



**Office of the Auditor General: Audit of the
Automated Meter Reading Project, Tabled at
Audit Committee – December 1, 2016**

Contents

Executive Summary	1
Purpose	1
Rationale	1
Findings	4
Conclusion	6
Recommendations and Responses	8
Detailed Audit Report.....	10
Audit of the Automated Meter Reader Project	10
Introduction	10
Background and Context	10
Audit objectives and criteria	13
Scope	13
Audit Approach and Methodology	13
Audit Observations and Recommendations	14
Conclusion	24
Appendix A: Audit Objectives and Criteria	25

Acknowledgments

The team responsible for this audit, comprised of individuals from Interis | BDO and Diameter Services, under the supervision and direction of Ed Miner, Deputy Auditor General, would like to thank those individuals who contributed to this project, and particularly, those who provided insights and comments as part of this audit.

Original signed by:

Auditor General

Executive Summary

Purpose

This provides a report for the Audit of the Automated Meter Reader (AMR) Project. This audit was included in the 2015 Audit Plan of the Office of the Auditor General (OAG), approved by City Council in March 2015.

The audit assessed whether the AMR Project was planned, implemented and managed economically and efficiently; and whether the intended objectives (including anticipated benefits), expected efficiencies, cost-savings and service improvements were achieved and reported.

Rationale

In 2006, the City of Ottawa had approximately 190,000 water accounts that were billed based on consumption measured from water meters. At that time, consumption was measured by capturing reads from the exterior of the premises from an outside receiver (i.e., an endpoint) that was wired to the water meter. By 2006 this technology had reached the end of its useful life and obtaining reads at regularly scheduled intervals was becoming increasingly difficult.

In 2006, a report to City Council recommended moving to AMR with Radio Frequency (RF) as the technology was proven, reliable and cost effective. An RF deployment using a drive-by vehicle was to provide savings in meter reading and billing of more than \$20 million over the next 20 years. These anticipated savings would be realized due to staff reduction/avoidance in both meter reading and customer support while supporting future growth, a higher level of reading frequency and an increase in customer confidence and trust in the accuracy of their water bills. The benefits set out in the AMR business case to justify the purchase of a new meter reading system were to:

- Replace the existing meter reading system and its predominantly failing meter reading units (black box/touchpad)
- Manage cost of customer billing services
- Control maintenance costs of the present, out-dated equipment
- Improve job safety and health of meter readers

In 2008, by the time a Request for Expression of Interest (REOI) was issued the industry technology had changed and drive-by technology was displaced by a fixed

Audit of the Automated Meter Reading Project

network technology called Advanced Metering Infrastructure (AMI). Approval of the City's 2009 capital budget brought the available spending authority for the project to \$28.4 million.

By 2009, the City had realized growth and the number of water accounts had reached almost 210,000. Approximately 15,000 of those accounts had meters that were incompatible with the new technology being procured so the project scope called for the installation of approximately 195,000 endpoints.

During contract negotiations the City scoped out the installation of 10,000 of the 195,000 endpoint installations to help reduce overall costs and to give the City an inventory of endpoints to install for training purposes. This scope change reduced the project's overall budget to \$24.99 million, of which \$22.89 million was for the primary contract which included installation of 185,000 endpoints. During the project, the 10,000 endpoints were added back into the contract's scope and 4,000 were returned back from the contractor to the City to install. The City accepted these more challenging installation where there was: a) an incompatible meter, b) the location of the meter was inaccessible, or c) the homeowner/account holder refused the endpoint installation.

Table 1 – Water Meter Project Scope

Accounts/Endpoints	# of Accounts¹	Percentage
Water Accounts in 2006	190,000	-
Add: City Growth (2006 – 2009)	20,000	-
Water Accounts in 2009	210,000	100%
Less: Incompatible Meters	(15,000)	(7.1%)
Water Accounts Available for Endpoint Installation	195,000	92.9%
Less: Endpoints Scoped Out for Budget Purposes	(10,000)	(4.8%)
Endpoints in Original Contract Scope	185,000	88.1%
Add: Endpoints Added to Scope During Project	10,000	4.8%
Less: Endpoints Returned by Contractor	(4,000)	(1.9%)
Endpoints Installed by Contractor	191,000	91.0%

At the end of contract, 91% of the meters in the City had been converted. The remaining 9% were read manually until the meters could be repaired or replaced. The meters that still had to be read manually were scattered through the City, resulting in reader routes being much less efficient with more transportation time between reads. This led to a slower reduction in the number of meter reader staff than planned. The target number of staff was reached in 2016 after a separate meter change out project which commenced immediately after the AMR project.

The project was managed by the Environmental Engineering branch within the Environmental Services department (ESD).

¹ Figures rounded

Findings

The following are findings in the three areas of the audit's scope; Governance, Project Management, and Benefits Realization.

Governance

The AMR project had a governance structure to ensure it was implemented and managed economically and efficiently; however, the project lacked a steering committee and a single business owner was not defined until over three years after the project was completed.

