Port of Seattle Aviation Division

Asset Management Gap Analysis Report

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Executive Summary

To address the asset management needs of the Port of Seattle Aviation Division, WSP conducted a gap analysis to identify current asset management practices and provide recommendations for improvement.

Overview

This report presents the findings of an asset management gap analysis conducted for the Port of Seattle Aviation Division (generally referred to as "the Port" in this report). Its purpose is to present observations on current asset management processes and practices in order to identify opportunities for improvements in line with good industry practices and global standards.

Asset management is the optimized lifecycle management of physical assets (fleet, facilities, and infrastructure). It is about being able to make the right decisions based on facts, to do the right work in the right place, and to spend money where it is most needed. To achieve a mature asset management program, it is important to have clear organizational asset management objectives that align key decisions as well as established asset management processes that provide consistent working practices.

Figure 1: Asset Management Eight Assessment Areas

Approach

WSP used its proprietary Asset Management Capability Assessment Model (am^2c) to conduct this assessment. The model assesses the Port's asset management practices against 267 questions that describe the broadest scope of activities (subjects) that should be considered when optimizing the management of assets. The subjects are grouped into eight assessment areas or pathways that describe specific operational processes for asset management success.

WSP held a series of interviews with over forty Port of Seattle Aviation Division staff members between March and May 2018. WSP found the Port staff to be very engaged during the process, and received additional reference material and clarification that was used in this report.

As with all management system processes, the most mature asset management processes are those that are clearly defined, applied, measured, integrated with other processes, reviewed, and continuously improved. As outlined in Table 1, the assessment in this report has awarded highest ratings (Excelling) to those aspects of the agency's management systems that meet these criteria. Processes that were absent scored lowest (Innocent). Processes that were compliant with industry good practice or the international standard for asset management (ISO-55001:2014) received a median score (Competent). Processes were assessed insofar as they contribute to an effective and mature asset management system—not whether each process is effective and mature.

Results and Key Findings

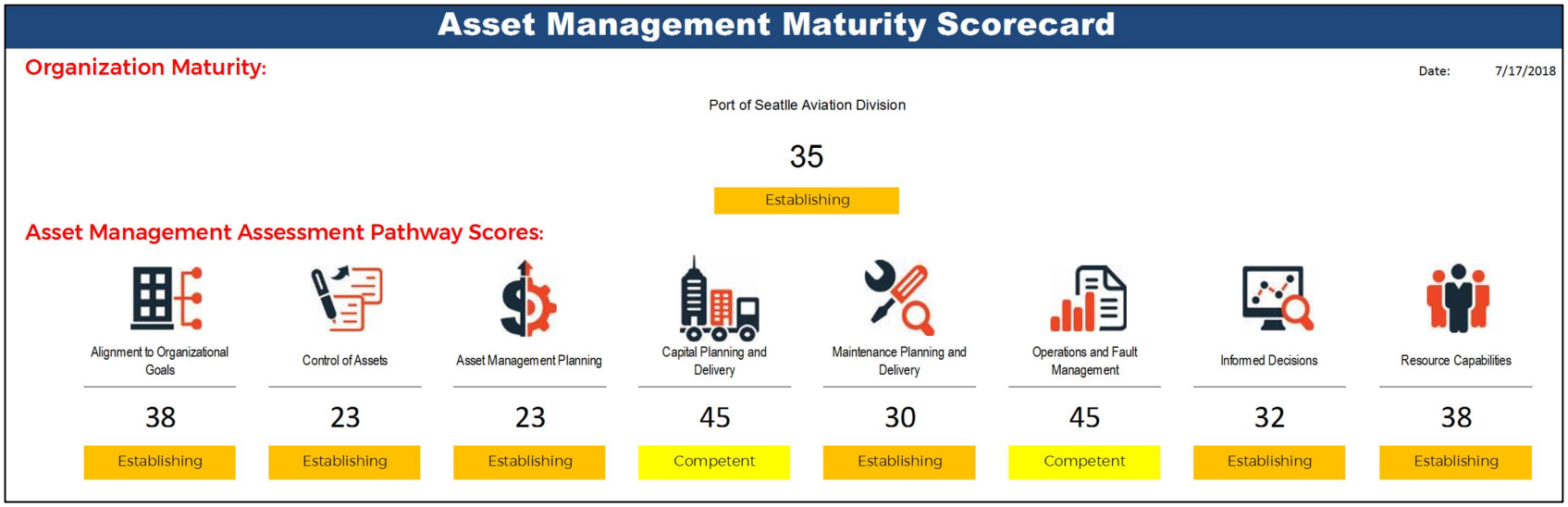
The Port of Seattle Aviation Division's asset management processes were overall scored as "Establishing". As per the grading key in Table 1, this indicates that the Port has established activities and processes in many of the assessment areas that form the overall asset management system. However, many important processes are not yet properly defined and embedded.

The overall grade and assessment area grades mask a wide variance between the maturities across and within the 31 subjects that comprise the pathways. The scores are detailed in the main body of this report along with identified recommendations, while a summary of the scores for each of the eight assessment areas are shown in Figure 2.

Table 1: Grade Description

Grade	Description
Innocent	The organization is starting to learn about the importance of Asset Management
Aware	The organization is aware of the importance of Asset Management and is starting to apply this knowledge
Establishing	The organization is developing its Asset Management activities and establishing them as business as usual
Competent	The organization's Asset Management activities are developed, embedded and are becoming effective
Effective	The organization's Asset Management activities are fully effective and are being integrated throughout the business
Excelling	The organization's Asset Management activities are fully integrated and are being continuously improved to deliver optimal whole life value

Figure 2: Asset Management Maturity Scorecard Snapshot



The majority of the eight pathways were assessed at a grade of "Establishing" for the Port of Seattle Aviation Division. Capital Planning and Delivery as well as Operations and Fault Management had the most mature grade at "Competent." While the Control of Assets and Asset Management Planning received the lowest scores, a number of improvement initiatives already are underway to address the opportunities identified in these pathways.

Next Steps

The recommendations identified in this report will be developed into a series of projects, forming the asset management improvement program for the Port. The WSP team will next prepare a project brief for each recommendation, identifying an order of magnitude cost estimate, benefits, schedule estimate, dependencies and other elements. The WSP team will then work with the Port staff to prioritize the recommendations/projects and develop an improvement roadmap. The prioritized list of projects along with schedule, cost and resource requirements will form the Port's implementation plan for asset management improvements.

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1 Introduction

This report presents the findings of an asset management gap analysis conducted for the Port of Seattle Aviation Division by WSP.

1.1 Terms of Reference

This report presents the findings of an asset management gap analysis conducted for the Port of Seattle Aviation Division (generally referred to as "the Port" in this report). It presents observations on the Port's asset management processes and practices and compares them to good industry practices to identify gaps and to present recommendations for improvement.

This report:

- Summarizes the analysis approach, including the breadth of areas considered (Section 2)
- Provides observations on current practices and an asset management maturity scorecard grouped into eight assessment areas, or pathways (Section 3)
- Summarizes recommendations and next steps (Section 4)
- Evaluates existing information system configuration and presents recommendations (Appendix A)

1.2 Document Relationship to Overall Project

This document represents the deliverable for the gap analysis (Task 2) and the information systems assessment task (Task 3) of the project. The content is based on the outputs of interviews with over forty staff members and document reviews conducted at the Port between March and May 2018. This report will support developing an implementation plan and business case for the improvement of the Port's asset management capabilities.

1.3 Next Steps

This report is the principal deliverable from the 'Gap Analysis' stage of the project. The observations and recommendations from this deliverable will be used to develop an improvement program that sets out the roadmap and projects for implementing the recommendations from this report. The list of projects along with schedule, cost and resource requirements will form the Port's implementation plan and business case for asset management improvements.

2 Gap Analysis Approach

WSP has used its industry-leading Asset Management Capability Assessment Model (am^2c) to assess, measure, evaluate, and benchmark the Port of Seattle Aviation Division's capability and support the development of an asset management improvement program.

2.1 Overview

WSP has developed an industry-leading Asset Management Capability Assessment Model (am^2c) that draws on over 20 years of experience in managing critical infrastructure. The model is mapped to global standards, industry best practices, and national industry legislative requirements.

The model provides an assessment of an organization's asset management maturity based on the degree of formality and optimization of processes and practices—from ad-hoc, to formally defined steps, to managed results, to active optimization. Its output is used to evaluate and benchmark an organization and support the development of an asset management improvement program. This approach ensures consistent and repeatable assessment and provides access to a significant global benchmark pool.

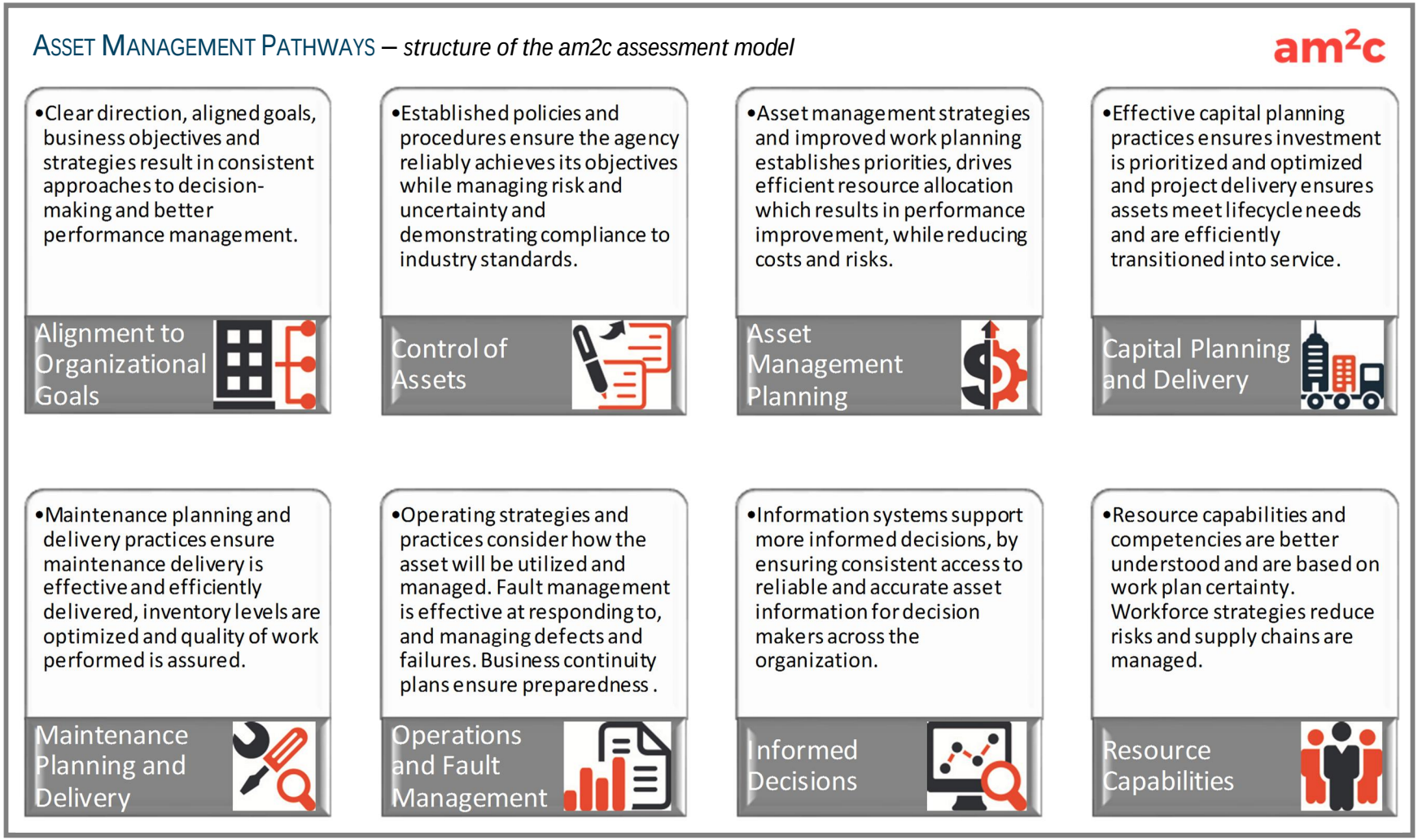
2.2 Assessment Criteria

The model assesses an organization against 267 questions that describe the broadest scope of activities (subjects) that should be considered when optimizing the management of assets. The subjects are grouped into eight assessment areas or pathways that describe specific operational processes for asset management success (Figure 2-1).

Mapped to best practice – including:

- *Requirements set out in the International Standard ISO-55001:2014 and BSI PAS-55:2008, which we were contributing authors of*
- *Recommendations in the ACHRP's Guide for Airport Asset Management*
- *Best Practice laid out in the International Infrastructure Management Manual, which we were contributing authors of*
- *The Asset Management landscape as set out by the Global Forum for Maintenance and Asset Management*
- *Requirements for risk management set out in ISO-31000:2009*
- *Reliability and Maintenance best practice states as developed by our understanding of best practice maintenance of critical assets*

Figure 2-1: Eight Assessment Pathways



2.2.1 Sources of Evidence

The questions in the assessment model are grouped into four categories, and the forms of evidence identified in Table 2.1 were typically used to support the maturity evaluation.

Table 2.1: Assessment Question Types and Evidence Sought

Type of Question	Source of Evidence
Completion: Establish whether something exists or not	Relevant documentation—processes, plans, reports, and information system content
Effectiveness: Establish how well something is carried out by the organization	Judgment or interviews
Integration: Establish how well something is integrated with other business and asset management functions	Judgment and reviews of relevant documentation
Commitment: Establish how committed the organization is and what is being done to achieve best practice	Judgement and interviews to determine how committed the organization is and whether that is enforced (documentation evidence) and reviewed (documentation evidence)

2.2.2 Port of Seattle Aviation Division Evidence

Although some documents were shared to support comments made during the workshops and meetings, much of the assessment was conducted on an observational basis based on feedback from the interviewees.

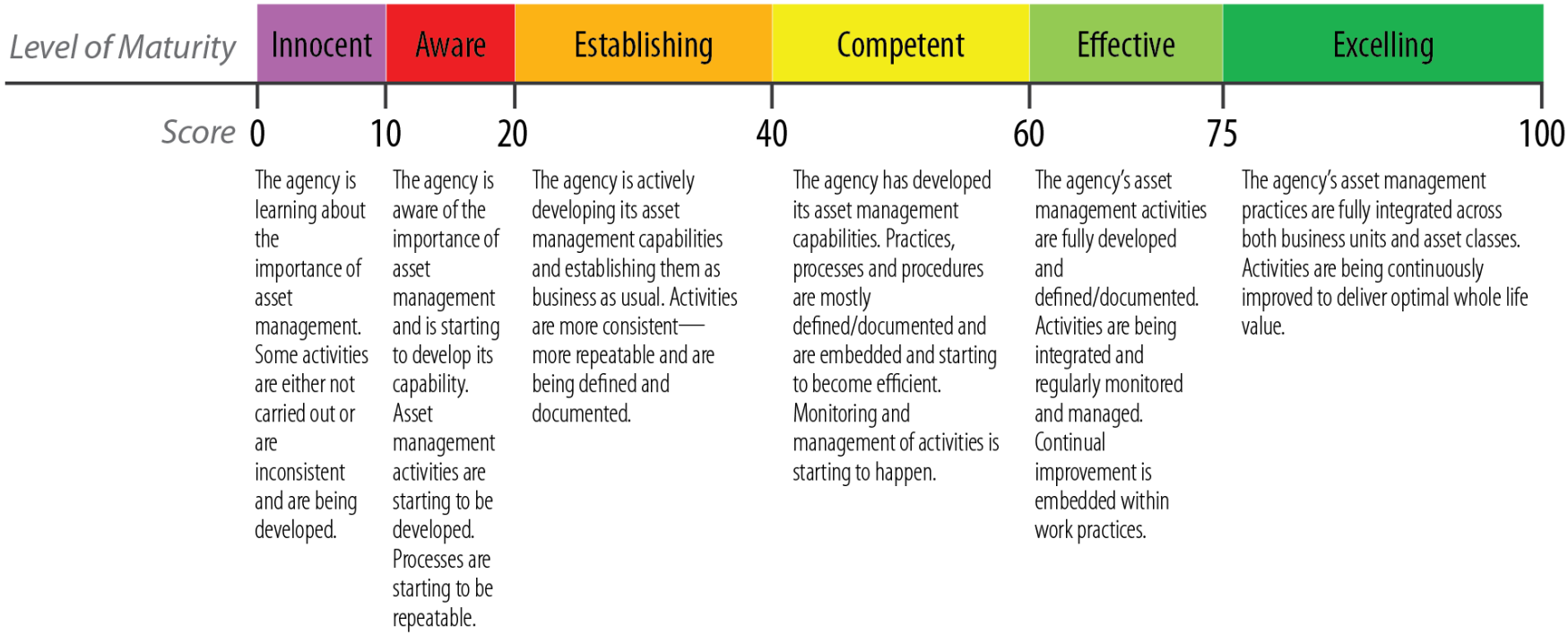
2.2.3 Scoring the Assessment

The key difference between the maturity grades is the definition and application of the processes.

WSP has used the industry standard for asset management maturity scoring from the Institute of Asset Management and the International Infrastructure Management Manual. Alignment to requirements set out in ISO-55001:2014 would be achieved at the higher end of the "competent" spectrum or higher.

The key difference between the maturity grades is the definition and application of the processes related to asset management activities. As shown in Figure 2-2, more novice agencies would score lower, principally because while they may perform asset management activities, their approaches are not always consistent, standardized, and/or not documented. As an organization develops its asset management maturity, its approach to asset management activities becomes more consistent and more repeatable. The approach can be formally defined and documented in a procedure once it is repeatable. Beyond that, agencies can manage, integrate, improve, and optimize their procedures.

Figure 2-2: Asset Management Maturity Scale



3 Gap Analysis Findings

The Port of Seattle Aviation Division's asset management processes and practices are at the ESTABLISHING level of maturity.

3.1 Summary

The Port of Seattle Aviation Division currently performs at the "Establishing" level of maturity in terms of its asset management processes and practices. Figure 3-1 shows where the Port resides on the asset management maturity spectrum and Figure 3-2 provides a detailed asset management scorecard. The Port demonstrated a clear understanding of the current and future forecast demand for services; however, the translation into requirements for assets – particularly aging infrastructure – is not clearly documented. The Port has not established strategies for managing its existing infrastructure assets. Asset class strategies would provide the necessary direction for developing asset management plans.

Figure 3-1: Port of Seattle Aviation Division Result

Further, while performance metrics are in place to monitor asset reliability and service performance, most areas reported that the metrics are not meaningful and do not support performance improvement analysis.

A key opportunity for improvement is risk management. Current practices are focused on insurance against asset loss and liability. There is no formal enterprise risk management program in place that addresses asset and asset management risk. Most areas reported having in place tactical risk approaches to prioritize workload. However, there is a need to developed enterprise-wide risk management processes that enable the capture of all asset and asset management risks to inform whole-life asset decisions.

A further key opportunity is the development of asset management plans. The general lack of asset management plans inhibits the Ports ability to justify the need for asset investment and to ensure the impact of its organization strategies and policies are adequately planned for. A challenge to developing cost optimized plans will be the lack of cost data as, in many areas, costs are not captured to sufficient granularity to support analysis. This will impact the Ports ability to undertake whole-life cost analysis in its asset management plans.

To ensure asset activities are controlled, it is important to establish standards, policies, processes and procedures. It is acknowledged

that the Port has developed and implemented a series of standards and procedures for managing different lifecycle activities – including for example design standards and asset commissioning procedures. However, it was noted that the application of these processes is inconsistent. Further, the Port needs to develop an overall management system, with integrated processes and procedures that cover all lifecycles stages and organization functions.

