

A Continuous Improvement Approach for Service and Asset Management

*This paper is an adaption of
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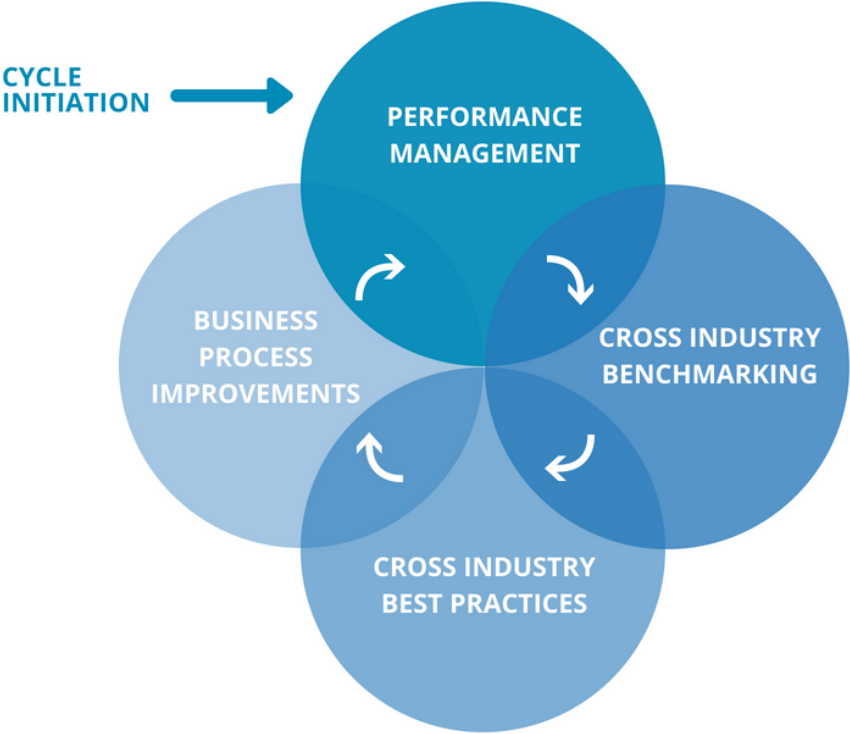
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Executive Summary

Service providers and asset managers such as utilities, cities, transportation agencies and facility managers are facing many challenges including:

- Increasing or ageing asset inventories such as roads, water systems, sewers, energy systems, buildings and vehicles;
- Decreasing or static operating budgets for maintaining and operating the asset inventory;
- A lack of a comprehensive approach for managing the life cycle of infrastructure including planning, design, construction, maintenance and operations.

The ultimate goal when planning to address these issues is to enter into a Continuous Improvement Cycle as depicted below.



Cycle Initiation

Prior to initiating the Continuous Improvement Cycle a number of questions need to be answered and where there are conflicting opinions, decisions must be made to resolve the issues. These questions include:

1. What services does the organization provide and what assets are they managing?
2. Who is accountable for providing these services and managing these assets?
3. How will service delivery and asset performance be measured in terms of efficiency and effectiveness?

The Service Delivery Framework described in Appendix A assists in answering these questions. In summary, the Service Delivery Framework provides a foundation for service definition, cost tracking, work management and service/activity reporting. Once implemented, the organization can start to understand the full service and asset life cycle costs, and move into a Continuous Improvement Cycle.

Performance Management

Inherent in the Continuous Improvement Cycle is the need to measure and track performance. Performance management is a management philosophy geared towards improving performance through goal setting. As part of performance management, service providers and asset managers need to:

1. Identify baseline performance (once)
2. Develop new performance targets (annually)
3. Continuously monitor actual performance (ongoing)

Cross Industry Benchmarking

Benchmarking can be used to compare service delivery and asset management methods with those of other providers and comparable organizations in industry. The goals of benchmarking are to:

- Improve operational performance
- Improve customer service
- Improve quality of products/services
- Incorporate best practices into processes

- Develop focused performance management goals
- Increase competitiveness

With structured benchmarking, service providers and asset managers can identify differences in performance and thus find areas of improvement. Prior to embarking on a benchmarking exercise, however, a model such as the Service Delivery Framework is required. Without this model, the services, activities and associated costs cannot be effectively benchmarked. As service providers and managers improve the results from benchmarking exercises, they will be better able to answer questions like:

- What is baseline performance?
- Are we over-servicing or under-servicing our customers?
- Are we spending effectively, in the right places with the biggest payback?

Cross Industry Best Practices

Best practices may exist in similar industries with asset investments such as pipelines, utility companies and the forestry industry. In conjunction with benchmarking, service providers and asset managers should try to find the best practices for service delivery and asset management. As part of the Continuous Improvement Cycle, providers need to implement best practices and find new methods for improving the effectiveness and efficiency management.

Business Process Improvements

With the input from benchmarks and best practices, as well as innovative ideas from staff, new ideas can be tested and the resulting effect on cost, quality, cycle time and throughput can be measured. In this way, service providers and asset managers can improve operational efficiencies and thus utilize dollars more effectively.