Project goals and drivers were clearly documented and communicated in the AMR Project Business Case, Project Control Manual (PCM) documents, and Reports to Council.

City Council and Senior Management received infrequent but sufficient information that was complete and accurate to inform decision making. A balance scorecard dashboard was presented to Council semi-annually. The Project Team held weekly meetings and the Project Manager held bi-weekly meetings with ESD Management.

The project did report to Council semi-annually and informally to Senior Management; however, given the size and duration of the project we would have expected that the AMR Project would have a project steering (or like) committee to provide guidance, direction and control. In a project such as this where there are multiple project sponsors (e.g., ESD, Finance and the Information Technology Services department) there could be requests coming into the project office from all directions. A steering committee consisting of representatives from each of the project sponsor areas can assist in avoiding scope creep, ensuring sound communication to all parties involved, and in ensuring adequate buy-in for all decisions.

Project Management

The AMR project was adequately planned, implemented and managed economically and efficiently.

The AMR project's business requirements and scope were well-defined in the business case, request for qualifications (RFQ), request for proposal (RFP), and final contract. Project stakeholders overwhelmingly stated that they understood the project's business requirements, project scope and intended benefits.

Audit of the Automated Meter Reading Project

There was regular monitoring and reporting of the project. The project's progress was well-documented through reports and meeting minutes. The City's internal project management team held bi-weekly AMR project update meetings and produced a monitoring report. The contractor and the City held weekly meetings to review the project status, deliverables and produce weekly deployment reports, which included project dashboards.

The City tracked costs throughout the project using a cost-tracking spreadsheet that was updated every time an invoice was sent from the contractor to the City. Expenditures were compared with the budgeted amount to ensure the project was not going over budget and in the end the project came in under budget.

Lessons learned were documented for the IT technical portion of the project but there was no lessons learned exercise conducted at the end of the over-arching project. A lessons learned document would have allowed the City to assess strengths from their management of the project and opportunities for improvement in future projects.

There was an established Return-to-Utility (RTU) process implemented on the project. An RTU is an endpoint that is returned to the City by the contractor when they were unable to complete installation for various specified reasons (e.g., customer unavailable, customer refusal, incompatible endpoint, etc.). All of the RTUs would be assessed for validity, with all valid RTUs being approved by the City and invalid RTUs sent back to the contractor. The City did investigate why some installations were not completed as scheduled.

Near the end of the project, a dispute occurred between the contractor and the City. In July 2012 the City asked the contractor for a price quote to finish the 10,000 endpoints that had originally been held out of scope by the City. As part of this request it provided the contractor with a list of these 10,000 accounts. Subsequently, during its review of RTUs, the City discovered that the contractor was installing endpoints on meters that were on this list of 10,000 without its approval. It was determined that the contractor was selecting locations where endpoints were easier to install than those on the list of 185,000 in-scope meters. They were doing this to more easily meet their overall targeted requirement of 185,000 installs.

In the end this dispute was resolved, all 195,000 endpoints originally in-scope were successfully installed, including the 10,000 installs originally scoped out, and the project remained on schedule and budget.

Benefits Realization:

Most of the AMR project's intended objectives, expected efficiencies, strategic goals and service improvements were achieved; however, the AMR project did not comprehensively track or report cost-savings or on the achievement of the strategic goals it had planned.

Objectives achieved by the project were the renewal of infrastructure, improving job safety and effectiveness, having endpoints installed in the targeted percentage of homes, and realizing efficiency gains and cost savings with respect to the number of meter readers employed. Though savings have been realized as a result of the reduction in staff, to date the amount of cost savings realized from the implementation of AMI has not been reported on.

Though there was no tracking mechanism to compare customer satisfaction before and after the AMI implementation it is clear that the expected service level improvements were achieved. AMI now provides the City with hourly data on each account's water consumption so if a customer calls with questions regarding their water bill the City has the ability to better address the customer's concerns. Prior to AMI, meter reads were done three to four times per year and monthly water bills were based on estimates derived from these reads so it was much more difficult to respond to customers' questions regarding their water bills. Further, the City can better help customers detect leaks with hourly water read data.

ESD now uses hourly water consumption data to assess water system performance to more precisely identify and determine the location of the system leaks, thus assisting with water conservation. The Infrastructure Services department (ISD) also uses this data to plan future infrastructure needs to support urban growth.

Conclusion

The AMR project had a governance structure and mechanisms in place to ensure the project was implemented and managed economically and efficiently. However, a steering committee should have been put in place to better govern the project.

The project was generally adequately planned, implemented and managed, with clearly defined business requirements and project scope. However, while the decision to scope out 15,000 incompatible meters and then an additional 10,000 endpoints did keep the project budget under \$25 million, it also had negative impacts. The meter reader routes in 2013 at the end of the project were inefficient so the anticipated reduction in the number of meter readers was not fully achieved until the end of the

Audit of the Automated Meter Reading Project

subsequent meter change-out project in 2016. In addition, the structure of the contract led to a dispute as the contractor paid its endpoint installers a fixed price per install which in turn led to them cherry-picking installation sites to minimize their installation time.