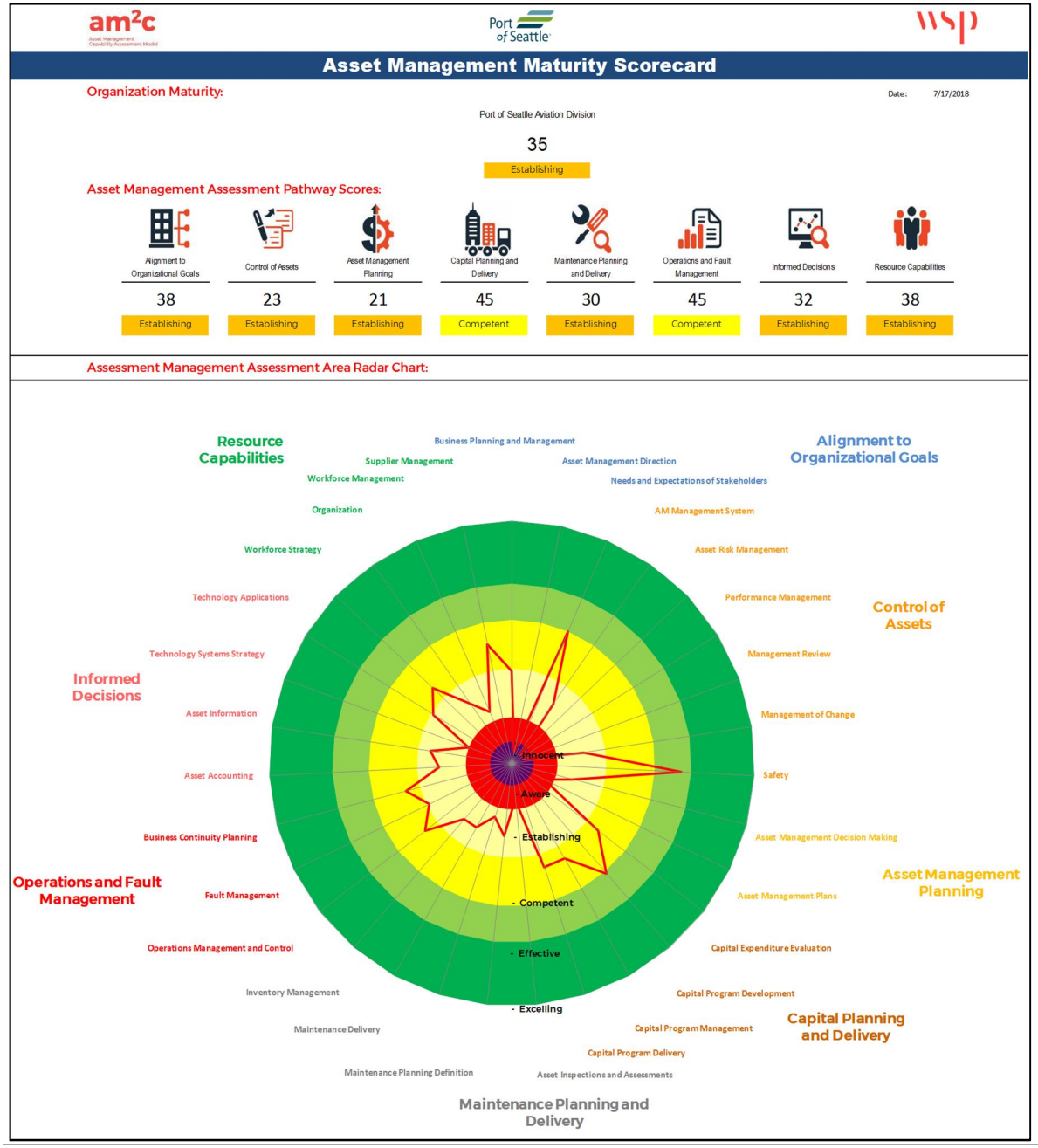
A significant issue facing the Port is poor quality information that provides analytical or management support. While the Port has invested in best-of-breed enterprise applications, the use of these systems is not consistent. In addition, there is a lack of system integration which results in manual reconciliation of data from multiple data sets which is both time consuming and introduces inaccuracies.

We repeatedly observed departments with home-grown applications, that, essentially provide collections of data to inform work activities. Without a single source of truth for assets there is a risk of inefficient and effective asset management decisions and working practices. A digital strategy should be developed to establish a path for how the application of technology and information can be used to improve the Port's performance.

Across all asset areas and departments, we observed teams that are very focused on doing everything necessary to deliver safe assets and to maintain the highest levels of reliability possible. There was some confusion between the departments regarding roles and responsibilities for asset management.

Asset management is innately integrated, so it is important that the Port thinks through how the organization should perform as a collective and work to reduce silo-mentality at every opportunity. A steering committee should be established to oversee the implementation of the recommendations in this document.

Figure 3-2: Port of Seattle Aviation Division Asset Management Scorecard



3.2 Alignment to Organizational Goals

The Port of Seattle Aviation Division is graded as ESTABLISHING in the *Alignment to Organizational Goals* assessment area.

The Alignment to Organizational Goals pathway assesses the extent to which the organization has processes and procedures in place to provide clear management direction and minimize disconnects in alignment between stakeholder needs, business goals, and the activities and decisions that contribute to asset management outcomes.

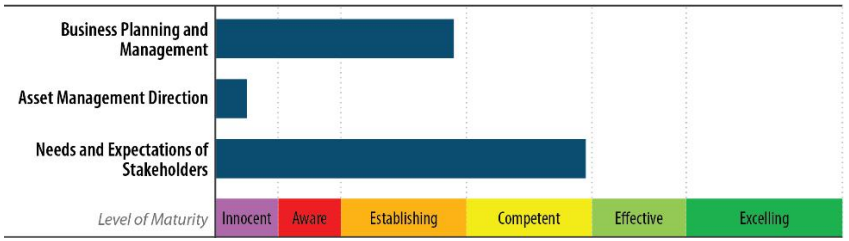
Three quality areas are assessed:

1. Business Planning and Management: Assesses the degree to which the organization has formal practices in place for understanding stakeholder needs and setting a realistic business plan and goals. This area also considers the organization's frameworks for management review and enterprise risk management and how they impact overall business planning.
2. Asset Management Direction: Assesses the practices related to establishing requirements for asset management capabilities aligned to the organization's goals and objectives, including the asset management policy, objectives, and strategy.
3. Needs and Expectations of Stakeholders: Assesses the understanding of customer needs and regulatory and legislative requirements. This includes the understanding of current and future demand and levels of service.

3.2.1 Assessment Summary

Figure 3-3 shows the level of maturity for the Alignment to Organizational Goals assessment area. Asset Management Direction is the area with the greatest opportunity for improvement. This will help align the asset management objectives with the Port's strategic business objectives and ensure that all stakeholders understand the direction for asset management improvements at the Port. This will also help stakeholders understand the present and future demands on the assets that are critical for delivering the Port's level of service to its customers and the impetus behind the improvements.

Figure 3-3: Alignment to Organizational Goals Assessment Results



3.2.2 Key Observations

3.2.2.1 Business Planning and Management

Long-range planning includes short and long-term forecasts, but lacks consideration of core infrastructure reliability.

The Port of Seattle uses a rolling five-year Long-Range Plan (LRP) to address the various strategic objectives outlined in the Port of Seattle's Century Agenda. The Century Agenda, as adopted by the Board of Commissioners at the Port of Seattle, identifies specific strategic objectives to accomplish the agency's mission of creating jobs in Seattle and across the state. The LRP includes short-term and long-term demand forecasting to help account for growth and expansion at both the airport and seaport. However, this forecasting and capacity analysis does not consider the condition of current infrastructure and assets. Certain aspects of meeting customer demand, such as amenities, are considered, but ensuring core infrastructure asset reliability is not explicitly considered.

3.2.2.2 Asset Management Direction

The Port of Seattle Aviation Division has recognized the value of assessing their asset management maturity before investing in a program of change.

The Port of Seattle Aviation Division sets annual priorities, which are prominently displayed across the airport's office building, and conducting an asset management gap assessment is one of these priorities. It is clearly understood that the Port must first understand where it is, in terms of asset management, before it can begin developing its comprehensive asset management program.

The Port of Seattle *Sustainable Asset Management Policy* needs to be reviewed, supported and communicated by the Port's senior management.

Asset management was first formally introduced at the Port through the agency's Sustainable Asset Management Policy (last updated in 2013). The policy provides overarching guidance to incorporating

3.2.3 Best Practice Benchmark

Denver International Airport

Has defined asset management objectives, as identified by a strategic asset management plan. The plan was developed by the Airport Infrastructure Management department which is responsible for asset management at the airport. The plan is linked back to agency-wide objectives and the airport's asset management policy.

Gatwick Airport London

Has a comprehensive program to manage the business to ensure that asset management processes meet the objectives of the business. GAL uses a holistic measurement framework to track asset requirements assuring governance in parallel to delivering sustainable value improvements.

Schiphol Airport

Uses a dynamic strategic planning approach to master planning by systematically identifying vulnerabilities (for example, demand for air traffic grows more quickly than forecast), their mitigating actions, and possible signposts or triggers.

Brisbane Airport

Infrastructure capacity analyses are based on peak demand, both for the passenger traffic and aircraft movement. To reduce uncertainty in the growth projections, the airport studies the trends in the airline and aviation industry through a review of Airbus Industries and Boeing forecasts and orders. This provides input into demand for runway and terminal building requirements. The airport also reviews internal operations to evaluate the capability of the existing infrastructure to support future demand requirements. Standards for passenger throughput and infrastructure performance are set against which performance is monitored.

asset management at its airport (Aviation Division) and seaport (Maritime Division), with implementation and execution falling to each respective division. The policy has not been reviewed recently. To have a successful asset management system in place, the Aviation Division needs to embrace asset management as a way of doing business. Executives and senior managers need to ensure there is alignment between objectives set at the top of the Port of Seattle organization and capital and operational decisions made at all levels. For the policy to be effective it is important that it is now reviewed, supported and communicated by senior management.

Connection between stakeholder needs and how the Ports assets serve these needs would be improved through a strategic asset management plan.

There is widespread understanding that the Port's assets support its primary mission, and many assets are either beyond their expected life, or beyond capacity. A connection to how managing the assets more efficiently will serve the stakeholders is currently missing.

A solid, widespread understanding of asset management requirements exists, but the lack of a strategic asset management plan puts at risk improvement initiatives.

We acknowledge that the Port of Seattle Aviation Division asset management program and governance are developing as part of this project and require early focus to ensure future success. Based on the gap analysis interviews, it was evident that employees across the airport understand the basic principles of asset management and the ever-increasing importance it has in maintaining the airport's assets. That said, the Port of Seattle Aviation Division currently does not have a strategic asset management plan that describes the organizations long-term approach to managing its assets (or more correctly – its long-term approach for how it will extract value from its assets). The plan should therefore provide two narratives – (1) provide the line of site from the organizations goals, establish asset

Uses community and stakeholder engagement as part of the capacity planning process. A committee approach is used to undertake community and stakeholder consultation and negotiation. The airport also works with professional associations and local industry to build relationships

Metropolitan Transportation Authority (MTA), New York
Asset Management Improvement Strategy aligns MTA headquarters' priorities with agency operating objectives, network service levels, asset lifecycle, and project delivery.

Bay Area Rapid Transit (BART), California
Links asset and risk management strategy and analysis to its annual budget development cycle.

Dallas Area Rapid Transit (DART), Texas
Senior management review, adopts and supports the Agency-wide AM policy and strategy. AM strategy is supported by the organization's business processes.

ProRail, The Netherlands (the infrastructure manager for the Dutch rail system)
Incorporates qualitative expectations set by the Dutch government into its own organizational objectives for maintenance management, lifecycle management, quality assurance, information, management instruments, and staffing and organization.

Washington Metropolitan Area Transit Authority (WMATA), D.C.
Maintains an enterprise-wide performance management group with dedicated staff. The organizational performance management framework requires each department/group to develop performance metrics and targets consistent with the organization's strategic objectives.

management objectives, and provide direction, alignment and prioritization for developing asset management plans and (2) provide the description of the organizations asset management capabilities and proposed improvements to meet the future requirements of the organization.

A process for translating strategic initiatives, plans or goals into asset requirements is missing. A strategic asset management plan would translate business requirements into asset management requirements.

The Port currently has no processes in place for translating strategic initiatives, plans or goals into requirements for assets or asset management. To achieve alignment from Port organization strategic goals to asset class level decisions it is necessary to establish a governance structure and planning framework to translate strategic initiatives into asset management requirements.

Asset management objectives are limited to service performance. Measures to assess progress towards asset management maturity, efficiency/performance improvement, and the Port's strategic goals are yet to be developed.

Asset management objectives should be established to provide a measure of progress toward meeting division-wide strategic goals for undertaking and improving asset management activities. The setting of measurable objectives for the assets enables policy and strategy implementation to be monitored and supports the further translation of strategic goals into maintenance and investment plans. Asset management objectives may take the form of specific performance and condition targets, and can include measures of utilization, reliability, functionality, capacity, safety, legislative or statutory compliance. Further, as the Port of Seattle Aviation Division is in the process of developing the asset management program, we would recommend that objectives also consider progress toward improving asset management maturity and driving maintenance and operations efficiency.

Washington Metropolitan Area Transit Authority (WMATA), D.C. WMATA's Transit Asset Management Office (TAMO) uses the agency's AM Policy to introduce consistent working practices across multiple asset classes.

Through the TAMO, departments/groups are integrating their performance metrics into the Asset Management Plan development process, linking the enterprise-wide performance management framework to asset management planning processes.

3.2.2.3 Needs and Expectations of Stakeholders

Regular feedback from key stakeholders informs the planning process.

The Port of Seattle Aviation Division regularly seeks and obtains feedback from both its customers (passengers and tenants) and employees. The Port measures customer satisfaction through questionnaires, interviews and ongoing feedback surveys; these results are then incorporated in the agency's long-range planning process. In addition, the Port also conducts regular employee engagement and culture surveys, to measure its employees' satisfaction. Results from both the Airport Service Quality Index and employee surveys are regularly shared with employees and acted on through multiple avenues including but not limited to agency-wide communications, all-hand meetings, and the employee innovation program.

3.2.4 Recommendations

Recommendation	Description/Scope
Review and Update Asset Management Policy	The Aviation Division should review, support and communicate the Port of Seattle's Sustainable Asset Management Policy at the earliest opportunity to demonstrate commitment to developing asset management maturity. This will send a positive message to the business.
Develop a Strategic Asset Management Plan	Develop a comprehensive strategic asset management plan setting the direction for how the agency and its departments will manage the public's investment in its assets consistent to the agency's overall asset management policy. While asset management is well understood at the Port, there is no formal document that identifies the plan/direction for the Port's asset management program. A strategic asset management plan will establish alignment with the agency's strategic business objectives, explain the benefits, the roles of various stakeholders, and ensure that all Port divisions have a clear understanding of a path forward.
Develop Asset Management Objectives	Asset management objectives should be developed. A series of measures should be developed, aligned to the strategic goals of the Port, that monitor progress toward meeting division-wide strategic goals for undertaking and improving asset management activities.
Integrate Business Planning Processes with Asset Management	Integrate the strategic asset management plan outputs with the business planning process – to ensure that the long-range plan considers the state of repair of existing assets, and their ability to support stakeholder needs and Port objectives.

3.3 Control of Assets

The Port of Seattle Aviation Division is graded as ESTABLISHING in the *Control of Assets* assessment area, with key strengths in the areas of Asset Management System and Safety. Asset Risk Management and Performance Management are key areas for improvement.

The Control of Assets pathway assesses the extent to which the organization has established policies and procedures to ensure it reliably achieves its objectives, while managing risks and uncertainty and demonstrating compliance to standards. Good practice asset management organizations are able to demonstrate an overall business framework that ensures all activities are harnessed toward the delivery of the service and business objectives.

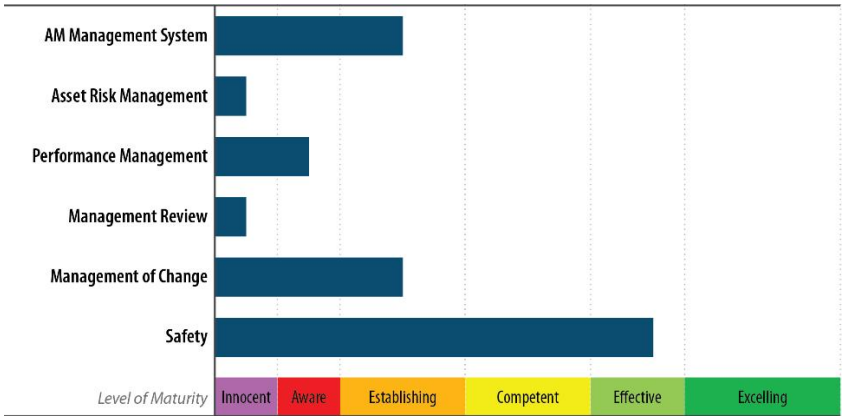
Six quality areas are assessed:

1. Asset Management System: Assesses the extent to which asset management practices are defined, established, documented, and applied across the organization. This quality area also assesses the organization's approach to benchmarking and innovation and how it continually improves its practices.
2. Asset Risk Management: Assesses the organization's approach to identifying, assessing, evaluating, and managing risks related to asset utilization, operations, and management.
3. Performance Management: Assesses the organization's approach to identifying performance requirements and monitoring, managing, and reporting asset performance.
4. Management Review: Assesses the extent to which the organization conducts management reviews of its management system and the activities related to assurance of asset work activities.
5. Management of Change: Assesses the extent to which the organization manages changes to its asset management activities, as well as changes to operations and assets, including configuration management.
6. Safety: Assesses the extent to which the organization has policies and processes for managing safety, including both job-related and operations-related safety processes.

3.3.1 Assessment Summary

Figure 3-4 shows the level of maturity for the Control of Assets assessment area. Asset Risk Management is the area with the greatest opportunity for improvement. Currently, the Port of Seattle Aviation Division does not conduct any risk-based asset management and therefore may not consider all risks related to asset utilization, operations, and management. Implementing a more formal approach to asset risk management will allow the agency to identify, mitigate, and manage asset risks more efficiently, ultimately reducing asset failure and improving overall safety.

Figure 3-4: Control of Assets Assessment Results



3.3.2 Key Observations

3.3.2.1 AM Management System and Management Review

The capture of processes and procedures varies across the organization. There is no integrated management system for asset management. The Port of Seattle Aviation Division needs to develop an overall management system, with integrated processes and procedures that cover all lifecycle stages and organization functions.

The Port of Seattle Aviation Division has documented standards for maintenance and design specifications and has standard operating procedures for engineering and maintenance activities. These documents provide the rules for interfacing with assets. However, it was noted through the interviews that an overall asset management – management system is not in place. Procedures for whole-life management of assets need to be defined, including the roles and responsibilities across the organization.

Asset management is an inherently integrated approach and cannot be successfully implemented by managing individual assets or different lifecycle stages (such as maintenance) in isolation. Therefore, it is important that the Port of Seattle develop an overall business model for all its assets and ensure this covers all lifecycle stages and organization functions. An overall management system is missing and should be developed. The Port would benefit from applying a consistent structure both among operating divisions, as well as at across asset classes within a division, particularly in the areas that interface with other offices (for example risk or capital planning). This needs to be developed to support performance improvement, and in particular is a key enabler to removing many of the risks and issues identified in this report.

3.3.3 Best Practice Benchmark

Port Authority of New York and New Jersey
All of the facilities of the Port Authority have emergency plans that address hurricanes and business continuity. Tabletop and full-scale exercises are conducted in preparation of storms.

The agency's standard design guidelines are updated to ensure that projects are more resilient to climate events. They comply with updated resiliency codes, identify critical infrastructure, consider federal, state, and local recommendations, and consider changes to the climate (e.g. sea level rise, heat waves, etc.).

