



Purchasing Department
530 Water Street
Oakland, CA 94607

February 11, 2021

Addendum No. 1

RFP No.: 20-21/11, Enterprise Asset Management System

This Addendum modifies the original RFP Documents for the above-mentioned RFP. **Acknowledge receipt of this addendum in the space provided on the RFP Acknowledgement and Signature Form (Attachment 3). Failure to do so may disqualify your Proposal.**

The following questions were submitted by the deadline and are answered in this addendum.

1. **Question:** Can the final proposal submissions be made electronically, in lieu of hard copies?

Answer: No electronic RFPs will be accepted. To protect the integrity of the RFP process, the Port must receive sealed RFPs (physical submittals only), delivered to the Port either in-person or by mail by the Due Date and Time indicated in the RFP. (Please note: Some physical deliveries have been intermittent/delayed in certain areas, so please plan accordingly and submit your RFP early to ensure timely receipt.) The Port of Oakland is open, and a hard copy can be dropped off at the security desk (9:00a.m. – 3:00p.m daily.) or call Nickulaus Sioson at 510-627-1140 to make an appointment when submitting the proposal before the due date in person.

2. **Question:** How many of each of the following users do you anticipate will need access to the new system?
 - a. Regular Users (includes Routine, Power, Management and System Administrator Users)
 - b. Casual Users
 - c. Mobile (Field) Users

Answer: The precise number in each role has not been determined at this time. For purposes of pricing the benchmark for this project will be the following number of users:

*300 Total Users
100 Mobile Users
50 Concurrent users*

The actual number of users will be determined at time of contract award.

3. **Questions:** Please provide clarification to one of the requirements in your recently released EAM RFP stating that "*Proposers must have direct experience in providing EAM solutions to both Seaports and Airports*". Having been a member of ACI-NA and AAAE for the past 3 years and discussed EAM approaches with many U.S. airports, I've found that (1) EAM requirements of Sea/Air Ports are not significantly different than those of other industries leveraging EAM extensively, and that (2) most existing EAM systems at airports appear to be sub-optimal, not cloud based or mobile efficient, and not easily configured.

Answer: We would prefer the proposer have experience in providing EAM solutions to both Seaports and Airports. However, we will accept proposals from those proposers that have direct experience at either a Seaport or Airport.

4. **Question:** If the objective of this requirement is, as I suspect, to get the most qualified system for your use and the most qualified provider to deliver it (vs. providers experienced in delivering historically sub-optimal systems), I'm hoping you will consider modifying this requirement to reflect vendors with experience delivering the type of highly configurable, extensible, and mobile-enabled solution you are describing in your RFP (i.e., "functional" vs "industry" specific work referenceability). This would benefit the Port as well by providing a broader spectrum of innovative solutions proposed to satisfy your use case, irrespective of the industry.

Answer: Yes, the Port is looking for the vendors with experience delivering a configurable, extensible, and mobile-enabled solution as outlined in the RFP. However the proposer must have direct experience at either a Seaport or Airport.

5. **Question:** Does the Port have an estimated start date for the Project?

Answer: Not at this time. The start date will depend upon finalization of contract.

6. **Question:** Will the work (final report) that was conducted on the EAM Needs Assessment by the firm called EDI, be provided to all vendors as relevant information to this project?

Answer: Yes, see attachment.

7. **Question:** I would like to inquire as to whether the firm (EDI) is permitted to submit a proposal on the EAM tender, considering they did a lot of the tender pre-work under this engagement with the Port....

Answer: EDI conducted a Gap Assessment of the existing Electronic Asset Management in 2019. EDI did not participate in the preparation of this Request for Proposals or its contents.

Port staff will review all information disclosed by any proposers as a requirement of the RFP to determine if any proposer should not move forward for full evaluation by the Port.

8. **Question:** Was a professional consultant used in development of this RFP?

Answer: No professional consultant was used to develop this RFP.

9. **Question:** User Roles. How many users of each user type is required? i.e., Number of Routine users, number of power users etc.

Answer: The precise number in each role has not been determined at this time.

10. **Question:** Expected Project completion: Can you confirm that the expected go-live is 6 months following project initiation? The tender indicates 180 days from Notice to Proceed.

Answer: Yes, the six months or 180 days is correct.

11. **Question:** Is the only integration going to be GIS within the 180 days:

Answer: Integration with other Port systems could extend past the 180 days.

12. **Question:** Can you confirm the initial implementation is for the Airport only, or for all Port Operations, within the 180 day period?

Answer: All

13. **Question:** Has Port of Oakland seen demonstrations of any Enterprise Asset Management System in the past 24 months?

Answer: No

14. **Question:** Has Port of Oakland hired an outside consultant to do a requirements analysis for this RFP? If so, would that consultant be prohibited from bidding on the RFP due to conflict of interest? Also, if so, would the results of the requirements analysis be published anywhere?

Answer: No, the Port did not use a consultant to provide scope of services details for this RFP.

15. **Question:** Is this project fully or partially funded?

Answer: Upon Board approval, this project will be fully funded

16. **Question:** Is there a budget for this project, and if so, what is the budget/budget range?

Answer: Due to the competitive process of this project, the Port will not disclose the overall budget amount at this time.

17. **Question:** What is the Port's current EAM system?

Answer: Oracle eAM

18. **Question:** Is the current EAM cloud-based or on-prem?

Answer: Cloud-based

19. **Question:** What is the Port's business case for funding a migration to a new EAM (major pain points being addressed)?

Answer: Port is seeking an up to date EAM solution to accurately track Port-owned assets as well as provide a variety of analytical functions and to provide data to assist with operational efficiency as well as process automation for the Port's business operations.

20. **Question:** Does the Port plans to extend use of the system beyond EAM on a configurable cloud platform?

Answer: Future plans to extend the system have not been fully defined yet.

21. **Question:** What is the Port's current and planned use for Oracle EBS eAM? The assessment document discusses EAM use and recommendations, but the RFP omits EAM (other than reference to Projects and Grants).

Answer: Planned use for Oracle EBS eAM is undetermined at this time.

22. **Question:** Section 3 cites, "The proposed EAM shall: 6. Have seamless integration with EAM to Port's scheduling solution (MS Office 365 or Google Cloud)." Please describe what these tools are used to schedule (people; tools; spaces/rooms...). Also, please identify any other scheduling tools used by the Port (e.g., Primavera P6; Microsoft Project).

Answer: Currently the Port is not using a scheduling program as part of maintenance work. The intention of this requirement is to leverage the scheduling capabilities of the system that the Port will be using and integrating it with calendaring solutions.

23. **Question:** Please identify the underlying technology for the Port's GIS, identified as an integration target. E.g., ESRI ArcGIS 10.8.

Answer: Esri ArcGIS Enterprise 10.2

24. **Question:** Are the required forms included in the 20-page count?

Answer: No

25. **Question:** Is the GIS system server based or online?

Answer: Server based

26. **Question:** Are airfield assets in the GIS system and is the data current?

Answer: Not all assets exist in the current GIS system, however pavement, airfield lighting and signs have been installed recently.

27. **Question:** Will the Port consider replacement of IntelaTrac Mobile Operator Rounds with the Maximo solution?

Answer: The Port will review all recommendations to utilize with the chosen solution to move forward with.

28. **Question:** Is the current Part 139 process used at the port a paper or electronic process?

Answer: Aviation utilized both an electronic process as well as a paper process.

29. **Question:** Is this application currently in use for airfield inspections “Part 139 Airfield Inspection (Eagle)?

Answer: Yes

30. **Question:** Does the port have non-GIS based assets to manage in the EAM system?

Answer: Yes Oracle eAM

31. **Question:** Can the Port please clarify if they are requesting the system be on premises or they are asking for a Software-As-A-Service Hosted solution?

Answer: The Port is asking for a hosted solution.

32. **Question:** Is the RFP document available in Word to use the attachments and forms easily for responses?

Answer: No.

33. **Question:** Does the 20-page limit include any Appendices, and or graphics?

Answer: No, they will NOT count against the page limit.

34. **Question:** Which 3 business units is the system required to support at the Port? Will these be phased in?

Answer: Within the scope of this project, only Maritime and Aviation will be supported by the eAM. These will be done at the same time.

35. **Question:** I would like to register Acumen as a subconsultant for the mandatory pre-proposal meeting on Feb 8, 2021 at 9am. Who collects my info?

Answer: Any interested subconsultant must contact the prime directly.

36. **Question:** What Solutions are currently in use at the Port for EAMS/CMMS/Asset Management?

Answer: Oracle eAM

37. **Question:** Can early questions be responded to, so we can prepare our proposal in advance as much as possible?

Answer: We will make an effort to respond to questions early.

38. **Question:** Will a list of assets for the initial implementation be provided?

Answer: Once a contract is awarded an asset list will be provided to the company that was selected.

39. **Question:** Does the Prime company need to have the Port/Airport experience? Or can that experience be made up by the Prime with Subs?

Answer: The Prime company should have either Airport or Seaport experience in implementing an EAM solution. The Port would prefer the Prime have experience in both.

40. **Question:** Are you going to capture communication and network assets?

Answer: Not at this time.