Business process improvement is the final stage of the cycle where the innovative ideas come to fruition. It is at this time where the process improvements become operational and are imbedded into the day to day business processes.

Implementing a Continuous Improvement Cycle

Implementing the Continuous Improvement Cycle takes time and commitment from all levels inside the organization. It requires commitment from staff, management and stakeholders.

In addition, information systems are needed to capture and normalize the data to support the continuous improvement program. These systems include work order management systems, analytical applications and asset tracking systems.

Introduction

Service providers and asset managers such as utilities, cities, transportation agencies and facility managers are facing many challenges. One major challenge is how to ensure the longevity of investment in facility assets such as buildings, roads, sanitary and storm sewers, energy systems, water systems and park networks while minimizing service fees. Ultimately, this equates to how to do more with less. Some of the issues that make this a complex problem include:

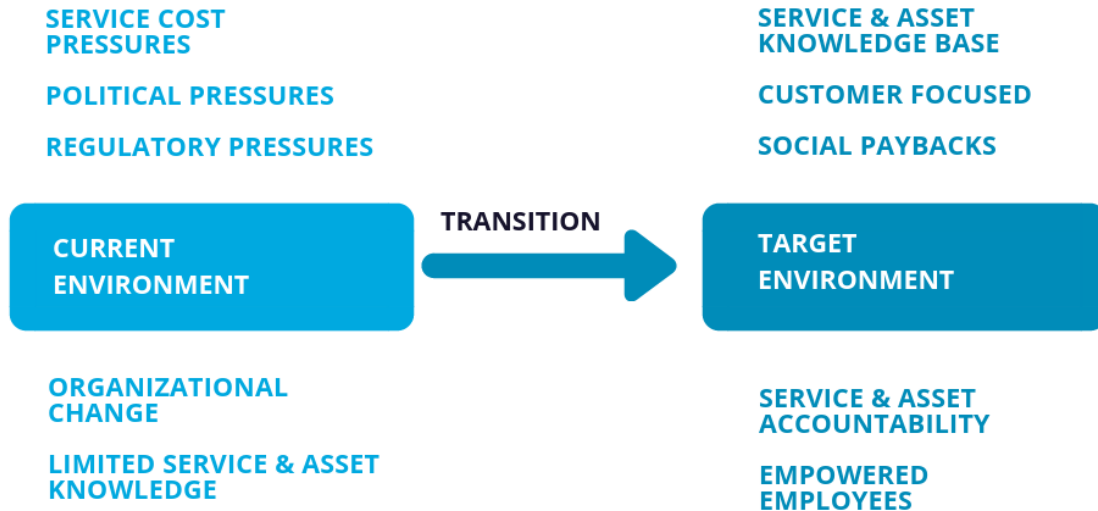
- *Increasing and ageing facility asset inventories.* Facility assets are added or replaced annually. These assets need to be maintained and operated.
- *Decreasing or static operating budgets.* Maintenance and operating budgets continue to fall behind the amount of new inventory being added.
- *A lack of a framework for managing service delivery and asset life cycle costs.* Comprehensive data about the full life cycle costs of asset management (planning → design → construction → maintenance, operations and replacement) does not usually exist in a useable nor integrated fashion which affects the decisions related to effective operations and maintenance.
- *A lack of a comprehensive service and asset information system.* An organization cannot move to a preventative maintenance model without a comprehensive maintenance management system. Costs in an emergency or reactive maintenance environment are three to five times more expensive.
- *The priority of asset maintenance relative to other services.* Asset maintenance does not always receive the highest priority when competing against other services. Maintenance managers have difficulty explaining the implications of asset related service level reductions and justifying the costs attributed to these services.

An opportunity exists to implement a comprehensive solution for asset life cycle management. Figure 1 demonstrates the transition that needs to be taken.

Current Environment

Figure 1 depicts the numerous pressures and variables affecting the operations of service providers and asset managers. Service providers and asset managers are being forced to rationalize all expenditures while maintaining or improving customer service. In addition, regulations such as changes to accounting practices are forcing organizations to look at new business processes and practices.

Figure 1 Environment Overview



Example: A Public Agency

As an example, a typical asset-intensive organization may have over \$10,000,000 worth of new facility assets being added every year, yet experience no budget increase for asset maintenance and operations. State or provincial government projects compound this problem, delivering new facility assets which the public agency must then manage.

Continuing in the current environment assumes that the issues identified above are insignificant and there is no need to capitalize on the potential of improving the management of the agency’s facility assets and service delivery. The overall result of this proposition is an increasing cost trend associated with poorly maintained assets and unplanned capital and operational draws.

Target Environment

The primary objective in the target environment is to understand the implications of management decisions on the life of facility assets and service delivery. This will determine the effectiveness and efficiency of operations.

Characteristics

One of the key characteristics of the target environment is that the service provider or asset manager operates with outcomes in mind. That is, the direction of management decision-making is oriented towards satisfying specific paybacks. Decisions are made based on business and social economics. Payback periods, both financial and social, are used to assess the relative merit

of capital and operating expenditures. Operating an organization in this manner results in the best utilization of resources.

