Canadian Gas Association
Asset Management Taskforce
Guiding Document on Asset Management

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1.0 Introduction to Asset Management

The Canadian Gas Delivery business, which includes distribution and transmission companies, is an asset intensive industry. It requires substantial capital investments resulting in the creation of significant physical assets with long life cycles. It would be fair to say that Canadian Gas Delivery companies, some of which have been in existence for over 150 years, have been engaged in the practice of asset management for a long time. Therefore, it is important to clarify at the outset that the use of the term “asset management” in this guiding document refers to a comprehensive and strategic application of a set of concepts, techniques, and tools that, when adopted and used effectively, can enhance a company's current management of its assets.

Asset intensive industries such as aerospace, defense, oil and gas refineries, roads, bridges, railway works, and other utilities have been developing this asset management discipline since the late 1970s. In particular, Australia, New Zealand, and the UK have been leaders in the advancement and implementation of asset management, treating it as a holistic approach that considers the whole business and the whole asset over the long term. In more recent years, asset management has gained increasing attention among North American transportation/municipal infrastructure managers and electric and gas utilities.

1.1 Background

In early 2007, the Standing Committee on Operations (SCO) of the Canadian Gas Association (CGA) formed the Asset Management Task Force with a three year mandate to study and make recommendations with respect to the application of asset management best practices to the Canadian Gas Delivery industry.

The rationale for taking on this work was based on the current environment being one of changing regulations, increased scrutiny on costs, heightened awareness of the legal ramifications of not meeting stakeholder expectations, and the need to ensure that member companies focus their attention on how they maintain their assets. An effective gas delivery business relies on a broad variety of assets to achieve corporate strategic objectives. Optimal management of those assets is dependent on an optimized balance between asset performance, business risk, and expenditures.

Given this environment, the industry needs to collaborate on shaping asset management in order to meet the needs for public safety, reducing costs, developing process improvements through best practices, and reducing regulatory risks.

This guiding document is the culmination of the Asset Management Task Force's efforts to fulfill the SCO’s mandate. Its objectives are to present a shared understanding of asset management and its relevance to the Canadian Gas Delivery industry and to provide practical recommendations for implementing asset management within member companies.

Applicable standards and local regulation may mandate requirements in excess of this document.

NOTE: Subsequent to the publishing of these Asset Management Guidelines, the CGA Asset Management TF, at the request of the Standing Committee on Operations, has also produced two additional documents/tools for use in assisting with integrity management programs & the consideration of Asset Management for the natural gas delivery industry:

• Asset Management Self-Assessment Tool
• Asset Management Database (confidential; for use by CGA members only)

For CGA member access to either, please contact the Canadian Gas Association Operations Group.
1.2 Definition of Asset Management

The task force gained a broad understanding of asset management from a number of reference sources, including PAS 55, a “Publicly Available Specification” published by the British Standards Institution (BSI). This specification was developed by a committee of the Institute of Asset Management (IAM) with consultation from various industries, government departments, and regulators. It outlines a management system for the optimized management of physical infrastructure assets.

Based on these reference sources, the task force has developed the following common definition of asset management as it pertains to the Canadian Gas Delivery industry:

“Asset management is a strategic management system used to optimally manage assets over their life cycle by balancing performance, risk, and expenditures to achieve corporate strategic objectives.”

The following high level concepts are intended to further clarify this definition:

Strategic management system
- Is a set of interrelated processes and controls designed to produce a significant result
- Includes the concepts of policy, planning, implementation, monitoring, evaluation, review, and continuous improvement with the focus on balancing performance, risk, and expenditures

Optimally manage assets
- Refers to critical capital assets that have a direct and significant impact on achieving corporate objectives
- Includes fixed, physical, and capital assets (e.g., pipeline system, buildings, and fleet)
- Includes planning, design, procurement, construction, operating and maintaining and decommissioning

Performance
- Includes developing an understanding of assets in terms of condition and performance

Risk
- Includes a consistent approach to risk identification and evaluation to support decision making
- Includes understanding risk tolerance

Expenditures
- Includes the concept of maximizing life cycle value
- Includes O&M and capital expenditures

Corporate strategic objectives
- Includes the concept of aligning asset-related decisions with corporate strategic objectives
1.3 Objective of an Asset Management System

The primary objective of an asset management system is to maximize the lifetime value of a corporation’s assets in a way that is consistent with its strategic objectives.

To achieve this, asset management:

- Links the asset-related cost, risk, and performance decisions to the corporation’s strategic objectives
- Provides a platform to more effectively utilize information to achieve the most value from assets while operating in a safe, sustainable manner
- Ties risk-based decision making to financial and other performance objectives

Further, asset management has the potential to integrate a company’s existing management systems, such as Integrity, Measurement Accreditation, Environmental Health and Safety, Quality, and Safety & Loss.

The Canadian Gas Association should view asset management as a strategic response to the challenges that the industry is facing. These challenges include:

- Increased scrutiny on financial results due to strategic business drivers and the move from cost-of-service regulation to incentive regulation in some jurisdictions
- Expectations on risk-based decision making
- Increased expectations on the implementation of management systems in our organizations
- A continuing focus on operational excellence strategies
- A need to reduce costs without impacting safety and reliability
- Gas supply challenges driving a different look at expenditures (e.g., challenges with mitigating volatility in commodity pricing and the need to look at non-traditional sources like LNG)
- Declining residential use (normalized annual consumption) impacting revenues
- Addressing justification for replacement of aging infrastructure
- The ability to demonstrate that sustainability and environmental concerns are actively considered as part of asset utilization and selection
- Achieving enhanced customer satisfaction from improved performance and control of product or service delivery to the required standards
- Pending demographic issues
1.4 Scope of the System

Asset management principles could be applied at the enterprise level. However, our research to date indicates that most completed work in this area has focused on the practical application of asset management to physical assets only, as opposed to human, financial, information, or intangible assets. In the case of the Canadian Gas Delivery industry, the focus would likely initially be on core physical assets. Further application of asset management principles could then be extended to buildings and fleet.

With respect to these physical assets, asset management deals with the entire life cycle including planning, design, procurement, construction, operating and maintaining, and decommissioning.

Asset management should be viewed as a complete management system encompassing the entire “Plan-Do-Check-Act” cycle characteristic of all management systems. This guiding document does not set out to provide a detailed description of every element of a management system as it pertains to asset management. Section 2 of the guiding document will outline in some detail the “distinguishing elements” of an asset management system. Section 3 will provide a brief outline of the other “supporting elements” that are common to all management systems.

1.5 Potential Benefits

The Task Force has identified the following potential benefits of asset management that are specific to the Canadian Gas Delivery industry:

Improved Safety and Reliability

- Having the ability to understand and optimize the health of assets and asset systems
- Minimizing the impact of aging infrastructure
- Proactively provide insight into cost/risk decisions

Improved Financial Performance

- Investment optimization
- Reduced O&M costs
- Reduced annualized cost of ownership

Improved Regulatory Relationship

- Ability to prioritize spending with consistent, repeatable, and defensible decisions
- Creating industry alignment

Improved Decision Making

- Linking the corporate values and strategic plan to the physical asset decision-making process

Ability to capture tacit knowledge from aging workforce

- Asset Health Review provides a framework for gathering tacit knowledge from field workers and Subject Matter Experts (SMEs).
1.6 Stakeholder Considerations

To be successful, any enterprise must effectively balance the short-term and long-term, and often conflicting interests of multiple stakeholders. For example, customers and regulators expect gas delivery companies to meet or exceed safety, reliability, customer service, and cost expectations. On the other hand, shareholders expect companies to generate earnings, maximize the value of assets, and ensure the long-term viability and growth of the business. Asset management provides capabilities that help to achieve the required balance by linking asset-related decisions to corporate strategic objectives.