Brisbane Airport
Has a set of development objectives that are used in the evaluation of asset options. These include facilitation of safe passenger, freight, and aircraft movement, sound environmental management, accessibility and land use, improvement of quality of services, sound business management.

London Underground, United Kingdom
Has a comprehensive policies, processes and procedures framework for all asset management and asset-related activities that is web-enabled and accessible on the company intranet. It is integrated with several other applications, which improves workflow. A key best practice is the link between the EAM system and the document management system such that work procedures can be pulled up within the EAM system – which supports maintenance scheduling.

Maryland Transit Administration, Maryland
Established a register of processes and procedures that supports a comprehensive review process wherein every process/procedure is at least looked at annually and reviewed bi-annually; the approach also considers whether the process/procedure is high risk – which prompts a higher level of review.

3.3.2.2 Asset Risk Management

Enterprise risk management is focused on insurance against asset loss and liability. There is no formal enterprise risk management program in place that addresses asset and asset management risk.

Agency-wide, there is no defined Enterprise Risk Management (ERM) program. The Port does have an ERM Group that focuses on monitoring insurance, liability, and any claims to/from the Port. In addition, the ERM Group does conduct one-off risk analyses based on departmental requests or external impact factors. These have included an earthquake risk analysis and a risk assessment for the Facilities & Infrastructure department. Most localized risk management at the Port focuses on weather or natural disaster-related risks, not risks related to specific assets or managing them.

While most areas reported having in place tactical risk approaches to prioritize workload, asset related strategic risk management processes were lacking.

Each department throughout the Port has its own processes and procedures for handling 'known concerns', but enterprise-wide risks are not captured and as a result are not sufficiently monitored or considered in the planning cycle. This introduces a further risk of professional exposure for senior directors due to a lack of identification, visibility and management of risks.

3.3.2.3 Performance Management

Performance measures are established, but are not always monitored. The Port of Seattle Aviation Division lacks a hierarchy of performance measures to ensure all departments contribute to the strategic vision and objectives.

The Port primarily measures performance through the Airport Service Quality Index, which scores the airport based on customer satisfaction. The Port uses these scores to help guide its long-range plan and processes as well as benchmark its scores against other airports. Further, individual departments have their own, identified

Network Rail, United Kingdom

Uses standards that are written by Network Rail ensuring compliance with the Railway Group Standards (RGS) under the Railway Interoperability Directive 2008/57/EC as published by the European Union. Railway Group Standards (RGSs) are national safety rules and national technical rules applicable to the mainline railway system. In line with these Network Rail derives KPIs as well as performance measures for safety, productivity, infrastructure failures by asset, backlog, financial and compliance. In relation to managing potential asset failures the target for speed restrictions is zero however this does not limit the use of speed restrictions to migrate the risk to safety of the line where appropriate.

Regular audits are a requirement by the regulator. These are conducted internally to be monitored and presented to the regulator. Network Rail uses an electronic system to manage the compliance of audit actions and ensure transparency. Closure of major non-compliances require review and sign off by the regulator. Minor non-compliances are managed internally and recorded in the system.

Metropolitan Atlanta Rapid Transit Authority (MARTA), Georgia

Developed adaptation strategies for handling climate change for each of its functional units: first identified potential climate hazards, assessed risks, developed short- and long-term adaptation strategies.

Metrolinx, Ontario

Has a well-developed enterprise risk management framework with established risk management policies, procedures and monitoring tools. The approach is systematic and managed by a dedicated team. An enterprise risk management application is used to monitor agency-wide risks and report on changes, etc. An annual risk health assessment exercise is undertaken to seek areas for improvement and to reduce risks.

metrics around maintenance, inventory, renewals, etc. However, these indicators may not be formally tracked and shared across departments. Several employees noted that current indicators are not complete and may not track the right information needed. In addition, stakeholders mentioned that the metric data being reported may not be accurate because the data in the systems used to track that data may not be accurate. There is also no comprehensive dashboard or report capturing asset management metrics.

3.3.2.4 Management of Change

The Port of Seattle Aviation Division works closely with its stakeholders and suppliers to identify opportunities for improvement – it has a strong focus on innovation.

A key component to an asset management system is continuous improvement and how the organization fosters innovation across the business. While not yet specific to asset management, the Port focuses heavily on innovation, working closely with its vendors to identify potential opportunities to improve business and operational performance, as well as the Employee Innovation Program, which allows employees to submit ideas to advance their department and/or the entire agency.

The lack of formal change control processes for asset management introduces risks – both with driving successful change, and ensuring the change does not adversely impact other parts of the organization

It was identified that there is no formal process to manage changes to management systems and practices. This includes communicating the change and the "why", "what" and "how" behind those changes. It also includes the governance of changes to ensure that anything introduced goes through a comprehensive review cycle to reduce risk of adverse impact on other parts of the organization. Processes for management systems and practices change, should be introduced across the organization – not just maintenance and engineering.

Crossrail, London, United Kingdom
Has an established enterprise risk management system that is implemented across the organization and mandated across its supply chain to its major tier one contracting organizations. The system provides portfolio-wide risk visibility, ensuring that all the various project management teams understand their risks and can take steps to mitigate them.

Washington Metropolitan Area Transit Authority (WMATA), D.C.
Current plans consider risk mitigation strategies for both strategic asset management risks (organizational, investment, etc.) and asset risks (obsolescence, performance, etc.); risk is being introduced as a key consideration in the capital planning approach.

3.3.2.5 Safety

A strong safety culture exists which is well integrated across departments.

The Port of Seattle has an overarching safety policy that is primarily based on the Century Agenda. Safety is well integrated across the agency and imparted across departments through the Health and Safety Program Managers. Safety hazards and incidents are reviewed within departments, and actions are identified and executed to resolve any potential hazards. The Port reviews all state and federal regulations around safety to ensure compliance. Safety Committees exist in each department and are responsible to meet regularly to review their specific safety policies and procedures, as well as any applicable hazards or incidents that might have occurred.

3.3.4 Recommendations

Recommendation	Description/Scope
Develop Asset Management Business Architecture	Develop the Port of Seattle business architecture to support the integration of multiple planning horizons and align organization strategic objectives with asset class tactical demands.
Develop Asset Management Business Processes and Procedures	Develop and document key business processes and procedures for the whole-life management of assets. These should include the integration between existing long-term planning efforts and tactical asset planning efforts, as well as the development of processes for integrating risk management in the planning cycle. The architecture should also consider the transition of assets across life-cycle stages – such that any changes to the asset or asset management are controlled.
Define Asset Owners	Develop and define owners of various assets as an extension of defining roles and responsibilities. Upon the completion of capital projects, an asset transfer form is completed to transfer the ownership of the asset from the Project Management Group to the appropriate division that will serve as that specific asset owner. However, there is no documented, comprehensive list identifying asset responsibilities by department or class during construction, maintenance or disposal. This includes, among others, responsibilities for defining design and construction standards, asset onboarding, defining an asset lifecycle plan, tracking all work on the asset and conducting reliability analysis on assets. Defined asset ownership will ultimately improve the relationship and collaboration between various departments.
Create an Asset Class Common Framework	A common framework for asset class procedures should be developed setting out the minimum documentation requirements for each asset class. This should be consistent with current operating requirements and ISO-55001:2014. Existing asset class specific procedures should be reviewed against the developed common framework. Procedures for operations, maintenance and management should be developed to satisfy both the common framework requirements as well as asset class specific requirements.
Establish an Audit Program for the Asset Management (AM) Management System	An audit program should be established to monitor the performance and consistent application of the asset management – management system. This will be a key driver for ensuring changes to the way the Port manages assets are consistently applied and that any issues can be addressed as part of a continuous improvement program.
Develop a Risk Management Framework	An Enterprise Risk Management Framework should be developed. The framework should include a risk policy, risk management procedures and the process to develop a risk register. The procedures should consider how risks are identified, evaluated, monitored and when risks should be escalated.

Recommendation	Description/Scope
Develop Asset Management KPIs	Develop asset management key performance indicators (KPIs) to better measure asset management outcomes. The Port should review current KPIs and metrics across Facilities & Infrastructure, Maintenance, and other departments and identify a collective set of KPIs for asset management tracking and reporting. The Port should also review the effectiveness of the current metrics and the quality of data to ensure that the right metrics are in use, and the data reported is accurate. This will result in enhanced data to manage maintenance decisions and programs, provide a comprehensive KPI dashboard for senior leaders, and help track and demonstrate progress of the asset management program.
Develop Asset Management Reporting Framework and Processes	Develop a template and produce a high-level quarterly or annual asset management report with executive-level metrics and reporting on key benefits, outcomes, and impacts along with a summary of key initiatives and status. Currently, specific asset management metrics are not routinely tracked nor are related metrics captured comprehensively across the Aviation Division. Further, there is no consistent message around asset management and its impacts to the agency. Through creating defined reporting processes and standards, the Port will foster greater visibility and transparency of asset management, a clear link to elements of the Airport Service Quality Index, as well as provide an avenue to communicate progress, benefits, and impacts to key stakeholders.
Establish a Continuous Improvement Program of Asset Management	Establish a continuous improvement program for asset management, including reviewing the asset management roadmap and maturity every few years. As the Port develops its asset management strategy and a roadmap, a continuous improvement program will allow the Port to confirm that its maturity is improving consistent with its improvement plan and change its program based on additional information or changes as time progresses.

3.4 Asset Management Planning

The Port of Seattle Aviation Division is graded as ESTABLISHING in the *Asset Management Planning* assessment area. Efforts are currently being led by Facilities & Infrastructure to address many of the gaps identified in this area.

The Asset Management Planning pathway assesses the extent to which the organization has put in place processes and practices to establish strategies that determine the most appropriate intervention activities that result in work plans that efficiently deliver performance improvement and effectively manage risk.

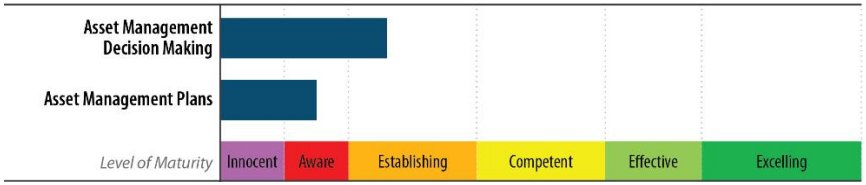
Two quality areas are assessed:

1. Asset Management Decision Making: Assesses the extent to which the organization considers asset condition, risk, performance, whole life cost analysis, and other factors to ensure its asset policies/strategies represent the most appropriate range of activities for achieving service and performance objectives.
2. Asset Management Plans: Assesses the extent to which the organization has developed asset management plans and the extent to which it monitors, reviews, and continually improves the implementation of the plans.

3.4.1 Assessment Summary

Figure 3-5 shows the level of maturity for the Asset Management Planning assessment area. Currently, the Port does not have formal asset management plans for its assets. Moving forward, it will be critical for the agency to formally adopt an asset management plan template and develop lifecycle management plans for all major asset classes incorporating inspection and maintenance strategies, reliability targets, performance metrics, and long-term renewal and replacement.

Figure 3-5: Asset Management Planning Assessment Results



3.4.2 Key Observations

3.4.2.1 Asset Management Decision Making

Long-term planning at the Port of Seattle Aviation Division focuses on demand for new infrastructure and not the maintenance or condition of its aging infrastructure.

The Port is currently developing a Sustainable Airport Master Plan (SAMP), which is addressing critical needs to meet future regional demand. In addition to considering forecasted passenger and cargo demand, the master plan takes into account current facilities, infrastructure, and operations — looking at scenarios 5, 10, and 20 years in the future. It includes air quality, energy and water conservation, recycling, and other strategic environmental goals, and will align with the Port's sustainability and energy-efficiency goals. The Port of Seattle does have a fully integrated sustainability strategy as part of their master planning efforts. Guided by the Port of Seattle's Century Agenda and overseen by the Sustainability & Environment Group, the airport is committed to reducing environmental impacts, ensuring economic performance, and working closely with local communities on sustainable practices.

That said, long-term planning at the Port focuses more on passenger and cargo demand resulting in new infrastructure and does not necessarily consider the maintenance or condition of its aging infrastructure. A large gap exists between airport growth and the resources needed to ensure delivery of work programs for asset management. The airport is aware of this gap and is developing processes to improve asset condition tracking and renewal/replacement.

The Port of Seattle Aviation Division has not established strategies for managing its existing infrastructure assets. Asset class strategies would provide the necessary direction for developing asset management plans.

3.4.3 Best Practice Benchmark

Greater Toronto Airport Authority

The Greater Toronto Airport Authority undertakes business case analysis on an asset to determine the most appropriate investment in airside pavements, people moving equipment (escalators, elevators, moving walkways, etc.), bridge structures, for example. Each of the investments in maintenance, rehabilitation or replacement are identified and prioritized and then passed on to a higher-level cross-asset evaluation and life-cycle benefits using a software application (ReCAPP).

Sarasota/Bradenton International Airport

Lifecycle costing of project alternatives include all standard operations, maintenance, and capital component assessments, with the addition of comparison of delivery mechanisms, such as turnkey and annual maintenance contracting.

London Underground, United Kingdom

Asset management plans have gone through close to ten years of iterative refinement and consider a one year 'look back' on performance and a nine year "look forward" for capital programs and maintenance activities.

In many instances plans are supported by decision support tools that guide the intervention requirements. Its ESTEEM tool is used to develop optimized strategic plans that account for the lifecycle costs of all assets and the risks associated with each. ESTEEM not only links to inspections and work orders, but also provides an uncertainty probability for the degradation and costs of assets. In addition, it can serve as a data management system.

A key best practice is the 'AMP-On-A-Page' concept – which provides a period (4-week) summary of the maintenance and capital works that were planned along with forecast performance metrics;

Currently the Port does not have in place life-cycle strategies for each asset class, that define the maintenance, rehabilitation and replacement cycles. The development of asset class strategies would provide the necessary direction for developing asset management plans that set out the operational and capital programs necessary to meet organization goals and strategies. They also provide transparency, ensuring confidence in decisions at all levels. The upward and downward linkage between these tiers is absolutely critical to ensuring that decisions deliver their intended benefits and where not appropriate actions can be taken.

Asset class strategies set out *what* needs to be done to each asset group to achieve the long and medium-term objectives. This is consistent with global best practices. The strategies must be defined based on the following types of analysis:

- Definition of asset base
- Historical analysis of performance and condition
- Understanding of asset criticality and risk
- Performance and condition requirements
- Review of degradation rates, failures and consequences
- How each asset is managed through its lifecycle
- Maintenance intervention options
- Capital investment optimization
- Lifecycle considerations
- Asset knowledge and information requirements
- Application of technology and best industry practices

Development of asset class strategies and asset management plans will require resource to undertake the above analyses and importantly harmonize these plans with existing investment planning and project delivery cycles. It should be recognized that these analyses and the associated condition/ performance/ cost data have a large implication from the capital planning perspective and will require additional work to meaningfully establish capital priorities

management reviews these one-page documents to determine whether any corrective actions are needed.

Metrolinx, Ontario
Currently developing baseline Asset Strategies and Asset Plans for every major asset class that will provide a starting point for future development – including the introduction of improved maintenance definition (RCM, RBM, etc.) and maintenance delivery capabilities. The effort is being aligned to the agency's annual budgeting process.

Washington Metropolitan Area Transit Authority (WMATA), D.C.
Has established baseline Transit Asset Management Plans that consider both the asset strategy and the asset plan for each major asset. The planning approach includes risks and enhancements, considers where possible the current condition and performance of the asset, and identifies key action plans designed to improve performance and the robustness of the plans.

King County Metro Transit, Seattle, Washington
Has established a Transit Asset Management Plan for its fixed transportation system assets that derives from the Metro mission statement, defines the state of good repair, provides an asset inventory, lays out roles and responsibilities, describes business processes, and documents its asset management work plan for the following six years.

Metropolitan Atlanta Rapid Transit Authority (MARTA), Georgia
Established asset management plans, developed using information held within MARTA's EAM system, are integrated into its capital planning and maintenance planning capabilities.

across asset classes, as well as link processes for capital planning in the current constrained funding environment.

Current asset decisions lack whole-life cost analysis as, in many areas, costs are not captured to sufficient granularity to support analysis.

These plans do not consider whole life cost analysis and include details to maintain an asset through its lifecycle and ensure that the Port can use the asset for its expected life. In most cases, documented asset lifecycle costs are not available because departments lack the structure and tools to capture and report full lifecycle costs for assets.

The Port of Seattle Aviation Division recognizes the challenges it faces in establishing renewal strategies – and is working to improve its approach through better condition assessment and improving data capture.

Facilities & Infrastructure (F&I) is responsible for tracking asset condition and assigning a replacement plan based on age, but this method is incomplete and not incorporated holistically when looking at the asset's entire life. F&I is working to improve its asset renewal strategies and processes, as well as developing lifecycle cost analyses for all asset classes. Preventive maintenance (PM) schedules exist for assets and are loaded into Maximo during onboarding. However, the PM schedules are not tied to performance or service level nor are maintenance strategies used in investment forecasting.

3.4.2.2 Asset Management Plans

Asset management plans consistent with the requirements of the ISO-55001:2014 standard are not in place.

Across all the Port's asset classes, asset management plans do not exist. The Port has what are known as "asset plans;" however, these are not the same as a formal asset management plan (AMP), as defined by industry best practice. At the Port, asset plans are used to book assets (including installation/replacement cost allocations) in

their enterprise resource planning (ERP) system, PeopleSoft. Prior to asset onboarding, the project manager of the respective capital project is responsible for populating the asset plan and identifying the individual valued assets (assets valued at $20,000 or greater) to be booked and tracked in PeopleSoft. The goal is to begin asset plans at the start of a project, but typically these are not created until the final stages of the project, just before the assets are placed in service.

The general lack of asset management plans inhibits the ports ability to justify the need for asset investment and to ensure the impact of its organization strategies and policies are adequately planned for.

Asset management plans document the coordinated approaches to delivering the objectives and goals of the organization. They present the 'when and where' for maintenance and capital expenditure, as defined by the 'how and why' set out in the asset class strategies, described above. Typically, at a minimum, plans should contain basic information on assets, service levels, planned work and financial forecasts. Asset management plans are also a key requirement of ISO-55001:2014.

Asset management plans would improve coordination across the organization and demonstrate the right level of resourcing.

The asset management plans are important documents for defining the activities necessary to meet the required level of service at the airport. It would encourage a more "joined-up" approach to whole life asset management decisions. This includes the capital investment program, maintenance of assets, and disposal or rationalization of assets. The plans also sets out the resources necessary to deliver the activities, including human, financial, or others. For the Port this is a particularly relevant exercise as all asset classes reported both manager and technical staff shortages. The plans would provide the justification for expenditure and would ensure that future maintenance or capital deficits are controlled.

Asset management plans would further reinforce the alignment between maintenance and capital planning.

It was reported in some asset classes that alignment between capital planning and maintenance could be improved. In many areas, capital needs are determined by Engineering with little input from the asset supervisors who manage the asset on a day-to-day basis. Though operating departments and engineering groups develop condition ratings, this process is somewhat independent from other performance assessments. The ratings are only used for the capital program and do not have a direct impact on maintenance practices, though they reflect the overall condition of an asset at the capital investment level. Similarly, in many instances information used to support maintenance interventions are not made available to monitor future capital replacement need. An asset management planning process that worked to integrate maintenance, capital planning and long-term planning would ensure alignment between Port strategic objectives and asset activities.

Implementation and monitoring processes for asset management plans need to be established.

In those areas were some level of planning is established it was reported that they are not well followed. To ensure the value of an asset management plan is achieved, it is important to establish monitoring and review processes. To be effective, the asset management plans should be reviewed on an ongoing basis. An effective means of achieving this is to develop month-by-month summarized versions of the plans (some agencies refer to these as 'one-page AMPs'), which are integrated into a review cycle to increase integration of the asset management plans in the Port's management processes.