Lastly, most of the AMR project's intended objectives, expected efficiencies, and service improvements were achieved and reported on. However, the AMR project has not comprehensively tracked or reported on cost-savings and as noted above the savings related to reducing the number of meter readers was partially deferred.

Recommendations and Responses

The audit resulted in a number of recommendations, as listed below. Please refer to the attached audit report for additional details.

Recommendation #1

That the City define and adopt an approach for defining when a formal steering committee is required, including factors such as project size and duration, project risk and complexity, and the capability and experience of the organization to manage the project.

Management response:

Management agrees with this recommendation. The City's project management methodology already contains guidance on governance and stakeholder management. The need for a formal steering committee is dependent on the unique needs of each project and it is the project manager's responsibility to bring together stakeholders, clients and the project authority to ensure appropriate governance. Management recognizes that enhancements can be made to provide further guidance on when a formal steering committee is required and as such, management will update the Project Management Policy and Framework. This update will occur by the end of Q1 2017.

Recommendation #2

That the City expand the Project Management Policy to require a clear definition of the business owner at the outset of the project.

Management response:

Management agrees with this recommendation. While the City's project management methodology does contain guidance on governance and stakeholder management, management recognizes that enhancements can be made to clarify the role of a business owner. As such, management will update the Project Management Policy, Framework and Project Charter template to require a clear definition of the business owner at the outset of the project. This update will occur by the end of Q1 2017.

Recommendation #3

That the City, for future projects of similar scope and scale, consider including both variable and fixed pricing mechanisms in the contract to provide incentives for contractors to carry-out their contracted duties in a manner that is consistent with the City's objectives.

Management response:

Management agrees with this recommendation. For future projects of similar scope and scale a detailed assessment of potential Bases of Payment, which could include the use of variable and/or fixed pricing mechanisms, will be undertaken and documented as part of the development of the procurement strategy. It is expected that this will be implemented in Q1 2017 contingent upon when projects of similar scale and scope arise.

Recommendation #4

That the City should consider the value of assessing and reporting on the amount of cost savings and benefits realized to date to provide stakeholders and interested parties information on whether the project achieved its intended objectives.

Management response:

Management agrees with this recommendation. Consideration will be given to determine how to assess and report back to interested parties and stakeholders on the outcome of the AMR project and whether or not the intended benefits were achieved. City staff will complete this reporting in Q3 2017.

Audit of the Automated Meter Reading Project

The detailed section of this report is available in English only and may be translated in whole or in part upon request. For more information, please contact Ines Santoro at 613-580-2424, extension 26052.

La section détaillée de ce rapport n'existe qu'en anglais et pourrait être traduite en partie ou en totalité sur demande. Renseignements : Ines Santoro, 613-580-2424, poste 26052.

Detailed Audit Report

Audit of the Automated Meter Reader Project

Introduction

The Audit of the Automated Meter Reader (AMR) project was included in the 2015 Audit Plan of the Office of the Auditor General (OAG), approved by City Council in March, 2015.

Background and Context

In 2006, the City of Ottawa had approximately 190,000 water accounts that were billed based on consumption measured from water meters. At that time, consumption was measured by capturing reads from the exterior of the premises from an outside receiver wired (i.e., a meter reading device) to the water meter. By 2006 the technology being used had reached the end of its useful life. Obtaining reads at regularly scheduled intervals became increasingly difficult due to failing receivers, wiring issues, obsolete meter reading equipment and staffing issues.

In 2006, a report to City Council recommended moving to AMR with Radio Frequency (RF) as the technology was proven, reliable and cost effective. An RF deployment with a drive-by vehicle was to provide savings in meter reading and billing of more than \$20 million over the next 20 years. These anticipated savings would be realized due to staff reduction/avoidance in both meter reading and customer support while supporting future growth, a higher level of reading frequency and an increase in customer confidence and trust in the accuracy of their water bills. The benefits set out in the AMR business case to justify the purchase of a new meter reading system were to:

- Replace the existing meter reading system and its predominantly failing meter reading units (black box/touchpad)
- Manage cost of customer billing services

Audit of the Automated Meter Reading Project

- Control maintenance costs of the present, out-dated equipment
- Improve job safety and health of meter readers.

A Request for Expression of Interest (REOI) was issued in September 2008 that identified the requirements for the proposed system, followed by a suppliers' forum. By this time the industry technology had changed. The RF meter reading technology had evolved at such a pace that drive-by technology was being displaced by fixed network technology called Advanced Metering Infrastructure (AMI). An RFQ was issued in February 2009 followed by an RFP. Approval of the City's 2009 capital budget brought the available spending authority for the project to \$28.4 million.

