International Practices and Trends for Managing Municipal and Utility Infrastructure

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1 Introduction: What is Asset Management?

Asset Management (AM) is a process of maintaining asset performance at a required level of service while minimizing total life cycle cost. Integrated asset management systems provide information to support decision-making on capital and operational spending, optimization of infrastructure assets, and rehabilitation and eventual replacement of assets. As the costs of operating and maintaining critical infrastructure rise – primarily as a result of asset aging and demand for system expansion – resources continue to tighten as municipal taxpayers and utility ratepayers prove reluctant to approve new funding without compelling demonstration of need. Asset management equips organizations such as utilities with effective tools to maximize return on investment on both capital and operating works, demonstrate these successes to stakeholders, and make a clearer case for rate increases as required.

Asset management processes and systems allow service-driven organizations to:

- Assess service responsiveness and accessibility
- Monitor and report performance of assets, systems and services
- Measure results and ensure overall accountability
- Make effective short to mid-term business decisions and long-term plans
- Institutionalize a culture of continuous improvement
- Incorporate stakeholder involvement into decision-making and obtain support.

An effective AM system will address six key performance areas:

- **Practices** to plan and manage infrastructure assets to ensure a sustainable future.
- **Processes** to measure and support performance management.
- **Data and information** to provide complete and accurate records of assets.
- **Technology systems** integrated to manage, monitor and report asset information.
- **Organizational integration** of asset management principles and practices.
- **People** management strategies to instil a culture of continuous improvement.

Asset management is a way of doing business that is strategic, long-range and comprehensive. It combines engineering principles with business practices and economic theory, and provides tools to support agencies in making informed decisions about investments in infrastructure assets. Asset management includes:

- **Asset Performance Management** processes and systems to measure, analyze and report on asset performance in order to enable informed decision-making and planning for renewal, replacement and expansion.
- **Asset Operations Management** processes and systems to manage the design, build, operations and maintenance of infrastructure assets and services, including smart metering, control systems, and work management.

- **Asset Financial Management** processes and systems to manage financial reporting and address accounting and other regulatory reporting requirements.

1.1.1 Asset Performance Management

Asset Performance Management (APM) is a set of mid and long term processes of decision-making and planning in order to maintain and optimize asset performance at required levels of service while maximizing return on asset investment and minimizing total life cycle cost. APM processes and systems should:

- Be driven by the organization's mission and long-term strategic goals.
- Support informed decision-making about current and long-term management of infrastructure.
- Be flexible and adaptable for a variety of uses.
- Be accessible to organization stakeholders, including staff at all levels, policy makers and customers.
- Incorporate effective planning and budgeting tools to set, track and report on overall asset, system and service performance.

1.1.2 Asset Operations Management

Asset Operations Management is the process of managing and maintaining assets on an ongoing "real-time" basis in order to achieve required levels of service in a reliable, cost-effective manner. AOM incorporates:

- A primary focus on providing services to the customer effectively, efficiently and reliably.
- Responsibility to ensure maximum uptime, reliability and serviceability of assets at reasonable cost.
- Reliance on sound business processes to manage work and predictive/preventive maintenance.
- Reliance on established and developing technologies that can include:
    - Work/maintenance management systems
    - Supervisory Control and Data Acquisition (SCADA) systems
    - Geographic Information/Mapping systems
    - Smart Metering/Intelligent systems management technologies
    - Mobile fieldwork technologies

1.1.3 Asset Financial Management

Asset Financial Management (AFM) is a conceptual framework of objectives, standards, policies and practices linked rationally to meet the needs of the stakeholders. This framework includes:

- Projection of maintenance and capital replacement trends into the future.
- Development of annual funding profiles for maintenance, repair, rehabilitation and replacement of assets.
- Identification of assets projected for disposal.
- Reliable information for policy makers to determine long-range funding needs.
- Assessments of service efforts and costs of programs.
- Tools to assess the organization's financial position.
- Alignment of budgeting and accounting processes related to management of capital assets.
- Customer management, including acquisition and billing.

1.1.4 Benefits of Asset Management

Organizations can expect a range of benefits from a comprehensive asset management program:

- Improved system management, with returns in five to 25 years.
- Improved asset life cycle management, with returns in three to 10 years.
- Improvement work management, with returns in one to three years.
- Improved resource management, with immediate and ongoing returns.
- Improved financial support for a corporate infrastructure strategy.
- Improved tools to assess the utility's financial position and measure performance.
- Improved information for policy makers to determine long-range funding needs.
- Improved systems to support AFM.
- Consistent corporate definitions, policies and terminology.
- Consistent accounting treatment of asset-related expenditures.
- Consistent framework for decision-making.
- Clarity of asset accounting processes for all stakeholders.