To understand payback, tangible and intangible metrics need to be developed and tracked. This metric information can be used as the basis for improvement. As an organization increases its knowledge base, it is better able to make informed decisions.

Benefits

A service provider or asset manager which implements the proposed management model, business processes and accompanying information technology should obtain the following results:

- Asset life will increase, and average unit cost of maintenance and operations will decrease. By tracking asset performance information, asset life would be extended through directed maintenance and replacement. Sharing of information with other organizations will produce a collection of the best methods and materials.
- Records may justify a more costly original investment in assets while leading to reduced long term maintenance costs.
- As service providers and asset managers reorganize, performance information such as cost per unit will be left intact. Performance measures are left independent of organizational structure.
- As leadership and administration changes, the service and asset knowledge repository (a collection of valuable information) will remain intact.
- Service and asset information can be easily shared across departments.

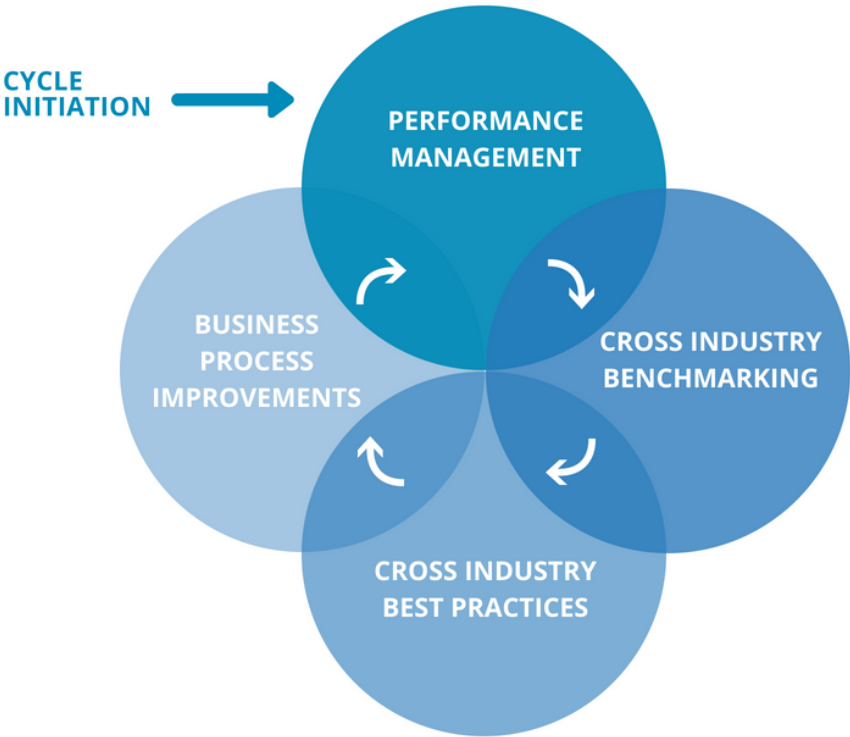
Service providers and asset managers can anticipate quantifiable net benefits from the implementation of this management model, including major financial benefits related to productivity improvements, maintenance cost avoidance and additional revenue realization. These savings can be used to:

- Improve asset management by decreasing the unit cost of maintenance and operations, moving to more programmed maintenance and reducing premature asset replacement; and
- Improve a customer service by increasing the efficiency in handling service requests and maintaining infrastructure service levels.

The Continuous Improvement Cycle

An opportunity exists to improve asset life cycle management within and across service providers and asset managers. Ultimately, the goal is for service providers and asset managers to enter into a Continuous Improvement Cycle as depicted into Figure 2. Once in this cycle, the organization can decrease the overall life cycle cost of their investment in assets and service delivery. A more detailed description of the Continuous Improvement Cycle is contained in the following pages.

Figure 2 Continuous Improvement Cycle



Many service providers and asset managers are experimenting with many of the concepts depicted in Figure 2. Some are trying to benchmark against similar organizations, while others are trying to implement a performance management system. The following pages describe a structured approach for implementing these concepts.

Cycle Initiation

Prior to initiating the Continuous Improvement Cycle a number of questions need to be answered and where there are conflicting opinions, decisions must be made to resolve the issues. These questions include:

1. What services are provided and what assets are being managed?
2. Who is accountable for providing these services and managing these assets?
3. How will service delivery be measured in terms of efficiency and effectiveness?

The Service and Asset Delivery Framework described in the following section and in detail in Appendix A assists in answering these questions.

In addition to answering these organizational and management questions, service providers and asset managers need tools and technologies to understand the ramifications of changes made to processes and procedures. As part of the Cycle Initiation, organizations need to redesign work management processes to incorporate information technology. This would include:

1. Implementing automated work management software that incorporates the performance measures and targets.
2. Designing policies and procedures that are understandable and adaptable.
3. Clearly defining roles and responsibilities.

Some service providers and asset managers have implemented automated maintenance management software, however, it only deals with one stage in the life cycle of assets and does not include a management model geared towards understanding and utilizing the available information.