41. **Question:** System user types prior can impact licensing requirements and costs. Can descriptions of each users use of the system be provided at least 10 days prior to the submission due date so that a well-considered licensing approach can be proposed based on the Port's specific situation / requirements?

Answer: The user types are described in the RFP on page 5.

42. **Question:** What data from the current system is expected to be migrated into the new solution? For example, will it be more "core" data such as Locations/Assets or will transactional/historical data such as Work Orders, Purchase Reqs, Inventory Transactions, etc. also be required?

Answer: The data that will be transferred to the new system may include transactional data. Transactional data to be migrated is undetermined at this time.

43. **Question:** Will the complete recording and chat be provided to all participants?

Answer: Yes, click link below. Passcode: zM#UY^p3

https://portoakland.zoom.us/rec/share/nNImxIS2yH2-oYlrVKWuQ7ZxFb7VNWfQX_2NdV_Ty3YEBAMzZ7DMvKf-z0JQlj4Q.DPn9QwHKONpvX7wR

44. **Question:** Please clarify local company that is defined in the RFP. We have an office in San Francisco, does that qualify?

Answer: The Port considers cities located in Alameda and Contra Costa Counties as local. A San Francisco office does not qualify as a local company.

45. **Question:** Appendix B references a Maximum Amount for the consulting services. Will the Port consider time and material estimates for the proposal?

Answer: Proposers should provide a maximum amount in Appendix B. Time and material cost will not be accepted.

46. **Question:** Based on a 20-page response limit, will there be a short list stage following the RFP deadline?

Answer: Please see Section V. Evaluation Criteria, item B. Selection Procedure of the RFP.

47. **Question:** Can we include supporting appendices to the 20-page limit of the RFP?

Answer: Yes

48. **Question:** Are you going to be supplying an asset list?

Answer: No, not in advance of award of contract.

49. **Question:** Are you going to release a list of types of assets?

Answer: No, not in advance of award of contract

50. **Question:** Is there a materials management site in place or warehouse?

Answer: The Port does not currently utilize a warehouse for supplies; however, the proposer should include inventory functionality in the proposal.

51. **Question:** Does the Port have a list of small businesses that can be partnered with?

Answer: Yes, that list is on our website at: srd.portoakland.com

52. **Question:** Has the Port determined what data it would want to be transferred to the new system? The data that will be transferred to the new system will be basic data with limited transactional data

Answer: The data that will be transferred to the new system may include transactional data. Transactional data to be migrated is undetermined at this time.

53. **Question:** What is your expectations of the end-to-end-business process review?

Answer: Please provide your experience with end to end business process in your proposal. Please refer to page 2 Management Requirement of the RFP.

54. **Question:** What is your expectation of Port employee interaction during the EAM process?

Answer: The Port employees are committed to have a successful implementation of the eAM and will be made available as needed.

55. **Question:** Does the Prime company need the Airport/Seaport experience? Can a sub's experience be counted?

Answer: The Prime needs to have the experience.

56. **Question:** Is this going to be a multi-select proposers or are you going to select the proposer you will work?

Answer: All submittals will be graded and the top ranked candidates will be asked to do a presentation at a later date. The project is not divisible and shall be awarded, if an award is made, to a single Proposer.

57. **Question:** How many concurrent users will be on the system at any given time (50 to 60)?

Answer: See response to question# 2.

58. **Question:** Does IOT needs to be in phase 1 of the project?

Answer: The Port would like to have its IOT integrated in phase 1 if possible but it's not critical.

59. **Question:** Are you looking for software as a service or installed on your system?

Answer: Software-as-a-service.

60. **Question:** Any technical requirements that we should be made aware of?

Answer: We want a hosted solution as we would like a mobile solution. The Port does not typically allow outside connections. We are open to some minor interconnect to allow for hosted.

61. **Question:** Will folks have connectivity where they will work or is there a need for disconnected capabilities?

Answer: The system will need to provide for some disconnected capabilities as there are some areas on the airport and possibly maritime area that do not get cell signal.

62. **Question:** What are you looking for in a mobile solution (seamlessness)? Are third party mobile solutions allowed?

Answer: We would like a mobile solution that is integrated into the system and not a third party app.

63. **Question** Will you be sharing the attendee list?

Answer: Yes, click link below.

<https://www.portofoakland.com/wp-content/uploads/20-21-11-Pre-proposal-Meeting-Sign-In-Sheet.pdf>

64. **Question** Do you have a deadline for questions? Will your answers be coming sooner or later?

Answer: All proposers are required to submit questions by February 18, 2021 until 4:00p.m.. All pertinent questions will be responded to and answered in writing no later than the Response Date of February 24, 2021.

TABLE OF CONTENTS

1	GENERAL ASSESSMENT OVERVIEW	5
1.1	ORGANIZATION AND CURRENT PRODUCTS	5
1.2	ASSESSMENT OBJECTIVES	5
1.3	ASSESSMENT WRAP-UP	7
2	OVERVIEW.....	8
2.1	ASSETS AND LOCATIONS.....	8
2.1.1	ASSET AND LOCATION STRUCTURE	10
2.1.2	ASSET RELIABILITY CENTERED MAINTENANCE (RCM) PROGRAM	10
2.1.3	ASSET ON-BOARDING PROCESS	11
2.1.4	IMPACT OF POOR ASSET DATA	11
2.1.5	TRAINING	12
2.2	INVENTORY	12
2.3	PLANNING	13
2.3.1	JOB PLANS.....	13
2.3.2	WORK ORDER TYPES	14
2.3.3	ROUNDS, ROUTES, AND INSPECTIONS.....	15
2.3.4	SAFETY PLANS	15
2.4	WORK EXECUTION	15
2.4.1	CURRENT SITUATION OVERVIEW	16
2.4.2	WORK IDENTIFICATION	16
2.4.3	PLANNING AND SCHEDULING	17
2.4.4	WORK EXECUTION	17
2.4.5	HISTORY RECORDING.....	17
2.4.6	ANALYSIS.....	17
3	RECOMMENDATIONS.....	18
3.1	ASSETS AND LOCATIONS RECOMMENDATIONS	18
3.1.1	LOCATION HIERARCHY OVERVIEW	18
3.1.2	ASSET FAILURE CODES	19
3.1.3	ASSET METERS AND CONDITION MONITORING	19
3.1.4	OTHER ASSET RECOMMENDATIONS	20
3.1.5	SUMMATION OF ASSET AND LOCATION RECOMMENDATIONS.....	20
3.2	MAINTENANCE, REPAIR, OVERHAUL (MRO) PARTS MANAGEMENT RECOMMENDATIONS	22
3.2.1	SUMMATION OF MRO PARTS MANAGEMENT RECOMMENDATIONS	22
3.3	PLANNING RECOMMENDATIONS.....	23
3.3.1	SUMMATION OF PLANNING RECOMMENDATIONS	24
3.4	WORK EXECUTION	25
3.4.1	MOBILE.....	25

3.4.2	WORK ORDERS.....	25
3.4.3	WORK IDENTIFICATION AND WORKFLOW.....	26
3.4.4	RECORDING MATERIALS ON A WORK ORDER.....	29
3.4.5	SUMMATION OF WORK EXECUTION RECOMMENDATIONS	30

1 GENERAL ASSESSMENT OVERVIEW

1.1 ORGANIZATION AND CURRENT PRODUCTS

Between the days of June 11, 2019 and June 14, 2019, EDI assessed the Port of Oakland, Harbor and Airport Oracle PM asset management system against established enterprise asset management systems (EAM) best practices. These systems are currently being used to manage assets for the following Port of Oakland organizations:

- Harbor
- Airport

Port of Oakland has the desire to evaluate top tier EAM system capabilities against their current system's capability to determine which systems best fit their current desire for asset management. In order to make this determination, Port of Oakland must consider best practices for the following:

- Asset and Location Structure
- MRO Parts Management
- Strategic Planning for Maintenance
- Work Execution

Because this assessment was an evaluation of the processes, systems, and its data, the related maintenance processes and maintenance personnel were evaluated or interviewed as part of this assessment. The strategy of the assessment was to review the current systems and evaluate the configuration, processes, and data. The evaluation of the data was to determine if the current structure and information captured supports best practices for maintenance. Specific information and data included in this evaluation were:

- Asset Location Hierarchies and structure
- Dashboards, Result Sets, and KPIs
- Work Identification and Priority
- Work Execution and Review
- PMs
- Policies and Procedures
- Planning and Scheduling
- Materials Management
- Classifications

In addition, EDI assessed the current practices for managing the use of the system and how records are created and maintained within the system. Besides the assessment of the practices, EDI also evaluated the structure and hierarchy to ensure a corporate strategy and objective was in place and that the documents created were in support of this strategy.

1.2 ASSESSMENT OBJECTIVES

The objective for asset management is to manage and mitigate risk to the business. In almost any industry, the company's assets represent one of the largest, if not the largest, investment of capital. The primary responsibility of maintenance is ensuring these assets are delivering their required function, thereby allowing the organization to meet their business objectives. The process of delivering this objective, in the most efficient way possible, is often referred to as reliability

centered maintenance (RCM). RCM is accomplished by taking a scientific approach to ensure these assets perform the user's requirements with the least possible cost and/or disruption to the business. User requirements not only dictate the function of the system, but the availability of the system as well. Looking at an asset systematically allows one to see the impact of the individual components to the overall delivery of the system.