The asset management system can also provide a useful framework for more effective communication with stakeholders. As regulators become more familiar with asset management concepts and principles, it is anticipated that they may expect companies to submit asset health assessments and asset plans as part of the explanation and justification for proposed investments and operational expenditures. Considering the significant challenge that the industry faces with aging infrastructure, asset management can help companies present their investment needs to the regulator in a clear and defensible way.
2.0 Asset Management System Distinguishing Elements

Although asset management, as a management system, shares the same “Plan-Do-Check-Act” structure of most management systems, it includes a number of key elements that distinguish it from other management systems that member companies may currently be using. This section of the guiding document presents relatively detailed descriptions of these distinguishing elements. Member companies may choose to adopt and utilize these elements to varying degrees. However, these elements are interrelated and build upon each other; therefore, the full benefit of asset management may not be realized with only partial implementation.

2.1 Asset Health Review

**Purpose:**
To establish a baseline and identify trends indicating specific issues affecting the health of the assets in order to help identify and prioritize activities that need to be performed on the assets.

**Deliverables:**
Production of a recurring report with a consolidated view of the health of the assets, and identifying issues that require action or further study.

The cornerstone of the asset management system is the Asset Health Review. Its purpose is to establish a baseline and to identify trends in the performance and condition of the assets. It may involve gathering both quantitative and qualitative information. To facilitate identification of trends in asset health, reviews should recur at an appropriate frequency.

Knowledge of asset health helps an organization understand the likelihood of asset failure, or which assets may require continued or changing levels of attention to ensure that they perform their intended function over their intended life cycle. Responses may include new or revised maintenance practices, replacement, or “do nothing” decisions. Measures of asset health may help an organization prioritize its responses, possibly on the basis of failure likelihood or the rate of change in asset health or performance over time. This information is a required input into an Asset Management Ranking Mechanism or into selected Maintenance Optimization techniques such as Reliability Centered Maintenance (RCM). Within this document, discussion on these elements of an asset management system describes how the consequences of failure may be brought into the equation to formulate effective asset management strategies.

The Asset Health Review contains the following elements:
- A decision regarding which assets to include
- A categorization of the assets into asset groups and, potentially, sub-groups
- An inventory of those assets by group and sub-group
- Metrics used to measure condition and performance of the assets
- Maintenance history
- Projected life
- An assessment of the asset’s current condition and performance
All sources of information should be mined including, design and procurement data, construction files, maintenance files, operating files, and tacit knowledge from construction, operations, and maintenance personnel. New processes may need to be developed to gather the information.

The assets need to be categorized. An example of a categorization of gas delivery plant assets into groups and sub-groups is shown below.

### Asset Categorization

| MAINS          | Polyethylene | ≤ 700 kPa | ≤ NPS 6          |
|                |              |           | NPS 6 - 16       |
|                |              | 700 < x ≤ 1900 kPa | ≤ NPS 6          |
|                |              |           | NPS 6 - 16       |
|                | Coated Steel | ≤ 700 kPa | ≤ NPS 6          |
|                |              | 700 < x ≤ 1900 kPa | > NPS 16         |
|                |              |           | ≤ NPS 6          |
|                |              |           | NPS 6 - 16       |
|                |              | > 1900 kPa | ≤ NPS 6          |
|                |              |           | NPS 6 - 16       |
|                | Other Materials | Aluminum • Bare Steel • Cast Iron • Composite • PVC • Other |

| SERVICES       | Polyethylene | ≤ 700 kPa | ≤ NPS 6          |
|                |              |           | NPS 6 - 10       |
|                |              | 700 < x ≤ 1900 kPa | ≤ NPS 6          |
|                |              |           | NPS 6 - 10       |
|                | Coated Steel | ≤ 700 kPa | ≤ NPS 6          |
|                |              | 700 < x ≤ 1900 kPa | ≤ NPS 6          |
|                |              |           | NPS 6 - 16       |
|                |              | > 1900 kPa | ≤ NPS 6          |
|                | Other Materials | Aluminum • Bare Steel • Cast Iron • Composite • PVC • Other |

| STATIONS       | District Regulator | ≤ 6000 m³/hr | Farm Tap         |
|                |                    |              | Other            |
|                |                    | > 6000 m³/hr |                  |
| Customer Stations | Diaphragm Meters 200 series and smaller | Inside Customer Premises |
|                  | Diaphragm Meters larger than 200 series | Inside Customer Premises |
|                  | Rotary Meters      | Inside Customer Premises |
|                  | Turbine Meters     | Inside Customer Premises |
|                  | Other Meters       | Inside Customer Premises |
|                  |                    | Outside Customer Premises |
Once the groupings and sub-groupings of the assets have been decided, an inventory of the assets by these groupings and sub-groupings needs to be established. Other parameters that could be considered in grouping and sub-grouping assets include material, wall thickness, pressure rating, meter capacity, regulator capacity, and age.

Metrics allow the various assets to be compared against industry and internal benchmarks and key performance indicators. They also allow a comparison between asset groups. The metrics could include such data as leaks/km, damages/km, meter seal extensions, age, mileage, and network usage. Existing industry metrics should be considered as this provides the opportunity for collaboration between departments and possibly other companies in the gas delivery industry. Examples of possible metrics that could be used to define the performance and condition of distribution assets are shown below.

### Asset Health Indices

#### PERFORMANCE HEALTH INDICES

<table>
<thead>
<tr>
<th>Cost Operating and Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reactive O&amp;M $ per km Main</td>
</tr>
<tr>
<td>Reactive O&amp;M $ per Service Line</td>
</tr>
<tr>
<td>Reactive O&amp;M $ per M&amp;R Facility</td>
</tr>
<tr>
<td>Events • 3rd Party Damages</td>
</tr>
<tr>
<td>Damages per km Main</td>
</tr>
<tr>
<td>Damages per Service Line</td>
</tr>
<tr>
<td>Damages per M&amp;R Facility</td>
</tr>
<tr>
<td>Events • Corrosion</td>
</tr>
<tr>
<td>Corrosion Shorts per km per year</td>
</tr>
<tr>
<td>% Annual Downtime per km (est.)</td>
</tr>
<tr>
<td>Corrosion Repairs per km per year</td>
</tr>
<tr>
<td>Events • Leaks</td>
</tr>
<tr>
<td>Leaks per km of Main per year</td>
</tr>
<tr>
<td>Leaks per Service Line per year</td>
</tr>
<tr>
<td>Leaks per M&amp;R Facility per year</td>
</tr>
</tbody>
</table>

#### CONDITION HEALTH INDICES

<table>
<thead>
<tr>
<th>Cost Operating and Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preventative O&amp;M $ per km Main</td>
</tr>
<tr>
<td>Preventative O&amp;M $ per Service Line</td>
</tr>
<tr>
<td>Preventative O&amp;M $ per M&amp;R Facility</td>
</tr>
<tr>
<td>Condition • Residual Life</td>
</tr>
<tr>
<td>Mains</td>
</tr>
<tr>
<td>Service Lines</td>
</tr>
<tr>
<td>M&amp;R Facilities</td>
</tr>
<tr>
<td>Events • Corrosion</td>
</tr>
<tr>
<td>Corrosion Health Rating per km</td>
</tr>
<tr>
<td>Events • Leaks</td>
</tr>
<tr>
<td>Leaks per km over multiple years</td>
</tr>
<tr>
<td>Leaks per Service over multiple years</td>
</tr>
<tr>
<td>Leaks per M&amp;R over a specified period</td>
</tr>
</tbody>
</table>

These types of measurements provide information required in making assessments and decisions about the assets, such as: fitness for purpose, remaining life, and prioritizing maintenance and replacement expenditures. They also provide the foundation for capital and maintenance optimization.
2.2 Asset Management Ranking Mechanism

**Purpose:**
To establish a methodology and supporting tools to help assess and compare capital investment opportunities based on financial, risk, and strategic considerations in order to rank these opportunities according to their total business value.