By this time the City had realized growth and the number of water accounts had reached almost 210,000. Approximately 15,000 of those accounts had meters that were incompatible with the new technology being procured and thus the project scope called for the installation of approximately 195,000 endpoints.

During contract negotiations, in addition to the 15,000 endpoints with incompatible meters, the City scoped out the installation services for another 10,000 endpoints to reduce installation costs and to give the City an inventory of endpoints to install for training purposes. This scope change reduced the project's overall budget to \$24.99 million, of which \$22.89 million was for the contract to install 185,201 endpoints and the RFI network. During the project, the 10,000 endpoints that had been scoped out were scoped back in as it was projected that it was feasible to do so within the overall project budget.

Table 2 – Water Meter Project Scope

Accounts/Endpoints	# of accounts²	Percentage
Water Accounts in 2006	190,000	-
Add: City Growth (2006 – 2009)	20,000	-
Water Accounts in 2009	210,000	100%
Less: Incompatible Meters	(15,000)	(7.2%)
Water Accounts Available for Endpoint Installation	195,000	92.8%
Less: Endpoints Scoped Out for Budget Purposes	(10,000)	(4.7%)
Endpoints in Original Contract Scope	185,000	88.5%
Add: Endpoints Added to Scope During Project	10,000	4.7%
Less: Endpoints Returned to Utility (RTU)³ by Contractor	(4,000)	(1.9%)
Endpoints Installed by Contractor	191,000	91.0%

The contractor was to provide and install all components, except for the server hardware and server database application that was to be purchased and installed by the City’s Information Technology Services department (ITSD). As part of the installation process, the contractor installs the endpoint. If the existing wires are defective or non-existent, the contractor also installs the wires from the endpoint to the water meter, so that the endpoint can transmit water meter reads to the City’s AMI system via the RF network. This part of the installation process is called a wire run and was not required in the vast majority of installations. The length and difficulty of the wire run could vary depending on the location of the meter within the building.

During the installation process, the contractor encountered installation issues with approximately 4,000 of the compatible meters. This resulted in 19,000, or 9% of the

² Figures rounded

³ They City accepted RTU accounts that were returned by the Contractor in cases where there was: a) an incompatible meter, b) the location of the meter was inaccessible, or c) the homeowner/account holder refused the endpoint installation.

Audit of the Automated Meter Reading Project

meters in the City's network not being connected to the required transmitter. Therefore, at the end of contract roughly 91% of the meters in the City had been converted.

After the project ended in 2013 the remaining 9% of the meters were read manually until the meters could be repaired or replaced. The meters required to be read manually were scattered through the City, resulting in reader routes being much less efficient with more transportation time between reads. This led to a slower reduction in the number of meter reader staff than planned. The Environmental Services department (ESD) undertook a separate meter change out project with a different contractor which commenced immediately after the AMR project to change out the remaining meters and install the new transmitters. This work was completed within the first quarter of 2016. It resulted in approximately 99% of the endpoints being installed with meters being read through the RF network and the targeted number of staff reductions was achieved.

The AMR project was managed by the Environmental Engineering branch within ESD.

Audit objectives and criteria

The audit objectives include:

1. To assess whether the Automated Meter Reading (AMR) project was planned, implemented and managed economically and efficiently.
2. To assess whether the intended objectives (including anticipated benefits), expected efficiencies, cost-savings and service improvements were achieved and reported.

Scope

The audit scope involved three lines of enquiry:

- Governance
- Project Management
- Benefits Realization

All phases of the AMR project from business case to post-implementation benefits realization were included in the scope.

Audit Approach and Methodology

The audit was designed so that sufficient and appropriate audit procedures were conducted and evidence gathered to provide reasonable assurance of the accuracy of audit findings and conclusions, as they existed at the time of the audit. Information was

Audit of the Automated Meter Reading Project

obtained through documentation review and interviews, in addition to engaging a subject matter expert.

Audit criteria developed to address the areas of audit scope were based on the policies and practices of the City of Ottawa.

Audit Observations and Recommendations

Governance

The AMR project had a governance structure to ensure it was implemented and managed economically and efficiently; however, the project lacked a steering committee and a single business owner was not defined until over three years after the project was completed.

Project goals and drivers were clearly documented and communicated in the AMR project business case, project control manual (PCM) documents, and reports to Council.

City Council and senior management received infrequent but sufficient information that was complete and accurate to inform decision making. Balance scorecard dashboards were presented to Council on a semi-annual basis while the project team held weekly meetings and the project manager held bi-weekly meetings with ESD management.

The project did report to Council semi-annually and informally to senior management; however, given the size and duration of the project it was expected that the AMR project would have a project steering (or like) committee to provide overall guidance, direction and control. In a project such as this where there are multiple project sponsors (e.g., ESD, Finance and the Information Technology Services department (ITSD)) there could be requests coming into the project office from all directions. As a result it was expected that a steering committee would exist consisting of representatives from each of the project sponsor areas. A steering committee can assist in avoiding scope creep, ensuring sound communication to all parties involved, and in ensuring adequate buy-in for all decisions. The City's current Project Management Policy does not define when a formal steering committee is required.