For example, to evaluate a heating, ventilation, and air conditioning (HVAC) system, we can't just evaluate the delivery of the air handler. Instead, we must also look at booster fans, air box distribution and type, exhaust fans that effect the balance of the system, cooling water temperature, reheat distribution and coils, etc. Once we have structured the data to allow us to roll-up and evaluate the system in this manner, we can then begin the process of how a system fails to deliver on the user requirements. Consequently, the hierarchy of setting up a system for RCM must follow this basic structure:

- Ensure a data structure exists that enables the ability to classify the system and create a boundary of what's included in the system
- Understand the different ways a system can fail to deliver its functional requirement and the severity of those inabilities
- Understand the component failures that result in the system's inability to deliver a functional requirement and the ability to detect component failure prior to failure
- Understand the impact and relationship of maintenance to failure
- Understand the purpose of the job plan and job plan task
- Understand maintenance triggers and their strategic order

The data in the EAM, and the processes developed by the business, must be able to deliver on these points. Otherwise pulling out the necessary data to evaluate overall equipment effectiveness (OEE) and risk priority will be a very manual process; if it is even possible. RCM is a journey, rather than a destination. And while the Port of Oakland may not be able to implement advanced RCM processes at this time, the EAM they select should provide the capability they need for the future.

1.3 ASSESSMENT WRAP-UP

This document is structured to include the following sub-sections:

- Overview
- Recommendations
- Gap Analysis of Oracle to Mainstream EAM Capabilities

The Overview section will capture current practices in place by Port of Oakland and give a brief review of industry best practices for Asset Structure, Maintenance, Repair, Overhaul (MRO) Parts, Planning, and Work Execution. The Recommendations section will elaborate the data changes, process changes, and procedures we recommend for Port of Oakland at this time, based on business need and cultural acceptance. Finally, one of the most important outputs of this assessment is to deliver a Gap Analysis section to assess the gap created by the current system when compared to current top tier EAMs. This Gap Analysis not only addresses capability needed for current requirements, but for future requirements Port of Oakland wants to incorporate in their selected EAM. Regardless of the system selected, an implementation project will be required to configure the selected system to meet Port of Oakland requirements. Port of Oakland needs this assessment to provide the critical information required to make this decision.

2 OVERVIEW

2.1 ASSETS AND LOCATIONS

This section addresses asset structure, onboarding of assets, and the decommissioning of assets. Below is a summary of the EDI findings examples:

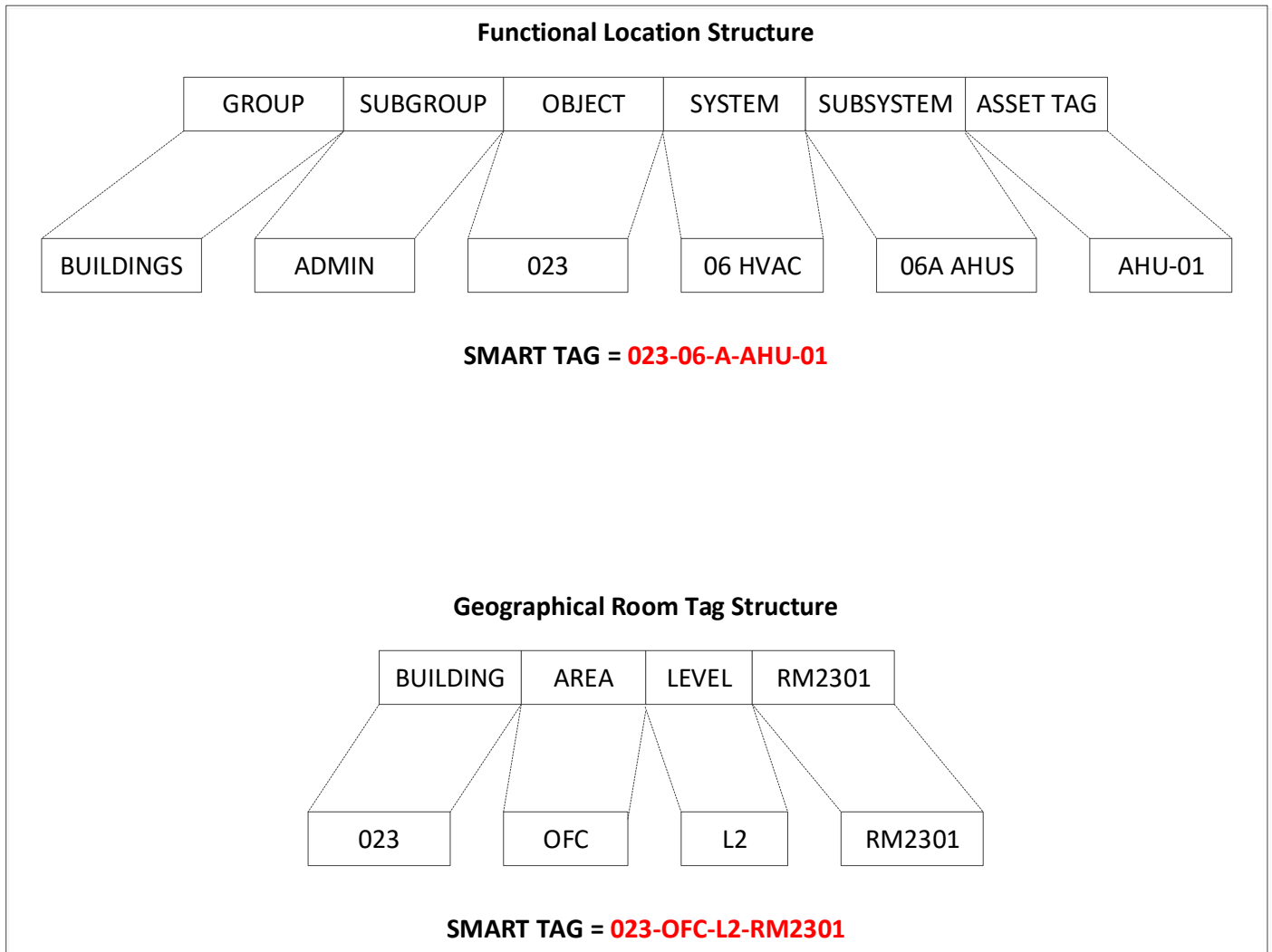
- The Location hierarchy in the Oracle system is a mix of geographic and functional
- Each object (i.e. runway) on the airfield is a single location and there are no individual asset structures for airfield lights
- There isn't a delineation between Assets and Function in the asset object
- Oracle is not using any type of classification or template system to ensure the consistent naming of assets and locations
- There is little to no functional information within the location hierarchy

When assessing the data for managing any maintenance program, the location systems and hierarchy structure is critical in order to apply a self-sustaining maintenance program. While complex reports can be written to tie any group of assets together for cost and failure analysis, it is far better to create a structure that allows anyone in the maintenance organization to pull up data by group, subgroup, object, system, or subsystem for horizontal and vertical analysis.

Systems and subsystems are NOT similar type assets. This is a frequent mistake made during EAM implementations and prevents the type of analysis required for RCM and cost management. For example, we might think it makes sense to create a pump system with centrifugal pumps as a subsystem. On the surface this seems like a logical method for categorizing an asset group. However, the criticality and risk data for these pumps is based on what they do, rather than what they are. While being able to categorize pumps together in this method is critical, this should be done through asset classification and not using a system. Two specific points of information needed to manage cost and risk would be to:

- Understand the entire cost and reliability data for an asset group, i.e. pumps
- Understand the entire cost and reliability data for a system/subsystem, i.e. tower water system

Creating this level of differentiation allows us to quickly rollup failures and/or costs to a specific group such as buildings, a subgroup to buildings such as terminals, a system within the terminal such as HVAC, or a subsystem to HVAC such as air handler units, using only simple ad hoc reports. Thus, allowing front line management to glean critical information from the EAM without having to create custom reports. The model below shows how using a structure for creating and labeling the location hierarchy can allow this to easily happen. The critical aspect of this strategy is to ensure the elements of the hierarchy, other than the P&ID tag, always utilizes the same number of characters.



The next important aspect of Location and asset data is using the system to capture the information that currently resides only as “tribal knowledge” with your employees. Tribal knowledge reflects pertinent, relative knowledge to the organization’s employees that is known and available to some employees, but not made available to everyone who may require the knowledge. In establishing the system, we must consider the five things that a technician must know before they can perform a repair or maintenance task:

- What it is
- Where it is
- What it does
- How it is configured
- Who owns it (responsible for cost of repair)

If any of this knowledge is “tribal”, the organization has a reliance on its workforce that puts it at great risk. Especially as organizations face an aging workforce where the next five years could see over 30% of the people holding this “tribal knowledge” retiring. Based on this information, it becomes more critical to design a system that contains this critical information and displays it prominently on the work order where the technician can use it.