2 International Trends and Practices

2.1 Global Trends

Infrastructure assets are a crucial part of a society's development. Supporting and developing these assets is very costly and time-consuming, and it has been realised that there is a greater need for accountability and sustainability. Infrastructure managers worldwide have recognized the need to fundamentally change how they do business, shifting from managing short-term projects and services to strategically planning comprehensive delivery of services over the long term. Implementation of an asset management philosophy, systems and business practices have helped agencies manage our significant investments in existing assets; plan for growth, renewal and replacement of assets; define service levels and report on performance; and provide reliable information to customers and stakeholders to improve accountability and build trust. Today, a series of interconnected trends is driving the adoption and advancement of asset management in the field of public infrastructure in both the developed and developing worlds. These trends include:

- **Infrastructure Funding Deficit:** Throughout the world, stewards of critical infrastructure, including utilities and local governments, face the challenges of renewing or replacing their existing assets and expanding infrastructure systems to serve growing populations while they are constrained by ongoing funding shortfalls and economic uncertainty. According to analysts Booz Allen, global infrastructure investment over the next 25 years is estimated to exceed $40 trillion US for water, wastewater, energy and transportation systems. In North America alone, annual expenditures on infrastructure operations and capital replacement exceed $800 billion. The tools of asset management (processes and systems) and performance analytics and optimization (performance benchmarking and system modeling) have become critical to enabling infrastructure managers "do more with less."
- **Sustainability:** The operation and maintenance of infrastructure such as utility systems in a safe, sustainable manner has become a public expectation, if not a legal requirement, in many societies. The notion of sustainability as a "triple bottom line" proposition – economic, environmental and social – recognizes that issues such as public health, energy consumption and environmental responsibility are closely intertwined with the efficient operation of critical infrastructure assets. From this perspective, asset management and system performance

optimization have implications and benefits that extend beyond simply operating infrastructure and delivering services cost-effectively.

- **Regulation and Compliance:** In today's fast-changing business climate, utilities also face a growing web of regulations that typically address public health and workplace safety, financial reporting and environmental footprinting, among other issues. Sound asset management practices, processes and systems all support the various dimensions of compliance required of utilities. For example, in many jurisdictions, accounting standards such as the International Financial Reporting Standards – or here in South Africa, GRAP 72 – require detailed reporting of the inventory and value of physical assets. Assembling this information is an essential first step in introducing a full-fledged asset management program into an organization.
- **Service-Driven Management:** Increasingly, infrastructure operators are managing their systems not simply as assemblies of physical assets but as complexes of services which need to be delivered optimally to subscribers or customers. This approach takes into consideration factors such as growth, demand and cost in managing asset systems in order to achieve agreed or expected service levels efficiently and sustainably. This calls for an advanced approach to asset management that includes better-informed decision-making, long-term planning and advanced system modeling.
- **Smart Metering/Smart Grid:** The introduction of smart metering in utility systems such as water and energy and the development of smart energy grids require managers to do more than inventory and value their assets. They now need to monitor systems, gather data and evaluate performance in real time, and optimize the performance and service value of assets over their entire life cycle. This represents the most advanced level of asset management. Smart metering is, of course, advancing rapidly in North America, the United Kingdom, Europe and elsewhere as a means of encouraging conservation and enabling flexible billing systems. In Canada, for example, the province of Ontario has mandated smart metering to support time-of-day billing for electricity.
- **Performance Optimization:** The development of new systems management technologies and the unprecedented volumes of data generated by smart meters and similar intelligent sensors and controls in infrastructure systems create the opportunity to harness these tools to manage systems more efficiently today and optimize their performance over the long term. Operations management at this level calls for sound practices and processes, integrated technologies, and tools for performance benchmarking and analytics and long-term system modeling.

2.2 International Asset Management Practices

2.2.1 Canada

In recent years, Canadian municipalities and utilities have made significant advances in adopting asset management principles and programs, driven by a combination of legislation, regulation, infrastructure funding programs and structural changes in the energy distribution industry. Among these drivers:

- Public Sector Accounting Board Standard PS 3150 requires Canadian municipalities to report all tangible capital assets in their financial statements, including valuation and amortization, and to develop plans for replacement, renewal and overcoming infrastructure funding deficits. Canadian utilities face similar requirements.
- In Ontario, Canada's most populous province, deregulation of the electric industry has required utilities to inventory their assets, a first step in establishing asset management, to inform regulators and address the incoming International Financial Reporting Standards. Introduction of asset management by the province's utilities is also being driven by the Green Energy Act, the Sustainable Water and Sewage Systems Act, and a mandate to install smart electric meters in order to support time-of-day customer billing.