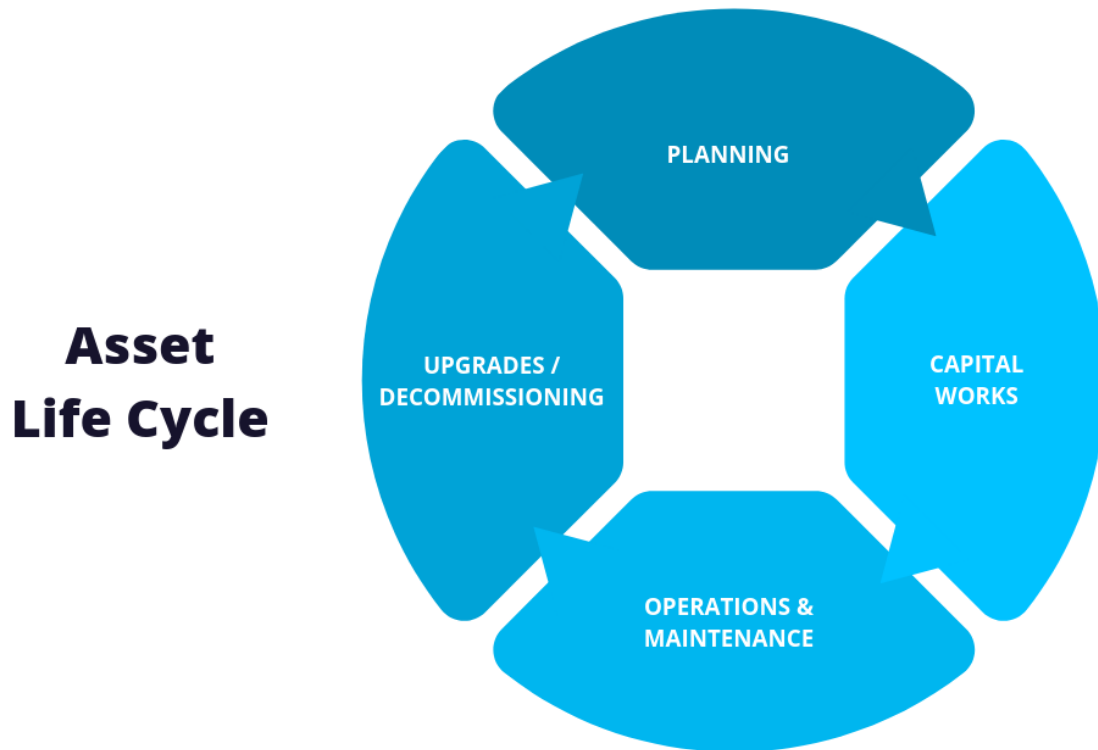
Once these two steps have been completed, the key pieces are in place to enter the Continuous Improvement Cycle. Staff and management can experiment with the various aspects of the business processes such as: new types of equipment, different inventory methods, different crew sizes and compositions, and different skill composition. Over time, the business practices can be refined to improve service delivery efficiency and effectiveness. For continuous improvement, the cycle should not stop, especially in an environment of changing technologies and techniques.

Service Delivery Framework

A fundamental building block for entering into a Continuous Improvement Cycle is to have a common tracking and reporting framework. One option is to develop a *Service Delivery Framework* that is independent of administration and organizational structure. Once fully implemented, this management framework will allow asset life cycle management to become a

reality. Figure 3 depicts the life cycle of assets, which provided the basis for the Service Delivery Model.

Figure 3 Asset Life Cycle



The Service Delivery Framework includes a common terminology, a method for defining service accountability, a set of performance measures and a costing model. A synopsis of the model is included in Appendix A.

With full implementation of this framework, questions such as the following can be answered:

- How long should assets last?
- What are the levels of routine service?
- How often should maintenance and operation activities be performed to optimize asset life?
- What is the justification for major capital repairs?
- Where can costs be eliminated while limiting the effect on service delivery?

- Of the many brands and types of parts and materials used by the industry, which ones perform the best?

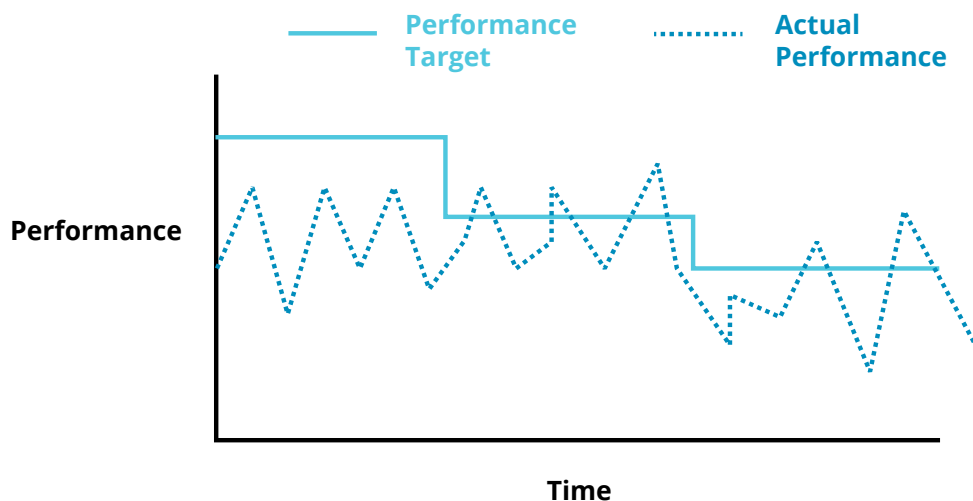
Performance Management

Inherent in the Continuous Improvement Cycle is the need to measure and track performance. Performance management is a management philosophy geared towards improving performance through goal setting. It also includes a component for personal improvement, however, this is outside the scope of this paper.