**Deliverables:**
Ranking of a project relative to other investment opportunities.

Another important component of the asset management system is the development of a mechanism to assess and rank investment opportunities. This can be a complex task as it involves objectively prioritizing the organization’s business strategy, getting consensus between stakeholders, and assessing and prioritizing competing spend requirements. In essence, this attempts to compare various investment opportunities on an “apples-to-apples” basis.

The range of techniques used to rank investment opportunities can vary from qualitative to quantitative and depends largely on the data available, ease of use, and level of understanding of employees. Whether the system is qualitative, quantitative, or somewhere in between, the important aspect is that it be disciplined and structured so as to ensure consistency.

A logical starting point is to develop a scoring criterion to evaluate and prioritize competing investment proposals. Again, this is no small task when considering how many varied projects, programs, and applications should be assessed in order to optimally allocate resources within an organization. Asset management best practices strive to objectively and systematically assess projects, programs, and applications by taking into account strategic value, financial value, and risk. Essentially, each project is assigned a value in these key areas and is ranked according to the overall score.

**Strategic Value**

Asset management attempts to link asset-related decisions to the strategic objectives of the company. Therefore, one of its fundamental primary tasks is to define and prioritize the organization’s business strategy. Once again, this can be challenging because executives from different functional areas may have distinct perspectives on which drivers are the most important to the business. The Marketing Vice President may consider “increase market share” to be the most important business driver, while the Operations Vice President may consider “reliable and safe delivery of natural gas” to be the most important. They can also often view assets as individual, stand-alone projects rather than pieces of a greater whole. It is especially important to achieve understanding and consensus because the entire organization is competing for finite resources. Fundamentally, all assets owned by the organization should contribute optimally to the business strategy.

Prioritizing the organization’s business strategy can be achieved simplistically by ranking the business strategies 1-10 or using more advanced techniques, such as a pair-wise comparison matrix that assesses each business driver against one another. Regardless of the methodology used, the important aspect is achieving consensus and understanding.

Each project, program, or application will then need to have a strategic value assigned to it so as to clearly indicate how it contributes to the overall business strategy.
Financial Value

Project financials, which are typically part of an organization’s business case requirements, summarize the project in financial terms. Every item associated with the project needs to be quantified as best as it can be known at the time of the business case development. Again, this is nothing new to member companies, but with asset management, the financials need to include full life cycle costs. It is therefore important to quantify investment dollars as well as ongoing operating costs such as maintenance, depreciation, etc., and the potential revenue generation for each project.

Finally, the information is presented in the form of financial metrics. There are many financial metrics that can be used for comparison purposes, each with advantages and disadvantages to their use. Each organization must determine which financial metrics will be used in their asset management ranking mechanism in order to provide a financial value.

Risk Value

Another aspect to be considered is the risk score for each project. In our industry, organizations mitigate risks through established policies, practices, procedures, and solid engineering principles. However, without assessing each project individually the total risk profile may not be well understood. It should be considered that even deferred projects can affect the overall risk profile that the company may be exposed to because these deferred projects may leave the company with a retained risk.

Risk is defined as a function of likelihood (i.e., how likely is it for the asset to fail) and consequence (i.e., how severe are the impacts of asset failure). There are several risk analysis tools available to determine a risk score; they range from relative risk ranking to comparison of quantitative risk estimates to established risk tolerability criteria. These can include, but are not limited to, Matrix risk ranking, Nomogram ranking, Level of Protection Analysis (LOPA), Event Tree and Fault Tree Analysis (FTA), Failure Modes and Effect Analysis (FMEA), and Quantitative Risk Assessment (QRA). For most situations a full quantitative risk assessment may not be feasible; however, a simplified risk matrix approach will normally be sufficient for relative ranking. The point is that each organization needs to develop a tool that works for it and then apply the tool consistently to all projects.

Qualitative measures of likelihood may include considering condition of the asset, effectiveness of O&M protocols, capacity and utilization, annual maintenance. A sample rating system is shown below.

<table>
<thead>
<tr>
<th>Level</th>
<th>Descriptor</th>
<th>Example detail description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>Rare</td>
<td>May occur only in exceptional circumstances</td>
</tr>
<tr>
<td>L2</td>
<td>Unlikely</td>
<td>Could occur at some time</td>
</tr>
<tr>
<td>L3</td>
<td>Possible</td>
<td>Might occur at some time</td>
</tr>
<tr>
<td>L4</td>
<td>Likely</td>
<td>Will probably occur in most circumstances</td>
</tr>
<tr>
<td>L5</td>
<td>Almost certain</td>
<td>Is expected to occur in most circumstances</td>
</tr>
</tbody>
</table>
Qualitative measures of consequence/impact may consider loss of service, effect on the environment, health and safety implications, community disruption, damage to property, loss of revenue, regulatory compliance and public image. A sample rating system is shown below.

<table>
<thead>
<tr>
<th>Level</th>
<th>Descriptor</th>
<th>Example detail description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Insignificant</td>
<td>No injuries; low financial loss</td>
</tr>
<tr>
<td>C2</td>
<td>Minor</td>
<td>First aid treatment; on-site release immediately contained; medium financial loss</td>
</tr>
<tr>
<td>C3</td>
<td>Moderate</td>
<td>Medical treatment required; on-site release contained with outside assistance; high financial loss</td>
</tr>
<tr>
<td>C4</td>
<td>Major</td>
<td>Extensive injuries; loss of production capability; off-site release with no detrimental effects; major financial loss</td>
</tr>
<tr>
<td>C5</td>
<td>Catastrophic</td>
<td>Death; toxic release off-site with detrimental effect; huge financial loss</td>
</tr>
</tbody>
</table>

By plotting its likelihood and consequence on an established matrix, each project can then be assigned a numeric risk value to be used in the overall ranking score. A sample matrix is shown below.

The higher the ranking the more critical the project and therefore the more worthy it is to receive funding. As with most tools, one size does not always fit all scenarios so it is also important to allow a management over-ride to allow for funding of projects that are considered “unrankable” or “must do” according to the risk matrix.
2.3 Capital Optimization

**Purpose:**
To provide a methodology and supporting tools to help select a set of capital investment opportunities which maximizes contribution to corporate strategic objectives while balancing performance, risk, and expenditures.

**Deliverables:**
An optimal portfolio of capital investments.

Limited funding availability and increased fiscal accountability may drive the need for Canadian Gas Delivery companies to adopt a new approach to budget decision making. An objective capital optimization methodology links decision making and action with asset information.