3.4.4 Recommendations

Recommendation	Description/Scope
Develop Asset Class Strategies	Develop Asset Class Strategies for each asset class. The strategies should demonstrate the work necessary at the asset class level to implement the Port of Seattle's strategic plan (business plan) and the strategic asset management plan. Asset Class Strategies should also consider the system interfaces between assets and how conditions or changes of an asset impact another. For example, new high technology procurements will have a different load requirement on power assets.
Develop Asset Management Plans	Produce a uniform template and pilot the development of formal asset management plans that address inspection and maintenance strategies, rehabilitation/overhaul programs, reliability targets, performance metrics, and capital renewal and replacement. The Port of Seattle Aviation Division does not consistently consider lifecycle costs in renewal/replacement and maintenance decisions. In most cases, documented asset lifecycle costs are not available because departments lack the structure and tools to capture and report full lifecycle costs for assets. Comprehensive lifecycle plans will result in greater adherence to inspection and PM programs, enhanced long-term capital budget and financial forecasts as well as improved tracking, reporting, and accountability of asset lifecycle data. These plans should be considered accompanying plans or subsets of the strategic asset management plan (recommended earlier in this chapter).
Develop Management Review and Monitoring Processes for Asset Management Plans	Processes should be developed to establish a management review mechanism for monitoring progress in plan delivery. This could take the form of the period (monthly or quarterly) summary of planned activities or forecast performances compared to actuals. The processes to be defined should integrate ongoing review of the asset management plans in the internal management review cycle.

3.5 Capital Planning and Delivery

The Port of Seattle Aviation Division is graded as COMPETENT in the *Capital Planning and Delivery* assessment area and is consistent across all assessment subjects.

The Capital Planning and Delivery pathway assesses the extent to which the organization has processes and procedures in place to ensure capital expenditure is optimized to support delivery of the organization's strategic goals and program development practices and to effectively prioritize investments. The pathway also considers the management and delivery of capital projects.

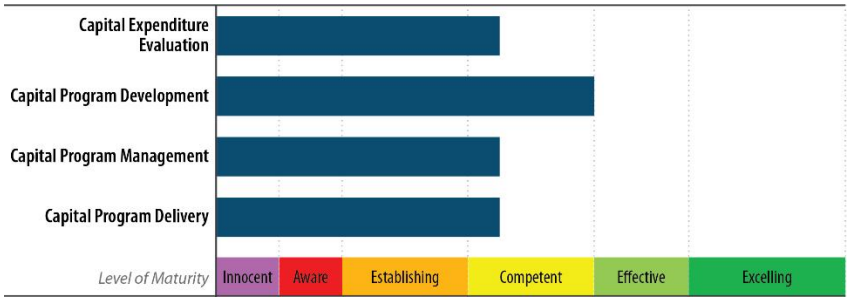
Four quality areas are assessed:

1. Capital Expenditure Evaluation: Assesses the organization's approach to developing investment criteria and the processes and practices for capital evaluation.
2. Capital Program Development: Assesses the practices for developing capital requirements and the organization's approach for prioritizing and approving capital programs.
3. Capital Program Management: Assesses the project development and management capabilities and the extent to which the organization monitors, manages, and reviews capital program delivery.
4. Capital Program Delivery: Assesses the processes and practices related to procurement and execution of capital projects and the commissioning and handover of new/refurbished assets.

3.5.1 Assessment Summary

Figure 3-6 shows the level of maturity for the Capital Planning and Delivery assessment area. Overall, the Port of Seattle Aviation Division scored well in this area. One key area for improvement includes ensuring asset maintenance and condition data is incorporated into the annual capital project identification. Further, the agency should review its asset commissioning process, ensuring asset data is being properly captured and transferred during onboarding.

Figure 3-6: Capital Planning and Delivery Assessment Results



3.5.2 Key Observations

3.5.2.1 Capital Expenditure Evaluation and Capital Program Development

A structured approach, with a defined set of prioritization criteria produces a rolling five-year Capital Improvement Program.

The Port has a rolling five-year Capital Improvement Program (CIP) supported by well-defined processes for identifying, prioritizing, and monitoring capital projects at the airport. The CIP is overseen by a group of seven who provide oversight and support to all projects, from initiation through design and construction. The Port follows a defined set of criteria to prioritize CIP projects, which includes a variety of factors such as run-to-fail, business needs, physical wear and tear, regulatory, and nice-to-have's.

An extensive business case process ensures projects provide value for money.

All prospective CIP projects go through an extensive review and justification process (business case). The CIP also uses net-present value analysis as needed/required. Based on submitted projects, the Capital Program department may conduct additional studies or will ask for additional information/evidence to support the project. All CIP projects are reviewed extensively and various scenarios are developed to ensure the proposed project is the most appropriate solution.

While asset condition and maintenance history is considered, the process is laborious due to limitations with the data and its structure. As a result, this at times results in inefficient work practices.

A major input into the Port's CIP is asset renewals and replacements, which, for airport assets, is the responsibility of F&I. Currently, F&I identifies asset renewals and replacements based primarily on remaining useful life. This data is only tracked in Microsoft Excel and is not linked to maintenance history (which is captured in Maximo). When assessing renewals and replacements, condition and

3.5.3 Best Practice Benchmark

Greater Toronto Airport Authority

The airport's facilities asset management system supports the overall capital planning process by providing a technically prioritized listing of required restoration requirements for all fixed assets. A high-level planning and capital expenditure tool is used to understand the condition of the airport's physical assets, their replacement costs, lifecycle costs, and the implication of deferred investments called Renewal Capital Asset Planning Process (ReCAPP). ReCAPP includes a fixed asset ledger, asset valuation and condition deterioration and weighting tools, minimum condition thresholds and requirements, and financial reporting to assist in programming asset renewal.

Long Beach Transit, California

Long Beach Transit prioritizes projects using its asset criticality measure "code" based on the likelihood and severity of an asset's failure. Managers then rank and prioritize funding for all capital projects based on the code.

King County Metro Transit, Seattle, Washington

Replacements are optimized based on maintenance records and expected lifecycles.

Los Angeles Country Metropolitan Transportation Authority (LA Metro), California

Capital investment decision process uses eight categories, with the most important category—"is the project mission critical?"—counting for 20 percent. A Resiliency Indicator Framework builds on existing climate change adaptation work to prioritize and evaluate adaptation implementation alternatives in two dimensions: technical/asset and organizational.

maintenance data must be compared manually. Stakeholders shared anecdotes where major components of assets were replaced a year before replacing the entire asset – something that could have been avoided if maintenance history and renewal/replacement plans were integrated and stored in Maximo. Integrating the maintenance history into the lifecycle needs assessment will allow the Port to make more informed capital planning decisions considering factors such as cost to maintain and risk of failure.

3.5.2.2 Capital Program Management and Delivery

Capital projects are managed consistently, with progress monitoring and stakeholder who are informed through the delivery.

Once projects are approved, the projects are transferred to the Project Management Group (PMG) and a project manager is assigned. The PMG is responsible for monitoring projects and ensuring the asset owners/project sponsors are kept up-to-date throughout delivery. The PMG creates regular project status reports on all projects.

Design standards have been developed, however are not always adhered to – impacting the agency's ability to optimize through life costs of the asset.

Through F&I, the Port has defined design standards that must be adhered to throughout construction; however, sometimes these standards are not adhered to. While with good intentions, a contractor may identify a "cost-saving" measure during construction which is approved by the PMG. These might cause the Port to ultimately spend more due to lower life expectancy, mismatch with current assets in place, available spare parts, and/or repair/maintenance expertise.

Metropolitan Atlanta Rapid Transit Authority (MARTA), Georgia
A fully integrated TAM model includes various modules include for capital decision-making, project decision-making, and project delivery and control. The decision-support module prioritizes capital investments based on consideration of weighted criteria such as customer service, funding optimization, financial impact, environmental stewardship, and project deliverability. Field condition assessments are combined with replacement and rehabilitation cost and useful life information to predict capital investment needs over a 40-year period.

Regional Transit Authority (RTA), Chicago, Illinois
A Capital Optimization Support Tool (COST) collects and prioritizes needs based on funding and long-term strategic goals; its multi-criteria decision analysis process assigns weights to each criterion -- asset age and condition, riders impacted, service reliability, safety and security, and operating and maintenance costs -- and the weighted average is used to score a candidate project.

Network Rail, United Kingdom
Train planning and track access are agreed upon three years out. GRIP (Governance for Rail Investment Projects) is used which includes Go/No Go Stage Gates.

For capital renewals ("capital maintenance"), the engineer creates a plan based on the work bank captured in Ellipse and root cause analysis on failures of the specific asset. This plan is presented to and agreed to by the Route Asset Manager.

The commissioning/handover process includes a "takeover certificate" for handing over assets to contractors and taking them back from contractors. Before the agency accepts the hand back of an asset after the contractor has renewed it, Network Rail engineers ensure that the asset and site are exactly what was sought or is corrected before acceptance and final payment.

Well defined processes for asset commissioning exist – but are not always followed, resulting in a lack of information to support the efficient management of the asset.

The Port has well-defined processes in place for asset commissioning and handover; however, actual execution does not always follow the documented processes. For example, asset plans (used to book assets into PeopleSoft) are a major component of the asset commissioning process and must be completed prior to the asset being placed in service. Upon project completion, an asset transfer form is completed to transfer ownership of the asset from the PMG to the division that will serve as the asset owner throughout its life. The Port ensures operational and maintenance training is conducted on all new assets, which is provided by the manufacturer or contractor. In addition, the Port ensures receipt of all supporting asset data (drawings, manuals, etc.) for new assets.

Stakeholders mentioned that it is generally difficult to get complete asset plans from various team members due to the workload and perceived value of the plans. The asset plans are typically not completed on time. This results in the assets being setup in various systems with limited information, and the complete information is never populated in the electronic systems (PeopleSoft, Maximo). The information collected on these forms does not always provide the right details for maintenance, not does it provide an easy way to add more details once transferred to maintenance. Also, in many cases, the documents that are provided by the contractor upon project closeout (as-builts, OEM manuals) are not in the data format requested by the Port. Defining asset owners and roles and responsibilities (a recommendation presented earlier in this chapter) will help the Port improve coordination between different departments during design and construction.

Contracts include the requirement that contractors add asset data, attributes, and maintenance information into Ellipse before handing the asset back to Network Rail.

ProRail, The Netherlands
A 'yardstick' tool is used to assess the condition of track as it approaches its expected lifespan. The decision of whether to maintain the track or replace it is based on a lifecycle cost model.

Long Island Rail Road (LIRR), New York
The Track group's renewal strategy is based on a data-driven approach that considers usage (annual tonnage, loading, etc.) to prioritize renewal programs.

3.5.4 Recommendations

Recommendation	Description / Scope
Integrate Maintenance and Condition Data with CIP	Establish a defined process to integrate maintenance and condition data into capital needs evaluation. A major input into the Port's CIP is asset renewal and replacement plan for asset, which is primarily based on remaining useful life. This data is tracked only in Microsoft Excel and is not linked to maintenance history. Integrating the maintenance history into the lifecycle needs assessment (and storing this in Maximo, the Port's asset management system), will allow the Port to make more informed capital planning decisions considering factors such as cost to maintain and risk of failure.
Enhance Asset Commissioning Process	Review and document the asset commissioning process and add additional rigor for asset definition, hierarchy, and booking assets via asset plans. The Port has well-defined processes in place for asset commissioning and handover; however, actual execution does not follow the documented processes and there are some opportunities for improvement. These include adding more specifics around roles and responsibilities and updating the level of detail of the information required to match maintenance needs will save the Port time and money during an asset's life. This recommendation is tied to two others presented in this chapter – defining asset owners and their roles and responsibilities (presented previously) and preparing detailed asset hierarchies (presented later in this chapter).
Establish Audit Processes for CIP Delivery and Handover	Audit processes should be established to ensure design standards and asset handover processes are followed consistently.
Update Maintenance with Penalty Clauses for Failing to Follow Standards	Maintenance contracts should be updated to include penalty clauses for failing to follow design standards or for failing to follow asset commissioning processes.

3.6 Maintenance Planning and Delivery

The Port of Seattle Aviation Division is graded as ESTABLISHING in the *Maintenance Planning and Delivery* assessment area. Of the eight assessment pathways, this offers the greatest opportunity for improvement, and we recognize that this is already an improvement focus for the Port.

The Maintenance Planning and Delivery pathway assesses the extent to which the organization demonstrates clearly defined processes for the definition, planning, and delivery of maintenance activities. It also considers the organization's approach to asset inspection and assessment.

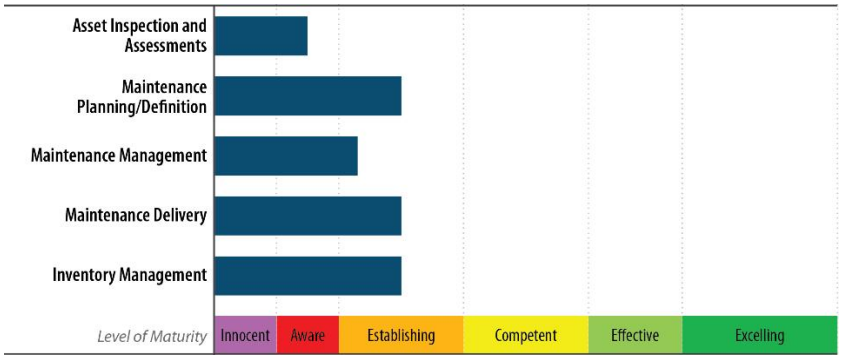
Five quality areas are assessed:

1. Asset Inspections and Assessments: Assesses the extent to which the organization monitors asset performance and condition and uses this information for maintenance scheduling.
2. Maintenance Planning/Definition: Assesses the extent to which the organization ensures that maintenance and inspection activities are clearly defined and focused on achieving specified levels of performance and risk for a given cost. This area considers both the operational impact of maintenance and the organization's use of advanced techniques, such as risk-based or reliability-centered maintenance to guide maintenance definition. (Maintenance definition is 'doing the right thing.')
3. Maintenance Management: Assesses the extent to which the organization has defined delivery strategies and put in place documentation and performance reviews to ensure maintenance is undertaken correctly and delivers intended results.
4. Maintenance Delivery: Assesses the extent to which the organization delivers maintenance and inspection activities efficiently and effectively. It considers the extent to which a maintenance scheduling function is utilized. (Maintenance delivery is 'doing things right.')
5. Inventory Management: Assesses the extent to which the organization plans and optimizes its inventory (stock/spares) holdings, including consideration of how well stock levels are integrated into planned maintenance programs.

3.6.1 Assessment Summary

Figure 3-7 shows the level of maturity for the Maintenance Planning and Delivery assessment area. Asset Inspection and Assessments is the area with the greatest opportunity for improvement. Currently, F&I only conducts asset condition assessments on an ad-hoc basis and there is no consistent assessment methodology across the agency. Further, of the assets that are assessed, the data is only stored in Microsoft Excel spreadsheets and not linked to the asset record in Maximo. Properly conducted assessments and tracked data will significantly improve the Port's ability to identify and prioritize critical needs for asset renewal and replacement.

Figure 3-7: Maintenance Planning and Delivery Assessment Results



3.6.2 Key Observations

3.6.2.1 Asset Inspection and Assessments

The Port of Seattle Aviation Division has introduced condition assessment processes that consider observed condition and remaining useful life. However, the assessment does not consider the maintenance history – or other asset related data – including for example whether the asset has become obsolete.

The responsibilities of maintenance planning and delivery are split across two departments—F&I and Maintenance—with the responsibility of asset condition assessments falling under F&I, and general maintenance, inspections, and materials management all falling under the Maintenance department.

It was not until recently (about seven years ago) that the Port formally started tracking the condition of its assets. Currently, F&I conducts visual condition assessments on assets using a three-point scale, where the score is based on observed condition and its remaining useful life. These assessments do not consider any historical maintenance on the asset through either a review of data in Maximo or discussions with the maintenance staff.

The data is collected and stored in Microsoft Excel spreadsheets and is not linked back to the asset records in the Port's enterprise asset management (EAM) system, Maximo. F&I uses these spreadsheets for its renewal and replacement program and as an input to the capital improvement program.

The Port of Seattle Aviation Division's condition assessment methodology is not documented to the extent necessary to ensure consistency.

There is no documented methodology for conducting these visual condition assessments, which can lead to variations in scores based on the assessors. The asset breakdown (hierarchy) used for the condition assessments is high-level and not setup based on any industry standards or best practices. This makes aggregating the data

3.6.3 Best Practice Benchmark

Gatwick Airport London

Intelligent monitoring techniques have been introduced as part of the refurbishment of a bridge over the railway. This bridge will have built-in condition monitoring to avoid some of the need for railway possessions to undertake inspections.

At Gatwick, maintenance comprises statutory inspections (SI) and maintenance (SM), corrective maintenance, and planned maintenance. The information system provides a readily available measure of the status of SIs and SMs that, when published, proved effective in increasing the level of compliance because there should not have been a backlog. The SIs are now achieving 100 percent and the SMs are at 95 percent and improving.

Greater Toronto Airport Authority

Regular formal condition assessments are conducted to establish performance models for the assets. The performance data is used to determine investment needs, which are then fed into the agency's 5-year capital restoration plan.

King County Metro Transit, Seattle, Washington

In addition to their six-year plan, King County Metro Transit also produces an annual Facilities Condition Report which discusses asset conditions and recommendations for replacement or refurbishment. Replacements are optimized based on maintenance records and expected lifecycles. To prioritize facilities projects for inclusion in the annual capital plan, metro brings together a team of staff members from different departments and also seeks the perspective of stakeholders.

Network Rail, United Kingdom

Maintenance and refurbishment planning process starts 3+ years in advance. An initial plan for a specific work activity, including staffing, materials and equipment needs and track access is identified 26

difficult and to compare similar high-level assets. Additionally, not all Port's assets are in Maximo.

Due to misalignments between data sets, inspections may result in the discovery of assets – the Port of Seattle Aviation Division has a process for recording these assets but it is not fully adopted across the agency.
For condition assessments, the Port uses the Maximo asset list and the PeopleSoft asset list as a list of assets to inspect. When assets are "discovered" in the field during inspections, the process for adding these assets should be reviewed and updated to ensure full adoption.

It was reported that there is a lack of resource supporting condition assessments.
Further, there is no individual or group fully dedicated to asset condition tracking. F&I started collecting condition data on its assets about seven years ago and to date (since this is only a secondary responsibility), condition data has only been collected for about 60 percent of the airport's assets. Typically, condition assessments need to be conducted more frequently to ensure that the data is not obsolete. This typically requires dedicated staff or contracted staff that follow a pre-defined condition assessment methodology.

3.6.2.2 Maintenance Planning/Definition

Maintenance resource levels require review, as aging assets and additional assets create a greater demand on the workforce.
Existing maintenance workforce requirements are based on historical staffing level and anticipated workload for new infrastructure. It was reported that maintenance employees are regularly pulled in to support capital development. As airport demand increases, capital growth and aging assets will increase the demand on maintenance staff and as such staffing levels should be continually reviewed.

Maintenance scheduling is coordinated across asset classes. Maximo is used to support scheduling activities.

weeks out; at 13 weeks out, the plan is reviewed by all departments to understand clashes and priorities; and at 6 weeks out, the plan is locked down. Last minutes changes may be accommodated in extraordinary circumstances, but safety of assets always takes priority with the discipline engineer holding accountability.

Asset inspections are used to identify the work required as per the Network Standards. These jobs are entered into Ellipse to create a work bank. The work bank is reviewed in Ellipse by the Section Manger to plan and prioritize.

The Maintenance Engineer reviews the work bank with the Section Manger to ensure compliance with standards.

The Maintenance Engineer also reviews the work bank to create an annual plan for the volume of work that needs to be delivered. Using the current and historic work banks in Ellipse, the efficiency and quality of previous maintenance undertaken, along with failure trends and asset condition analysis using the Optram based system LADS, the Maintenance Engineer is able to make an informed decision on the maintenance, refurbishment or renewal requirements of an asset.