Recommendation #1

The City define and adopt an approach for defining when a formal steering committee is required, including factors such as project size and duration, project risk and complexity, and the capability and experience of the organization to manage the project.

Management response:

Management agrees with this recommendation. The City's project management methodology already contains guidance on governance and stakeholder management. The need for a formal steering committee is dependent on the unique needs of each project and it is the project manager's responsibility to bring together stakeholders, clients and the project authority to ensure appropriate governance. Management recognizes that enhancements can be made to provide further guidance on when a formal steering committee is required and as such, management will update the Project Management Policy and Framework. This update will occur by the end of Q1 2017.

The over-arching project lacked a formalized project charter. The ITSD Project Manager prepared a "project charter lite", which is a condensed version of a project charter for the technical portion of the project to install servers, database and software. It specified the project objective, key deliverables, milestone, initial risk assessment and roles and responsibilities for the IT technical implementation. The business project team; however, did not prepare a full project charter to provide the detail one would expect given the size and duration of the project.

Given the size and duration of the project we would have expected a detailed project charter to have been prepared at project initiation that specified: project objectives, scope, timelines, roles and responsibilities, deliverables, change control process, issues management process, etc. The "project charter lite" should only be considered a subset of the larger Charter for the entire project. It briefly provided project objectives, key deliverables and roles and responsibilities, project milestones, risk factors and roles and responsibilities for the Request for Information (RFI) and Request for Proposal (RFP) stage of the project and did not fully capture and summarize the key elements of the business case (e.g., objectives, scope and benefits of the overall project).

Furthermore, the benefit of having a project charter completed and approved by senior management that has the delegated authority over the relevant operations is to ensure the scope of the project is complete, approved and the appropriate levels of authority for management of scope and decision making purposes have been identified. The format and level of detail required is proportional to the size and complexity of the project, with the intent that conscious thought is given to the various factors influencing the project, potential risks and resources required. In 2014 the City implemented a Project Management Policy that requires project charters to be completed on all projects.

Audit of the Automated Meter Reading Project

Roles, responsibilities and accountabilities were clearly addressed in several documents (e.g. PCM documents, IT Project Charter, etc.) to ensure the achievement of the project objectives. During the project roles and responsibilities were clearly defined and understood. ESD was responsible for managing and owning the project; Finance owned the applications and ESD owned the collectors, repeaters and endpoints assets.

Once the project was completed ESD, Finance and ITSD defined a joint governance model with clear roles and responsibilities for the three parties outlined in the AMI System Sustainability document. This joint ownership model occasionally led to some conflicts between departments when goals were not aligned.

In early 2015, the AMI stakeholders were requested to identify one application owner. This was part of the ITSD strategy to clarify ownership for all applications and to clearly identify the roles and responsibilities of each organization as they relate to the Application's complete solution lifecycle. This strategy was adopted to ensure clear direction and to eliminate conflicting direction between multiple owners of an application.

Finance, ESD and ITSD met on several occasions to determine and agree on who would be the appropriate business application owner; however, it was not until April 2016 that it was agreed to by Finance and ESD that Finance would be the single business application owner. The lack of a clearly defined business owner at the end of the project could have been addressed if a detailed project charter was completed. The City's current Project Management Policy also does not require that the business owner be formalized at the outset of the project.

Recommendation #2

That the City expand the Project Management Policy to require a clear definition of the business owner at the outset of the project.

Management response:

Management agrees with this recommendation. While the City's project management methodology does contain guidance on governance and stakeholder management, management recognizes that enhancements can be made to clarify the role of a business owner. As such, management will update the Project Management Policy, Framework and Project Charter template to require a clear definition of the business owner at the outset of the project. This update will occur by the end of Q1 2017.

Audit of the Automated Meter Reading Project

Going forward, ESD is responsible for field deployments and supporting the field hardware and associated RF communications network, as well as supporting future field system enhancements and network growth. Finance is responsible for system administration including software administration, software training, data integrity and implementing future system enhancements. Lastly ITSD is responsible for providing support to ESD and Finance with the AMI system, hardware and software services.

Project Management

The AMR project was adequately planned, implemented and managed economically and efficiently.

The AMR project's business requirements and project scope were well-defined in the business case, RFP/RFQ, and final contract. Project stakeholders consistently stated that they understood the project's business requirements, project scope and intended benefits.

The project's scope stayed relatively stable throughout the project. There were acceptance certificates that were signed throughout the project for major milestones, including the pilot and project closeout, to ensure the completed work was aligned to the contract. The project had a formal change order process to address any concerns with the scope of the work and given change orders totaled only 4.4% of the project value it was evident that the project stayed within scope. The project also stayed within its budget and was finished on-time, despite a dispute with the contractor (see below).