A key benefit of asset management comes from the ability to optimize the expenditure of capital by creating the right balance between cost, performance, and risk that is consistent with a company’s corporate strategic objectives and obligations.

**Required capital expenditures**
Some capital expenditures must be made. They are non-discretionary and receive top priority for capital funds. For various reasons, certain projects or expenditure requirements arise and are not within the purview of the company to deny or defer. These expenditures could include those required for regulatory compliance, business continuity, franchise obligations, or non-controllable third party activities such as road widening.

Where a project is approved, initiated, and funded as a multi-year expenditure, the expenditures required in subsequent years may also be considered to be in this non-discretionary category. Based on the nature of the expenditure or project, cancelling the expenditure partway through may be imprudent or have significant financial implications. Once started, expenditures in this realm should continue until completion.

**Rankable capital expenditures**
Given a suite of capital investment opportunities, decisions must be made on what will and what will not receive capital funding. The asset management ranking mechanism discussed earlier lays out objective criteria and techniques to rank investment opportunities based on parameters such as strategic value, financial value, and risk value. The ranking mechanism yields a method to develop a portfolio of capital investment opportunities based on the prioritization criteria used by the company.

With a proper, objective ranking mechanism, capital can be focused where it is best aligned with corporate objectives and can be applied to a wide range of investment opportunities. In addition to investments in plant, the ranking mechanism can assess and rank diverse capital requirements such as fleet, buildings, tools, and information technology.
Portfolio Optimization and Management

With the ability to rank projects, all capital needs can be brought together into a portfolio of projects to facilitate capital optimization and management. A portfolio can be managed by applying a limited capital pool to the highest-ranking projects, (i.e., those that deliver the greatest value based on the ranking mechanism). Funding would be applied to the highest-ranked remaining opportunities until the capital pool is exhausted.

Alternatively, a company could determine that it will support expenditures that make a certain hurdle based on the ranking criteria. The portfolio would rank opportunities, highlighting those that meet or exceed the cut-off hurdle applied. Those opportunities falling below the hurdle would not receive capital funding.

This will permit capital expenditure deferral for investment opportunities where the current determination of value for that investment falls below the value of other opportunities. The investment opportunity will be kept for subsequent re-ranking and should the situation change and the criteria applied yield a higher ranking at a later date, it will then receive capital funding.

Further, the portfolio can be divided into sub-portfolios, such as customer-related projects, system integrity projects and information technology projects, to allow a two-stage optimization process.

Each sub-portfolio could be optimized to meet specific criteria. For example, a company objective of adding 25,000 customers this year will require that capital be allocated in the customer-related sub-portfolio. Optimizing this sub-portfolio could involve considering factors such as the expected revenue and return on equity that these new customers will generate versus any capital constraints. Attempts to optimize this sub-portfolio could also focus on ensuring that unit cost per customer addition is optimized.

Other sub-portfolios could be similarly optimized. Then all sub-portfolios would be brought together and the portfolio as a whole could go through a separate stage of optimization. This portfolio optimization would look at various scenarios of return versus invested capital, and could involve trade-offs between sub-portfolios based on overall project rankings and overall capital constraints.

The portfolio is also used to maintain the ranking of projects should additional capital become available. The additional capital can then be applied next to the highest-value opportunity of those opportunities remaining.

Portfolio management provides a tool to apply objective criteria to the choice of which of many investment opportunities receive the often limited capital funding available. It reduces judgment bias traditionally associated with less rigorous capital expenditure planning.

Example of a Capital Investment Portfolio
2.4 Long-term Capital Planning

**Purpose:**
To assess the long-term capital needs of the assets to support system growth, asset replacement, and operational performance.

**Deliverables:**
A capital plan with a sufficiently long time horizon to prepare for orderly system growth and asset replacement.

Asset management values a multi-year perspective. Capital planning needs to look at not only initial capital costs, but also, through life cycle costing, future costs as well. Costs are minimized starting with the initial investment, continuing through operations and maintenance, and ending with disposal. The connections between the choice of assets and their lifecycle costs are critical. These connections require that multi-year asset plans be integrated with multi-year financial plans.

Delivery systems require capital planning for system growth, to expand the delivery system to new areas, and to connect new customers. Capital is also required for asset replacement. To maintain safe, reliable service, assets need to be replaced as they deteriorate, become obsolete, or when risk of failure becomes intolerable.

**System growth**
Multi-year capital plans are required to manage system growth. While customer energy choices, changes in the economy, and conservation efforts may reduce the load in certain areas, new customer growth will add load, requiring capital investment for customer additions and system capacity. Economic drivers can drive load changes in certain economic sectors or customer classes. This can result in load patterns that evolve over time requiring plant additions to meet the growing or shifting load patterns. As these developments typically follow multi-year trends, they require a multi-year focus and planning to provide the capital at the required level to meet these opportunities and obligations. Part of capital optimization is determining an appropriate planning horizon for system capacity planning and design.

**Asset replacement**
A multi-year plan is essential for asset replacement plans. As plant reaches the end of its serviceable life, or as materials and technologies are developed, replacement is required for continued delivery system operation or performance. Asset replacement is not a new concept for many utilities. Many years ago, several utilities replaced original wooden pipes with pipes made of cast iron. This cast iron is now being replaced with steel or plastic pipes. Some of the early plastic pipes are approaching the end of their useful life and similarly will need replacement. Other components of the delivery system, such as regulators, meters, pressure regulation stations, and compressor stations, will require replacement at some point due to equipment obsolescence, end of useful life, or changing system capacity requirements. With the vast magnitude of asset replacement needed for system renewal, a multi-year focus is vital.
Operational performance
Maintaining or improving system reliability also requires a multi-year focus. Capital expenditure planning is required for system reliability improvements to mitigate customer impacts related to potential failures of supply or flow continuity in a delivery system. This could include system reinforcements such as looping or back-feeding. Long-term planning is appropriate to address pipeline system management issues. Technology is constantly improving and operational data requirements are increasing. A multi-year approach may be required for projects that implement the acquisition of data such as pressure, flow, and operational status at facilities such as pressure regulation stations, pipelines, or individual customer delivery points.

In summary, long-term capital planning ensures that the needs of assets can be accommodated in an orderly manner, without incurring rate shocks or other negative consequences. Long-term capital requirements need to be understood so that efforts can be made to smooth out capital requirements and to ensure that regulators and other stakeholders are informed about long-term capital needs.

Example of Changing Capital Expenditures in a Capital Forecast
2.5 Life Cycle Costing

**Purpose:**
To establish a methodology and supporting tools to help assess the total life cycle costs of an asset.

**Deliverables:**
A Life Cycle Costing Model to help determine the economic life of an asset and support repair/replace and other asset-related decisions.

Life Cycle Costing looks at the total costs that may be encountered throughout an asset’s lifetime, including planning, design, procurement, construction, operating and maintaining and decommissioning.

Understanding life cycle costs provides a means to help assess a variety of asset management decisions, such as:

- Affordability/financial impact of current and proposed practices
- Source selection (supplier studies)
- Possible need for design trade-offs due to sustainment cost impacts
- Appropriate repair levels and changes over time
- Repair versus replace strategies
- Determining the economic life of an asset

A generic “Economic Life Model” is illustrated below.
Inputs to a life cycle cost analysis would typically include the following:

- Expected rate of return
- Depreciation rate
- Investment tax credit, capital cost allowance, CCA depreciation type, federal and provincial tax rates
- Inflation rates
- Unit purchase year and price
- Unit yearly total operating and maintenance costs
- Unit yearly salvage returns
- Replacement costs

As a practical example of how Life Cycle Costing can be applied to Canadian Gas Delivery assets, consider the following Life Cycle Costing Model for cathodically protected steel mains.