2.1.1 ASSET AND LOCATION STRUCTURE

Currently Port of Oakland is using a location system hierarchy in Oracle that is a combination of division, function, and geographical location. EDI recommends using a single location system that is based on function rather than geographical or division as a best practice in setting up an EAM. This Functional System is where the asset object is attached, thereby creating the asset structure. The system is designed this way as most maintenance organizations tend to view assets by their function rather than where they're located. Division structure is dangerous because reorganization of responsibility can result in having to rebuild the hierarchy. Best practice dictates that there should never be more than one asset attached to a location. Having the system structured in this manner, we ensure that history is written both to the location, and the asset objects. This is extremely important where assets are repaired out of place, such as airfield lights and ground power units. This method allows the gathering of data on each position as well as the tracking of an asset's history, regardless of where it has been located.

Using the key record number for creating a "smart" numbering system is generally considered a bad practice, and EDI strongly recommends against the use of smart numbering in this manner. Most EAM top tier products are highly configurable and we can create or use a variety of fields to accomplish the same strategy that a smart number provides. When the record ID is used for a smart number, this number cannot be edited. This can result in an asset or location needing to change function and the only way to fix the number is to delete the old record and create a new one. This, of course, results in historical data being lost.

Currently, there are no naming controls in place in Oracle. Using classifications to name assets and locations is considered a best practice in EAM configuration as this ensures all assets are named consistently, thereby enabling accurate asset analysis. Because of this, naming structure should be implemented as part of any future upgrade or implementation.

2.1.2 ASSET RELIABILITY CENTERED MAINTENANCE (RCM) PROGRAM

Port of Oakland is not currently utilizing failure codes on their assets, but they have a desire to use them in the future. For this reason, the EAM selected should have this capability. While the Port of Oakland will not be implementing failure codes in the immediate future, there needs to be an understanding of the requirements for failure codes for when they do use them.

For failure codes to be valuable in an RCM program, the problem code should map to a functional failure of the system and the cause code should map to the component that has failed. This enables assignment of severity of the failure to the problem and detectability to the cause. For example, on a car we have a functional requirement for the engine to start so it can deliver power to the drive train. If the engine won't start, the severity is attached to that functional requirement, regardless of the reason for it not starting. Severity of failure is much more important than the criticality of the asset. Obviously, there are many components that can fail on a critical asset that don't cause the asset to go out of service; thereby not creating a critical situation. This demonstrates why attaching the problem to the functional failure is so important in determining risk and thereby work order priority. The table below shows examples of good codes versus codes to avoid.

Failure Code Use and Avoid Examples

Use this	Avoid this
Problem	
Inability to start engine	Starter motor non-functional
Inability to supply air at pressure set point	Filter plugged
Inability to supply air at temperature set point	Cooling control valve inoperable
Cause	
Starter motor	Bearings in starter motor failed
Primary filter	Primary filters loaded
Cooling coil control valve	Cooling coil control valve stuck
Remedy	
Replaced starter motor bearings	Repaired
Replaced primary filters	Replaced
Rebuilt cooling control valve	Rebuilt

In most cases, the failure class will match up to the subsystems in the EAM. This way it enforces the problems to capture the functional requirements of the subsystem. Building the failure class in the manner above, one can determine work order criticality by the severity assigned to the problem code. In addition, they can determine reoccurring failure modes by searching the cause across multiple systems.

2.1.3 ASSET ON-BOARDING PROCESS

During the assessment, EDI assessed the asset onboarding process for the Port of Oakland. There isn't a current process to determine what is an asset or to determine the necessary maintenance strategy when one is created. There is a need for an onboarding Standard Operating Procedures (SOP) to define what is an asset and dictates how to perform a maintenance needs assessment (MNA) to establish the maintenance strategy for the asset. The onboarding SOP should define clear instructions for the use of the location and asset objects, so the data reflects the critical aspects of the asset structure. Implementing workflows on these objects is the best way to ensure a proper review of these objects before they are released for maintenance.

2.1.4 IMPACT OF POOR ASSET DATA

Location and asset structure are one of the most critical, if not the most critical, of any EAM deployment. The way you set up the asset structure, will help you create an efficient process in developing life cycle asset management as well as ensuring your data will go into the system in a consistent manner without data drifting (as is so common in many EAMs). The Gartner group offers seminars on managing data quality and the costs associated to poor data quality. Below are two links to studies conducted by Gartner concerning the cost of data quality and what it means to a business. Furthermore,

they emphasize how the IT organization cannot be responsible for the integrity of the data, as they have such a little understanding of maintenance data.

<http://www.gartner.com/newsroom/id/501733>

https://www.data.com/export/sites/data/common/assets/pdf/DS_Gartner.pdf

2.1.5 TRAINING

No current formal training program exists for Port of Oakland other than “on the job training”. It is recommended there be a formal training program for whichever system Port of Oakland decides to implement. This should be a role-based program with manuals, and qualified trainers to support the roles. Having a training program in place ensures employees can be productive faster in their role. It also ensures a consistent approach to how work is performed that drives accurate data.

2.2 INVENTORY

As part of this assessment, EDI evaluated Port of Oakland’s practices, processes and procedures concerning inventory management. Currently Port of Oakland does not have an MRO parts management strategy. MRO parts are ordered directly by the leads or the foremen. If they order more than is required for the work order, the extras are still charged to the work order, or the department cost code, thereby skewing the cost of ownership on the asset. There are no formal storerooms established at any of the Port of Oakland sites. Any spares kept are in an area the maintenance group defines. Stock levels in these areas are managed using manual means that can result in frequent stock-outs.

The current environment will not facilitate or support consuming or recording of Maintenance, Repair, and Overhaul (MRO) parts on a work order, other than designating the work order when the parts are purchased. Any part used on a work order obtained from stock, is not captured. This diminishes Port of Oakland’s ability to manage risk introduced by not having parts on hand that are long lead items. Without the capability to record all MRO parts on a work order, it is impossible to assign the true cost of repair to an asset. Thus, the total cost of ownership (TCO) cannot be accurately calculated and risks cannot be wholly managed.

Port of Oakland acknowledges there are drawbacks to this system, but they don’t want to introduce a fully functional MRO Parts Management system currently. EDI agrees with this decision. There are more critical areas that provide greater business value as part of an EAM implementation to concentrate on first. However, should the Port of Oakland decide they want to introduce a fully functional MRO system the EAM selected should have this capability.

2.3 PLANNING

Currently, Port of Oakland does not engage in formalized reactive maintenance planning. In fact, the current Oracle system as it is being used, doesn't allow for job plans on a work order. Port of Oakland is fortunate to have a staff of qualified journeymen technicians that know what work is required in any proactive maintenance task. However, even with qualified technicians, there are times when external pressure causes critical steps to be missed if they are not dictated in the work order.

The major issue Port of Oakland is having with their proactive work is there are insufficient resources to perform the amount of proactive work generated. This results in PMs not being completed every month. Not completing a scheduled PM work order, is referred to as deferring the work. The next scheduled instance of the PM will be generated by the EAM, prior to the last instance being completed. The process of deferring work needs to be improved as it currently provides incorrect information as to what work is not being performed. This prevents management from being able to determine a correlation between deferred maintenance and asset availability as well as reducing the administrative burden of managing deferred work.

Port of Oakland desires to have a better method of forecasting resources on PMs. There is a need to capture the duration on PMs and to have visibility in the EAM on resource scheduling. The current system does not offer this capability to the level of detail desired by Port of Oakland.

2.3.1 JOB PLANS

The Port of Oakland is not currently utilizing Oracle for assigning job plans on a work order. This is an issue for Port of Oakland and must be addressed in selecting an EAM. In selecting the EAM, it should have a workflow for revising and approving job plans as necessary to ensure job plans are reviewed by the planner role before being activated. This will ensure that job plans can be easily updated but ensures any updates are approved prior to activating the changes.

When creating a job plan, the job plan should be broken down into three sections:

1. Activities required to setup the job such as Lock Out Tag Out (LOTO), notifications, tool setup, spare parts acquired, etc.
2. The job tasks or specific steps required to perform the job
3. Activities required to return the asset to operation such as LOTO removal, post maintenance testing, notifications, etc.

All three of these components are critical to effective maintenance and should be covered in detail whereby management is reasonably ensured that technician safety, notification, proper execution of maintenance, and asset function are achieved. To accomplish this, the job plan should use a workflow where a person(s) evaluates the plan to ensure these aspects of each component are met:

1. Setup
 - a. Ensure current LOTO procedures are being followed.
 - b. People or departments impacted by the asset outage are notified and aware of the window of maintenance where the asset is not available.
 - c. Tools and spare parts are identified on job plan and have been secured prior to beginning the job.
2. Job tasks
 - a. Job tasks are at a detail to ensure a qualified technician has the information required to perform the work which means job tasks address the “what” and not the “how” for any task. For example, there is a reasonable expectation that a plumber knows how to replace a backflow preventer on a water line. Therefore, the job task should state replace backflow preventer, without the detailed instructions on how to accomplish the task.
 - b. Every job step in this section should be able to answer yes to three questions:
 - i. Does it address a failure mode?
 - ii. Is the failure mode reasonable and likely?
 - iii. Is this the most effective method of addressing the failure mode?
 - c. Job tasks should be clear, specific and succinct without ambiguity. The technician should never have to guess on what the job task is asking them to do.
3. Return to service
 - a. Specific tasks to address the correct removal of LOTO.
 - b. There needs to be a set of tasks that tell the technician what testing needs to be performed to ensure the asset works as intended with no maintenance induced failures.
 - c. Ensure notification to asset users communicates that the asset has been returned to service.
 - d. Task to ensure the return of tools and unused spare parts.

