backflow) or show greatly increased or decreased use.

Project Challenges and Recommendations

1. Carry out a pilot program. This allows you to identify problem areas which can be addressed before full-scale rollout, saving time and money in the long run. With the pilot, DEP was able to see that the vendor handheld software was insufficient for a project the size of New York City, and to develop a software system that met their needs at no additional cost to them
2. Have a meter and MIU inventory system in place before the project starts. DEP did not have an inventory system in place before implementation and while it did not ultimately affect the success of the project, it would have been useful in maintaining a steady supply of meters and MIUs
3. It is important to know, regardless of who is selected for any aspect of an implementation, that some contractors will be very easy to work with and responsive, while others will be challenging. Start out managing the contractors tightly, and modify that as needed. Provide feedback, both positive and related to errors/issues
4. Collect updated data over the course of the project. For example, DEP collected a variety of information, such as updated phone numbers, updated meter location information, vacant buildings, plumbing problems, and customers who refused, during the AMI implementation
5. Include steps in the process of meter installation to catch errors immediately and to provide better data for resolving customer disputes
6. It has been challenging to handle the final 3 percent of installations that were not accomplished during the project. There have been a variety of reasons including: the property being vacant, extensive plumbing rework required to support the new meter, or the customer actively refused AMI installation and or meter replacement
7. DEP developed an MIU test bench to speed warranty claims for failed MIUs, and an RF interference analysis tool for site-specific RF problems

Benefits

Since the installation of the AMI system, NYC DEP has captured the following benefits:

1. The estimated read rate has dropped 82 percent since 2009 (the start of AMI)
2. As a consequence of fewer estimated bills, billing disputes have been reduced by 56 percent
3. DEP has seen a two to five percent revenue increase from small meter replacements
4. 41 percent of all users are registered to access their water use online
5. 29 percent of all users are registered to receive email Leak Alerts if their use increases suddenly. Notifications are sent when DEP records five consecutive days of above average water consumption (200 percent or more from historical average). Large customers can customize the percentage increase and period of time before notification. This program is estimated to have saved customers over $85,000,000 since its inception in 2011
6. 7 percent are registered for monthly billing
7. DEP now has on-demand reports for individual building backflow events or meters installed backwards. They can run hourly reports on demand. This provides quick

notification if someone installs or replaces a meter backwards, or the wiring is not properly done
8. They have alarms for failing meter registers, enabling efficient and proactive register maintenance
9. DEP has far more granular data available on citywide water use
10. DEP and the City also have the ability to precisely monitor "before" and "after" water use for building conservation projects (toilet replacements) and large meter replacements
11. DEP employees can see citywide water consumption in near real-time by aggregating consumption data from all AMI accounts. They can also analyze consumption by borough, building class, zip code, and time period (daily, weekly or monthly)
12. Eliminated meter reading paperwork in the field, freeing up supervisors from reviewing data entries
13. Customers now have the ability to schedule their own appointments online since the tablets update at real-time

Although the goal was not to reduce meter reading costs, there have been headcount savings (by attrition) as a result of efficiencies gained through the project.

Next Steps

Currently, the MIUs are one way; however, future MIUs will have two-way communications. Additional future applications being considered include:

1. Data collection from sewer water level sensors
2. Remote meter shutoff (requires coordination with meter manufacturers)
3. Distribution leak detection
4. Continuing a large meter replacement program (about 1,000 to 1,200 meters/month in 2013- 2015). DEP is concentrating on compound meters more than seven years old, and 1½" to 2" positive displacement meters
5. Moving toward meters with higher resolution
6. Developing an analytical model of meter age, registration, size, manufacture and technology to inform the replacement policy
7. Gradually move to monthly billing (currently about 62,000 customers including customers on electronic billing and customers with payment agreements)
8. Providing a smart phone application for leak notification
9. Develop a plan to identify and address problems related to:
   - Register failures
   - Intermittent MIU blockages
   - Intermittent RF interference
   - MIU failure
   - Installation flaws (both physical and programming errors)
10. Developing a program to provide for ongoing field staff training (ongoing training cycle) related to proper wiring/troubleshooting, MIU programming, and MIU troubleshooting

Conclusion

DEP is highly satisfied with their AMI system and believes the implementation went well (went when and how it was planned, within the budget originally allocated, and without any upsets during implementation or after go-live).

The Chief of Strategic Planning and Operations was quoted as saying, "The (AMI implementation) project was an example of one of the best projects I have ever seen done in the City of New York."