The model involves deriving a Total Cost curve by summing the Capital Cost curve and the O&M Cost curve for this class of assets. The Capital Cost curve would be based on factors such as initial capital costs, depreciation, and eventual abandonment costs. The O&M Cost curve would be based on all of the potential maintenance costs of sustaining the asset, such as inspection costs, cathodic protection costs, and repair costs. One of the major challenges in developing the O&M Cost curve is predicting the repair costs due to leaks over time. However, there are well-established maintenance engineering models, such as the Proportional Hazards Model (a statistical procedure for estimating the risk of equipment failure when it is subject to condition monitoring), which can be applied to this problem.

**Life Cycle Costing Model**

\[
\text{Total Cost} = \text{O&M Costs} + \text{Capital Costs}
\]
The first benefit that can be derived from the Life Cycle Costing Model is the predicted economic life of the asset. Having a better understanding of the economic life of assets is clearly useful for long-term capital planning. The Life Cycle Costing Model can also be used to provide a more rigorous basis for repair/replace decision making.

Having a better understanding of the life cycle costs of assets also highlights the significant benefit of taking appropriate measures to extend the economic life of the assets. The graph below illustrates the savings opportunity, in terms of Equivalent Annual Cost of ownership, if the life of the assets can be extended.

**Value of Extending Asset Life**

![Graph illustrating the value of extending the economic life of assets](image-url)
Another potential benefit of having a better understanding of life cycle costs is to support decision making where alternative solutions exist to a given problem. For example, when faced with spanning a river with a pipeline, alternative solutions may be available, such as a bridge crossing versus installing the pipeline under the river using directional drilling. The initial capital costs of the directional drilling option are considerably higher than the bridge crossing option. As a result, the common industry practice is to choose the bridge crossing option. However, the bridge crossing option inherently requires more maintenance over time. A better understanding of the life cycle costs of these two options might reveal that the directional drilling option is the better long-term financial choice.

**Optimizing the Cost of Ownership**

![Cumulative Life Cycle Costs: BRIDGE CROSSING vs. DIRECTIONAL DRILLING](image)
2.6 Maintenance Optimization

**Purpose:**
To establish an optimal maintenance portfolio by balancing performance, risk, and expenditures.

**Deliverables:**
Optimized maintenance tactics and maintenance intervals.

Maintenance Optimization refers to the allocation of operating and maintenance (O&M) funds in accordance with corporate strategic objectives by balancing risk, cost, and performance. To achieve this, appropriate maintenance tactics and maintenance intervals must be identified.

Different maintenance tactics may apply depending on the nature of the assets, their intended function, their failure modes, and the consequences of failure. Examples of maintenance tactics include run-to-failure, condition-based maintenance, and time-based maintenance.

Optimizing maintenance intervals involves determining the interval that minimizes the sum of proactive and reactive maintenance activities.

**Optimizing Maintenance Intervals**
As a general statement of current industry standard practice for Canadian Gas Delivery companies, it can be said that maintenance activities and frequencies are generally derived from the following sources:

- Prescriptive frequencies in regulations or adopted standards
- Industry standard practices
- Manufacturer’s recommendations
- Risk assessments, where data is available to support decisions and/or where it makes business sense to expend the effort on a risk assessment

As the field of asset management has expanded, more specific tools, methods, and concepts have been developed for the purposes of achieving specific outcomes, such as reliability centered maintenance (RCM).

RCM is an analytical process used to determine appropriate failure management strategies to ensure safe and cost-effective operation of a physical asset in a specific operating environment. Implementing a proactive maintenance program using RCM has been shown in many applications to greatly reduce the cost of ownership of an asset.

The RCM methodology develops the appropriate maintenance tactics through a thorough and rigorous decision process as shown below.

**The RCM Process**

Select Asset

Define Functions

Define Functional Failures

Identify Failure Modes & Causes

Identify Failure Effects & Consequences

Select Tactics Using RCM Logic

Implement & Refine the Maintenance Plan

Maintenance actions are performed to mitigate functional failures. A decision logic tree is used to select the appropriate maintenance tactics for the various functional failures.

The path to maintenance optimization can be through expansion of data-based and risk-based decision making. This requires collection of information from asset operation and maintenance work, analysis and measurement of asset and program performance, and continuous improvement through revised O&M plans and programs.
3.0 Asset Management System – Supporting Elements

Asset management has been consciously defined as a strategic management system, which implies a collection of distinct, ongoing, and interlinked elements that should be performed in order to fully achieve the benefits of asset management. These elements will most likely exist, in various stages of maturity, within an organization either as stand-alone programs or within the framework of other management systems. These elements should therefore be interlinked appropriately so as to address the asset management objectives and follow a “Plan-Do-Check-Act” approach that is consistent with many international management system standards.

3.1 Policy
The purpose of an asset management policy is to declare the organization’s commitment to the development and implementation of an asset management system. It will provide the vision, high level guidelines, common principles, and goals that can be communicated to all stakeholders to ensure the asset management system’s ongoing suitability, adequacy, and effectiveness. The policy should be approved and endorsed by top management.

3.2 Objectives, Targets, and Planning
The organization should define a process for developing and reviewing objectives and targets to ensure consistency with the asset management policy, vision, and goals. This will promote objectives and targets with proper documentation, communication, implementation, and periodic review. To achieve the targets adequate resources must be provided.

3.3 Document Management
Documentation of policies, practices, and procedures forms the basis for understanding the asset management system. It is foundational in assisting to describe and communicate the asset management system to others and as a basis for training, auditing, and objective setting. The extent of the required documentation depends upon the size of the organization, the complexity and interaction of the processes, and the competency of the organization’s people.
The organization should define the requirements and processes for ensuring that the asset management system and all associated documents are controlled appropriately. This includes defining how documentation is prepared, reviewed, approved, distributed, revised, and archived in a controlled manner. It is also important to define who requires the use of this documentation and ensure that it is made available at all required locations.

3.4 Records Management

A record is a special type of document that provides evidence that an activity has taken place or an event has happened. Records also provide all relevant information about an asset, such as condition, manufacturing reports, quality reports, mill reports, pressure tests, design drawings, corrosion reports, and leak reports.

The organization should define the requirements for the maintenance of records from the time they are created until their eventual disposal. This is critical because of the primary concern with respect to evidence of activities, and the extensive data requirements needed for various asset management analyses. Records can be either physical, such as paper-based drawings, test charts, bill of materials, or digital, such as GIS, databases, and emails. Records management should include establishing protocols for the identification, storage, protection, retrieval, retention, and disposition of all records.

3.5 Legal and Other Requirements

Ensuring compliance with all legal and other requirements is paramount in a regulated industry.

The organization should define the process used to identify and provide access to legal and other requirements and ensure compliance. This should include the identification of requirements, including federal, provincial, and municipal regulations; operational permits and approvals; licences and authorizations. Once identified, these requirements must be reviewed periodically to ensure continued compliance.