A performance-oriented organization identifies areas of improvement and works toward achieving above average results. Accountability for services is easy to identify in a performance-oriented organization. As part of performance management, critical infrastructure providers need to:

1. Identify baseline performance (once)
2. Develop new performance targets (annually)
3. Continuously monitor actual performance (ongoing)

Figure 4 Performance



The above diagram shows the relationship between performance targets and actual performance. As performance improves, performance targets are modified. The key question however, is “What determines the appropriate measures?”

Each service provided can be viewed independently with specific goals geared towards contributing to the organization’s overall success. The goals are measured in terms of

effectiveness and efficiency. Effectiveness includes metrics like quality standards and response times. Efficiency includes metrics like unit cost, cycle time and throughput.

Cross Industry Benchmarking

Benchmarking can be used to compare service delivery and asset management methods with those of comparable organizations in the industry. The goals of benchmarking are to:

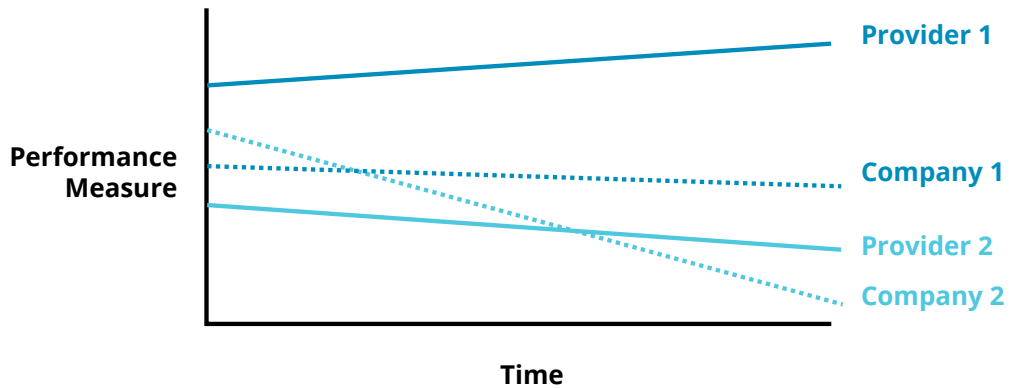
- Improve operational performance
- Improve customer service
- Improve quality of products/services
- Incorporate best practices into processes
- Develop focused performance management goals
- Increase competitiveness

With structured benchmarking, service providers and asset managers can identify differences in performance and thus find areas of improvement. Prior to embarking on a benchmarking exercise, however, a model such as the Service Delivery Framework is required. Without this model, the services, activities and associated costs cannot be effectively benchmarked. As service providers improve the results from benchmarking exercises, they will be better able to answer questions like:

- What is baseline performance?
- Are we over-servicing or under-servicing our customers?
- Are we spending in the right places with the biggest payback?

The following graph depicts some of the performance measures component of benchmarking. In this part of the cycle, service providers and asset managers are trying to identify other organizations who show better and/or improving performance. Once identified, further analysis of the business processes and practices will yield areas for improvement.

Figure 5 Benchmark Analysis



Cross Industry Best Practices

Best practices may exist in similar industries with asset investments such as pipelines, manufacturing and the forestry industry. In conjunction with benchmarking, service providers and asset managers should try to find the best practices. Best practices include:

- Decreasing demand maintenance with preventative and predictive maintenance programs.
- Creating vendor partnerships to facilitate volume discounts for purchases and to limit the diversity of equipment within the organization.

As part of the Continuous Improvement Cycle, service providers and asset managers need to implement best practices and find new methods for improving the effectiveness and efficiency for asset management. Benchmarking is one method to find the innovations. Research and experimentation are other methods. The main variables that affect the performance of service delivery and asset life cycle costs include:

- Service Delivery Mix - outsourcing, contract out vs. internal staff
- Organizational Structure
- Work Methods
- Policies & Procedures
- Tools & Technologies

Looking at other organizations and changing any one of these variables will change performance.

Business Process Improvements

With the input from benchmarks and best practices, as well as innovative ideas from staff, new ideas can be tested and the resulting effect on cost, quality, cycle time and throughput can be measured. In this way, service providers and asset managers can improve operational efficiencies and thus utilize resources more effectively.

Business process improvement is the final stage of the cycle where the innovative ideas come to fruition. It is at this time where the process improvements become operational and are imbedded into the day to day business processes.

Implementation

Service providers and asset managers have been using maintenance management systems for many years. Many of these systems, however, only deal with the maintenance and operations side of assets. The planning and capital works are done in partial isolation.