Source: NYC DEP

Figure 7.22 Mural found in New York City, New York

CHAPTER 8: APPLICATION TO THE INDUSTRY & FUTURE RESEARCH

The contents of this report are applicable to all water (and wastewater) utilities who:

- Are planning on implementing a CIS (whether custom or COTS)
- Have a CIS and are planning an upgrade, or
- Are planning on moving to AMR or AMI technologies

Utilities can use the contents to help them prepare for a CIS or AMS project, assess their readiness to undertake such a project, enhance their chances of success, and to find ideas when facing project challenges. There are many practical suggestions throughout the report.

As the previous study found, "there is no silver bullet or single act that will guarantee a successful project. However, there are many business practices – big and small – that utilities can use to improve the odds of success" (Rettie et al. 2005).

There are a few other areas in which additional research might be valuable:

- The staffing impacts of an AMI system. Many utilities struggle with the cost justification of moving to an AMI system. They know there are staffing impacts, but they are not sure how to best address the impacts, or plan for them. Potential issues to address include the following:
  - Responsibilities for the infrastructure (who should be responsible, how much time will this take, what skills are required, and so on)
  - What are the impacts on staffing beyond meter reading (what are the impacts on the other key functions of the Meter-to-Cash cycle – billing, contact center, and collections; conservation, and engineering groups)
- Better understand how AMI data can be used for maximum utility benefit. This research would identify the methods for AMI data analyses, results of the analyses, and actual examples (case studies) of utilities to show the value of using AMI data
- Develop a meter performance index based on actual AMI data. This would enable any utility with AMI data to base its meter maintenance and replacement strategies on meter performance. This research would enable utilities to use actual AMI data from their meters to reduce the guesswork from current practices
- Develop additional quantification of the benefits of moving to AMI, and the impact of AMI on other business processes at the utility. This would include developing an AMI business case tool to help utilities estimate the benefits of implementing an AMI
- Identify what utilities can do to accelerate obtaining the benefits from investments in CIS and AMS. Possibilities include analyzing if a maturity model could be applied, and defining specific steps that could be taken to ensure the investment is maximized

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ABBREVIATIONS

ABCWUA	Albuquerque Bernalillo County Water Utility Authority
ACD	Automatic Call Distribution
ACH	Automated Clearing House
AHT	Average Handle Time
AMI	Advanced Metering Infrastructure
AMR	Automated Meter Reading
AMS	Advanced Metering System
ARRA	American Recovery and Reinvestment Act
ASA	Average Speed of Answer
BPO	Business Process Outsourcing
BUI	Browser-based User Interface
CEO	Chief Executive Officer
CFO	Chief Financial Officer
CIO	Chief Information Officer
CIP	Capital Improvement Program
CIS	Customer Information System
COTS	Commercial Off-the-Shelf
CMMS	Computerized Maintenance Management System
CRM	Customer (or Constituent) Relationship Management
CSR	Customer Service Representative
CTI	Computer-Telephony Integration
DCU	Data Collection Unit
DoE	Department of Energy
DoITT	Department of Information Technology and Telecommunications
DPW	Department of Public Works
EAMS	Enterprise Asset Management System
EBPP	Electronic Bill Presentation and Payment
EFC	Environmental Finance Center
EFT	Electronic Funds Transfer
ERP	Enterprise Resource Planning
ERT	Encoder Receiver Transmitter
FMS	Financial Management System
FTE	Full-time Equivalent
GIS	Geographic Information System
GUI	Graphical User Interface
HAN	Home Area Networks/Home Automation Network

IP	Internet Protocol
IoT	Internet of Things
IT	Information Technology
IVR	Interactive Voice Response (or Interactive Voice Recognition)
IVR/IWR	Interactive Voice Response/Interactive Web Response
ITIL	Information Technology Infrastructure Library
KPI	Key Performance Indicator
LADWP	Los Angeles Department of Water & Power
MBE	Minority Business Enterprise
MD	Maryland
MDMS	Meter Data Management System
MDU	Montana Dakota Utilities
MGD	Million Gallons per Day
MIU	Meter Interface Unit
MOIT	Mayor's Office of Information Technology
MTU	Meter Transmitting Unit
NYC DEP	New York City Department of Environmental Protection
NYCWiN	New York City Wireless System
OCA	Outside Collection Agency
OTS	Off-The-Shelf
O&M	Operations and Maintenance
PAC	Project Advisory Committee
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
RF	Radio Frequency
RFB	Request for Bid
RFI	Request for Information
RFP	Request for Proposal
RFQ	Request for Qualifications
RSR	Read Success Rate
ROI	Return on Investment
SaaS	Software as a Service
SGIG	Smart Grid Investment Grant
SLA	Service Level Agreement
SOP	Standard Operating Procedure
SOW	Scope of Work
SME	Subject Matter Expert

TX	Texas
UNC	University of North Carolina
WAN	Wide Area Network
WBE	Women Business Enterprise
WMS	Work Management System
WRF	Water Research Foundation

APPENDIX A
GLOSSARY

311 – The non-emergency equivalent to 911 used to inquire about or request local government services.