3.6 Risk Management

The organization should establish a means to identify, assess, control, mitigate, and establish its tolerance of risks. Managing risks will help a company operate within the established levels of tolerance. Risk Management is a systematic approach to decision making that addresses uncertainty, increases transparency, and supports due diligence while considering all stakeholders’ interests. Examples of risk include financial performance, operational performance, market share, safety, image, environment, legal compliance, and regulatory compliance.

Understanding, assessing, and managing risks and aligning them to strategic values will help an organization optimize its decisions.
3.7 Training and Competency
Having competent personnel at all levels of the organization is critical to meet the goals of the asset management system. It is essential that the organization ensures the competency of personnel, including employees and agents of the company, with critical asset management tasks and processes. Competence should be based on appropriate education, training, skills, and experience. The determination of the necessary competence required, the assessment of competence, the action necessary to address competency gaps, and the evaluation of the effectiveness of actions to close competency gaps are all key components that must be addressed. Guidance for competency assessment can be found in the CGA Competency Assessment Plan (CAP) November, 2007.

The organization should ensure that training needs for all critical roles are identified and competency assessed for those performing these functions.

3.8 Performance Evaluation and Audit
The organization should determine the processes required to achieve the asset management goals and ensure that the necessary performance evaluation, including monitoring, measuring and analysis, is done. The intent is to identify trends and factors for continual improvement. In addition to performance evaluations, the organization should conduct internal audits at planned intervals to determine whether the management system conforms to plans and is being effectively implemented and maintained. Audit results should be documented and reviewed at the appropriate level of management to ensure follow-up and continual improvement.

3.9 Communication
Communication is key to the successful implementation and understanding of the asset management system. The organization should develop a communication plan that defines the key requirements, responsibilities, and methods for communicating information to internal and external stakeholders.

3.10 Management Review
Management review of the asset management system is the responsibility of top management and must identify opportunities to improve the system and its processes.

The organization should define the process by which top management will periodically review the management system to ensure its continuing suitability, adequacy, and effectiveness. The review should address the potential need for changes to policy and objectives based on results of audits, changing circumstances, and the commitment to continual improvement.

3.11 Management of Change
The organization should define the methods for managing the implementation of a change and accounting for how the decision to make the change was reached. This should include, at a minimum, a decision-making process, documentation, and an approval process. It must ensure that critical aspects are properly considered prior to implementing a change within the asset management system. Changes typically pertain to plant and facilities, procedures, materials, construction, operations, equipment, information technology, and organizational changes. Asset-related changes are a particular concern within asset management.
4.0 Implementation Considerations

In planning the implementation of an asset management system, there are a number of issues that need to be considered to help ensure success. This section highlights a number of these issues.

4.1 Management Commitment and Governance

Effective implementation of an asset management system requires an environment of organizational buy-in and culture change. This environment, at a minimum, requires the commitment of the company’s top management. Without such commitment, it will be difficult to achieve employee buy-in and empowerment, leading ultimately to failure in the implementation of the organization’s asset management objectives. Commitment to an organization’s asset management objectives can be supported by its top management by:

- Appointing a member of the Executive to act as a Sponsor to the organization’s asset management initiatives
- Ensuring the company’s asset management policy is consistent with the organization’s overall and long-term objectives
- Communicating to the organization the overall asset management objectives through a defined communication plan

In addition to having top management commitment, it is important to ensure decision-making accountabilities are clear. To accomplish this, roles, responsibilities and authorities need to be defined, documented, and communicated to individuals across the organization. This should include assigning responsibility for the various assets to member(s) of management. These assignments will include the necessary authority to ensure the strategic asset management objectives set for the various assets are achieved.

At the same time, corporate governance needs to be addressed by ensuring the consistency, viability, and continuity of the company’s asset management plan as compared to its overall corporate goals and policies. This can be accomplished by a review of existing and proposed process and policy, then the establishment and maintenance of an organizational structure of roles, responsibilities and authorities.

4.2 Organizational Structure

For a Canadian Gas Delivery company to successfully implement an asset management system, consideration must be given to the company’s organizational structure. While there is a certain freedom and flexibility as to the levels and/or elements of an asset management system that a company may choose to implement, certain organizational structures may help optimize the process.

It should be noted that organizational structure changes may not be required, provided the company’s existing organizational structure aligns with the organization’s asset management objectives. However, because an asset management system involves many functions within an organization, one of the most challenging aspects of implementing an effective system may be organizing the people involved. An effective organizational structure will help focus the functions, relationships, responsibilities,
authorities, and communications of the staff within the company. While organizational change is not a prerequisite for implementing an asset management system, it is important that the company understands the implications, benefits, and challenges of how different organizational structures will relate to asset management. There are many different types of organizational structures, and for simplification only three types of organizational structures will be discussed. The three structures to be considered are: Functional, Divisional, and Asset Owner/Asset Manager/Service Provider.

Functional structures organize employees based upon the functions of specific tasks within the organization. Typically, functional organizational structures are utilized in small, geographically-centralized companies. The benefits of a functional structure when trying to implement an asset management system are:

- Centralizes decision making
- Avoids duplication of processes and activities
- Develops a strong core of technical knowledge

Some of the challenges that may be faced when implementing an asset management system in a functionally structured organization are:

- Groups tend to focus on individual tasks and not on overall goals
- Difficult to coordinate activities between various task groups
- May experience restrictions in decision making

Divisional structures can typically be divided into three classes: product, market, and geographic. Based on the nature of the Canadian Gas Delivery Industry, only geographic structures will be considered in this document. Geographic structures organize employees based upon their specific geographic location. Typically, geographic-divisional organizational structures are utilized in large, geographically dispersed companies. The benefits of a geographic-divisional structure when trying to implement an asset management system are:

- Decision making can be streamlined at the operational level
- Accountability is improved as each work group is directly responsible for their group’s performance.
- Improves coordination of tasks between various asset classes/groups

Some of the challenges that may be faced when implementing an asset management system in a geographic-divisional structured organization are:

- Difficult to coordinate entire asset class decision making
- Difficult to evaluate risks between various asset classes
- Hard to allocate corporate staff support
- Culture change may be difficult to implement
- Loses some economies of scale
- Fosters rivalry among divisions
An Asset Owner/Asset Manager/Service Provider organizational structure leads to a company becoming more asset-centric. Under this model, a separation between asset-related decision making and work execution is made. This leads to a culture of asset-driven decision and investment activities. With this organizational structure, the complexity of managing assets is clarified by dividing responsibilities among the Asset Owner, Asset Manager, and Service Provider.