Attempting to get into the Continuous Improvement Cycle takes time and commitment from all levels inside the organization. It requires commitment from staff, management and stakeholders. The following action plan highlights some of the key action items.

Immediate Action Items (Year 0 - Year 2)

1. Initiate organizational change initiatives geared towards fostering a continuous improvement culture for management and staff. This should incorporate performance management, business planning and team training.
2. Introduce business process redesign or similar approaches prior to or in conjunction with new business application implementations.
3. Identify and confirm all services being provided and assets being managed.
4. Acquire/build or convert to an enabling technology infrastructure.
5. Implement a standard costing model.
6. Implement the service delivery model.
7. Implement an automated work management system built around the management model described in Appendix A.

Longer Term Action Items (Year 2 +)

1. Foster continuous improvement in the organization.
2. Identify baseline service levels and improvement targets
3. Initiate industry infrastructure benchmarking.

4. Experiment with new methods of service delivery.
5. Foster the standardization of metrics.

Appendix A – Service Delivery Framework Synopsis

The service delivery framework describes an approach for managing all work associated with the services being provided and assets being managed. This appendix is divided into the following sections:

Terms: Provides some of the key definitions used throughout the service delivery framework.

Service Definition: Defines services related to assets owned and/or managed by a service provider / asset manager.

Performance Management: Defines performance management and how it applies to Resource Management

Costing Model: Describes the costing model to be implemented as part of the project.

Terms and Definitions

The following terms and definitions are used throughout the framework description.

Term	Definition
Program	A program is a presentation and packing tool used by a service provider / asset manager to roll up services. Programs may change from year to year; however, the underlying services will remain relatively static. Programs reflect the organizational mandate.
Service	<p>A service is a building block for defining and managing programs. In general, services remain constant from one year to the next.</p> <p>A service is where accountability and responsibility are usually managed. A service has performance targets expressed in terms of quality, cost effectiveness, throughput, cycle time and service levels. A service may have a set of associated activities performed to plan, deliver and monitor the service.</p>
Activity	An activity refers to a group of actions or task performed to provide services. Budgeting is usually conducted at the activity level with a roll-up to the service for accountability tracking and financial reporting. An activity may be performed as part of providing many different services.

Resource	A resource is an object owned or managed by an organization. A resource is an asset, human resource and/or fund employed in carrying out the business activities necessary to provide services, to manage other resources or to manage the organization.
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Service Definitions

As defined above, a service provider / asset manager, such as a city, can provide programs to target groups to meet social goals. A program, however, is not easily budgeted or managed. Thus, a service has been introduced as a means to describe what a service provider / asset manager does in layman terms. A service is also easier to manage and measure performance. Programs, and thus services, are divided into two main categories:

Industrial Services. Provides direct services to the external stakeholders (e.g., taxpayers, water and electricity consumers, transport users etc.).

Corporate Services. Provides services to internal users as their primary customer. Examples include Fleet Management and Information Technology Management where the primary users are internal departments.

Service Groups Example: A Public Agency or Campus

Table 1 Service Groups lists examples of service groups that can be defined as part of a Public Agency Work Management project.

Table 1 Service Groups

Program	Major Service Group	Accountable Department/Division
Transportation	Road Corridor Provision	Engineering
	Arterial Roads	
	Major Collector Roads	
	Local Roads	
	Winter Maintenance	Engineering
	Traffic Control	Engineering
	Street Lighting	Engineering
	Pedestrian Corridor Provision	Engineering, Parks
	Bicycle Corridor Provision	Engineering, Parks
	Vehicle Parking	Engineering, Parks, Bylaw
	Boulevard Tree Management	Parks
Transit Services	Engineering	
Water Provision	Water Distribution	Engineering
	Mainlines	

Program	Major Service Group	Accountable Department/Division
	Pumps and Controls Water Collection/Treatment	Engineering
Liquid Waste Management	Liquid Waste Collection Mainlines Pumps and Controls Liquid Waste Disposal/Treatment	Engineering Engineering
Storm Water Management	Storm Water Collection	Engineering
Solid Waste Management	Residential Garbage Collection Residential Recycling Garbage Disposal Litter Container Garbage Collection	Engineering Engineering Engineering Engineering, Parks
Property Management	Facility Provision Fire Halls Libraries Recreation Space Office Space Industrial Space Housing	Fire, Library, Recreation, Facilities, Planning
Clean City	City Beautification	Parks
Recreation & Entertainment	Parks Access Active Space Passive Space Recreation Facility Access Marine Access	Parks Recreation Parks
Environmental Protection	Urban Forestry Environmental Stewardship	Parks Parks
Public Health & Safety	Burial Plot Provision	Parks
Community Development	Community Development Support Special Events	Parks Parks
Corporate Services	Fleet Management Heavy Equipment Auxiliary Equipment Vehicles Information Technology Management Business Applications IT Infrastructure	Engineering Finance & Technology

Service Types

Every service falls within one of four types. A critical infrastructure provider, including a city, can deliver all four types of services. Table 2 Service Delivery Examples depicts various programs and the related services in relation to a city. Within each program, four service type examples are provided. A full description of each service type is provided in the subsequent sections.