Advanced Meter Infrastructure (AMI) –A two-way system that collects time-differentiated water consumption information and is capable of providing that information to the utility on at least a daily basis. AMI includes all the control system, communications and data management hardware and software between the meters and ancillary devices and the utility's business systems.

Automatic Meter Reading (AMR) – The electronic reading of customers' meters from a remote location.

Advanced Meter System (AMS) – A generic term to include both AMR and AMI systems.

Change Management – Change management involves understanding and helping people deal with change. A major change in technology imposes a major change on the people who use that technology, and can have ripple effects throughout the organization. Effective change management proactively develops strategies and action plans to manage the impact of the change. Involving people in the process and preparing them for the changes is key to a successful change process. Leadership is also key to working through change. Leaders need the skills and attributes to guide the organization while attending to the needs of employees. Most projects that an organization undertakes, regardless of whether the project includes a technology component, will result in changes to the organization and the way in which its people work. A successful project devotes significant attention to managing the impact of these changes.

Computerized Maintenance Management System (CMMS) – Very similar to WMS, but typically focused more narrowly on maintenance-related activities.

Computer-Telephony Integration (CTI) – The use of computers to manage telephone calls. The term is used in describing the computerized services of call centers, such as those that direct phone calls to the proper department.

Commercial-Off-The-Shelf (COTS) – Packaged vendor software provided to multiple customers for resale or leasing.

Custom Application – A custom application is a computer software system designed and programmed specifically for the requirements of a single organization (e.g., not available for resale through a vendor).

Customer Information System (CIS) – A CIS is the application that provides an integrated environment with which utilities enroll new customers, generate billings, manage credit and collections, track water consumption, track and manage meters, handle customer inquiries, complaints, and service orders, and provide call center support. A CIS must support multiple billing structures, rates, frequencies and entities. Utilities often integrate their CIS with other enterprise systems such as Geographic Information Systems (GIS), Work Management Systems (WMS) and enterprise decision-support systems.

Customer Relationship Management or Constituent Relationship Management (CRM) – A computer application that supports a comprehensive view of customer activities. Used to identify customer needs, segment customer classes, and improve marketing efforts.

Geographic Information System (GIS) – A computer system designed to relate any physical feature, description, event, or environment to a geographic location through the integrated

use of computer graphics and database systems. Typically integrated with other enterprise applications.

Interactive Voice Response/Interactive Web Response (IVR/IWR) – Systems that permit customers to take actions through telephone key pads, voice recognition, or the web.

Off-The-Shelf CIS – Describes a software product that is packaged and ready for sale, as opposed to one that is proprietary or has been customized. May still require significant configuration. (see COTS).

Read Success Rate (RSR) – The percentage of data that is transmitted successfully. The acceptable RSR should address such items as the period of time during which it is calculated (day, week, month), how many readings per day must be received, and what meters are to be included (for example, meters activated that day, that week, or in a defined area such as a route)

QualServe – A voluntary quality improvement program designed exclusively for water and wastewater utilities by the American Water Works Association and the Water Environment Federation.

Service Level Agreement (SLA) – A contract between a service provider and service receiver that specifies the level of service that is expected during its term. SLAs are used by vendors and customers, as well as internally by IT shops and their end users. They can specify bandwidth availability, response times for routine and ad hoc queries, and response time for problem resolution (network down, machine failure, etc.). SLAs can be very general or extremely detailed, including the steps taken in the event of a failure. For example, if the problem persists after 30 minutes, a supervisor is notified; after one hour, the account representative is contacted.

Work Management System (WMS) – Used to manage the work management process (in particular, maintenance-type work) and its associated support processes (e.g., inventory, purchasing and capital projects). These computer software programs are designed to assist in the planning, management and administrative procedures required for effective work management. The WMS is a business tool that allows control over the linked work and material processes and at the same time provides a means for collection of valuable cost and work history data.