

Effective Event Data
Collection for
Reliability Analysis



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Business Challenge

Collecting event data is a minimum requirement to measure the effectiveness of your current asset strategies. Without this information, those on the front line tend to allocate resources that focus on the “problem of the day” and as a result, do not have a systematic approach to removing defects from the operation. Having a complete set of event data for all asset events allows a much clearer understanding of how to get the greatest return on human and capital resources and enables operators break out of the reactive work cycle.

Event data can come from a variety of sources such as a maintenance management system, predictive and inspection systems, as well as production systems. For this discussion, we will focus our attention primarily on collecting event data related to equipment that resides in a maintenance management system.

It is important to understand the reasoning behind the data collection effort before getting into the details of how it is actually accomplished. The collection of event data has a double benefit. The primary benefit of comprehensive event data is to alert process owners as to whether their asset strategies are effective. Once we identify ineffective strategies, we can use the same event data to drill down and determine what might be the cause(s) of the ineffective strategies.

What is Reliability Event Data?

- Work events that occur on equipment
- Type of work performed
- Conditions found at the time of work
- Technical findings after work is completed
- Dates/time associated with the work
- Cost associated with performing the work

When an event occurs on a piece of equipment, it is critical to record what type of event actually occurred. For instance, was it a failure, repair or a PM? What was the condition of the equipment at the time of the event? Once the work is completed, we need to record the technical finding such as the failed item, failure mode, cause and several other data elements that will be discussed in further detail. Some of the most critical information on the recording of any event is the date and time

stamps related to the event and the costs associated with that event (e.g. labor, material, contractor, production losses).

Below is a list of the data and supplemental descriptions that are recommended to collect on a given event. This data will be used as the basis for compiling a balanced scorecard as well the information required to find the underlying causes.

A company's balanced scorecard is comprised of standardized, enterprisewide performance measurements related to production assets. A balanced scorecard provides a holistic view of key performance indicators (KPI's) spanning multiple plants and allows management to make strategic, fact-based decisions with greater confidence.

Identification	History	Dates	Consequence
Event ID	Functional Loss	Event Date	Maintenance Cost
Event Type	Functional Failure (ISO Failure Mode)	Mechanically Unavailable Date/Time	Production Cost
CMMS ID	Effect	Mechanically Available Date/Time	
Functional Location	Maintainable Item	Mechanical Downtime	
Functional Location Hierarchy	Condition	Maintenance Start Date/Time	
Level 1 (Site)	Cause	Maintenance End Date/Time	
Level 2 (Area)	Maintenance Action	Time to Repair	
Level 3 (Unit)	Narrative		
Level ...			
Level n (System)			
Equipment ID			
Equipment Name			
Equipment Category (Rotating)			
Equipment Class (Pump)			
Equipment Type (Centrifugal)			

Event ID - This is the unique identifier for each failure event.

CMMS ID - This is useful if you are using a CMMS system as the base data collection system for failure events.

Functional Location - The functional location is typically a "smart" ID that represents what function takes place at a given location. (Pump 01-G-0001 must move liquid X from point A to point B)

Functional Location Hierarchy - Functional hierarchy to roll up metrics at various levels

- Level 1
- Level 2
- Level 3
- Level ...
- Level n (System)

Equipment ID - The Equipment ID is usually a randomly generated ID that reflects the asset that is in service at the functional location. The reason for a separate Equipment ID and Functional Location is that assets can move from place to place and functional locations

Equipment Name - Name or description of Equipment for Identification purposes

Equipment Category (e.g. Rotating) - Indicates the category of equipment the work was performed on. Generally by discipline (Rotating, Fixed, Electrical, Instrument)

Equipment Class (e.g. Pump) - Indicates the class of equipment the work was performed on. Failure Codes can be dependent on this value

Equipment Type (e.g. Centrifugal) - Indicates the type of equipment the work was performed on. Failure Codes can be dependent on this value

Functional Loss - This indicates whether the equipment experienced a functional loss as part of this event. A functional loss can be defined as any of the following three types: (1) Complete Loss of Function, (2) Partial Loss of Function, (3) Potential Loss of Function

Functional Failure (ISO Failure Mode) - Basically the symptoms of a failure if one has occurred. Any physical asset is installed to fulfill a number of functions. The functional failure describes which function the asset no longer is able to fulfill.

Effect - The effect of the event on production, safety environmental, or quality.

Maintainable Item - This is the actual component that was identified as causing the asset to lose its ability to serve. (e.g. bearing)

Condition - This indicates the type of damage found to the maintainable item, in some cases this also tends to indicate failure mechanism as well.

Cause - The general cause of the condition, this is not the root cause. It is recommended to use RCFA to assess root causes.

Maintenance Action - Corrective action performed to mitigate the damaged item.

Narrative - Long text description of work and suggestions for improvements.

Event Date - This is the date that the event was first observed and documented.

Mechanically Unavailable Date/Time - This is the date/time that the equipment was actually taken out of service either due to a failure or to the repair work.

Mechanically Available Date/Time - This is the date/time that the equipment was available for service after the repair work had been completed.

Mechanical Downtime - Difference between Mechanically Unavailability Date and Mechanically Available Date (in hours).

Maintenance Start Date/Time - This is the date/time that the equipment was actually being worked on by maintenance.