A Section Manager can reprioritize work 6 times; on the 6th reprioritization, the discipline engineer's review and approval is required.

Planners meet weekly to review the planning milestones and ensure no clashes have occurred between departments. Engineers are consulted on any major changes that are required.
With increasing maturity of the organization's processes, risk based maintenance can be undertaken based on the condition of an asset. This is underpinned by the Business Critical Rules. This allows local discipline engineers to make informed decisions and changes to the application of standard such as a change to the frequency of inspection of a particular asset following a risk assessment.

Within the Maintenance department, a Maintenance Planning Group is responsible for working with the various maintenance shops to review and update maintenance plans & PM schedules. The group meets weekly to review past work and planned work for the forthcoming week to properly allocate and schedule resources and tools. The group uses Maximo to plan and schedule work.

3.6.2.3 Maintenance Management

Tracking of maintenance activities and closing out work orders is lacking – largely driven by the resource levels and a lack of time. Improving the data would ensure a better work history is available to support lifecycle decisions.

The Maintenance department is responsible for maintaining all assets at the airport except for conveyances (elevators, escalators, and moving walkways), which are maintained by contractors. Maintenance foremen are responsible for tracking their work in Maximo. The Maintenance department classifies work into three major categories: emergency work (to be addressed immediately), corrective work (to be addressed as soon as possible), and preventive work (planned work).

Various stakeholders reported while all work is tracked, it may not be tracked against the appropriate asset but assigned to a high-level asset or a "catch-all" asset. This is due in part to time constraints but also due to the incomplete data set. While it is difficult to gauge a percent, when a full inventory is not known, based on our interviews, it was a general understanding that approximately 70% of the assets are captured in Maximo. As a result, the EAM records do not accurately represent the work conducted by the maintenance staff or the assets requiring the work. Stakeholders shared anecdotes on how prior failures could not be resolved quickly because according to the electronic systems, there were no assets at the location of failure, and the staff members had to review as-built drawings to try and identify assets in place.

Defects found using train-borne and manual ultrasonic testing are automatically loaded into a Defect Management System. The actions required are loaded into Ellipse, forming part of the work bank. Due to the investment in asset databases and the tools to analyze the data, Network Rail can make informed decisions on asset management policy by identifying the deterioration rates and failure modes of assets. The data and tools allow for root cause analysis to be performed and for trends to be identified and monitored.

London Underground (LU), United Kingdom
Fault tracking is managed through a comprehensive Fault Reporting and Corrective Action System (FRACAS). This system, which schedules repairs and monitors trends is integrated into the EAM information system. A feedback loop is provided wherein all faults are discussed and closed out at a morning meeting.

Bay Area Rapid Transit (BART), California
Strategic Maintenance Program (SMP) focuses on a reliability-centered maintenance program intended to gradually achieve more planned and scheduled maintenance, moving away from reactive maintenance. The data acquired from the program are used to inform maintenance cycle timings. As a result, the amount of time spent on unscheduled maintenance has gone from more than 80% to less than 40%. Also, scheduled maintenance has provided greater stability for staff work.

RailCorp, Sydney, Australia
Uses the RCM approach for its signaling and infrastructure assets to identify failure modes and mitigation tasks.

Dallas Area Rapid Transit (DART), Texas
Uses a modified failure mode, effects, and criticality analysis (FMECA) methodology to inform a comprehensive Reliability Centered Maintenance approach to defining maintenance requirements.

3.6.2.4 Maintenance Delivery

Asset performance is not currently tracked – improving this would also support optimized lifecycle decisions.

KPIs are in place to monitor work activities, but targets are not yet fully developed. Data quality is still undergoing improvements. Maintenance currently tracks work orders, both corrective and predictive, and has begun tracking other maintenance and work information in Maximo to help analyze maintenance performance. Asset performance, however, is not tracked. Maintenance has started to track failure cause for some work orders on certain assets. In this case, the foreman is required to identify the cause of failure before closing the work order. The Port does not currently have a comprehensive reliability-centered maintenance program but is starting to track reliability of some assets, specifically using Maximo's Asset Health Insights.

There is limited flow of information from contractors to the Port of Seattle Aviation Division – resulting in little knowledge of the work completed on port assets.

As noted above, the only major assets maintained by contractors are conveyances. Only minimal asset and maintenance data is shared with the Port from the contractors for these assets. Further, the data that is shared is not added to any of the Port's system, such as Maximo, and is only captured through electronic PDFs. The Port tracks service requests that come in for conveyance-related issues but again there is no link back to the unique asset.

3.6.2.5 Inventory Management

The Port of Seattle Aviation Division operates one central warehouse and over 30 satellite storerooms – this impacts the ability to track and maintain sufficient stock levels for all variations of parts.

The airport's Inventory Management group (also part of Maintenance) is responsible for overseeing the airport's inventory

NedTrain, The Netherlands
Analyzed and modified its vehicle wheel set maintenance criteria using a failure mode, effects, and criticality analysis (FMECA), resulting in improved preventive maintenance planning and a savings of 40% of associated maintenance costs.

Long Island Rail Road (LIRR), New York
Maintenance of Equipment (MofE) group introduced a modified failure mode, effects, and criticality analysis (FMECA) methodology to inform a comprehensive Reliability Centered Maintenance approach to defining maintenance requirements.

stock to support emergency, corrective, and planned work volumes. There is one central warehouse (approximately 50,000 square feet) and over 30 satellite storerooms scattered across the airport's property. For inventory, min/max levels are assigned and monitored in Maximo. Purchase orders are automatically generated when limits are reached. Monthly and annual cycle counts are conducted and the Port has also adopted the use of mobile devices for component tagging. All new assets are tagged with bar codes or QR codes. The airport reviews its spare part requirements and is working to minimize holding costs.

The Port of Seattle Aviation Division is improving their processes for managing parts obsolescence.

Inventory Management is also reviewing its obsolescence issues and recently implemented an annual inventory validation process to identify obsolete inventory and inventory that has not been used for more than a 12-month period. Through this process, the maintenance shops will request disposition of obsolete materials, and/or justify the need to keep materials that have had minimal usage. Further, it was noted that the Port assets vary greatly by manufacturer and manufacture year, making it difficult for Inventory Management to track and maintain sufficient stock levels for all variations of parts and components.

3.6.4 Recommendations

Recommendation	Description/Scope
Update/Develop Standardized Condition Assessment and Scoring Guidelines across All Asset Classes	Develop/update condition assessment and scoring guidelines for all asset classes. This includes establishing a condition scale and assessment framework for each asset class. The Port can build upon the condition assessment framework being used by F&I for facilities as a start, and update it for facilities using a more detailed hierarchy, a 5-point rating scale with definitions for each rating, and a way to incorporate maintenance data into the assessment. The framework can then be applied to other asset classes – which will require asset hierarchies, rating guidelines and a methodology to incorporate maintenance data. These guidelines can then be a part of a risk-based approach to investment decision making and prioritization. Applying a condition assessment methodology to all assets will ensure that the Port can consistently understand and compare the condition of its assets across the entire airport. Note: Updating/developing detailed asset hierarchies for all asset classes is recommended later in this section.
Conduct Condition Assessments across All Asset Classes	The Port should conduct comprehensive condition assessments on all assets at the airport (including updating condition for facilities with data older than four years) once consistent condition assessment guidelines are created. We also recommend that the Port store the condition data in Maximo to expand the use of the system from a maintenance tracking system to a true enterprise asset management system. The condition assessments will allow the Port to prepare more informed lifecycle management plans (a previous recommendation in this chapter) and a more informed capital plan. Understanding condition will also improve the efficiency of maintenance work prioritization.
Improve Asset Data	Improve the quality of maintenance records data in Maximo. This includes having an accurate record of each trouble ticket in Maximo, related work order(s), failure codes, remedy, when it was closed, and the amount of effort and materials required for the work order. This includes recording work to the lowest maintainable unit in the asset hierarchy along with the proper failure codes and remedy codes. We also recommend that any work orders that are not worked on (not conducted) are either left open in the system, or closed with a special code to indicate that the work was not conducted – and a reason for it (e.g. staffing limitations, not required due to asset's planned replacement, not required since a new inspection work order is open due to frequency, work recently performed) This will result in improved accuracy of data in Maximo and will allow the Port to move towards reliability-centered maintenance.
Update Process for Adding "Discovered" Assets in the Field	Update the process for adding new assets into Maximo when they are "discovered" in the field. The Port has assets that have been in place for over 70 years, and systems and records have changed over time. As

Recommendation	Description/Scope
	a result, sometimes assets are "discovered" in the field; assets are in place but there are no electronic records of the asset in Maximo or PeopleSoft.
Implement Reliability-Centered Maintenance Philosophy	Implement a reliability-centered maintenance philosophy, including performance and reliability KPIs for all assets. The Port does not currently conduct reliability-centered maintenance and is not tracking sufficient reliability data to properly identify maintenance needs. Through reliability-centered maintenance, the Port will have the ability to analyze past failures (including their causes and remedies), address systematic asset issues through maintenance or the CIP, reduce lifecycle costs, and reduce the amount of emergency and corrective work.
Develop Guidelines to Align Future Contract Maintenance Agreements with Asset Management Standards	Develop guidelines to align future maintenance contract agreements with the Port's asset management standards. This includes: 1) use of Maximo by contractors, 2) record corrective work in Maximo, 3) define PM and inspection programs for the assets, 4) perform condition assessments before and after the contract period, 5) develop formal asset management plans, and 6) conduct annual performance reviews and audits. This will improve contractor performance and compliance along with the assurance that assets are maintained and delivered in acceptable condition. Currently, the only major assets maintained by contractors are conveyances, which include elevators, escalators, and moving walkways. At this time, only minimal data is shared between the Port and the contractors for these assets, and the data is not added in Maximo or any other Port's systems.
Enhance Inventory Efficiency	Review current inventory levels, including what parts, components, and assets are stored in inventory. Ensure all inventory items are intentional and that obsolete parts are removed from inventory. Implement new procedures to continually monitor parts usage, min/max levels, obsolescence and other key elements of inventory management. This will allow the Port to maintain an inventory that is based on expected usage and its risk profile.
Update Obsolescence Strategy	As part of the asset class strategies, review the risk of obsolescence on components and assets and establish strategies for mitigating the risk through campaign overhaul, asset replacement or revised operating procedures.

3.7 Operations and Fault Management

The Port of Seattle Aviation Division is graded as COMPETENT in the *Operations and Fault Management* assessment area.

The Operations and Fault Management pathway assesses the organization's practices related to asset operations and the capability of the organization to identify, respond to, and manage asset incidents. The pathway also considers the processes related to business continuity planning in the event of an incident.

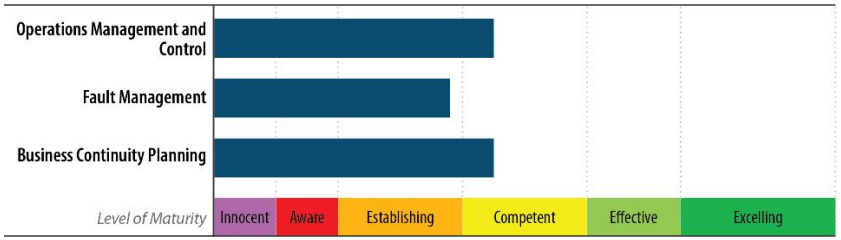
Three quality areas are assessed:

1. Operations Management and Control: Assesses the extent to which the organization has established strategies, policies, and procedures for the management of asset operations, including consideration of access and operational demand management during maintenance outages.
2. Fault Management: Assesses the extent to which the organization has defined processes and practices for fault identification, response, management, investigation, and close out. It also considers the extent to which costs and claims related to the faults are managed.
3. Business Continuity Planning: Assesses the extent to which the organization has established strategies, policies, and procedures that consider an appropriate range of threats and risks and establish management action plans to ensure asset operations can continue or can rapidly return to normal function in the event of an incident.

3.7.1 Assessment Summary

Figure 3-8 shows the level of maturity for the Operations and Fault Management assessment area. Overall, the Port of Seattle Aviation Division scored well in this area. It was noted, however, that an agency-wide asset criticality framework does not exist and therefore should be a key priority. This framework will not only support maintenance prioritization but also provide a more comprehensive input into and alignment with the capital plan.

Figure 3-8: Operations and Fault Management Assessment Results



3.7.2 Key Observations

3.7.2.1 Operations Management and Control

While operational needs take priority, the Port of Seattle Aviation Division does have processes for managing outages and shutdowns.

Operations at the airport are categorized into three areas based on location: airfield (taxiways, runways, etc.), landside (public roads, parking garage, drop-off area, etc.), and the terminal (operations inside the terminal). Shutdowns for preventive and corrective maintenance are performed when needed with priority given to operational needs. For major outages that impact airfield operations (e.g., runway, taxiway, and apron work), preventive work is coordinated between maintenance and operations through a pre-planned scheduling process.

In most cases, Operations employees are responsible for entering work requests directly into Maximo, when issues are identified. The Maintenance department is then responsible for reviewing the work requests, and if Maintenance identifies the issue as something it cannot fix due to complexity or scope, the responsibility falls back to Operations, which then typically is addressed through Operations budget or capital projects. The Port does not have a defined framework to prioritize most critical work based on the asset function, other than by the three location-based areas. This may prevent work from being conducted in the most effective manner to reduce operational or other risks.

With no asset criticality processes in place, priority is typically given to the airfield assets.

Typically, priority is given to the airfield assets, primarily because of Federal Aviation Administration (FAA) regulations. There is no consistent asset criticality framework across the agency for all assets. As a result, landside assets may not be addressed in a timely fashion or at all.

3.7.3 Best Practice Benchmark

Gatwick Airport London

There has been a change in the way the business is driven, with operations taking a much more significant role in contributing to setting the direction for asset management decisions that ultimately support service delivery. There is the recognition that operations is the final service delivery interface with the customer, and the business is entirely dependent upon retaining customers.

Dallas Area Rapid Transit, Texas

DART has a preventive maintenance schedule for its asset. In addition, DART uses a predictive failure modelling tool, RelCode, which is applied to a subset of assets and then used to analyze the failure of all assets.

Network Rail, United Kingdom

All incidents and failures are logged in a Failure Management System to be reviewed and analyzed.

A hierarchy of approvals is used to manage last minute changes to the plan with safety always taking priority. This requires liaison with stakeholders and train operating companies.

Merseyrail, United Kingdom

Introduced a defect reporting system that prompts train operators to report defects as part of the shift sign-off process together with a culture change training program to encourage more accurate information capture. This resulted in an 84% improvement in performance.

3.7.2.2 Fault Management

The airport has well-defined processes for responding to faults/incidents.

Airport Duty Managers and Operations Supervisors are trained to handle and report incidents appropriately. All incidents are called into the Airport Communication Center and are then documented in the Port's incident tracking system, Origami. Airport Duty Managers are also responsible for contacting the authorities based on the level of severity. Incident response processes appear widely understood across the airport. Staff and tenants are alerted via email and mobile phones as necessary. The public is made aware of incidents through the airport's public-address system, local news media, and the Port's website.

The Port of Seattle Aviation Division investigates incidents in a timely manner and seeks ways in which future incidents can be avoided.

The Port has both a hazard and incident reporting portal and detailed processes to review and address these issues. Adjustments to preventive maintenance occur on a case-by-case basis after particular failures but not systematically. Results from incident investigations are sometimes communicated to relevant stakeholders; however, frequency varies and it is not done consistently. Recording and tracking asset information related to incidents is improving, but currently there is no integration between Maximo and Origami (linking incident data to specific assets).

3.7.2.3 Business Continuity Planning

Established Business Continuity Plans exist.

The Port has a Contingency of Operations Plan (COOP), which outlines the agency's strategy, policies, and procedures in the case of major incidents, threats, and risks to operation. The plan is available to all employees and routinely updated. The plan includes action steps to ensure asset operations can continue or can rapidly return to normal function in the event of an incident.

3.7.4 Recommendations

Recommendation	Brief Description
Develop Asset Criticality (Consequence of Failure) Criteria	Identify the assets that are most critical to the Port, understanding the consequences of failure and informing a risk-based approach to prioritization. This framework should include a scoring and ranking methodology for social, financial, and environmental impacts, as well as a methodology for assessment of system redundancy to factor into risk calculations. This risk/criticality score should then be embedded in Maximo to help prioritize work when issues arise. This will not only support maintenance prioritization but also provide a more comprehensive input into and alignment with the capital plan.

3.8 Informed Decisions

The Port of Seattle Aviation Division is graded as ESTABLISHING in the *Informed Decisions* assessment area. Asset Information is the area with the most opportunity for improvement.

The Informed Decisions pathway assesses the extent to which an organization has established requirements for, developed, maintained, and provided access to asset and asset management-related information to support whole life decision making.

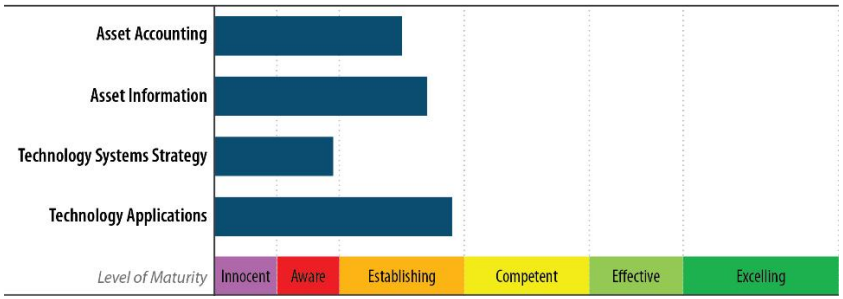
Four quality areas are assessed:

1. Asset Accounting: Assesses the organization's approach to asset valuation and the extent to which the organization captures costs related to asset management activities, including maintenance and capital spend.
2. Asset Information: Assesses the extent to which the organization has defined, developed, captured, and maintained information about the asset and about asset activities. It also considers whether data standards and governance have been put in place.
3. Technology Systems Strategy: Assesses the extent to which the organization has developed and deployed a technology strategy for integrating various applications to support effective asset management.
4. Technology Applications: Assesses the extent to which the organization has implemented effective finance, human resources, procurement, materials management, asset planning and scheduling, and asset management technology applications.

3.8.1 Assessment Summary

Figure 3-9 shows the level of maturity for the Informed Decisions assessment area. The Port has a dedicated IT team that supports the various departments across the agency and is guided by a detailed IT strategy and development roadmap. While the Port has up-to-date systems, there is little to no integration between systems. Further, asset data is not consistent and incomplete across departments and maintenance shops.

Figure 3-9: Informed Decisions Assessment Results



3.8.2 Key Observations

3.8.2.1 Asset Accounting

Consistent definition of an "asset" would improve cross department integration.

A core component of asset management – the definition of an "asset" is not consistent. Maintenance and finance use definitions that are different and there is a need to align them and communicate it widely among the Port.

The Accounting department uses PeopleSoft to track assets. Useful life indices are assigned by Accounting which may not be applicable to the assigned asset and may not align to the expectations of maintenance.

The Port has multiple asset inventories, all tracked in different systems (Maximo, PeopleSoft, etc.) and managed by different departments. The Accounting department uses PeopleSoft to track the airport's fixed assets. Assets are defined by Accounting as a physical item that:

- Is owned by the Port of Seattle
- Has a useful life of 3 years or more
- Has a total capital project cost of $20,000 or more

Assets are booked in PeopleSoft during onboarding as part of the Port's asset plans. Further, the Accounting department is responsible for assigning the useful life to the fixed asset based on a list of predefined asset profiles. These asset profiles, similar to asset categories, all have an associated useful life that then gets applied to the asset during onboarding. The useful life may not be applicable to the actual assigned asset and, in many cases, the asset profiles do not cover all types of assets at the airport.