Under this structure, the Asset Owner is the group that sets an organization’s business values, risk tolerance level, corporate strategy, corporate structure, and financial and operational performance targets. In this role, the Asset Owner would address the areas of:

- Governance
- Finance
- Regulatory Management
- Business Planning

Taking guidance from the Asset Owner, the Asset Manager is the group that formulates asset strategies and decisions along with optimizing asset value in line with Asset Owner objectives. In this role, the Asset Manager is accountable for:

- Clearly defining asset strategies
- Procurement
- Project management
- Economic decision making
- Ensuring asset performance and integrity
- Performance analysis
- Financial analysis
- Risk management
- Implementation strategies and policies

The relationship of the Asset Manager to the Service Provider is to provide technical support and convey decisions regarding the building, operation, maintenance, and replacement of the assets. The Service Provider is the group that accomplishes the front line execution of the Asset Manager’s plan and day-to-day operation of the assets. In this role, the Service Provider group would:

- Manage the scheduling of resources
- Monitor asset performance
- Acquire resources
- Continually improve performance
- Provide continuous support to the operation and repair of the assets in the company’s system
- Meet defined service levels
- Provide asset performance feedback and data
The benefits that may be experienced when establishing an asset management system in this type of organizational structure include:

- Specialization within groups leading to focus on specific capabilities and responsibilities
- Improved understanding of the impact of spending on asset condition by geographic area and asset type
- Increased capital efficiency
- Defensible investment decisions
- Improved customer service and regulatory compliance
- Reduced maintenance costs
- Increased clarity on roles and responsibilities
- Improved risk management understanding and implementation

Some of the challenges that may be faced when implementing an asset management system in conjunction with an Asset Owner/Asset Manager/Service Provider structured organization include:

- Ensuring alignment, support, and growth of core competencies
- Loss of service provider knowledge within the Asset Manager groups over time
- Tension within the organization created by the required behavioral changes
- Initial transition and implementation costs
- Requirement of strong leadership and compelling business rationale for change
- Need for substantial data integration from previous geographic and functional work groups
- May foster a “them versus us” attitude between manager and service provider groups

4.3 Implementation Approach

In this document, asset management has been characterized as a management system comprised of a number of elements. Implementing these elements requires the development of new processes and supporting tools and enhanced corporate competencies. The implementation of asset management can also involve implementing a new organizational structure such as the Asset Owner/Asset Manager/Service Provider model.

One way to approach implementing elements of asset management is to take a building block approach. Asset Health Review is a logical place to start. Once this is in place, an organization can progress to the Asset Management Ranking Mechanism, then to Capital Optimization, and so on. This approach would also make sense if a member company is unsure about adopting a full asset management system and is only interested in tackling certain elements of asset management to start.

One of the challenges for member companies is determining how to adapt asset management concepts to their particular situation. For example, in implementing a formal Asset Health Review process many decisions must be considered, such as:

- How should the assets be grouped?
- What health indices are appropriate for each asset grouping?
- What existing reports can be incorporated into the review?
Given the nature of the task, a “learning by doing” approach can work well. In one example, a member company formed a small core team to learn about asset management concepts and do the initial ground work to determine how each concept could be implemented in their company. This team then engaged the business department that would eventually own the new process, transferred the knowledge they had gained to the appropriate members of the department, and facilitated the first application of the new process. The business department then took custody of the new process and worked to refine and improve the process, while the core team moved on to tackle the next asset management element.

An alternate approach to implementing asset management could be through structural changes within the organization to promote and facilitate an asset management focus. These structural changes could include the creation of organizational positions with accountability for some or all asset management system elements. As an example, accountability could be assigned for maintenance optimization for a selected asset or group of assets. To meet objectives, processes would need to be developed, requirements for data would need to be set, and systems would need to be specified to improve the ability to optimize maintenance. Accountability should include control over planning and budget for the assets in question.

Regardless of the implementation approach, it should be noted that structural changes alone or asset management system elements alone may not be sufficient. Implementing a successful asset management system will inevitably involve both system elements and organizational structure considerations.

4.4 Asset Management Information System (AMIS)

Successful implementation of an asset management system requires the collection and integration of asset data. Companies may have a variety of paper-based or computer applications managed by individual departments to satisfy the corporate objectives and goals in their respective areas of operation. Data integration from these various paper-based or computer applications is a particularly important consideration. The concept of an AMIS is to have the appropriate system or combination of systems to automate the collection, integration, and organization of asset data for improved decision making.

An AMIS needs to have the capability to support the asset management system. In particular, it needs to have the capability to support the distinguishing elements outlined in section 2 of this document. The core components of an AMIS would include:

- Asset Registry (asset information)
- Work History Collection (work orders) – see “what data to collect”
- Proactive Maintenance management
- Reporting ability
An AMIS is an essential tool to collect and organize data into useful information and to gain knowledge that can be used to more effectively manage assets. As such it could be integrated with other sources of information such as:

- Standards (job plans, safe work procedures, repair procedures, emergency response plans, etc.)
- Risk analysis
- Planning and scheduling
- Inventory/Material management
- Human Resource management
- Billing
- Accounting/Financial
- GIS
- Meter Management
- CAD (drafting)
- Mobile Dispatching
- Incident Tracking
- Contract Management
- Service Management
- Procurement Management
- Metrics or Key Performance Indicators
- Data Analysis and Graphing

4.5 Work Management

Work Management, the process by which a company actually performs work on its assets, can be considered an integral part of the asset management system. The scope of this guiding document does not cover a detailed discussion of Work Management. Also, most member companies already have some form of Work Management in place. Therefore, this guiding document will only highlight the important supporting role of Work Management in the asset management system.

Work Management usually includes six key components: work identification, planning, scheduling, assignment or dispatching, execution, and completion. A work management system generally uses work orders to manage the various work activities and to gather data regarding the cost and other details of the completed activities. The job instructions on the work orders should be aligned to the company's standard practices, providing consistent and safe work procedures. The data collection should be aligned to support the information needs of the asset management system. Asset management techniques like life cycle cost analysis and maintenance optimization set the strategies used to optimally manage distribution assets. Work management supports the planning and execution of these strategies.
4.6 Supply Chain Management

Supply chain management, which includes components such as inventory management, materials management, and the procurement process, can also be considered an integral part of the asset management system. It supports maintenance optimization by ensuring the right materials for the execution of maintenance are available when required. It contributes to optimizing the life cycle costs of assets by procuring the right assets at the beginning of the life cycle.

4.7 Use/Relevance of PAS 55 During Implementation of Asset Management

One approach for the development of an asset management system in our industry is to use the model established in the British Standards Institute’s publicly available specification, PAS 55. While this specification was devised to meet the needs of a number of asset intensive industries, its original application began in deregulated water and wastewater utilities in the UK to ensure that water assets were being managed in a way that served and protected the public interest as well as the interests of private shareholders. However, it contains many useful elements that are applicable to any organization that manages large physical assets. PAS 55 is currently being used in other industries.

PAS 55 provides one possible framework for an asset management system, however its wholesale adoption, in its entirety, to the Canadian Gas Delivery industry may not be appropriate. Each organization would need to assess the elements, incorporate their company’s nomenclature and culture, and determine what level of adoption is appropriate.

We recognize that PAS 55 is the only known published specification for the optimized management of physical assets and is, therefore, an important reference source. This guiding document is our attempt to interpret the intent of PAS 55 for the Canadian Gas Delivery Industry.
5.0 Relationship of Asset Management to CSA Z662-07

Overview of CSA Z662-07

The CSA Z662 Standard for Oil and Gas Pipeline Systems is the governing standard for gas pipelines in Canada. It specifies the accepted practices, technical requirements, and terminologies for pipelines and has been developed by a committee of interested experts.

The objective of the CSA Z662-07 is safety. It specifies the essential requirements and minimum technical standards for the design, construction, operation, and maintenance of pipeline systems. CSA Z662-07 Commentary, section 0.1 states that “CSA Z662-07 presents a collection of requirements for oil and gas pipeline systems to describe what has been accepted as good practice from the standpoint of safety.”

A significant majority of the content of CSA Z662-07 contains specific technical criteria specifying what an operating company shall do. These can be design criteria, testing parameters, materials requirements, welding requirements, corrosion protection requirements, or other such technical requirements. Operating companies can measure their pipelines, facilities, or practices against these requirements to assess compliance.