- The federal government has allocated approximately $3 billion in fuel tax revenue to enable municipalities to upgrade their traditionally underfunded infrastructure systems. Municipalities can use a portion of this funding to advance their asset management capacity in order to support funding plans.

The City of Hamilton, Ontario, was an early adopter of asset management principles and practices, and is now considered a leader among North American municipalities. Hamilton applies AM principles across its transportation, water and wastewater assets. A dedicated team of 22 staff is responsible for buried infrastructure (water and wastewater distribution and collection) and above-ground assets (pavement, bridges, parks, public works facilities). The team monitors current levels of service, life cycle trends and deterioration models to plan and develop an integrated three to five-year budget, a 20-year capital budget, and a 100-year financial forecast of the city's infrastructure investments.

The city's AM program began in 1998 when managers began focusing on questions about asset sustainability and funding issues. In 2000, the provincial government required the amalgamation of the Regional Municipality of Hamilton-Wentworth and six other municipalities into one city, and the resulting reorganization provided further impetus for creating and funding the AM program and implementation team. Hamilton has seen a number of benefits from the program:

- Staff can demonstrate to managers and the public that the city is using its resources cost-effectively.
- AM processes and data have sped up the capital budget development process.
- All players see the community as a whole and how assets function together to deliver higher quality of life.

Calgary, Alberta, is another leader in municipal asset management. The city has embraced multi-sector AM as a way to balance its rapid growth and its need for infrastructure renewal. A corporate-wide infrastructure AM strategy is one of Calgary's key tools to address its growing infrastructure needs and enable effective service management. The city has introduced a Corporate Asset Program across 13 business units that applies a triple bottom line approach, assessing economic, social and environmental issues. The benefits have included:

- Enhanced decision-making, supported by better data about assets on which to base project prioritization and budget allocation decisions.
- Better data to justify capital and maintenance expenses to the public.
- Growing city council confidence in the asset data generated by CAMP.

Our company, Fuseforward, has worked with a number of Canadian municipalities to introduce the philosophies and tools of advanced asset management into their organizations. We are currently leading a demonstration of the optimization of electric and water/wastewater systems in the City of Kingston, Ontario. This project includes the implementation of our "Smart Utility" asset and operations management system for Utilities Kingston, a multi-service utility that serves a population of about 120,000 in Kingston, Ontario.

2.2.2 New Zealand and Australia

New Zealand and Australia are world leaders in implementing asset management practices, having developed effective, advanced systems over the past 30 years.

New Zealand mandates involvement by citizens and businesses in choosing levels of affordable service prior to distribution of national funds. Inventory, condition and defined risks associated with various funding levels inform the discussion. New Zealand's Local Government Act requires local councils to consult with citizens on major community decisions. The LGA established a framework that each council must follow in developing its long-term community consultation plans (LTCCP) to reflect sustainable social, economic, environmental and cultural decisions. Asset plans must also include:

- Estimated additional demand and current system capacity, the associated costs of meeting demand, and expected funding sources.

- Levels of service options, growth assumptions and associated risks.
- Maintenance, renewal and development projects to address risks.
- Intended level of service (LOS) performance targets and measures, the estimated cost of achieving and maintaining identified the LOS, and funding sources.

In Australia, a study of 15 similar wastewater agencies between 1990 and 2001 found that implementation of asset management process and practices resulted in asset life cycle cost savings of between 15 and 40 percent, with an average of 22.5 percent.

The city of Brisbane, Australia is a world leader in asset management implementation, driven by state mandates, a desire to further its reputation as an innovative city, and strains on its infrastructure introduced by rapid growth. The city's decision-making considers the triple bottom line while focusing on achieving stated objectives within its adopted vision. Asset strategic plans and 10-year AM plans have been developed for all major asset classes. Key Performance Indicators (KPIs) have been developed for pavement condition and quality, congestion, public transit system performance, customer satisfaction and worker safety. The city's Total Asset Management system is an asset planning tool that supports decision-making for capital investment, and strategic, operational, maintenance and disposal planning. A well-defined process directs data collection for 16 asset classes. Life-cycle costing and scenario analysis are conducted on pavement condition and are compared to engineering standards, leading to a four-year funding program for operations, maintenance, and rehabilitation.