Once a job plan is written in the above manner, it is important that each of these steps require an affirmation that the task was completed and who completed it. This isn't intended to get technicians in trouble, but rather it allows management to evaluate skills and training gaps when there are maintenance-induced failures because of performing or not performing the required tasks.

Finally, any work order using a job plan should give the technician the ability to record the adequacy of the job plan, and if the job plan is inadequate, to provide the reason why.

2.3.2 WORK ORDER TYPES

Port of Oakland is currently using several work order types. This is mainly because they are using work order type as to the type of asset being worked on rather than the type of work being performed. In implementing a maintenance program, it is extremely important to understand what type of work is being performed. For example; setting up a conference room, performing a data load, assisting on Capital Projects, Bill to Others, and repairing a pump are not the same type of work. One is performing an ongoing task for the organization to achieve business needs, one is administering the system, one is support work for a Capital Improvement Project, one is work performed for a tenant and the other is to restore an asset to its designed state. The system needs to be able to differentiate between these work types. Using work types to define the system being worked on is not a function of work type.

Considering PMs, the current system can't differentiate among time-based, use-based, predictive, condition, or Run to Failure (RTF). This ability is very important in establishing an effective maintenance program. Otherwise there is no way to measure the organization's ability to maximize asset time between repairs.

2.3.3 ROUNDS, ROUTES, AND INSPECTIONS

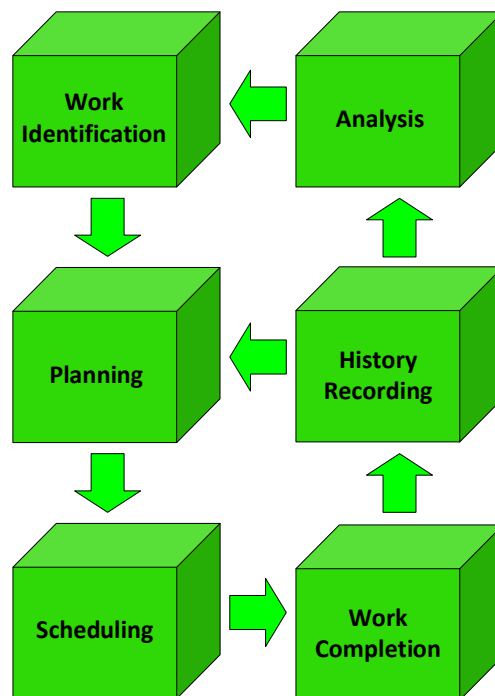
While Port of Oakland performs rounds, they are performed on forms and paper rather than within the Oracle EAM. As a result, the rounds are often not reviewed and critical recordings are ignored. Because Oracle does not support Rounds, the Port of Oakland is unable to perform these in the system. Additionally, Oracle does not have the capability of Routes and Inspections. Consequently, these are either not done or done via paper forms. Because Oracle does not have this capability, the usual function of routes being able to use condition monitoring or meters is not available. Consequently, no recordings of the routes can be captured, even if routes existed. The same is true of inspections, the functionality simply does not exist in Oracle. Utilization of rounds, routes, and inspections are a critical component to a maintenance program and especially important for predictive maintenance strategies.

2.3.4 SAFETY PLANS

Port of Oakland does not currently use safety plans within Oracle. They would like to use the first step in a job plan to ensure safety procedures are followed. EDI agrees with this desired strategy, with the caveat that formalized safety procedures are captured in the long description of the safety task in the work order.

2.4 WORK EXECUTION

The work order is the heart of any EAM system as it is the object that defines the central purpose of the EAM. The diagram below depicts how work execution is carried out in a well-functioning EAM. The EAM selected should have this capability.

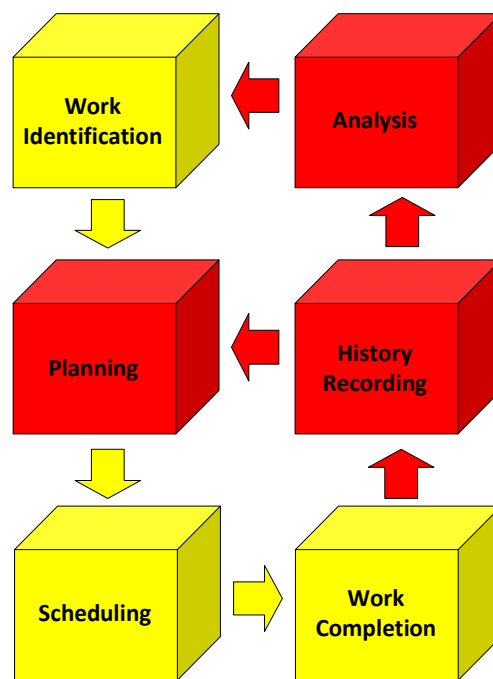


When analyzing work execution in any industry, it is important to look at how well they perform the action depicted in each of these boxes. Also, one should analyze the arrows that exist between the boxes to understand how they transition between the actions. This model is valuable in understanding the effectiveness of work execution.

2.4.1 CURRENT SITUATION OVERVIEW

Port of Oakland is currently using a unique system of work order execution that is a combination of paper, radio, and email. Work is rarely recorded on paper and in most cases, paper is used as a method of assignment, rather than a vehicle to record work activities. Instead of recording activities on the paper work order, it is recorded on Oracle time reporting. There is no mobile technology in place in any department. Work orders enter the system either by maintenance personnel who key them in or from email, radio or phone call notifications (Port of Oakland can also receive them via a phone call from the AOC), or a work request that requires approval from the Asset Management group.

In performing the assessment, our observation of how work execution was being performed at Port of Oakland is depicted in the model below. It must be understood, this is not meant to be an indictment, but rather a method of determining areas of opportunity to help define a long-term strategy for Port of Oakland.



2.4.2 WORK IDENTIFICATION

Work Identification is done fairly well at Port of Oakland. While there are opportunities to improve, there aren't numerous situations where critical work is going unidentified. The reason this box is not green at Port of Oakland, is that there is a significant amount of work that is not written to the correct asset. This makes it impossible to achieve accurate total cost of ownership (TCO). Port of Oakland does allow a work request to be entered by any employee. However, this request must go to the administrator for approval before being sent to the trades. Often, the work has been started before the work order is entered and approved. The only time a work order can be created in an approved status, is if it is created by the qualified personnel in the trades.

2.4.3 PLANNING AND SCHEDULING

All planning and scheduling of work is done by the Foreman, Leaders, and Supervisors at Port of Oakland. While this isn't best practice, Port of Oakland feels this is the most effective strategy given present staffing. However, Port of Oakland does not use job plans on PM work. There is one aspect of planning that the Port of Oakland wants to consider, which is "look ahead resource planning". This will require an accurate schedule of labor records in the EAM.

2.4.4 WORK EXECUTION

As typical in most organizations, this is something Port of Oakland does well. Staff are competent and trustworthy. The quality of work is not a major concern to Port of Oakland currently. However, they lack the dashboards and KPIs to determine the impact preventive strategy has on corrective maintenance. As a result, The EAM of choice must have the capability for front line management to have the ability to perform real time analysis of work performed.

2.4.5 HISTORY RECORDING

History recording at Port of Oakland is nonexistent. The only history recorded on a work order is the time recorded on the timecard. In addition, it is left to the staff to create follow-up work orders when an issue is uncovered during the performance a of PM. Because only time is recorded on a work order, it is difficult to say that history is recorded at all.

2.4.6 ANALYSIS

Because work is not recorded, analysis is not being performed. There are instances of work recorded on paper, but these notes are not transferred into the system, and therefore analysis is difficult, if not impossible. The best way to perform analysis, is using failure codes as explained in the Assets section of this assessment. This allows one to quickly determine functional failure (problems) and failure mode (cause). However, even recording just notes on the work order would allow some level of analysis to be performed.

Having this data allows one to determine the effectiveness of the maintenance strategy and make necessary adjustments based on this analysis, thereby impacting how work is identified.