In the RFP, the contractor was initially required to install 210,000 endpoints on existing water meters. It was estimated prior to signing the contract that there were 15,000 incompatible meters of which most were known as being incompatible with technologies proposed by each of the bidders, so it was decided to scope those meters out of the project.

Sites with these meters were identified in the City's propagation study before the contract was issued. If an additional incompatible meter that was not on the list of 15,000 was discovered during an endpoint install, the contractor was not to install the endpoint and would submit a RTU report to the City. When possible, City staff booked appointments and installed endpoints at RTU locations during the AMI Project. Where not possible, the City planned to install endpoints at these sites when the meter was replaced after the AMR project ended.

Additionally, the City withheld a further 10,000 compatible meters from the contract by issuing a change order to remove them from the original purchase order. ESD planned

Audit of the Automated Meter Reading Project

to install endpoints on these meters itself. The City chose to scope out the 15,000 meters that needed to be replaced and the 10,000 compatible meters as cost saving measures to reduce the overall budget of the project. These two scope reductions led to the contractor having to install 185,000 endpoints.

Another reason why the meter change outs for incompatible meters were excluded from the project scope was due to the upfront cost of replacing meters and the fact that the majority of meters deployed throughout the City still had additional years of useful life. Not including meter change outs in the contract would allow the contractor to more quickly install the AMI system/endpoints, thus allowing the City to realize the benefits of having the AMI system sooner. As described below, these benefits included reducing meter reader staff levels, reducing maintenance costs and improving customer service.

Near the end of the project, a dispute occurred between the contractor and the City. In July 2012 the City asked the contractor for a price quote to finish the 10,000 endpoints that had originally been held out of scope by the City. As part of this request it provided the contractor with a list of these 10,000 accounts. Subsequently, during its review of RTUs, the City discovered that the contractor was installing endpoints on meters that were on this list of 10,000 without its approval. It was determined that the contractor was selecting locations where endpoints were easier to install than those on the list of 185,000 in-scope meters. They were doing this to more easily meet their overall targeted requirement of 185,000 installs.

Since not all accounts were in scope and the price paid to the contractor's installers for each install was fixed, the endpoint installers had incentive to select easier endpoints. At some sites the wire from the meter to the endpoint had to be replaced and in some of these cases there were long wire runs resulting in a relatively longer installation. As all installations yielded the same remuneration, the contractor was incented to avoid ones with long wire runs and replace them with relatively easy installations.

In addition to noticing this issue during its review of RTU's, in September 2012 the City also became aware of customer complaints. Customers were complaining to the City that the contractor was not completing the necessary wire runs from the water meters to the endpoints. Once this issue was identified, it was brought to the attention of City senior management and the contractor using the escalation process defined in the contract.

The City presented its findings to the contractor and negotiations were undertaken to rectify the problem. An agreement was reached between the City and the contractor whereby the City agreed to increase the contract's scope to include all 10,000

Audit of the Automated Meter Reading Project

previously excluded installations while keeping the overall project under budget. This resolution was agreed to by both parties and allowed for the project to remain on schedule.

The dispute arose from two main factors. Firstly, the AMR contract had a fixed price per endpoint install regardless of the difficulty of the installation. Because longer wire runs were paid the same as shorter wire runs, the contractor was incented to install shorter wire runs. The pricing structure in the contract was unsustainable. It is common in major AMR projects such as this one to include some variable pricing components in the contract where the contractor cannot reasonably estimate the level of the work.

Usually residential wire runs can be reasonably defined to keep them at a fixed/unit price, but we expected that the specifications would have defined a maximum wire length or difficulty (e.g., number of holes to be drilled to run the wire). On commercial wire runs a maximum length or difficulty could have been set in the contract and beyond that there could have been a per meter price to run wire. Ultimately any work order that results in a variable pricing component would have City pre-approval to ensure costs are controlled. The pricing in the City's subsequent meter change-out contract provided variable pricing via different rates for seven different types of installations based on the size of the meter and whether the customer's dwelling had a finished versus unfinished basement.

It is recognized that variable pricing based on wire length or difficulty would have required additional City oversight and resources to ensure the City was being invoiced accurately for the actual work completed. As a result consideration would have needed to be given to the cost associated with the additional oversight required.

The second factor behind the dispute was that the AMR contract's scope did not include installation of 100% of the endpoints. As described above, the City excluded 15,000 incompatible meters and 10,000 additional endpoints, primarily for budgetary reasons. We recognize that in addition to budgetary reasons this allowed the City to realize some of the benefits from the installation of the AMI system sooner.

Recommendation #3

That the City, for future projects of similar scope and scale, consider including both variable and fixed pricing mechanisms in the contract to provide incentives for contractors to carry-out their contracted duties in a manner that is consistent with the City's objectives.