Table 2 Service Delivery Examples

Campus Services						
Major Service Groups		Water Services	Fleet Services	Facility Services	IT Services	Energy Services
Service Types	Planning services	Water system planning services	Fleet planning services	Facility planning services	IT planning services	Energy planning services
	Capital works services	Water system design and construction services	Fleet acquisition and improvement services	Facility construction and improvement services	IT acquisition and improvement services	Energy acquisition and improvement services
	Maintenance services	Water system maintenance services	Fleet Maintenance services	Facility Maintenance services	IT maintenance services	Energy Maintenance services
	Operations services	Water system operations services	Fleet operations services	Facility operations services	IT operations services	Energy Operations services

Planning Services

Planning services track all projects and activities related to the planning of facility assets. Planning services are funded from both operating and capital funds. Some of the long-term feasibility studies and advanced design work conducted by the organization are capitalized. The capitalization policy will define the rules for capitalizing planning services.

Typical Performance Measures

Measuring the performance of planning services related to the organization’s facility assets is usually a combination of long-term system failures and trending of customer complaints.

Capital Works Services

Capital Works services relate to designing, building and improving facility assets. The majority of Capital Works Services are organized into projects. The projects are managed as part of long range planning, service planning, strategic planning and annual capital planning.

Funding for projects may come from many sources. A capitalization policy (to be developed by the Finance Department) will define when an improvement or upgrade to a resource will be capitalized and when it will be expensed. If the improvement is to be expensed, it will be part of the maintenance service associated with the resource.

For a specific resource (e.g., the Water System), the capital works service group is divided into services based on the major types of assets (e.g., major grid mains). Each project will separate the costs for each asset produced within the scope of the project.

Typical Performance Measures

Measuring the performance of Capital Works projects is a combination of unit cost and cycle time for design and construction projects as well as the life cycle cost of assets. In addition, the ability to design and build new assets within the project budget is also a performance measure.

Maintenance Services

Maintenance services relate to activities that support the maintenance of facility assets. Maintenance is defined to be any activities that maintain or extend the life of the asset. Maintenance cost could be considered the fixed costs of owning the asset. Major upgrades and improvements to a resource would be covered as part of the Capital Works Services. Typical activities for maintenance services include repairing and maintaining the resources.

Typical Performance Measures

Measuring the performance of Maintenance Services is a combination of unit cost, throughput and meeting service level expectations.

Operations Services

Operations services are composed of activities that relate to operating a resource or service. Many facility services are operational in nature, such as Field Services. To differentiate from Maintenance Services, Operations Services could be stopped at any point if the organization decides not to provide a program (e.g., Water Distribution). However, the Maintenance Services would not fully disappear. Certain Maintenance Services would still be performed to protect the facility assets (e.g., annual risk inspections). Operational activities do not increase the asset value, nor extend the life of the asset.

Typical Performance Measures

Measuring the performance of Operations Services is a combination of unit cost, throughput and meeting service level expectations.

Performance Management

A service provider / asset manager can implement performance management as a means of managing operations and rewarding management and staff for meeting annual goals and objectives.

Description

Performance Management is a management system used to manage and evaluate management and staff's performance against stated goals and objectives. Goals and objectives can be identified annually, with bonuses paid to exempt staff based upon meeting and/or exceeding these identified goals and objectives.

The proposed Service Delivery Framework includes links to an organization's performance management system. Within the framework, annual objectives can be defined for each service and the associated activities. These annual objectives need not be limited to staff. Performance goals can also be included in contracts with external service providers.

Accountability for performance is linked to accountability for budgets and resource management. To meet the annual goals and objectives, a manager or foreman must have budget accountability.

Accountability Definition

To be held accountable for stated annual goals and objectives defined within a Performance Management system, an employee must have the authority and responsibility to act. Operational and fiscal accountability have been defined as having:

- The responsibility to provide the defined level of service within the allocated budget and/or profitability targets. The responsible employee must report and explain all budget variances.
- The authority to redeploy budget funds between services and activities while ensuring that service levels are maintained. The responsible employee must report and explain all service level variances.
- The authority to set work and resource schedules while following existing policies and labour contracts, WCB and Legislative requirements.
- The authority to purchase goods and services based upon an organization's purchasing policies.
- Optionally, the authority to define the service delivery mix (e.g., contracting out versus hiring additional staff).

Within the organization, accountability rolls up within the various management ranks. Ultimately, the General Manager of the department is accountable for ensuring that the levels of service are provided within the allocated budgets and that all policies are followed.

Performance Measures

As part of Performance Management, goals and objectives need to be expressed in quantitative terms. These terms are defined as service and activity performance measures. Performance measures for Work Management have been defined in the following terms:

Unit Cost - measures the cost of providing a service or performing an activity based on the relative units of measure. For instance, the Water Distribution service is measured as the cost to distribute a cubic metre of water. Similarly, the main line flushing activity is measured as the cost to flush a metre of main line.

Throughput - measures the amount of work units accomplished in a given period of time. Throughput is usually measured in years given that an organization usually budgets annually.