3 RECOMMENDATIONS

3.1 ASSETS AND LOCATIONS RECOMMENDATIONS

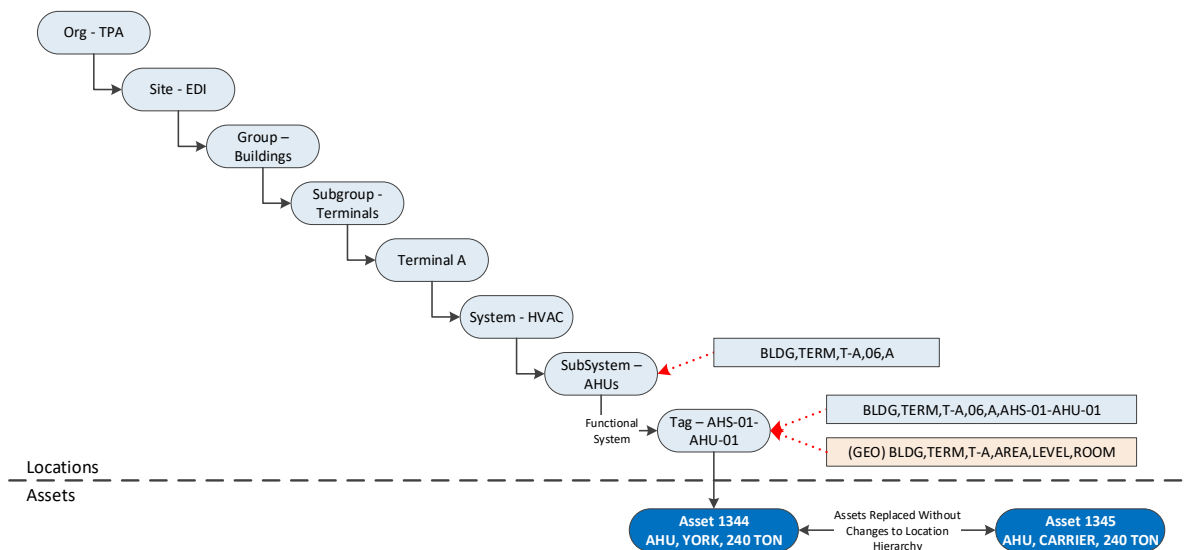
3.1.1 LOCATION HIERARCHY OVERVIEW

Most organizations have a heavy dependency on tribal knowledge. In fact, it is not uncommon for staff to be in place for a year or more before they are adequately functional in their role because of the time required to transfer tribal knowledge to a new technician. The EAM must provide critical data to a staff to prevent the requirement of phone calls and conversations to enable effective maintenance. Additionally, having this information in the system, prevents improper maintenance that can insert additional risk in the system. When determining the structure for asset setup and configuration, it is important to reflect on the five pieces of information a technician must know to perform maintenance that is mentioned above in this document. EDI recommends this information be captured in this manner:

- What it is – Asset record
- Where it is – Geographical Room Tag on Functional Location record
- What it does – Functional Location record
- How it is configured – Functional Location record
- Who owns it (responsible for cost of repair) – Cost information on the Functional Location record

Note that in this structure, everything that uses contextual information regarding the asset is in the functional location record. The reason for this is that what an asset does has more impact on the way it is maintained and the risk it presents to the business than any other aspect of the asset. In the Port of Oakland system, the location (if present) doesn't exist in a one-to-one relation with the asset record and it doesn't define the function. This results in functional information being put at the asset record, which in turn makes the asset record responsible for defining not only the "what it is" information, but also the "what it does". This means that when assets are repaired out of place, or decommissioned, the potential for data loss or data drift is substantial.

The example below demonstrates how these objects fit together allowing this to take place:



Using the Location/System hierarchy as described, will allow Port of Oakland to build out each aspect of a system. EAM functionality should be set to allow for parent/child relationships on locations. A best practice recommended by EDI is using the location structure to create the asset hierarchy and avoid building the hierarchy on the asset object itself. This avoids the situation where decommissioning an asset that is in a top position in an asset hierarchy results in decommissioning children in the hierarchy not intended for decommissioning.

To implement a Functional Location Hierarchy, we recommend you start with mechanical drawings for your buildings. Even if they're not up to date, they will still give you a guideline for numbering and system boundaries. Each of these drawings represent a system, and on each of these systems are bubbles that represent a location or folder an asset will go into. This is referred to as the Functional Location Hierarchy.

By using this system, we can now remove contextual data from the asset description. The asset object can now be used only to describe the "what it is" function (allowing the remaining data to be put on the location objects). In the example above, the location string identifies the org, site, group, subgroup, object, system, subsystem, and asset. This structure allows a technician or planner to know that this is an air handler unit at terminal A on air handling system 1. By building this structure, the Planner can look at work identified based on the building, a combination of building and system, or a combination of building, system and unit.

Using the location function in this manner, combined with using the asset object strictly as the "what it is", provides a structure where object data rarely, if ever must be modified, even when using rotating assets. Thus, data integrity is maintained at a consistent level.

With this System Location hierarchy, you can maintain system maintenance history along with asset history. By building a one-to-one relationship with an asset and location, users can track all work to the system, as well as tracking work performed on an asset regardless of the system it was used for. The EAM selected should have functionality to bring the asset with the location to the work order when either one is identified.

3.1.2 ASSET FAILURE CODES

Even though there are no failure classes in the Port of Oakland system, the organization has a desire to start using them. EDI recommends an initial implementation with basic failure codes and begin building them up as they are used. Regardless of whether Port of Oakland feels they are ready to implement RCM, they need to be careful on anything that prevents or complicates implementing it in the future. An RCM strategy could have profound impact on Port of Oakland asset management in reducing cost and decreasing downtime of assets, and should be part of any long-term plan for asset management at Port of Oakland.

3.1.3 ASSET METERS AND CONDITION MONITORING

Currently, Port of Oakland is not using meters or condition monitoring to maintain their assets, but they have expressed the desire to move in this direction. Especially concerning rounds that they are already performing. Even though they have most preventive maintenance identified, at this time, it is all schedule based. While this is a better option than not performing preventive work, it is the least effective method of maintenance. Utilizing meters and condition monitoring in inspections and rounds to drive use-based maintenance and predictive maintenance will provide an effective RCM strategy. Implementing a simple maintenance needs assessment process would provide a strategy where Port of Oakland

could provide maintenance that would drive higher overall equipment effectiveness (OEE). In addition, EDI believes it would provide better metrics for these strategies to be recorded and setup in the EAM.

3.1.4 OTHER ASSET RECOMMENDATIONS

One difficult aspect in deploying an EAM in any industry is effectively answering the question; “what is an asset?” If the system becomes loaded with assets that don’t contain all the data written to them, then analyzing the data delivers inaccurate results. For example, say you make the decision to call the pump and the motor on a 5 HP pump both assets. If the pump fails and the work order is written to the pump, yet it was the motor that failed, you then have incorrect data at the asset level. In addition, the failure codes known as Problem, Cause, and Remedy or PCRs, should be written so the problem expresses the inability of a specific user requirement; this would make the motor a component or spare part that was the cause of the failure. If a motor is not rebuilt (as is typically the case of motors under 50 HP), it should be considered a spare part.

As is typically the case, the above example will have exceptions both ways. Sometimes we need to make something an asset that is never rebuilt, while in other instances we rebuild things that we will never make an asset. EDI recommends creating a set of guidelines, such as the ones listed below, in determining what constitutes an asset:

- The asset can be refurbished or rebuilt and is not associated to an overall maintenance strategy. For example, valves on a condensate return skid would most likely be maintained as part of skid maintenance rather than individually. However, a pump on the same skid may have its own asset number because the maintenance strategy for maintaining it is not in alignment with the rest of the skid.
- The asset is repaired ‘Out of Place’ (OOP). Airfield Lights, Pumps, Control Valves, Pressure Safety Valves, are all good examples of this. In the EAM, this is called a ‘Rotating Asset’.
- The asset requires calibration or certification. An asset that requires history for certification or calibration must have an asset number for this data to be tracked.
- The asset requires tracking even though the asset is not maintained. This is usually because it has a high value and is portable enough to wander. This could also be for assets being tracked by the financial system, as in the case where the asset was salvaged prior to it being fully depreciated, accounting would need to know to write the asset off and stop depreciation. Large screen monitors would be a good example of this situation.
- The asset requires a number because it is used to secure a hazard in a safety plan. Typically, valves are maintained as part of an overall system maintenance plan. But valves that are used for locking out a hazardous energy source require an asset number, so they can be used in a safety plan.
- The asset needs to be tracked for compliance with an external agency. Maintaining turf on the airfield is a good example of this. It does not meet any of the above requirements, but the cutting and maintenance must be recorded and stored for compliance purposes.

Regardless of whether Port of Oakland agrees with this definition for an asset, it is recommended that a standardized definition be provided where all departments can utilize the definition and help drive consistency in maintenance and reliability strategies.

3.1.5 SUMMATION OF ASSET AND LOCATION RECOMMENDATIONS

EDI recommends Port of Oakland create documentation on structuring and managing the data that is entered into the system. The best way to ensure documentation practices and processes are followed is to utilize workflow and approvals

so that a group of people familiar with these policies are the ones approving the data that goes into the EAM. This will not only allow for better data quality, but also gives the system the capability for more efficient workflows and asset management as described below in the recommendation.

To summarize, EDI recommends Port of Oakland implement the following for assets and locations:

1. Adopt a functional hierarchy that breaks all assets into groups, subgroups, objects, systems and subsystems
2. Create classifications and domains for all asset structure objects
3. Create function locations to ensure assets exist in a one to one relationship
4. Map all Regulatory, Safety, Environmental, RCM, and any other contextual data to the functional location
5. Work with an implementor on a Data Plan to extract all assets from legacy systems and accurately load them into the new EAM
6. Develop a process for performing a maintenance needs assessment on systems rather than assets
7. Create some basic systematic failure codes for assessing overall risk

3.2 MAINTENANCE, REPAIR, OVERHAUL (MRO) PARTS MANAGEMENT RECOMMENDATIONS

While EDI agrees with Port of Oakland that a fully functional MRO Parts Management strategy should not be implemented at this time, we believe there are some improvements in this area that will allow opportunity for better costing to assets. Regardless of the MRO Parts Management strategy that Port of Oakland implements, it is important to understand the different types of MRO Parts. These are: Consumable Parts; Spare Parts; Rotating Items; Risk Managed Spares (RMS); Attic Stock; and Vendor Managed Inventory. A definition for the types of spare parts are detailed below.