Management response:

Management agrees with this recommendation. For future projects of similar scope and scale a detailed assessment of potential Bases of Payment, which could include the use of variable and/or fixed pricing mechanisms, will be undertaken and documented as part of the development of the procurement strategy. It is expected that this will be implemented in Q1 2017 contingent upon when projects of similar scale and scope arise.

As mentioned above, there was an established RTU process on the project. The City received a weekly batch of RTUs from the contractor and reviewed them for validity. A valid RTU would be an account where specified criteria existed, such as:

- Incompatible meter
- Homeowner/Account holder refusal
- Location of meter inaccessible

Valid RTUs were approved by the City and invalid RTUs were sent back to the contractor for it to complete. The City also investigated why some installations were not completed as scheduled.

There was regular monitoring and reporting of the project. The project's progress was well-documented through reports and meeting minutes. The City's internal project management team held bi-weekly AMR project update meetings and produced monitoring reports. The contractor and the City held weekly meetings to review the project status, deliverables and produce weekly deployment reports, which included project dashboards. Balance scorecard dashboards were presented to Council semi-annually.

Lessons learned were documented for the IT technical portion of the project but there was no lessons learned exercise conducted at the end of the over-arching project. A formal lessons learned document would have allowed the City to assess strengths from their management of the project and identify opportunities for improvement in future projects. The City's Project Management Methodology introduced in 2014 after this project commenced now requires that lessons learned, both positive and negative, be documented for further reference in the 'Administrative Close-out' stage.

Although there were different forms of change management activities carried out during the project, including engaging the meter readers' union and providing training to staff on the new hardware and software, no formal change management strategy was prepared. The City's 2014 Project Management Methodology also includes a Change

Audit of the Automated Meter Reading Project

Management Plan as a mandatory step for all City of Ottawa projects as part of the 'Planning Project Implementation' stage.

The City tracked costs throughout the project using a cost-tracking spreadsheet that was updated every time an invoice was received from the contractor. The actual invoiced cost was compared with the budgeted amount to ensure the project was not going over budget. The project's total budget was \$24.99 million, while the actual total amount spent was \$23.90 million, meaning the project, which includes costs beyond the contract, came in under budget. We found that project costs incurred were accurately tracked against the project budget.

Benefits Realization

Most of the AMR project's intended objectives, expected efficiencies, strategic goals and service improvements were achieved; however, the AMR project did not comprehensively track or report cost-savings or on the achievement of the strategic goals it had planned.

Intended objectives, expected efficiencies, and service improvements were achieved, as were some strategic goals. However, the AMR project has not comprehensively tracked or reported on cost-savings or on the achievement of the strategic goals it had planned for. Though some cost-savings were realized during the project, it was not until the end of the meter change-out project when the City was able to fully realize the cost-savings from the reduction in number of meter reader staff. The project did not quantify the target number of meter readers that would exist once the AMR project or meter change-out projects were completed.

Objectives achieved by the AMR project were:

- Improve customer service by basing all billings on actual readings (as opposed to every other billing being based on estimates) and having hourly usage information available to respond to customer queries
- Realize cost savings of an estimated \$23 million over the 20 year life of the RF units from a reduction in the number of meter readers employed (from a staff level of 14 FTEs at project commencement to 9 by end of project, and to 2 in 2016)
- Improve job safety and effectiveness (the RF technology avoids health and safety concerns due to the repetitive motion injuries that meter readers employees have experienced in manipulating the reading wands)

Audit of the Automated Meter Reading Project

- Install endpoints in the targeted percentage of homes (i.e. 90% by the end of 2012 and 100% by end of 2013⁴)
- Realization of other strategic goals (i.e., more detailed water consumption data, and improved water loss/leak detection data)
- Renewal and investment planning of water infrastructure

Though there was no tracking mechanism to compare customer satisfaction before and after the project, it is clear that service level improvements were achieved. For the majority of City's customers, those with new endpoints installed, the City has hourly data on water consumption. Therefore, when a customer calls with questions regarding their water bill, the City has the ability to better address the customers' concerns. Prior to the AMR project, meter reads were done 3 to 4 times per year and in the other months water bills were based on estimates derived from these reads so it was much more difficult to respond to customers' concerns. Further, the AMR project allows the City to better help customers detect leaks, where the customer has a newer, more granular water meter.

The cost savings realized from the AMR project and the subsequent full implementation of AMI have not been comprehensively calculated or reported on. All full time-employee (FTE) reductions were formally reported as savings annually as part of the budget process. Water meter reader FTE reductions were reported in this manner to Council as cost reductions to the City.

Before the project commenced there was a water meter reader staff level of 14 FTEs (10.33 water meter readers, 2 senior water meter readers, 1 supervisor, and 0.66 students). When the project ended in 2013 the staff level decreased to 9 (5.66 water meter readers, 2 senior water meter readers, 1 supervisor, and 0.33 students) and currently the staff level is 2 (both water meter readers).

Based on 2011 salaries, and assuming a 2% annual cost of living adjustment, we estimated savings related to the decrease in FTEs to be approximately \$1.93 million up to the end of 2016.