Not all assets are included in PeopleSoft, it was estimated that only a third of the airports assets are considered by finance.

Accounting also oversees an annual inventory update of approximately one-third of the airport's fixed assets. Accounting

3.8.3 Best Practice Benchmark

Denver International Airport

Is implementing an Enterprise GIS and notes three elements critical to the success of new information systems roll out—communication, training, and incentives. Denver is also using Maximo's route capability as a means to improving productivity by avoiding missed PMs and ensuring that all assets are managed.

Miami International Airport

Is introducing a detailed cost accounting structure to enable typing costs to the provision of a service (e.g., linking facility management costs to the user of a leased space within the airport terminal). This also enables the identification of preventive maintenance that is appropriately cost justified.

Gatwick Airport London

Intelligent monitoring techniques have been introduced as part of the refurbishment of a bridge over the railway. This bridge will have built-in condition monitoring to avoid some of the need for railway possessions to undertake inspections.

Greater Toronto Airport Authority

The Authority requires that all as-built project data be delivered to the agency's data center in accordance with pre-established CAD and GIS position standards. This includes all buildings, paved surfaces, fence lines, utilities, etc.

Has a fairly advanced system in place for information management. The airport has recently gone through a major development program replacing two of the three original terminals, adding a new runway, central de-icing facility, and associated taxiway and apron development. The asset inventory is managed using Oracle Spatial and CAD, and good standards are in place to maintain this information.

distributes Microsoft Excel spreadsheets to the various asset owners, who are then responsible to populate the spreadsheets with basic asset information. The annual updates are focused on assets that are listed in PeopleSoft. As a result, assets not listed in PeopleSoft are not verified. Based on our conversations with stakeholders, it is widely believed that about 30% of the Port-owned assets (using the Accounting definition) are not in PeopleSoft.

Asset lifecycle costs are not available as the Port of Seattle Aviation Division lacks the data structure and tools to capture costs at the asset level.

In most cases, documented asset lifecycle costs are not available because departments lack the structure and tools to capture and report full lifecycle costs for assets. The information that is collected is contained in separate, unintegrated spreadsheet files (rather than a single asset inventory), often on paper, and is incomplete for purposes of asset management. Work conducted on assets is recorded in Maximo, but as previously reported the data is not always accurate (e.g., work orders show as "complete" when they were "closed" because of elapsed time or reasons other than the work being done, and work orders reported against high level asset codes rather than actual assets due to inaccuracy in the inventory data).

A similar position was observed with capital costs; project costs are accurately tracked; however, they are not allocated to individual assets within a project.

Actual capital costs are captured at the project level and are not allocated to individual assets within a project. Understanding the cost breakdown for multiple asset purchases as part of one project is difficult. More could be done to capture a more detailed breakdown of capital acquisition costs of assets.

Uses ProjectWise software for content management and collaboration with all parties requiring access to asset data. Data records are nearly 100 percent complete for all recent development.

London Underground (LU), United Kingdom
Asset registers are available for all assets (with component and subcomponent level available for complex assets). The asset inventory also records data collection protocols.

Long Island Rail Road (LIRR), New York
The Maintenance of Equipment unit developed asset hierarchies for fleet down to the lowest maintainable item, initially to support fault analysis and maintenance scheduling. Over time, the hierarchies have been further developed to support more comprehensive reliability centered maintenance

Swiss Federal Railways (SBB CFF FFS), Switzerland
Asset-specific files, such as drawings and equipment configuration details, can be linked to the integrated asset information management system

Network Rail, United Kingdom
After failing to justify the level of funding it sought, Network Rail invested heavily in upgrading its asset management databases. Using an Optram based system which linearly maps multiple data streams, the asset policy can be assessed and changed based on quality data and failures trend analysis leading to a clearer understanding of whole life costing.

Use of Ellipse as the EAM information system (after many years of development) is central to agency's business (maintenance, capital, financial, etc.) and information/data drives functions
Ellipse is used to manage the work bank/scheduled work and captures productivity, maintenance unit cost, and previous work

3.8.2.2 Asset Information

The Maintenance department use the EAM system Maximo to manage asset activities. Not all assets are included in Maximo, it was estimated that about 70% of the airports assets are included.

The Maintenance department primarily uses Maximo to track the maintainable assets at the airport. An asset is defined by maintenance as something that:

- Is tangible property or component (regardless of its financial value)
- Requires regular maintenance (or is identified as 'run to fail' item)
- Gets repaired upon failure

It is widely believed that about 70 percent of the airport's assets are listed in the system. This number could be as low as 50% for underground assets, and as high as 99% for fleet assets, with other assets somewhere in between.

Outside of Finance and Maintenance – other departments have generated lists of assets and asset information to support their business needs.

F&I uses Maximo and PeopleSoft assets to populate its Microsoft Excel spreadsheets that are used to record the condition of those assets. The condition data is used as an input into the capital improvement program for asset renewals and replacements. Other departments, such as the Enterprise Risk Management group, have their own list of assets for tracking purposes in Origami Risk.

ESRI ArcGIS is being implemented but is not at the stage where it is fully integrated. GIS records are not consistent with other systems.

The Port uses a ESRI ArcGIS as its geographic information system (GIS), but it is not yet fully integrated to meet the division's asset history which allows engineers to review and authorize reprioritizing of jobs in the work bank

RailCorp, Sydney, Australia
For financial management of its assets, an Ellipse system relates cost information to asset management work, allowing the agency to conduct lifecycle cost analysis

Metropolitan Atlanta Rapid Transit Authority (MARTA), Georgia
Employs a systems approach in which asset hierarchies, inspections, and maintenance activities are directly related to the overall performance of the MARTA system, as well as to demonstrate compliance with regulatory requirements.

Washington Metropolitan Area Transit Authority (WMATA), D.C.
Employs the Maximo EAM system, with the Asset Configuration Manager, which facilitates performance measurement propagation to asset components, tracks life usage of repairable components, and alerts maintenance based on mileage thresholds. It also provides a view of an asset's availability based on configuration and maintenance, and can be linked with Optram for right-of-way asset visualization. WMATA undertook a trial project with the use of mobile devices and is currently expanding the trial over a much broader area.
Utah Transit Authority (UTA), Salt Lake City, Utah
Uses a comprehensive asset management system that includes three modules: an inventory module, which is a GIS based system of all critical assets; an inspection module that allows for paperless uploading of inspection results; and a budget module that correlates replacement and rehabilitation costs with deterioration models to provide financial projections

management needs. Currently, the GIS maps are populated by using data from the Engineering department (based on GPS coordinates in their engineering drawing). The GIS records are not consistently linked to records in Maximo or PeopleSoft.

Additional asset data – including master record drawings – are not all available digitally.

The Port also maintains master record drawings, but not all drawings are available digitally, and the assets shown on the drawings are not labeled on the field with a common number to identify them. As a result, staff members spend valuable time identifying the asset during emergency or other work. The Port uses some asset monitoring systems, specifically in support of its HVAC mechanical systems. It does not currently use SCADA or other monitoring systems to monitor its other assets but would like to in the near future.

Asset data is not consistently structured. The lack of an asset breakdown structure (asset hierarchy) impacts the roll-up of cost information, failure analysis and other analytical capabilities to support asset management decisions.

Due to these multiple systems, there is no one "source of truth" for asset data at the airport. Furthermore, assets in PeopleSoft cannot be easily "linked" to assets in Maximo since they do not follow a similar classification system (a hierarchy). The Port does not have a standard asset hierarchy that identifies parent-child relationships between assets, which makes reconciliation between the systems difficult. Each department and maintenance shop may have its own way of classifying assets, but there are no Port-wide standards. For example, Maximo asset records for plumbing follow a different classification than the records in F&I's condition assessment workbooks that have a combination of PeopleSoft and Maximo records.

Massachusetts Bay Transportation Authority (MBTA), Boston, Massachusetts

The state of good repair database provides a comprehensive inventory of the agency's transit assets and calculates the current state (i.e., the backlog – total cost to renew or replace those beyond useful life). It also identifies measures/funding levels to remove the backlog and analyzes impacts of funding and policy scenarios.

MTR, Hong Kong

The agency's Enterprise Asset Information System is used at all phases of the supply chain and records all maintenance activity, providing consistent information throughout the supply chain and across assets. The EAM system is linked with Oracle Financials, which is where unit cost information is stored.

Regional Transportation Authority (RTA), Chicago, Illinois

A decision support tool guides state of good repair priorities, using multi-criteria decision analysis, assigning weights to each criterion and then taking the weighted average to score a candidate project. The criteria considered include asset age and condition, riders impacted, service reliability, safety and security, and operating and maintenance costs.

A digital strategy should be developed to establish a path for how the application of technology and information can be used to improve the Port of Seattle Aviation Division's performance.

While asset information is available and captured throughout these various systems listed here, the data is siloed and employees typically do not know how to access the information. Employees have varying levels of access to these systems, also making it difficult to obtain. Additionally, it was acknowledged that information is not always available to support asset management decisions.

A digital strategy should be developed to focus on the use of asset and asset related technology and information to drive more efficient and effective decisions and management actions through the assets lifecycle.

A digital strategy also provides the first level of data governance, establishing both the landscape of information that needs to be made available and the functional requirements for technology to support full use of the information.

The digital strategy DOES NOT EQUAL an IT Strategy. An organization's IT strategy focuses on technology enablement for existing practices. IT strategies treat technologies in isolation and do not define the information requirements. Instead IT strategies focus on software and application strategies, hardware strategies, cloud and mobile strategies to better support existing practices.

Data governance processes for managing asset information need to be developed.

Standards for asset information were found to be lacking. An asset information standard should be developed that sets out how information will be structured and maintained, what information should be collected, how it should be collected and how it will be accessed.

3.8.2.3 Technology Systems Strategy and Technology Applications

The Port of Seattle Aviation Division utilizes various "best of breed" commercial systems to support its business.

An application architecture for asset management-related systems is presented in Appendix A. The primary systems related include:

- Oracle PeopleSoft for accounting and finance (Enterprise Resource Planning)
- IBM Maximo for maintenance management/asset management
- Origami Risk for risk management
- ESRI ArcGIS and Open Source for GIS
- PROPworks for property and tenant revenue management
- Tableau for reporting

The Port does not license a Building Information Modeling (BIM) software, though various vendors have provided BIM data to the Port using Revit BIM, Autodesk BIM 360 and/or other software.

The lack of system integrations results in a need for manual reconciliation of data which is both time-consuming and introduces data accuracy risks.

The biggest limitation for asset management is that these various systems are not linked through interfaces. The data between the systems has to be reconciled, shared or aggregated manually. This results in the Port possessing a lot of data, but without the ability to easily analyze the data to make more informed decisions.

The Port IT group has a well-defined systems strategy that tracks the software versions, maintenance agreements and other information, and ensures that systems are upgraded regularly. As a result, the software versions of the key systems in use are being actively supported by the manufacturers. The IT group considers other departments its clients, and is always working on ensuring that its clients have the right tools to efficiently and effectively do their jobs.

3.8.4 Recommendations

Recommendation	Description/Scope
Create Common Asset Definition	Create a common/consistent definition of an "asset" that is used across the Port, linking the financial and maintenance definitions. The definition of an "asset" is critical to establishing a consistent understanding of "asset management" across the Port and ensure that related processes are all aligned. The different "asset" definitions in maintenance and finance lead to inconsistencies in how stakeholders understand assets and asset management. A common definition will also ensure consistency of asset referencing and naming conventions across departments.
Digital Strategy	Develop a digital strategy to focus the use of asset and asset related technology and information to drive more efficient and effective decisions and management actions through the assets lifecycle. A Digital Strategy also provides the first level of data governance, establishing both the landscape of information that needs to be made available and the functional requirements for technology to support full use of the information.
Establish Data Governance Standards	A data governance framework for Port of Seattle asset management including policies, processes and procedures for the capture, management and control of asset related information should be developed. These should include both asset attribute and condition/performance information. This will also support a more effective asset creation/handover process.
Update/Develop and Implement Enterprise Asset Hierarchies	Update/develop and implement formal asset hierarchies (asset, process area, system, sub-system, etc.) along with applicable attributes consistently across all airport infrastructure. We recommend starting with the existing hierarchies for facilities and updating them based on best practices. The Port should develop hierarchies for other (non-facility) assets using best practices from other agencies with similar assets. Implementing asset hierarchies (along with prior recommendation to have a common asset definition) will allow the Port to setup data consistently in different systems, and allow for easy analysis of this information. For example, PeopleSoft may list a facility and its key systems (e.g. HVAC), while Maximo may break down HVAC into various other assets (down to the lowest maintainable unit) – but the data could be collated, reconciled, shared and analyzed easily. Further, the asset hierarchies are required to implement other recommendations such as identifying most critical assets and conducting a comprehensive condition assessment.

Recommendation	Description/Scope
Conduct Airport-Wide Asset Inventory Collection	Conduct an airport-wide asset inventory collection. This inventory should identify assets that are visible (above ground) through a physical review/check, and assets that are invisible (belowground) by using as-built drawings and any other available information. The airport assets are currently not clearly identified in any one system, and it is widely accepted that the Port of Seattle Aviation Division has documented about 70% of the assets it owns. An inventory of all assets (in conjunction with standard asset hierarchies) will ensure that conducted work is assigned to the correct assets, allowing the Port to track the assets, their condition and their performance more accurately.
Align and Integrate PeopleSoft/Maximo	Improve alignment and integration between PeopleSoft assets and Maximo. This will allow for automated transfer of information, reduce data duplication or data entry errors, allow for easier tracking of current asset value and expected life and plan for replacements. The Port should also review its overall application architecture to identify other opportunities for integration.
Integrate GIS with Maximo	Integrate Port's GIS systems with Maximo. This will allow users to view asset location graphically and identify certain trends more easily. It will also allow users to identify root causes of issues easily and address critical faults faster. Currently, the GIS maps are populated by pulling data from the Engineering department (based on GPS coordinates in their engineering drawing) and the data is not integrated with Maximo.
Develop Electronic Master Record Drawings	Develop a comprehensive set of electronic master record drawings for the entire airport that can be easily accessed from a computer or tablet. Currently, master record drawings are not all available electronically, and the assets shown on the drawings are not labeled on the field with a common number to identify them. Improved access to these master record drawings (combined with viewing data on a map and consistent hierarchies) will allow staff to locate assets more efficiently as well as improve work response time.
Assess/Enhance SCADA/Asset Health Monitoring Systems	Perform a comprehensive assessment and develop an improvement plan for SCADA/automated asset health monitoring system(s) for key equipment/assets (elevators, escalators, boilers, chillers, etc.). The airport does not currently use SCADA to monitor its assets but does use some asset monitoring systems, specifically on the HVAC mechanical systems. The use of these asset monitoring tools can greatly improve efficiency in monitoring their condition, maintaining assets as well as reduce failure/breakdown rates and inspection/ maintenance costs.

3.9 Resource Capabilities

The Port of Seattle Aviation Division is graded as ESTABLISHING in the *Resource Capabilities* assessment area.

The Resource Capabilities pathway assesses the extent to which the organization understands resource requirements and has established an organization that is aligned to deliver the asset management activities to ensure it successfully achieves its organizational goals.

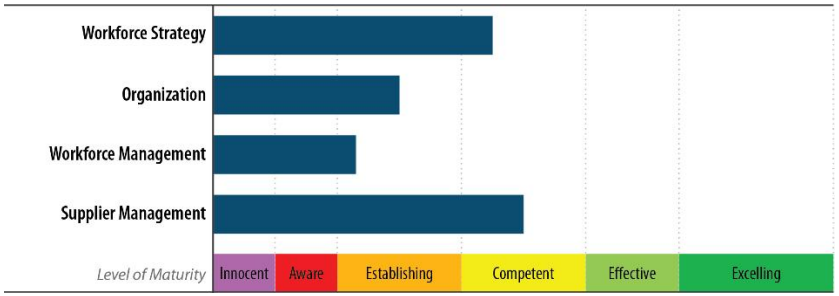
Four quality areas are assessed:

1. Workforce strategy: Assesses the extent to which the organization has reviewed its workforce needs and established strategies for delivering its asset management objectives and strategies.
2. Organization: Assesses the extent to which the organization has clearly defined the roles and responsibilities related to asset management and how it considers the value and culture in introducing management changes and improvements.
3. Workforce Management: Assesses the extent to which the organization has processes and practices for succession planning, skills development, and competency/certification management.
4. Supplier Management: Assesses the extent to which the organization has established processes and practices for the successful management of suppliers (vendors and contractors).

3.9.1 Assessment Summary

Figure 3-10 shows the level of maturity for the Resource Capabilities assessment area. In terms of asset management, the Port does not have a set of dedicated roles and responsibilities for asset management. Further, there is no asset management training nor communication plan to convey asset management benefits and goals across the agency. Going forward, it will be important to ensure employees are well aware of asset management, its key benefits, and how asset management fits into their specific job responsibilities.

Figure 3-10: Resource Capabilities Assessment Results



3.9.2 Key Observations

3.9.2.1 Workforce Strategy

A study to establish the right level of resourcing is necessary.

All asset classes and F&I, engineering and maintenance functions reported both manager and technical staff shortages. While processes are in place to review resource levels, it can be difficult to match the needed number of employees across departments. Remedying this is particularly necessary given the aging assets at the Port (which require more attention) and the construction of newer assets (which will require additional manpower).

Asset management is innately integrated – a steering committee should be established to oversee improvements.

There also is no overarching role dedicated to directing and managing asset management comprehensively across the airport. A steering committee should be established to ensure the needs of all users is considered.

3.9.2.2 Organization

There was some confusion between the departments regarding roles and responsibilities for asset management.

While a few positions focus primarily on asset management at the airport, in most cases these responsibilities are still "secondary" and asset management roles and responsibilities are not clearly defined. Currently, in terms of asset management responsibilities, F&I is responsible for tracking asset condition and identifying asset renewal/replacement, and Maintenance is responsible for tracking and monitoring the maintenance of the airport's assets. Maintenance has a few positions dedicated to asset management, including an Asset Manager who is responsible for asset data and integrity in Maximo. Further, F&I is currently seeking an Asset Manager of Renewal and Replacement.

3.9.3 Best Practice Benchmark

Gatwick Airport London

The responsibility for implementing the asset management system rests with the chief operating officer (COO). The head of asset management supports the COO and is responsible for project definition, providing maintenance, operations, and integration services for the full project lifecycle. The COO signs off on these projects.

Brisbane Airport

Brisbane Airport outsources the majority of the design and procurement of infrastructure assets. To limit the risk to the organization, quality assurance measures are in place to ensure the quality of contract documentation and specification, and to ensure the quality of contractors. Contractor performance is assessed in terms of safety record, relationships with stakeholders, and consistency in performance. An approved contractor database is maintained.

Greater Toronto Airport Authority

Uses performance-based contracts, for example, their baggage handling system operation and maintenance contract is evaluated on availability daily, and a monthly contract payment factor is determined and applied to contractor invoices.

Network Rail, United Kingdom

Each discipline (Track, Signaling, Electric Traction) is led by an engineer with clear roles and responsibilities including safety of the line.

There clearly is a desire to implement asset management at the airport.
Most employees are aware of the purpose and value of asset management but cite the need for dedicated staff as a major hurdle to improvements. Overall, employees are keen to see improvements made to planning, scheduling, and management of assets, as well as access to data and information that supports the execution of their job. That said, there is no governance structure to help with asset management improvements, which can significantly hinder progress on improvements.

Internal communications processes for asset management were cited by staff as being a major gap.
Communications with respect to comparing and prioritizing asset needs across departments using a common platform is crucial and does not currently exist as best practice. Further, there is no consistent message around asset management and its impacts to the Port. While most employees understand the concept of asset management, there is no ongoing means to communicate progress and its benefit to the organization. Employees acknowledged the need for staff to coordinate across departments and functions for asset management to be successful. With that said, the Port clearly communicates its overarching organizational strategy and priorities to its employees. This is good practice and will provide a solid avenue to introduce asset management communication.