- Consumable Parts are those that are consumed without being tracked to a work order. These include items like gloves, screws, wire nuts, etc. These parts need to be in a separate area that are often more easily accessed by the trades.
- Spare Parts are parts that are purchased specifically for maintaining assets. These parts should be assigned to the assets they support. These parts are typically fast moving and should be geographically positioned for easy access for stocking and picking.
- Rotating Items are parts that are rebuilt rather than discarded. These follow the same structure of the spare part with the exception that they rotate between operational, repair shop, and inventory. Thus, they will always have both an item and an asset number assigned to them. Airfield lights are a good example of a rotating item.
- Risk Managed Spares are parts that are not used as part of the PM program, but are required to prevent asset downtime that will present a critical risk to the business. These are typically long lead items as well.
- Attic Stock is a term used to identify excess building materials left over from a project. Storing and maintaining a certain level of this stock is important in maintaining a professional looking environment when items like wall paint, carpet, ceiling tile, etc. are damaged during the operation on an asset.
- Vendor Managed Inventory is inventory that is managed via a vendor contract and is stored and maintained by the vendor, rather than the business. The contract defines a service level agreement (SLA) for delivery of the inventory as a direct issue to work performed. HVAC filters are a great example of this category.

MRO Parts Management strategy will be fully assessed at a time Port of Oakland determines they want to utilize storerooms and traditional parts management.

3.2.1 SUMMATION OF MRO PARTS MANAGEMENT RECOMMENDATIONS

Considering Port of Oakland's wishes for MRO Parts management, EDI has summarized their recommendations as follows:

1. Create the ability to request material from a work order or a requisition. Requesting from the work order will result in all material requested costed to the asset the work order is written to. A requisition will allow each line to be assigned to a different work order or cost center.
2. Provide the ability to create nonstock items in a virtual storeroom for ease of ordering repetitive items and to determine stock levels of current inventory.
3. Provide basic inventory practices in the virtual storerooms that are trade managed. While not ideal, this will allow parts to be captured to work orders and parts to be ordered when stock drops below the prescribed level.

3.3 PLANNING RECOMMENDATIONS

Port of Oakland's biggest challenge in planning is the fact that there is more PM work than there are resources. By deferring PMs there is a risk of a catastrophic asset failure. However, it should be noted, that without recording history and analyzing historical data, it is impossible to establish current asset health. Regardless, there seems to be opportunity to develop a proactive maintenance program to effectively control business risk and asset availability while maximizing the impact of the PMs that are performed. We believe the only effective way to do this is to incorporate maintenance triggers other than schedule based. This can be accomplished using Meters and Condition Monitoring collected through the application of Inspections and Rounds. In addition, utilizing some rudimentary failure classes on a few critical asset groups will allow analysis of the effectiveness of the changes to the PM strategy.

EDI strongly recommends putting a document in place that details how to perform a maintenance needs assessment (MNA). The MNA is a process to determine a maintenance strategy for an asset or a group of similar assets. The MNA document is crucial to ensure a consistent strategy of implementing more effective maintenance triggers and reevaluating the period length on schedule-based PMs. With a reasonable level of effort, there could be a significant reduction in the number of PMs being generated each month with little to no impact on asset availability. In fact, there is data showing that unnecessary PM work actually decreases asset availability.

Currently Port of Oakland relies on paper or an email for the work order number to charge time to. In no instance is there documentation in the system that a task on the job plan was performed. Utilizing a paper system results in lack of data for performing data analysis. EDI recommends the implementation of a mobile solution as a critical decision for any future upgrade or implementation. A mobile solution will expedite all facets of work order execution.

EDI recommends that job tasks go back to the job plan and are written as recommended in this document. In addition, we recommend that the mobile software allow simple buttons on each task where the technician can identify the following:

- Y – Job task performed
- N – Job task not performed (this requires a comment from technician on why it was not performed)
- N/A – Job task not applicable to this asset
- FOLLOW – Follow-up work order needed to complete this task

If the job plan is written as recommended, requiring the technician to acknowledge the job tasks in this manner should not create an undue burden. In addition, this will allow Port of Oakland to evaluate job plan effectiveness and its impact on asset OEE. Continuing to use job plans in their current state, makes it impossible to evaluate maintenance effectiveness.

In addition to the above, EDI also recommends after the job plan that the technician be prompted to check a box for job plan effectiveness. If answered no, the technician is provided a text box to describe the issues with the job plan. Marking this checkbox, notifies the planner that there are issues with the job plan so these issues can be rectified, and the job plan can be made more effective.

Labeling assets with a tag, either barcode, QR, RFID, NFID, etc., is important in asset management. However, going out into the field to accomplish this can be an overwhelming task. EDI recommends a check box on the work order of "Label Required". This allows the asset management group to print a monthly report and tags and begin a process that will effectively label all assets over time.

EDI also recommends using workflow for job plan approval and revision control for job plan revisions. This ensures that the necessary people are reviewing and approving work and there is a clear understanding of the progression of planning. Using revision capability in the EAM allows planning to view the evolution of the job plan, thereby understanding how the RCM program is progressing.

EDI believes using rounds, routes, and inspections properly, could solve several issues around the identification of work at Port of Oakland. Especially in establishing an RCM program. This functionality needs to be utilized in conjunction with meters to allow an inspection route to kick out the corrective work that's being observed. Rounds and inspections are also a powerful tool enabling inspections and work to be performed across multiple locations and asset types.

3.3.1 SUMMATION OF PLANNING RECOMMENDATIONS

The following summarizes the recommendations EDI is proposing for this implementation:

1. Create a PM strategy for maintaining assets at Port of Oakland by adopting a life cycle asset management (LCAM) SOP, and a procedure for performing a Maintenance Needs Assessment (MNA) on their assets
2. Incorporate a workflow for job plan revision and approval
3. Create work types to give better resolution on the different maintenance triggers for proactive work
4. Create a strategy to reduce the number of schedule-based PMs
5. Record resource availability in the EAM
6. Utilize PM forecasting to determine planned maintenance against available resources
7. Create an MNA team on a specific asset group and implement an effect maintenance strategy so Port of Oakland can see the value of this program

3.4 WORK EXECUTION

3.4.1 MOBILE

Mobile is a critical component of successful asset management today. Because at the Port of Oakland, there are vast geographical areas that benefit from performing routes, rounds, and inspections using a mobile device, this should be considered a high priority. Using mobile technology allows for consistency of failure reporting which enables asset analysis that leads to better work identification. It provides real-time data that enables leading metrics to be created allowing for more in-depth analysis of processes and asset performance. It also allows for a consistency in how work is completed in the field.

Other benefits of mobile are for time recording and labor utilization reports. This allows management to level workloads and maximize labor utilization. Also, with mobile, priority of work becomes a meaningful method of determining what work needs to be performed first. Using the mobile device, work can be quickly given to a technician without the requirement of physically delivering a piece of paper. This includes after-hours work that may be dispatched by someone outside Port of Oakland. This means that a call center can create a work order to the on-call technician to resolve the event by a few answered questions. Review of the dispatched work order can then be performed for completeness by maintenance the following day.

3.4.2 WORK ORDERS

The work order is the culmination of the data put into the system. This is the object that is used for identifying, planning, scheduling, performing, recording, and analyzing work. Consequently, it is important to get it right. Port of Oakland is currently using way too many work types. The problem with this is it is easy to improperly type the work, and that the use of work types is based on asset type rather than the type of work. This makes any kind of analysis on delineating reactive versus proactive impossible.

Below is a grouping of work types EDI recommends. These work types have been developed over time to most effectively identify the type of work performed in the system. Being able to identify work type, gives a baseline on what the purpose of the work type performs.

Reactive Work Order Types:

- TC – Trouble Call
- CM – Corrective Maintenance
- SM – Service Maintenance

Proactive Work Order Types, by Strategy Preference:

- RTF – Run to Failure
- CdM – Condition Based Maintenance
- PdM – Predictive Based Maintenance
- UbM – Use Based Maintenance
- SbM – Schedule Based Maintenance

Other Work Order Types:

- CE – Change Evaluation
- PR – Project Work
- AD – Admin Work for EAM updates and data loads
- MNA – Maintenance Needs Assessment
- RCA – Root Cause Analysis
- IA – Investigative, usually a child to an RCA

While it may not be practical for Port of Oakland to utilize all these work types at this time, we feel they would benefit in adopting some different work types to differentiate their work processes. Having work types that truly differentiate the type of work versus the maintenance activity, gives you the ability to understand what type of work is consuming the hours, which gives you direction for your maintenance strategy.