⁴ At the end of 2013 all endpoints were installed with the exception of approximately 19,000 meters. ESD undertook the Meter Change-out project which included tendering a separate contract for those meters and endpoints. This work was completed in 2015.

Table 3 – Estimated Meter Reading Salary Savings

Project	Year	# of Meter Readers	Estimated Savings
AMI Implementation	2011	14	-
	2012	12	\$100,000
	2013	9	\$250,000
Meter Change-out Project	2014	6.67	\$360,000
	2015	3.66	\$560,000
	2016	2	\$660,000
Total			\$1,930,000

Benefit realization, however was not reported by the project owner as part of the project close out phase.

Recommendation #4

That the City should consider the value of assessing and reporting on the amount of cost savings and benefits realized to date to provide stakeholders and interested parties information on whether the project achieved its intended objectives.

Management response:

Management agrees with this recommendation. Consideration will be given to determine how to assess and report back to interested parties and stakeholders on the outcome of the AMR project and whether or not the intended benefits were achieved. City staff will complete this reporting in Q3 2017.

The AMI implementation led to improvements with respect to job safety and effectiveness as a result of fewer water meter readers being required to visit sites and obtain water meter reads. In addition health and safety concerns due to the repetitive motion injuries that water meter readers had been experiencing in obtaining meter reads were decreased as a result of the RF technology.

In addition to contributing to the achievement of most of the strategic goals, secondary benefits were achieved:

- The Infrastructure Policy Unit (IPU) uses water demand information from AMI when conducting long range planning for water and wastewater system demands and related capital/financial planning to anticipate when water infrastructure

Audit of the Automated Meter Reading Project

requires investment. Though the data from AMI is technically no more accurate than the data obtained previously from meter readers, the data from AMI is more abundant (i.e., hourly meter reads versus 3 to 4 reads per year) and more current (i.e., within the past hour versus the latest meter read which could have been up to 4 months old) and readily accessible. As a result AMI provides IPU with ready access to improved data allowing it to conduct more in-depth analysis, which it expects to yield improved infrastructure plans.

- ESD now uses hourly water consumption data to assess water system performance to more precisely identify and determine the location of the system leaks, thus assisting with water conservation. ISD also uses this data to plan future infrastructure needs to support urban growth.

Conclusion

The AMR project had a governance structure and mechanisms in place to ensure the project was implemented and managed economically and efficiently. However, a steering committee should have been put in place to better govern the project.

The project was generally adequately planned, implemented and managed, with clearly defined business requirements and project scope. However, while the decision to scope out 15,000 incompatible meters and then an additional 10,000 endpoints did keep the project budget under \$25 million, it also had negative impacts. The meter reader routes in 2013 at the end of the project were inefficient so the anticipated reduction in the number of meter readers was not fully achieved until the end of the subsequent meter change-out project in 2016. In addition, the structure of the contract led to a dispute as the contractor paid its endpoint installers a fixed price per install which in turn led to them cherry-picking installation sites to minimize their installation time.

Lastly, most of the AMR project's intended objectives, expected efficiencies, and service improvements were achieved and reported on. However, the AMR project has not comprehensively tracked or reported on cost-savings and as noted above the savings related to reducing the number of meter readers was partially deferred.

Appendix A: Audit Objectives and Criteria

Criteria listed below were developed from material gathered from planning interviews, document review and research. They have been organized according to the three lines of enquiry.

Audit Objectives and Criteria

<p>Line of Enquiry #1: Governance</p> <p>To assess whether the project governance structures and practices ensured that the AMR project was implemented and managed economically and efficiently.</p>	
1.1	The AMR project goals and drivers (including primary and secondary benefits) were clearly documented and communicated.
1.2	City Council and senior management oversight bodies (i.e. steering committee) received sufficient, complete and accurate information to inform decision making.
1.3	There were clear roles, responsibilities and accountabilities in place to ensure the achievement of project objectives.
<p>Line of Enquiry #2: Project Management</p> <p>To assess whether the AMR project was adequately planned, implemented and managed economically and efficiently.</p>	
2.1	Business requirements and project scope were well-defined throughout the project and aligned to desired business outcomes.
2.2	There was regular monitoring and reporting of the project.
2.3	The project had a proper change management function or process leading to help ensure AMR met clients' needs and project objectives
2.4	The project costs incurred were accurately recorded and within the allocated budget.
2.5	The project adequately planned, implemented, managed and reported on the installation of endpoints for compatible meters.
<p>Line of Enquiry #3: Benefits Realization</p> <p>To provide assurance that intended objectives, expected efficiencies, cost-savings and service improvements were achieved and reported.</p>	
3.1	The intended objectives (including primary and secondary benefits) were achieved.
3.2	The expected service level improvements (e.g. customer satisfaction) were achieved.

3.3	The expected cost savings and operational efficiencies were realized.
-----	---