2.2.3 United Kingdom

In the United Kingdom, parliamentary legislation mandating that the government maintain the country's infrastructure dates to 1825. In modern times, the UK adopted specific asset management-related legislation in 1999. Here are a few examples of current AM practice in the UK:

Transport for London's (TFL) 2000 business plan included a mandate to bring the city's transportation assets into a state of good repair. TFL's aim to reduce its maintenance backlog, new opportunities for public borrowing for transportation investment, and national requirements to implement whole-of-government accounting procedures and prepare local transport plans all coalesced to drive the implementation of an AM program.

The TFL program identifies critical asset needs, determines the most cost-effective strategy to address those needs and measures results in Best-Value Performance Indicators (BVPI). Managers also use AM information to value assets and distribute capital maintenance funds. Assets considered most critical and having the highest value to network effectiveness are prioritized for funding. TFL's Asset Inventory and Management System (AIMS) is part of its GIS platform used for city planning and management activities. The AIMS includes network descriptions, information on 59 asset types, condition data and crash data. The system includes both historic data and live video feeds. Condition index ratings establish project priorities for roads and sidewalks. A pavement deterioration model is used to develop a 15 to 20-year investment program for roads; a similar model is in place for streetlights. The models are used also to test long-term expenditure scenarios.

The Hampshire County Council developed a Highway Maintenance Management Plan that is integrated into the council's service plan, business plan and quality procedures. The strategy is intended to provide a common basis for assessing maintenance needs, resource requirements and implications; assist in the effective allocation of resources; and support a consistent, systematic approach to decision-making.

Gloucestershire was among the first local authorities to begin implementing an asset management strategy in response to national directives to more closely align transportation plans and AM. The county established an asset working group to spearhead the effort, resulting in a statement of objectives and desired outcomes, a definition of asset resources, and the identification of risks associated with asset condition. The group also conducted a gap analysis to identify the difference between current and desired levels of service and the cost of closing the gap, in preparation for developing an implementation plan.

2.2.4 United States

In the United States, the adoption of asset management practices by municipalities and utilities has been driven more by the pressures of growth and significant funding shortfalls than by government regulation. More recently, the dramatic growth of utility smart metering and the development of the Smart Grid and creating new pressures and new opportunities to advance asset management, data capture and performance analysis and optimization. The GASB 34 accounting rule requires annual reporting of all capital assets and long-term liabilities including infrastructure, utilizing accrual accounting methods. Agencies are required to report asset depreciation using a traditional straight-line method, and by reporting revaluations of depreciation based on condition of the asset. However, the rule also provides that agencies do not have to depreciate assets if the agency manages the infrastructure asset using an AM system. Infrastructure managers have concluded that straight-line depreciation did not provide the tools to help them manage the infrastructure and pursued implementation AM programs that brought best practices into their organizations.

Best practice agencies can be found in the following areas of municipal and utility management:

- Transportation (Portland, Oregon)
- Water (Las Vegas, Nevada; Seattle, Washington)
- Wastewater (Johnson County, Kansas; Portland, Oregon; Sacramento and Orange Counties, California)
- Storm water and Facilities (Seattle)
- Fleet (Fresno, California).

The growing deployment of smart meters and intelligent sensing and control devices in utility systems essentially requires that infrastructure managers move beyond basic asset management practices to leverage the terabytes of data these devices will produce in real-time analytics systems, performance optimization programs, and long-term system modeling processes. These initiatives make up the most advanced stage of asset management and are within the reach of infrastructure managers as utilities build out the smart grid. The U.S. and Canada already have the world's highest penetration of automatic meter reading, exceeding 50 percent, and many large U.S. utilities have embarked on ambitious smart grid schemes to deploy second-generation advanced metering infrastructure. Aggregation and analysis of the resulting data will mark the next significant advance in asset management in the utility industry.

3 Getting Started in Asset Management

3.1 A Phased Approach

Implementing an asset management program within an organization that is responsible for a complex of infrastructure assets – such as a municipality or a utility – is typically a four-phase process, as outlined below. This process often begins with "Asset Management for Compliance" in response to requirements for tangible asset accounting in financial reporting standards such as GRAP 72 (South Africa), PS 3150 (Canada) or IFRS.