3.9.2.3 Workforce Management

Currently, there is no regular training for asset management, either introductory or ongoing.
The Port of Seattle Seaport Division, however, has begun to implement asset management training with its employees, which could be easily transferred to the airport as appropriate. The Aviation Division regularly conducts operation and maintenance training for its assets, and these procedures are well-documented.

Organization:

- Clear accountable roles and responsibilities
- Frontline staff receive asset management analysis tools to help them assess the asset and improve performance using the latest mobile technology
- Budget responsibility for each route is managed by a Route Director who is accountable for expenditure.
- Local Section managers have core responsibility for maintenance refurbishment delivery. Section managers have resources, including planners who report directly to them.
- Maintenance Engineers have overall accountability and high level influence on resources and budgets. They are responsible for identifying renewal requirements of assets which are submitted to the Route Asset Manager.

Workforce:

- Apprenticeship and graduate programs
- Promotes people based on skills and ability as per a skills competency matrix instead of seniority
- Is employer of choice, perception of good jobs/benefits, skilled people
- Offers choice of potential career advancement paths; provides coaching, mentorships
- Works with the unions to support change; focus on what changes are happening, what's good for the industry and what's best for union members
- Developed its own values and leadership training to help all levels of staff understand the organization and to create a teamwork environment
- Annual succession planning effort. A plan is created for all vacancies; succession plans consider each individual currently in the role and the career goals of candidates for those positions

A formal succession planning program should be established that also considers the needs of the future.

The Port does not have a formal succession planning program; however, managers and supervisors are aware of the skill gaps and current employee attrition. Further, the Port does not have any formal knowledge management techniques in place, but managers and senior leaders do consult with other airports informally to capture best practices and apply this knowledge to their roles. The airport is looking to implement a more formalized program for knowledge capture and transfer across its staff.

3.9.2.4 Supplier Management

Existing contracts lack requirements for the provision of information.

The Port has well defined processes in place for contracting, managed by its central procurement office. The asset-management specific contracts to maintain elevators, escalators and some other assets do not provide details on the maintenance work conducted to the Port in an easy to analyze electronic format. Reviewing future contracts, (while considering authority having jurisdiction (AHJ) requirements for the Port's Maintenance Control Program (MCP)), to obtain necessary asset data will allow the Port to store an asset's history and use it to move towards reliability-centered maintenance in the future.

- Competencies are held in a database. Can scan an ID card and see the competencies of that person in order to determine whether or not they have the qualifications to do the work

SMRT, Singapore

Cultivates a sense of ownership among its staff by ensuring staff understand how their work is helping to achieve SMRT's corporate objectives

Bay Area Rapid Transit (BART), California

Includes staff in discussions and cultivates a sense of ownership; through this collaborative approach, staff provide helpful improvement suggestions regarding maintenance and work stations Instituted a training program for staff, and established a reliability performance effort, encouraging teams to take responsibility for their work.

London Underground, United Kingdom

Similar in some ways to Network Rail, has appointed 'Professional Heads' for each asset discipline. Their role is to ensure the expected performance resulting from operating and capital programs is achieved -- and where not, to ascertain the reason. LU's Professional Heads work to review asset condition and performance and recommend changes to the capital and maintenance divisions to ensure performance. This can also include changes to capital design to ensure recurring issues are addressed. They also work to understand current and future technologies and consider how these may be deployed within the organization.

3.9.4 Recommendations

Recommendation	Description / Scope
Undertake a Workforce Resource-Level Study	A study should be conducted to determine resource requirements across departments. This should be consistent with the asset management plan development, which will forecast needed work. The study should then determine what resources are needed to deliver this work (i.e., focus on the work needed for an asset to deliver the service, and then the resource needs to support this) including both capability and capacity requirements to support asset management activities.
Establish a steering committee	A steering committee should be established to ensure all departments needs are addressed through the development and delivery of the asset management improvement program.
Establish Asset Management Leadership & Authority	An asset management leader should be appointed within the Port of Seattle, with overall responsibility for establishing, managing and monitoring the effectiveness of the asset management system. In addition, asset class leaders should be appointed, who have overall through life planning responsibility for the assets under their control. Management performance reviews should include goals for improving the management of assets, including reducing costs, risks and increasing performance and should not focus on productivity.
Develop and Define AM Roles and Responsibilities	Define an organizational structure and clear roles and job descriptions for asset management across the Port of Seattle (specifically at the airport). This should include developing a position for overall AM coordination and implementation across the airport. By developing key asset management roles and responsibilities, the Port will begin fostering a more asset-focused culture along with a shared understanding of how asset management is integrated across the agency and among individual roles. This recommendation, in conjunction with defining asset owners (recommended earlier in this chapter) will ensure a clear understanding of roles and responsibilities, and the part various stakeholders play in managing the assets efficiently.
Develop EAM Stakeholder Engagement Plan	Develop an EAM stakeholder engagement plan, including identifying stakeholder groups and their requirements with regard to asset management. This includes creating the best channels for communicating with each group, and executing stakeholder awareness and involvement strategies beyond the gap assessment project. We also recommend developing and implementing a robust communications strategy for engaging all airport staff at all levels in considering their respective individual roles in achieving the benefits of improved asset management.
Develop Introductory and Ongoing Asset Management Training	Develop the material and implement asset management training for employees. Currently, there is no dedicated training for asset management; however, the Port of Seattle Seaport Division has begun to

Recommendation	Description / Scope
	implement this type of training, which could be applicable to the Aviation Division. A more complete asset management training program will help improve asset management awareness and understanding across employees, as well as increase employee engagement around asset management implementation.
Review Contract Language	Contract language should be reviewed to ensure it fully aligns to the strategic asset management plan. This will ensure that information is made available to the Port to inform long-term decisions on assets managed by contractors.

4 Recommendations

Forty-five recommendations were identified through the gap analysis exercise. These recommendations will inform the development of the Port of Seattle Aviation Division's asset management improvement program.

4.1 Recommendations

Table 4.1 lists all the recommendations identified across the eight assessment areas, or pathways.

Table 4.1: Port of Seattle Aviation Division Asset Management Recommendations

No.	Recommendation	Pathway	Description/Scope
1	Review and Update Asset Management Policy	Alignment to Organizational Goals	The Aviation Division should review, support and communicate the Port of Seattle's Sustainable Asset Management Policy at the earliest opportunity to demonstrate commitment to developing asset management maturity. This will send a positive message to the business.
2	Develop a Strategic Asset Management Plan	Alignment to Organizational Goals	Develop a comprehensive strategic asset management plan setting the direction for how the agency and its departments will manage the public's investment in its assets consistent to the agency's overall asset management policy. While asset management is well understood at the Port, there is no formal document that identifies the plan/direction for the Port's asset management program. A strategic asset management plan will establish alignment with the agency's strategic business objectives, explain the benefits, the roles of various stakeholders, and ensure that all Port divisions have a clear understanding of a path forward.
3	Develop Asset Management Objectives	Alignment to Organizational Goals	Asset management objectives should be developed. A series of measures should be developed, aligned to the strategic goals of the Port, that monitor progress toward meeting division-wide strategic goals for undertaking and improving asset management activities.

4	Integrate Business Planning Processes with Asset Management	Alignment to Organization Goals	Integrate the strategic asset management plan outputs with the business planning process – to ensure that the long-range plan considers the state of repair of existing assets, and their ability to support stakeholder needs and Port objectives.
5	Develop Asset Management Business Architecture	Control of Assets	Develop the Port of Seattle business architecture to support the integration of multiple planning horizons and align organization strategic objectives with asset class tactical demands.
6	Develop Asset Management Business Processes and Procedures	Control of Assets	Develop and document key business processes and procedures for the whole-life management of assets. These should include the integration between existing long-term planning efforts and tactical asset planning efforts, as well as the development of processes for integrating risk management in the planning cycle. The architecture should also consider the transition of assets across life-cycle stages – such that any changes to the asset or asset management are controlled.
7	Define Asset Owners	Control of Assets	Develop and define owners of various assets as an extension of defining roles and responsibilities. Upon the completion of capital projects, an asset transfer form is completed to transfer the ownership of the asset from the Project Management Group to the appropriate division that will serve as that specific asset owner. However, there is no documented, comprehensive list identifying asset responsibilities by department or class during construction, maintenance or disposal. This includes, among others, responsibilities for defining design and construction standards, asset onboarding, defining an asset lifecycle plan, tracking all work on the asset and conducting reliability analysis on assets. Defined asset ownership will ultimately improve the relationship and collaboration between various departments.
8	Create an Asset Class Common Framework	Control of Assets	A common framework for asset class procedures should be developed setting out the minimum documentation requirements for each asset class. This should be consistent with current operating requirements and ISO-55001:2014. Existing asset class specific procedures should be reviewed against the developed common framework. Procedures for operations, maintenance and management should be developed to satisfy both the common framework requirements as well as asset class specific requirements.

9	Establish an Audit Program for the Asset Management (AM) Management System	Control of Assets	An audit program should be established to monitor the performance and consistent application of the asset management – management system. This will be a key driver for ensuring changes to the way the Port manages assets are consistently applied and that any issues can be addressed as part of a continuous improvement program.
10	Develop a Risk Management Framework	Control of Assets	An Enterprise Risk Management Framework should be developed. The framework should include a risk policy, risk management procedures and the process to develop a risk register. The procedures should consider how risks are identified, evaluated, monitored and when risks should be escalated.
11	Develop Asset Management KPIs	Control of Assets	Develop asset management key performance indicators (KPIs) to better measure asset management outcomes. The Port should review current KPIs and metrics across Facilities & Infrastructure, Maintenance, and other departments and identify a collective set of KPIs for asset management tracking and reporting. The Port should also review the effectiveness of the current metrics and the quality of data to ensure that the right metrics are in use, and the data reported is accurate. This will result in enhanced data to manage maintenance decisions and programs, provide a comprehensive KPI dashboard for senior leaders, and help track and demonstrate progress of the asset management program.
12	Develop Asset Management Reporting Framework and Processes	Control of Assets	Develop a template and produce a high-level quarterly or annual asset management report with executive-level metrics and reporting on key benefits, outcomes, and impacts along with a summary of key initiatives and status. Currently, specific asset management metrics are not routinely tracked nor are related metrics captured comprehensively across the Aviation Division. Further, there is no consistent message around asset management and its impacts to the agency. Through creating defined reporting processes and standards, the Port will foster greater visibility and transparency of asset management, a clear link to elements of the Airport Service Quality Index, as well as provide an avenue to communicate progress, benefits, and impacts to key stakeholders.

13	Establish a Continuous Improvement Program of Asset Management	Control of Assets	Establish a continuous improvement program for asset management, including reviewing the asset management roadmap and maturity every few years. As the Port develops its asset management strategy and a roadmap, a continuous improvement program will allow the Port to confirm that its maturity is improving consistent with its improvement plan and change its program based on additional information or changes as time progresses.
14	Develop Asset Class Strategies	Asset Management Planning	Develop Asset Class Strategies for each asset class. The strategies should demonstrate the work necessary at the asset class level to implement the Port of Seattle's strategic plan (business plan) and the strategic asset management plan. Asset Class Strategies should also consider the system interfaces between assets and how conditions or changes of an asset impact another. For example, new high technology procurements will have a different load requirement on power assets.
15	Develop Asset Management Plans	Asset Management Planning	Produce a uniform template and pilot the development of formal asset management plans that address inspection and maintenance strategies, rehabilitation/overhaul programs, reliability targets, performance metrics, and capital renewal and replacement. The Port of Seattle Aviation Division does not consistently consider lifecycle costs in renewal/replacement and maintenance decisions. In most cases, documented asset lifecycle costs are not available because departments lack the structure and tools to capture and report full lifecycle costs for assets. Comprehensive lifecycle plans will result in greater adherence to inspection and PM programs, enhanced long-term capital budget and financial forecasts as well as improved tracking, reporting, and accountability of asset lifecycle data. These plans should be considered accompanying plans or subsets of the strategic asset management plan (recommended earlier in this chapter).
16	Develop Management Review and Monitoring Processes for Asset Management Plans	Asset Management Planning	Processes should be developed to establish a management review mechanism for monitoring progress in plan delivery. This could take the form of the period (monthly or quarterly) summary of planned activities or forecast performances compared to actuals. The processes to be defined should integrate ongoing review of the asset management plans in the internal management review cycle.

17	Integrate Maintenance and Condition Data with CIP	Capital Planning and Delivery	Establish a defined process to integrate maintenance and condition data into capital needs evaluation. A major input into the Port's CIP is asset renewal and replacement plan for asset, which is primarily based on remaining useful life. This data is tracked only in Microsoft Excel and is not linked to maintenance history. Integrating the maintenance history into the lifecycle needs assessment (and storing this in Maximo, the Port's asset management system), will allow the Port to make more informed capital planning decisions considering factors such as cost to maintain and risk of failure.
18	Enhance Asset Commissioning Process	Capital Planning and Delivery	Review and document the asset commissioning process and add additional rigor for asset definition, hierarchy, and booking assets via asset plans. The Port has well-defined processes in place for asset commissioning and handover; however, actual execution does not follow the documented processes and there are some opportunities for improvement. These include adding more specifics around roles and responsibilities and updating the level of detail of the information required to match maintenance needs will save the Port time and money during an asset's life. This recommendation is tied to two others presented in this chapter – defining asset owners and their roles and responsibilities (presented previously) and preparing detailed asset hierarchies (presented later in this chapter).
19	Establish Audit Processes for CIP Delivery and Handover	Capital Planning and Delivery	Audit processes should be established to ensure design standards and asset handover processes are followed consistently.
20	Update Maintenance with Penalty Clauses for Failing to Follow Standards	Capital Planning and Delivery	Maintenance contracts should be updated to include penalty clauses for failing to follow design standards or for failing to follow asset commissioning processes.
21	Update/Develop Standardized Condition Assessment and Scoring Guidelines across All Asset Classes	Maintenance Planning and Delivery	Develop/update condition assessment and scoring guidelines for all asset classes. This includes establishing a condition scale and assessment framework for each asset class. The Port can build upon the condition assessment framework being used by F&I for facilities as a start, and update it for facilities using a more detailed hierarchy, a 5-point rating scale with definitions for each rating, and a way to incorporate maintenance data into the assessment. The framework can then be applied to other asset classes – which will require asset hierarchies, rating guidelines and a methodology to incorporate

			maintenance data. These guidelines can then be a part of a risk-based approach to investment decision making and prioritization. Applying a condition assessment methodology to all assets will ensure that the Port can consistently understand and compare the condition of its assets across the entire airport. Note: Updating/developing detailed asset hierarchies for all asset classes is recommended later in this section.
22	Conduct Condition Assessments across All Asset Classes	Maintenance Planning and Delivery	The Port should conduct comprehensive condition assessments on all assets at the airport (including updating condition for facilities with data older than four years) once consistent condition assessment guidelines are created. We also recommend that the Port store the condition data in Maximo to expand the use of the system from a maintenance tracking system to a true enterprise asset management system. The condition assessments will allow the Port to prepare more informed lifecycle management plans (a previous recommendation in this chapter) and a more informed capital plan. Understanding condition will also improve the efficiency of maintenance work prioritization.
23	Improve Asset Data	Maintenance Planning and Delivery	Improve the quality of maintenance records data in Maximo. This includes having an accurate record of each trouble ticket in Maximo, related work order(s), failure codes, remedy, when it was closed, and the amount of effort and materials required for the work order. This includes recording work to the lowest maintainable unit in the asset hierarchy along with the proper failure codes and remedy codes. We also recommend that any work orders that are not worked on (not conducted) are either left open in the system, or closed with a special code to indicate that the work was not conducted – and a reason for it (e.g. staffing limitations, not required due to asset's planned replacement, not required since a new inspection work order is open due to frequency, work recently performed) This will result in improved accuracy of data in Maximo and will allow the Port to move towards reliability-centered maintenance.

24	Update Process for Adding "Discovered" Assets in the Field	Maintenance Planning and Delivery	Update the process for adding new assets into Maximo when they are "discovered" in the field. The Port has assets that have been in place for over 70 years, and systems and records have changed over time. As a result, sometimes assets are "discovered" in the field; assets are in place but there are no electronic records of the asset in Maximo or PeopleSoft.
25	Implement Reliability-Centered Maintenance Philosophy	Maintenance Planning and Delivery	Implement a reliability-centered maintenance philosophy, including performance and reliability KPIs for all assets. The Port does not currently conduct reliability-centered maintenance and is not tracking sufficient reliability data to properly identify maintenance needs. Through reliability-centered maintenance, the Port will have the ability to analyze past failures (including their causes and remedies), address systematic asset issues through maintenance or the CIP, reduce lifecycle costs, and reduce the amount of emergency and corrective work.
26	Develop Guidelines to Align Future Contract Maintenance Agreements with Asset Management Standards	Maintenance Planning and Delivery	Develop guidelines to align future maintenance contract agreements with the Port's asset management standards. This includes: 1) use of Maximo by contractors, 2) record corrective work in Maximo, 3) define PM and inspection programs for the assets, 4) perform condition assessments before and after the contract period, 5) develop formal asset management plans, and 6) conduct annual performance reviews and audits. This will improve contractor performance and compliance along with the assurance that assets are maintained and delivered in acceptable condition. Currently, the only major assets maintained by contractors are conveyances, which include elevators, escalators, and moving walkways. At this time, only minimal data is shared between the Port and the contractors for these assets, and the data is not added in Maximo or any other Port's systems.
27	Enhance Inventory Efficiency	Maintenance Planning and Delivery	Review current inventory levels, including what parts, components, and assets are stored in inventory. Ensure all inventory items are intentional and that obsolete parts are removed from inventory. Implement new procedures to continually monitor parts usage, min/max levels, obsolescence and other key elements of inventory management. This will allow the Port to maintain an inventory that is based on expected usage and its risk profile.

28	Update Obsolescence Strategy	Maintenance Planning and Delivery	As part of the asset class strategies, review the risk of obsolescence on components and assets and establish strategies for mitigating the risk through campaign overhaul, asset replacement or revised operating procedures.
29	Develop Asset Criticality (Consequence of Failure) Criteria	Operations and Fault Management	Identify the assets that are most critical to the Port, understanding the consequences of failure and informing a risk-based approach to prioritization. This framework should include a scoring and ranking methodology for social, financial, and environmental impacts, as well as a methodology for assessment of system redundancy to factor into risk calculations. This risk/criticality score should then be embedded in Maximo to help prioritize work when issues arise. This will not only support maintenance prioritization but also provide a more comprehensive input into and alignment with the capital plan.
30	Create Common Asset Definition	Informed Decisions	Create a common/consistent definition of an “asset” that is used across the Port, linking the financial and maintenance definitions. The definition of an “asset” is critical to establishing a consistent understanding of “asset management” across the Port and ensure that related processes are all aligned. The different “asset” definitions in maintenance and finance lead to inconsistencies in how stakeholders understand assets and asset management. A common definition will also ensure consistency of asset referencing and naming conventions across departments.
31	Digital Strategy	Informed Decisions	Develop a digital strategy to focus the use of asset and asset related technology and information to drive more efficient and effective decisions and management actions through the assets lifecycle. A Digital Strategy also provides the first level of data governance, establishing both the landscape of information that needs to be made available and the functional requirements for technology to support full use of the information.
32	Establish Data Governance Standards	Informed Decisions	A data governance framework for Port of Seattle asset management including policies, processes and procedures for the capture, management and control of asset related information should be developed. These should include both asset attribute and condition/performance information. This will also support a more effective asset creation/handover process.