Quality - measures the effectiveness of the service. Quality measures are usually subjective analysis based on customer complaints or system operation. For instance, colour and taste measure water quality based upon subjective analysis from customers. Also, system operations measures include the number of floods, the water pressure and the down time. These indicators are affected by many factors such as system design, maintenance and operations.

Service Level - measures the efficiency and effectiveness of the service or activity based upon a predefined set of performance targets. The performance targets are set based upon defined turnaround times, response times or frequency of performing a service or activity.

Each service can have all four measures associated with it. The service level definition will be defined in more detail than the other performance measures. A more detailed definition of service levels is provided below. Appendix B contains initial descriptions of service levels for an organization's programs and services.

Service Levels

A service level is composed of:

- The set of activities performed to provide the service.
- An explanation describing why each activity is performed.
- The frequency and/or turnaround time for performing the set of activities.

For each service and the associated group of activities, five levels have been defined. The five levels are described in Table 3 Service Level Types. While an infinite number of combinations are

possible for the various activities within a service, the options have initially been limited to five. Table 3 describes the types of activities within each service and the primary measurement.

Table 3 Service Level Types

Service Level Type	Description
A	This level of service would be classified as the premium level of service provided by a critical infrastructure provider without being unrealistic in providing the services.
B	A level of service which is better than the basic service but not the best that a critical infrastructure provider could deliver. Turn-around time, quality and cost are higher than service level C.
C	This is the level of service provided by an organisation where premature asset replacement is minimized. It is a good compromise between premium service and substandard service.
D	A level of service where response time decreases and where asset maintenance and operational activities will compromise the functionality of assets. This level of service will result in premature asset replacement but not to the same degree as service level E.
E	This service level is defined as the minimum an organization needs to do to provide the service. For resource management this equates to the minimum level to maintain assets in a safe working order. This level of service will usually result in premature asset replacement. Management will not recommend this level of service, however, due to budget constraints, resources may be serviced at this level.

Costing Model

Principles

The principles followed to develop a costing model for an organization are listed below. The Costing Model should be:

1. Simple and easy to use.

2. Flexible to allow for organizational changes and still has budgets reflect operating costs.
3. Based on a building block model to allow the calculation of service costs and job costs when necessary without the complexity of allocating all costs on a transaction by transaction basis.
4. Applicable to the whole organization. When departments are talking about costs, everybody is talking the same language.

Costing Model

Table 4 Costing Model defines the cost elements included in each expenditure type. All cost elements have been defined, however, the job costing system (Maximo) will only contain the activity cost elements.

Activity Costing

For charging costs to each activity, a rate will be calculated for each component of labour, equipment, materials and contracts. The rate, however, will only include the base costs and the direct overheads as depicted in the diagram by the first bold line. Annually, a rate will be calculated and used for budgeting purposes and job costing. The rules for each calculation are described below.

Labour Rate

The labour rate will include the direct employee or contractor charge plus a % allocation for the section administration associated with the employee. Rates will be created for each major job classification using a weighted average, not for each specific employee. The rates will be set annually and will be used for budgeting and job cost tracking.

Equipment Rate

The equipment rate will include the direct equipment costs for maintenance and operations based upon a forecasted utilization of each equipment class plus a % allocation for fleet administration and the equipment scheduling functions. Rates will be created for each major equipment classification not for each specific piece of equipment. The rates will be set annually and will be used for budgeting and job cost tracking.

Materials Rate

Materials are charged to jobs as they are consumed. Material rates will include the actual cost of the goods plus the taxes and freight. All materials charged to a job will also include a direct overhead % allocation which reflects the inventory carry costs incurred by a critical infrastructure provider. The rationale is to ensure that using inventory materials is the same as using a new purchase.

Contract Rate

Contract rates may be for units produced, fixed price to do a job or for the time and materials to provide the service. Where possible, an organization should track the time and materials for each contract. This does not mean, however, that a city will only issue time and material contracts. Instead, an organization should see the invoices for services itemized. For each contract job, a % allocation for section administration will be added. This will cover the costs of administering the contract including inspecting performance.

Table 4 Costing Model

		Cost Categories	Labour	Equipment	Materials	Contracts
		Cost Elements				
Activity/Job Costs	Base Cost	Wages and Benefits Contract Rate	Maintenance Costs Operating Costs Contract Rate	Material Cost Taxes Freight/Ship Loading	Contract Rates	
	Direct Overheads	Section Administration	Amortization Fleet Mgmt. Garage	Inventory Carrying Costs	Section Administration Inspections	
Cost of Service	Indirect Overheads • Administration	Division Administration Department Administration	Division Administration Department Administration	Division Administration Department Administration	Division Administration Department Administration	
	Indirect Overheads • Support Services	Information Technology Facilities	Information Technology Facilities	Information Technology Facilities	Information Technology Facilities	
External Billing Components	General and Administrative	Legal Human Resources Finance	Legal Human Resources Finance	Legal Human Resources Finance	Legal Human Resources Finance	
	Profit Margin	% added as required for billing	% added as required for billing	% added as required for billing	% added as required for billing	