The phases or stages of asset management are:

- **Asset Management for Compliance:** This phase focuses on ensuring that the organization is able to meet its statutory obligations related to asset financial accounting and reporting. Each business unit will, at a minimum, inventory, classify and value their assets for asset accounting purposes.
- **Asset Management Standardization:** This phase expands asset by establishing standards and processes across the organization, including management practices, processes, data collection and systems. The result of this phase is the implementation of standards for what assets are, where they located, and how the different assets are related to each other (e.g. system models).
- **Integrated Asset Management:** This phase focuses on implementing an integrated set of processes across an organization for designing, building, operating and maintaining all asset classes and systems. For instance, in an integrated utility or region, water and electric are

managed as integrated systems not independent systems. Integrated asset management incorporates cross system planning and operation. For instance, the replacement of water mains would be planned in relation to the repaving and / replacement of road infrastructure.

- **Sustainable Asset Management:** This final phase focuses on ensuring that all assets and systems are managed in perpetuity to provide required levels of service. Critical to this stage is the development of sustainable funding methods for all systems and asset within an organization.

A phased approach enables the organization to meet the challenge of providing resources to develop an asset management strategy and program while supporting its various competing initiatives.

A step-by-step implementation of an asset management program might proceed as follows:

Year 1: Establish Asset Management Support Infrastructure

- Design and develop the support infrastructure for asset management, including establishing base asset detail to meet financial reporting requirements.
- Establish asset management financial policies to enable compliance to new accounting guidelines and the reporting of tangible capital assets.
- Establish an asset management program office and governance structure.
- Establish asset management education and communication programs for audiences including elected councils, directors, executives, management and staff.
- Establish asset management standards.
- Implement base information technology, including asset management systems and an integrated asset repository (data warehouse).

Year 2: Implement AM Performance Management Practices

- Expand asset management education as it relates to the actual process implementation.
- Establish base set of key performance indicators and related service levels.
- Establish baseline performance for future benchmark and report cards.
- Develop initial set of asset management plans for critical assets.
- Develop long-range financial plans for all asset classes.
- Develop new rate models based on long-range financial plans.
- Finalize asset management system implementation.

Year 3 and Beyond: Institutionalize Asset Management

- Expand asset management plans for all asset classes.
- Incorporate criticality and risk analysis models for all major assets.
- Implement an integrated asset planning process as part of the regular budgeting process.
- Review and revise long-range financial plans regularly as part of an ongoing process.
- Enter a continuous improvement cycle (performance management + cross-industry benchmarking + cross-industry best practices + business process improvement) to support long-term reduction in overall life cycle costs.
- Implement an integrated service and asset planning process.

3.2 Conclusion: Looking Ahead

Over the coming years, infrastructure agencies will fundamentally rethink how they do business as they are driven to find innovative ways to balance funding shortages and the demands of growth, aging

infrastructure and changing demographics. Success will require a holistic approach to managing infrastructure in order to meet triple bottom line considerations – providing infrastructure services to support a diverse society and a vibrant economy while preserving the environment. New strides in the implementation of Asset Performance Management will include:

Practices

- Long-range planning processes will be integrated with sustainable infrastructure planning.
- Service level modeling across asset classes will support sophisticated consultation with customers to define levels of service and evaluate methods of service delivery.
- Decisions will be increasingly influenced by predictive asset information at the managerial and political levels.

Processes

- Organizations will be able to monitor performance in real time, making timely adjustments to optimize infrastructure operations and ensure continued service.
- Sophisticated risk modeling processes will help organizations understand and mitigate risks.
- Business case evaluation processes will help organizations develop sound and sustainable investment strategies for the long term, linking capital, operating and maintenance cycles.

Data and Records

- Asset records will be complete and accurate and fully accessible to all staff in reporting "dashboards" that present a unified view of asset data across the organization while providing role-specific views for asset managers, financial managers, executives and other stakeholders, including customers.
- Data confidence will be measured and reported to stakeholders, and data improvement strategies will be identified and implemented.

Technology Systems

- Technology systems will be integrated through a common foundation of information and communication, and will be accessible and secure.
- Management and assessment tools will enhance the organization's ability to monitor infrastructure condition and predict the consequences of decisions.
- New innovative infrastructure equipment can be installed, managed and monitored for benefits realization.

Organization and People

- Organizational structure will be designed to optimize the integration of asset management, resulting in greater collaboration across business units and job functions.
- Asset management data will inform decisions at all levels of the organization.
- Broad access to AM information will improve job performance and enhance personal productivity.

4 Appendices

4.1 Selected Sources

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