33	Update/Develop and Implement Enterprise Asset Hierarchies	Informed Decisions	Update/develop and implement formal asset hierarchies (asset, process area, system, sub-system, etc.) along with applicable attributes consistently across all airport infrastructure. We recommend starting with the existing hierarchies for facilities and updating them based on best practices. The Port should develop hierarchies for other (non-facility) assets using best practices from other agencies with similar assets. Implementing asset hierarchies (along with prior recommendation to have a common asset definition) will allow the Port to setup data consistently in different systems, and allow for easy analysis of this information. For example, PeopleSoft may list a facility and its key systems (e.g. HVAC), while Maximo may break down HVAC into various other assets (down to the lowest maintainable unit) – but the data could be collated, reconciled, shared and analyzed easily. Further, the asset hierarchies are required to implement other recommendations such as identifying most critical assets and conducting a comprehensive condition assessment.
34	Conduct Airport-Wide Asset Inventory Collection	Informed Decisions	Conduct an airport-wide asset inventory collection. This inventory should identify assets that are visible (above ground) through a physical review/check, and assets that are invisible (belowground) by using as-built drawings and any other available information. The airport assets are currently not clearly identified in any one system, and it is widely accepted that the Port of Seattle Aviation Division has documented about 70% of the assets it owns. As a result, various staff have to spend valuable time to identify the assets when issues arise. An inventory of all assets (in conjunction with standard asset hierarchies) will ensure that conducted work is assigned to the correct assets, allowing the Port to track the assets, their condition and their performance more accurately.
35	Align and Integrate PeopleSoft/Maximo	Informed Decisions	Improve alignment and integration between PeopleSoft assets and Maximo. This will allow for automated transfer of information, reduce data duplication or data entry errors, allow for easier tracking of current asset value and expected life and plan for replacements. The Port should also review its overall application architecture to identify other opportunities for integration.

36	Integrate GIS with Maximo	Informed Decisions	Integrate Port's GIS systems with Maximo. This will allow users to view asset location graphically and identify certain trends more easily. It will also allow users to identify root causes of issues easily and address critical faults faster. Currently, the GIS maps are populated by pulling data from the Engineering department (based on GPS coordinates in their engineering drawing) and the data is not integrated with Maximo.
37	Develop Electronic Master Record Drawings	Informed Decisions	Develop a comprehensive set of electronic master record drawings for the entire airport that can be easily accessed from a computer or tablet. Currently, master record drawings are not all available electronically, and the assets shown on the drawings are not labeled on the field with a common number to identify them. Improved access to these master record drawings (combined with viewing data on a map and consistent hierarchies) will allow staff to locate assets more efficiently as well as improve work response time.
38	Assess/Enhance SCADA/Asset Health Monitoring Systems	Informed Decisions	Perform a comprehensive assessment and develop an improvement plan for SCADA/automated asset health monitoring system(s) for key equipment/assets (elevators, escalators, boilers, chillers, etc.). The airport does not currently use SCADA to monitor its assets but does use some asset monitoring systems, specifically on the HVAC mechanical systems. The use of these asset monitoring tools can greatly improve efficiency in monitoring their condition, maintaining assets as well as reduce failure/breakdown rates and inspection/ maintenance costs.
39	Undertake a Workforce Resource-Level Study	Resource Capabilities	A study should be conducted to determine resource requirements across departments. This should be consistent with the asset management plan development, which will forecast needed work. The study should then determine what resources are needed to deliver this work (i.e., focus on the work needed for an asset to deliver the service, and then the resource needs to support this) including both capability and capacity requirements to support asset management activities.
40	Establish a steering committee	Resource Capabilities	A steering committee should be established to ensure all departments needs are addressed through the development and delivery of the asset management improvement program.

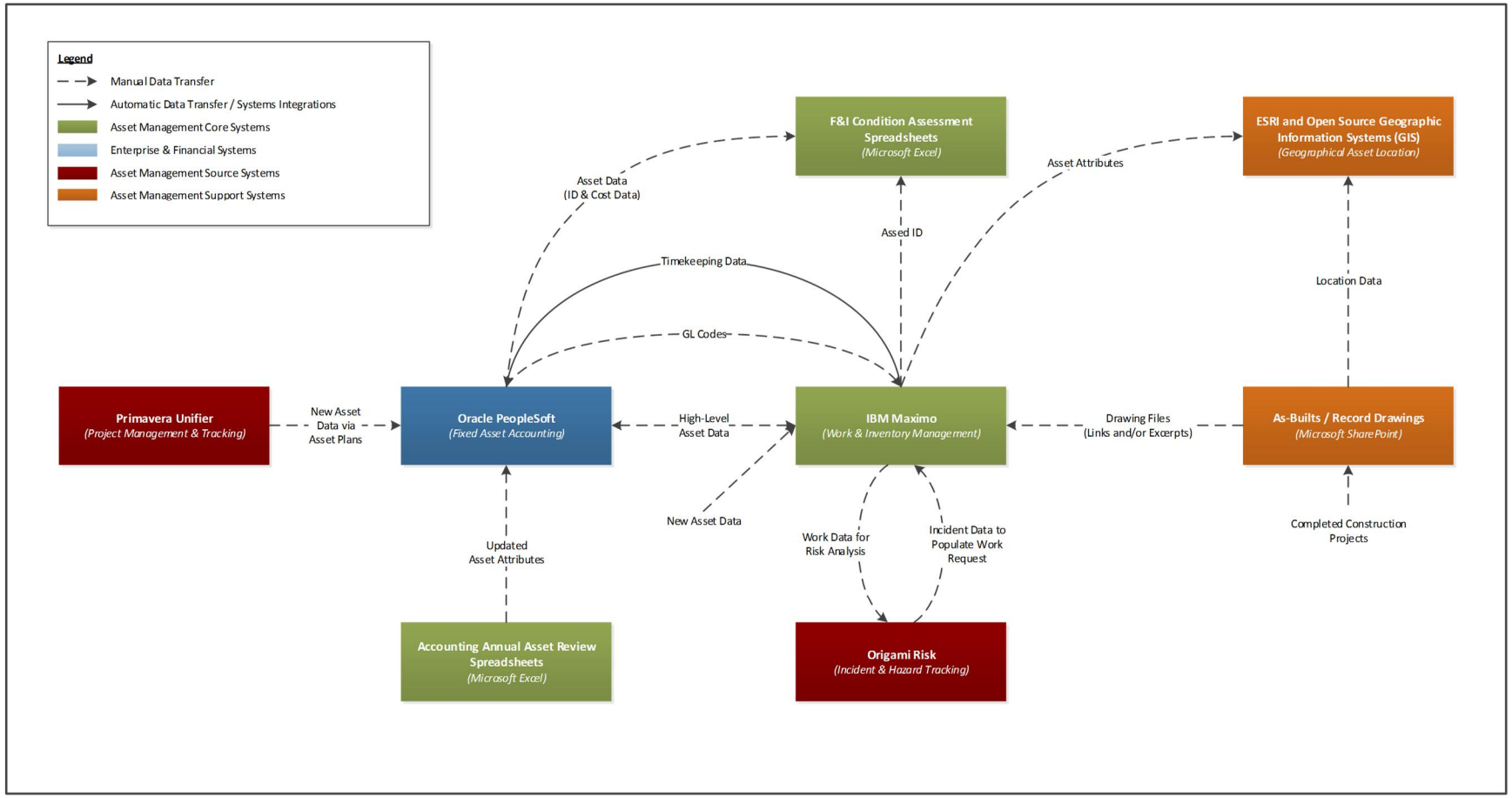
41	Establish Asset Management Leadership & Authority	Resource Capabilities	An asset management leader should be appointed within the Port of Seattle, with overall responsibility for establishing, managing and monitoring the effectiveness of the asset management system. In addition, asset class leaders should be appointed, who have overall through life planning responsibility for the assets under their control. Management performance reviews should include goals for improving the management of assets, including reducing costs, risks and increasing performance and should not focus on productivity.
42	Develop and Define AM Roles and Responsibilities	Resource Capabilities	Define an organizational structure and clear roles and job descriptions for asset management across the Port of Seattle (specifically at the airport). This should include developing a position for overall AM coordination and implementation across the airport. By developing key asset management roles and responsibilities, the Port will begin fostering a more asset-focused culture along with a shared understanding of how asset management is integrated across the agency and among individual roles. This recommendation, in conjunction with defining asset owners (recommended earlier in this chapter) will ensure a clear understanding of roles and responsibilities, and the part various stakeholders play in managing the assets efficiently.
43	Develop EAM Stakeholder Engagement Plan	Resource Capabilities	Develop an EAM stakeholder engagement plan, including identifying stakeholder groups and their requirements with regard to asset management. This includes creating the best channels for communicating with each group, and executing stakeholder awareness and involvement strategies beyond the gap assessment project. We also recommend developing and implementing a robust communications strategy for engaging all airport staff at all levels in considering their respective individual roles in achieving the benefits of improved asset management.
44	Develop Introductory and Ongoing Asset Management Training	Resource Capabilities	Develop the material and implement asset management training for employees. Currently, there is no dedicated training for asset management; however, the Port of Seattle Seaport Division has begun to implement this type of training, which could be applicable to the Aviation Division. A more complete asset management training program will help improve asset management awareness and understanding across employees, as well as increase employee engagement around asset management implementation.

45	Review Contract Language review	Resource Capabilities	Contract language should be reviewed to ensure it fully aligns to the strategic asset management plan. This will ensure that information is made available to the Port to inform long-term decisions on assets managed by contractors.

Appendix A: Existing Information System Configuration

A.1 Current Application Architecture

The following diagram and table define the current application architecture at the Port of Seattle Aviation Division.



Current Application Architecture – Inventory & Interfaces

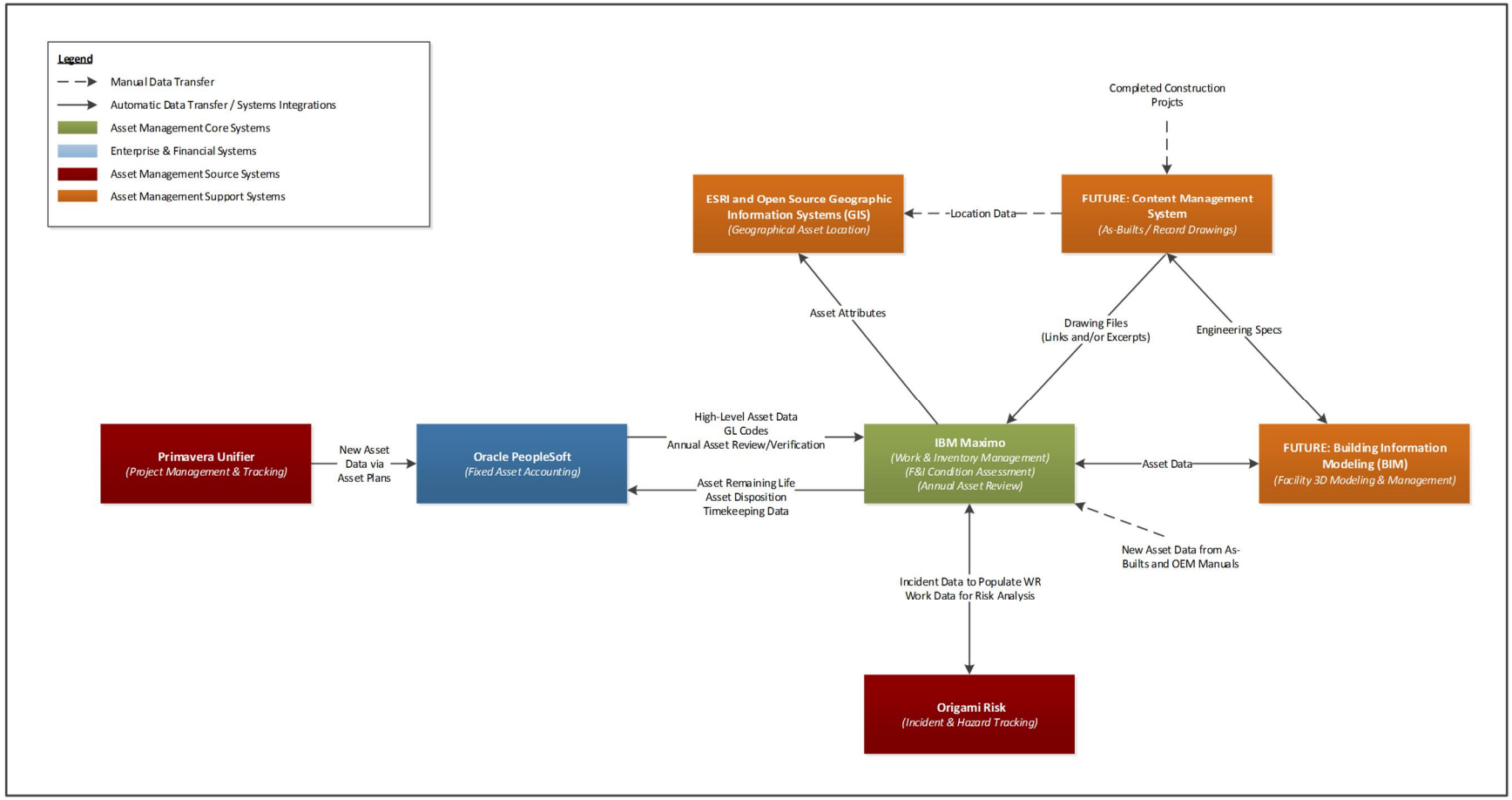
**Note this list of applications and interfaces is not inclusive of all systems used by the Port of Seattle Aviation Division. Applications and interfaces listed below are primarily focused on asset management and asset management-related interfaces.*

System or Tool	Description	Interfaces
IBM Maximo *(Version 7.6)*	An Enterprise Asset Management (EAM) software solution designed to help the Port of Seattle Aviation Division manage its physical assets through asset tracking, maintenance scheduling and workflow management.	Oracle PeopleSoft • GL codes pulled from PeopleSoft (manual) • Timekeeping data pushed to PeopleSoft (automatic) • Fixed asset reconciliation with PeopleSoft (manual) Origami Risk • Incident data from Origami to populate work requests (manual) • Work data pushed to Origami for risk analysis (manual) As-Builts / Record Drawings • Drawing files linked or embedded to asset record in Maximo (manual) F&I Condition Assessment Spreadsheets • Asset ID and other high-level data (name, location, etc.) pulled from Maximo (manual) ESRI and Open Source GIS • Some asset attribute data (not location data) pushed to help populate information on maps (manual)
Oracle PeopleSoft *(Currently upgrading to Version 9.2)*	An Enterprise Resource Planning (ERP) software solution used by the Port of Seattle Aviation Division for financial management and human resources management.	IBM Maximo • GL codes pushed to Maximo (manual) • Timekeeping data pulled from Maximo (automatic) • Fixed asset reconciliation with Maximo (manual) Primavera Unifier • New asset data entered via asset plans (manual) Accounting Annual Asset Review Spreadsheets • Updated asset attributes entered via spreadsheets (manual) F&I Condition Assessment Spreadsheets • Asset data (ID and cost data) pushed to F&I Condition Assessment Spreadsheets (manual)
Primavera Unifier	A project lifecycle management solution for capital planning, project delivery and cost	Oracle PeopleSoft • New asset data entered via asset plans (manual)

System or Tool	Description	Interfaces
	control. The tool is used specifically by the Project Management Group (PMG) at the Port of Seattle to track and monitor capital projects through design and construction.	
Origami Risk	A Risk Management Information System (RMIS) software solution that provides workflow, reporting and analysis support for risk management.	IBM Maximo • Incident data pushed to Maximo to populate work requests (manual) • Work data pulled from Maximo for risk analysis (manual)
ESRI and Open Source GIS	A geographic information system (GIS) mapping software.	IBM Maximo • Some asset attribute data (not location data) pulled to help populate information on maps (manual) As-Builts / Record Drawings • Asset location data pulled from drawings to populate asset location (manual)
As-Builts / Record Drawings (Microsoft SharePoint)	A web-based document management including inventory of as-builts and engineering record drawings.	IBM Maximo • Drawing files linked or embedded to asset record in Maximo (manual) ESRI and Open Source GIS • Asset location data pushed from drawings to populate asset location (manual)
Accounting Annual Asset Review Spreadsheets (Microsoft Excel)	Microsoft Excel Spreadsheets used by the Accounting department to capture updated asset information and attributes, to then populate asset details in Oracle PeopleSoft.	Oracle PeopleSoft • Updated asset attributes entered via spreadsheets (manual)
F&I Condition Assessment Spreadsheets (Microsoft Excel)	Microsoft Excel Spreadsheets used by F&I to capture asset condition which is then used to identify asset renewal and replacement.	IBM Maximo • Asset ID and other high-level data (name, location, etc.) pulled from Maximo (manual) Oracle PeopleSoft • Asset data (ID and cost data) pushed to F&I Condition Assessment Spreadsheets (manual)

A.2 Recommended (To-Be) Application Architecture

The following diagram and table define the to-be application architecture for the Port of Seattle Aviation Division.



To-Be Application Architecture – Inventory & Interfaces

**Note this list of applications and interfaces is not inclusive of all systems used by the Port of Seattle Aviation Division. Applications and interfaces listed below are primarily focused on asset management and asset management-related interfaces.*

System or Tool	Description	Interfaces
IBM Maximo *(Version 7.6)*	An Enterprise Asset Management (EAM) software solution designed to help the Port of Seattle Aviation Division manage its physical assets through asset tracking, maintenance scheduling and workflow management.	Oracle PeopleSoft • Asset and work data (remaining life, disposition, and timekeeping) pushed to PeopleSoft, as needed (automatic) • Asset data (attributes, GL codes, etc.) pulled from PeopleSoft, as needed (automatic) Origami Risk • Incident data from Origami to populate work requests (automatic) • Work data pushed to Origami for risk analysis (automatic) ESRI and Open Source GIS • Asset attribute data pushed to help populate information on maps and linked to location data via as-builts/record drawings (automatic) FUTURE: Content Management System • Drawing files linked to asset record in Maximo (automatic) FUTURE: Building Information Modeling (BIM) • Asset ID and other high-level data (name, location, etc.) shared with Maximo (automatic)
Oracle PeopleSoft *(Currently upgrading to Version 9.2)*	An Enterprise Resource Planning (ERP) software solution used by the Port of Seattle Aviation Division for financial management and human resources management.	IBM Maximo • Asset data (attributes, GL codes, etc.) pushed to Maximo, as needed (automatic) • Asset and work data (remaining life, disposition, and timekeeping) pulled from Maximo, as needed (automatic) Primavera Unifier • New asset data pulled from Unifier (automatic)
Primavera Unifier	A project lifecycle management solution for capital planning, project delivery and cost control. The tool is used specifically by the Project Management Group (PMG) at the Port of Seattle to track and monitor capital projects through design and construction.	Oracle PeopleSoft • New asset data pushed to PeopleSoft (automatic)

System or Tool	Description	Interfaces
Origami Risk	A Risk Management Information System (RMIS) software solution that provides workflow, reporting and analysis support for risk management.	IBM Maximo • Incident data pushed to Maximo to populate work requests (automatic) • Work data pulled from Maximo for risk analysis (automatic)
ESRI and Open Source GIS	A geographic information system (GIS) mapping software.	IBM Maximo • Asset attribute data pulled from Maximo to help populate information on maps and linked to location data via as-builts/record drawings (automatic) Content Management System • Asset location data pulled from drawings to populate asset location (manual)
FUTURE: Content Management System	An updated content/document management system where, specific to asset management, all as-builts and engineering record drawings are housed.	IBM Maximo • Drawing files linked or embedded to asset record in Maximo (automatic) ESRI and Open Source GIS • Asset location data pushed from drawings to populate asset location (manual) FUTURE: Building Information Modeling (BIM) • Engineering specifications shared between systems (automatic)
FUTURE: Building Information Modeling (BIM)	A software solution providing a digital representation of physical and functional characteristics of a facility.	IBM Maximo • Asset ID and other high-level data (name, location, etc.) shared with Maximo (automatic) Content Management System • Engineering specifications shared between systems (automatic)