3.4.3 WORK IDENTIFICATION AND WORKFLOW

An online tool for entering work orders in The EAM is essential to good asset management. The idea of having a group interpret emails, radio dispatches, or phone calls to create work orders is not a sustainable process and is inefficient. Effective asset structure setup along with some key devices in the field for tenants to identify asset failure ensures accurate work orders enter the system.

Port of Oakland also needs to establish an Asset Management Group. In fact, the proper use of roles at Port of Oakland is critical for establishing a good asset management system. Below is listed the roles suggested for a best in class maintenance organization and a brief description of the duties performed.

Role	Responsibility
Asset Management Team	
<i>The Asset Management Team oversees the administrative functions of Asset Management.</i>	
Requestor	<ul style="list-style-type: none"> ■ Request work on an Asset ■ Often the user of the Asset
System Administrator	<ul style="list-style-type: none"> ■ Has all rights to the EAM ■ Does not perform any Asset Management functions ■ Perform EAM system modifications as directed by the Asset Management Team to support the business functions required to meet their goals ■ Responsible for the configuration of objects and elements of the EAM after Go-Live
Manager	<ul style="list-style-type: none"> ■ Read Only Role ■ View records and KPIs ■ Run reports

Role	Responsibility
Work Order Management (WOM)	<ul style="list-style-type: none"> ■ Perform administrative functions of the EAM pertaining to Asset maintenance ■ Ensure corrective maintenance and on-demand Work Orders are written to the right Asset ■ Responsible for Asset and location review on Work Orders, printing reports, and data entry (where needed) to ensure Work Orders are being routed properly ■ Review records in the EAM for new assets ■ Plan/Schedule work that is contracted to and performed by outside vendors who do not have EAM access
EAM BA	<ul style="list-style-type: none"> ■ Support the business as needed ■ Has the rights of every other Role, except System Administrator ■ Has rights to perform data loading, Report Administration, Users, People, Domains, Report Object Structures, etc., to allow business needs to be accomplished without affecting Systems, such as what the System Administrator would be responsible for
Reliability Specialist	<ul style="list-style-type: none"> ■ Analyze the cause of maintenance and minimize the impact of Asset failure on the business ■ Develop and set maintenance strategy for the Site ■ Provide consult during creation of an Asset’s geographic location, functional location, job plans, datasheets, Asset data, and spare parts lists ■ Perform maintenance needs assessment (MNA) on assets to be maintained in the EAM ■ Ensure the system is ready for operation prior to being turned over to the Facilities department ■ Provide equipment and instrument tolerances and specifications within the system being delivered ■ Ensure new assets are classified per this standard ■ Establish, implement, and maintain documented processes and/or procedures for the ongoing identification and assessment of Asset-related and Asset management-related risks ■ Identify and facilitate the implementation of necessary control measures throughout the life cycle of the assets ■ Create, modify, and develop failure classes and codes ■ Provide support to the MRO Parts Management Team during the generation of job plans, preventive maintenance, and spare parts lists ■ Activate records in the EAM for new assets
Scheduler	<ul style="list-style-type: none"> ■ Negotiate with the client’s schedule window where scheduling is required for work performance
System Owner	<ul style="list-style-type: none"> ■ Typically, the manager of the area ■ Responsible for the availability of the Asset ■ Approve all modifications and maintenance strategy on the system ■ Provide consult to the Asset Management Team during creation of functional locations, maintenance needs assessments, maintenance strategy, job plans, technical specifications, and Asset data ■ Provide user requirements and SLA information for delivery of maintenance strategy for the Asset Management Team ■ Responsible for budget and approval of maintenance strategy for Asset Management Team

Role	Responsibility
MRO Parts Management Team	
<i>The MRO Parts Management Team is responsible for managing MRO parts. This includes maintaining inventory levels, adding new items, receiving parts, purchasing parts, and picking parts for Work Orders.</i>	
Procurement Specialist	<ul style="list-style-type: none"> ■ Purchase MRO inventory ■ Work on Vendor Agreements ■ Work on Purchasing Contracts ■ Develop strategies to maximize purchasing advantages
Warehouse Clerk	<ul style="list-style-type: none"> ■ Receive packages into the receiving staging area ■ Transport packages of MRO parts to the receiving areas of satellite storerooms across the Site
Inventory Clerk	<ul style="list-style-type: none"> ■ Receive parts into the storeroom ■ Label/Identify materials per assigned controls ■ Picking parts for Work Orders ■ Reconcile returned parts to Work Orders
Inventory Specialist	<ul style="list-style-type: none"> ■ Required to have craft experience in their area ■ Determine the correct part to order by making sure the right item number is selected ■ In most cases, create and approve the Item Master records ■ Ensure corporate Standard Modifier Dictionary (SMD) for MRO parts is adhered to ■ (This role may be under the Craft Group when performing those tasks)
Inventory Supervisor	<ul style="list-style-type: none"> ■ Manage Inventory ■ Change Cost Types ■ View Item Availability ■ View Inventory Transactions ■ Inventory Adjustments
Craft Team	
<i>The Craft Team oversees planning, assigning, and executing Work Orders. The roles under this group are the Supervisor, Maintenance Planner, and Technician.</i>	
Trade Supervisor	<ul style="list-style-type: none"> ■ Understand the priority of work ■ Assign Technicians to Work Orders that are qualified and able to perform the work ■ Analyze reports and metrics, including KPIs for open WOs, Priority WOs, and WOs Not Evaluated ■ Review completed Work Orders generated from a Finding ■ Performs the functions of the Asset Inspector

Role	Responsibility
Maintenance Planner	<ul style="list-style-type: none"> ■ “Super Tech” of the organization ■ Identify cause of work and develop job plans for the remedy of failures on the Systems ■ Create/Modify job plans and preventive maintenance per established maintenance strategy for assets managed in the EAM ■ Create Safety Plans and provide Job Hazard Assessments (JHAs) ■ Provide support to the Asset Management Team during the creation of an Asset’s parameters, Asset data, and spare parts list ■ Provide support to the Asset Management Team during the creation of an Asset’s geographic location, functional location, maintenance needs assessment, and maintenance strategy ■ Create/Modify Inspection Plans ■ Generate Inspection Plans to be entered in the EAM
Technician	<ul style="list-style-type: none"> ■ Perform work on assets per approved job plans and training ■ Record Labor, Materials, Failure Codes ■ Provide feedback on Job Plans ■ Perform Inspections ■ Mark tasks ■ Create Findings ■ Create Work Order from Findings ■ Create communications from Findings

The purpose of roles is not to match to departments or positions. It simply identifies every role required to perform asset management at an organization. The person performing these roles is often very different in title/position based on the various departments in the same organization. In addition, it is common for an individual to be in several roles. Especially when first establishing best EAM practices.

Workflows need to be formally established at Port of Oakland for the approval and assigning of work. While it is understood that due to resourcing challenges, most of reactive work is high priority and requires immediate dispatch, there is still a benefit to managing all work requests that enter the system. Workflow ensures correct review, approval, planning, scheduling, and assigning of work. By the proper use of workflow, management can quickly see where issues in work execution is happening.

3.4.4 RECORDING MATERIALS ON A WORK ORDER

While Port of Oakland does not feel an MRO Parts Management function would provide enough value at this time to implement a department, there is a desire to have the capability to record materials to a work order to better measure TCO. Currently, there is a process in Oracle where materials can be requested and costed against a work order. However, most parts are not properly costed to the work order.

In MRO Parts, it is important to distinguish between parts you have a record for to make it easier to reorder, versus parts you type out a description when ordered. This is commonly referred to as the difference between items and materials. Just because you make items out of commonly used parts, doesn’t mean you will create inventory for these items. In Port

of Oakland's case, most parts used will be recorded as materials. However, there was expressed the desire to create items for a few of the parts used, in order to make the ordering process more efficient.

You can record storage of parts within the EAM without using traditional stores function. This means you can order extra of an item and put it into a storeroom without processes to receive, count, or manage inventory. This just gives the capability of using parts in storage on a work order for costing functionality.

It is understood, that in many cases, parts can be used from internal parts storage and these parts will not be recorded to the work order. In cases where parts are used for chargeback, they will be recorded as Service, in order to capture the full cost of the repair. The material recording process must have the ability to record parts by line to a work order or a cost account.

3.4.5 SUMMATION OF WORK EXECUTION RECOMMENDATIONS

For Port of Oakland to implement these recommendations, the following activities are required:

1. Implement a fully mobile solution with recommended workflows, work types, and data structure.
2. Provide the ability to assign and record material to a work order.
3. Create work types to ensure that reactive work is limited to only the work required to return an asset to its required function. This will help establish more accurate TCO.
4. Provide an online request tool that can be used by Airport Operations Communications Center as well as Port of Oakland employees and selected tenants.
5. Establish processes to capture meters that will enable predictive and condition-based maintenance.
6. Create the ability to record services to a work order.
7. Create the ability to plan tools to a work order. This will not be used exclusively, but it will be available for tools in high demand that require scheduling.



2018 Gartner Magic Quadrant (MQ) for Enterprise Asset Management (EAM)

The above Chart is based upon an independent study by the Gartner group and should prove helpful to the Port of Oakland in selecting the EAM that can deliver on their needs.