Over the last few years, CSA Z662-07 has begun to introduce a management system approach through a number of non-mandatory annexes.

Annex N was introduced to “provide guidelines for developing, documenting, and implementing a pipeline integrity management program to provide safe, environmentally responsible, and reliable service.” While the wording throughout refers to “a pipeline integrity management program”, the content of the Annex clearly presents a management system approach.

Annex M was introduced to “provide guidelines for enhancing the management of integrity in gas distribution systems.” There were sufficient distinct aspects to gas distribution that this parallel annex was developed with provisions suited to gas distribution. As with Annex N, this Annex M was written with a management system approach.

Also, a new clause (10.2) and a new accompanying non-mandatory annex (Annex A) were added, introducing requirements for a Safety and Loss Management System. Although the entire CSA Z662-07 is a collection of requirements to describe what has been accepted as good practice from the standpoint of safety, previous editions of the Standard offered very little on the subject of safety and loss management systems. Although not explicitly stated in section 10, the CSA Z662-07 Commentary clarifies the intent that the principles of the safety and loss management system should also apply to the entire main body of the Standard. Some jurisdictions have now made these annexes mandatory.

Recognizing that there is duplication and overlap with these three annexes, the Technical Committee of CSA Z662-07 is endeavouring to amalgamate or restructure them. While at this time this work is in progress and the final result of this effort is yet to be determined, it is anticipated that the requirement for a management system for Safety and Loss and also Integrity will remain in CSA Z662-07.
Management System Common Elements
There is no singular definition of what comprises a management system. While general similarities often exist, management systems are tailored to the subject that they are intended to manage. This is the case with asset management, and it is also the case with the management system requirements stipulated in Annex A, M and N of CSA Z662-07. As such, a definitive list of the elements or components of a management system does not exist.

Section 3 of this guiding document presents elements and policies that support asset management. These elements can be found in many management systems. Examples of similarities to requirements found in CSA Z662-07 are outlined below.

Documentation Policy / Process:
Similar to Records above, documentation is core to any management system (CSA Z662 Annex A - A.3.3 Documents and records & A.3.3.2 Control of documents).

Records:
While there will be differences in some required records and similarities or overlap of other records, the record keeping structure and requirements are common (CSA Z662-07 Annex A - A.3.3 Documents and records & A.3.3.3 Control of records).

Management of Change:
Processes for the Management of Change are a common element to management systems (CSA Z662-07 Annex A - A.3.4 Management of change).

Training:
Although the training topics and curriculum requirements of a management system are designed for that particular system, the requirements of training and competency are commonly found in different management systems (CSA Z662-07 Annex A - A.5.2.1 Training and competency).

Risk Management:
Risk management is found in Annex A, and is a major part of the Integrity annexes, M and N (CSA Z662-07 Annex A - A.6.3 Risk management).

Measurement System / Performance Metrics:
The concept of monitoring and measuring is common to management systems (CSA Z662-07 Annex A - A.7 Continual improvement).
Distinguishing Elements of Asset Management

In Section 2, the key elements that distinguish asset management from other management systems were identified and described. The CSA Z662-07 content that relates to these asset management distinguishing elements is explored below.

Asset Health Review:
The CSA Z662-07 does not require, acknowledge, or mention Asset Health Review as it is understood in terms of an asset management system. While an Asset Health Review is not required, conducting one is in no way contrary to CSA Z662-07 and would be in keeping with parts of CSA Z662-07 if health concerns of certain components were identified.

CSA Z662-07 contains several references to the condition of the pipelines. Clause 10.14.1 requires an integrity management program for pipelines “so that they are suitable for continued service.” Elsewhere in CSA Z662-07, there are requirements for valve inspections, inspections of pressure control and pressure relieving devices, cathodic protection, and leak surveys. These activities relate to the condition and, in a broader sense, to the health of the pipeline but they are very focused and limited in scope. They address particular components of a pipeline system but not the whole pipeline, network, or corporate asset class.

Asset Management Ranking Mechanism:
The Asset Management Ranking Mechanism, being a method to assess and rank investment opportunities, is a subject matter not touched on and is outside the scope of CSA Z662-07. CSA Z662-07 can indirectly affect the ranking where one or more projects being ranked are being done to achieve compliance with CSA Z662-07. This would be but one factor that would be considered in the Asset Management Ranking Mechanism.

Capital Optimization:
The CSA Z662-07 is essentially silent on the subject of cost. The word “cost” does not appear in the main body of CSA Z662-07 and is used once in Annex A in the definition of a project. While cost is a consideration of the Technical Committee and Technical Sub-committees in their work developing and updating the CSA Z662-07, it is not carried forth in terms of a requirement in the main body of the code. Capital optimization is about spending dollars wisely while CSA Z662-07 is a technical code and does not address spending decisions.

Life Cycle Costing:
Whether addressing costs on a life cycle basis or through capital optimization, CSA Z662-07 does not have requirements for cost considerations.
Maintenance Optimization:
While CSA Z662-07 has many requirements for maintenance, cost performance in conducting that maintenance is not an issue for CSA Z662-07. Provided the minimum maintenance technical requirements are met, optimization in terms of activities, frequency, or cost is outside the purview of CSA Z662-07. The word “optimize” does not appear in CSA Z662-07.

Long-term Capital Planning:
Long-term capital planning addresses matching capital expenditures to the need for those expenditures presently and in years to come. CSA Z662-07 has no position on capital planning. The focus of CSA Z662-07 is on the technical requirements of the gas pipelines and other plant on which the capital will be spent.

Asset management is focused on balancing costs, risks, and performance, which includes meeting technical requirements. The CSA Z662-07 is focused on technical requirements and safety and, therefore, is complimentary to asset management.

The Safety and Loss Management System and the Integrity Management Program requirements of CSA Z662-07 are laid out as management systems in the annexes. Although the annexes are written to be informative and non-mandatory, the direction is clear that a management system approach is advocated. It should be noted that some jurisdictions have made the annexes mandatory.

The distinguishing elements of asset management are not included in the management systems promoted within CSA Z662-07. However, as there is commonality in several of the supporting elements, there is a synergy possible where one management system incorporating these elements would serve the needs of both.

In summary, there is no conflict between the requirements of CSA Z662-07 and asset management and there are synergies possible for several elements where a management system approach is used for both.

Relationship between Asset Management and CSA Z662 - 07
Appendices

A) Asset Management Task Force Members/Contact Information

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B) International Gas Union (IGU) - Participation

Given that utilities in countries such as the U.K. and Australia are currently more advanced in their adoption of asset management disciplines, it was decided that participation in the IGU working committee on asset management would be beneficial. Accordingly, Lloyd Chiotti, chair of the CGA Asset Management Task Force, joined Working Committee 4 (WOC 4) of the IGU in October 2008.

This committee, which focuses on the distribution sector of the gas industry, had formed a study group in 2007 to survey best practices in asset management amongst IGU member companies. The results of this work were presented at the World Gas Conference held in October 2009.

Even though participation in this committee was limited to the latter part of its work, it was very beneficial, particularly in helping to confirm the task force’s interpretation of asset management as it relates to the gas delivery business. As well, a number of papers presented at the World Gas Conference on the subject of asset management have been made available to all task force members. Finally, good contacts have been established with many gas companies around the world, which will provide an ongoing source of valuable information to the CGA.