Maintenance End Date/Time - This is the date/time that the equipment was actually finished being worked on by maintenance.

Time to Repair - This is the total maintenance time to repair the equipment.

Maintenance Cost - This is the total maintenance expenditure to rectify the failure. This could be company or contractor cost. This cost could be broken out into categories such as Material, Labor, Contractor, etc.

Production Cost - This is the amount of business loss associated with not having the assets in service. This cost includes Lost Opportunity, when an asset fails to perform its intended function and there is no spare asset or capability to make up the loss.

Process Improvement through Asset Performance Management

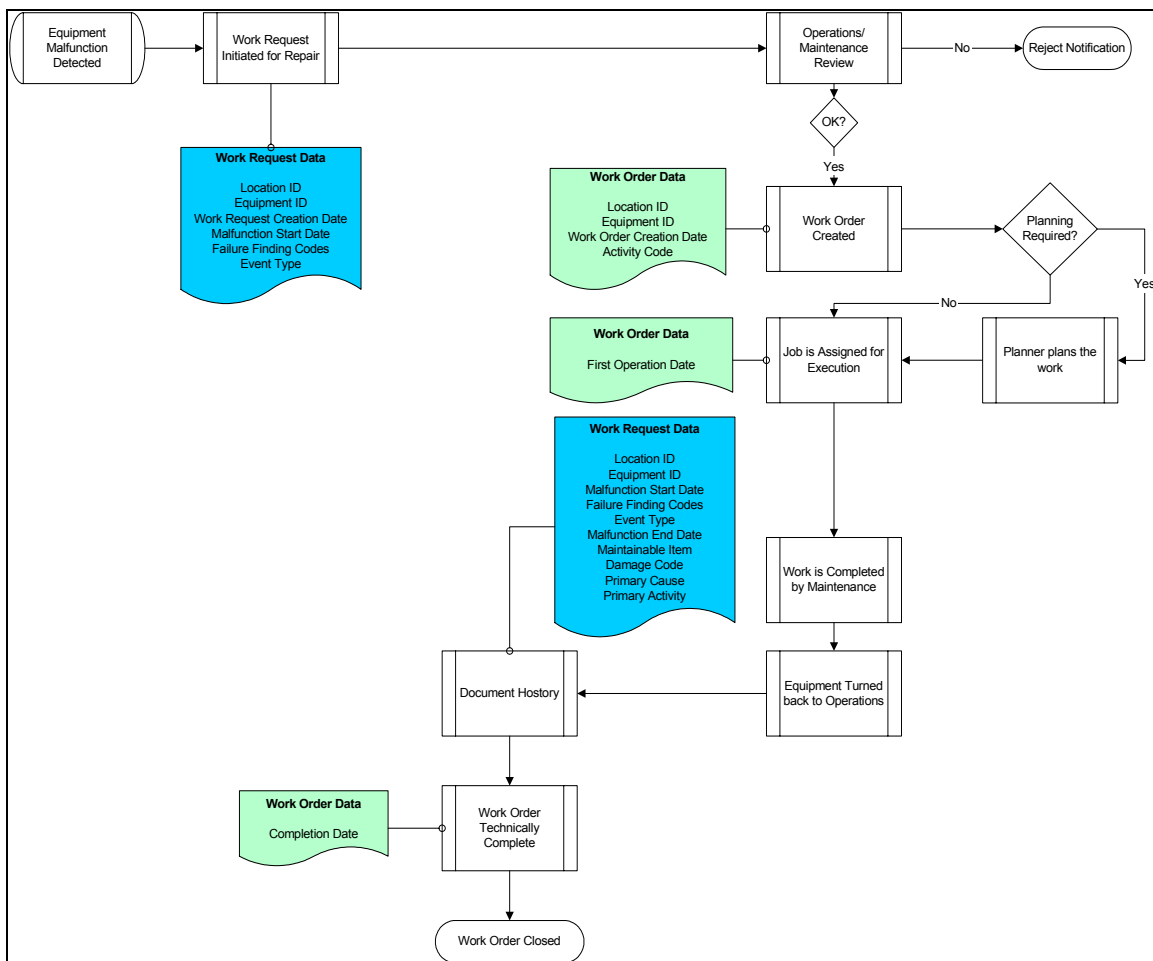
Most facilities in modern process and manufacturing plants utilize a Computerized Maintenance Management System (CMMS) to help manage the process of performing maintenance on plant assets. These systems provide the facility with a number of benefits, including the ability to:

- Store baseline asset information

- Manage store room inventory
- Plan and schedule maintenance work
- Document maintenance history
- Perform maintenance reporting

A vital element of these systems is the ability to document history of events that occur within the maintenance work process. Unfortunately, many organizations that employ a CMMS either do not use this capability or do not use it to its full capacity. It is important to instill the expectation in the workforce that all work history events will be recorded so that plant personnel can make informed decisions about where and when to use valuable plant resources.

In order to guarantee that work history data gets collected on a regular basis, there needs to be a documented work process. Below are the high level elements or steps involved in the maintenance work management process and how critical event data is collected at various steps.



Data Workflow

Step 1 - Work Request Is Initiated

Typically, the first step in the maintenance process is when a work request or notification gets initiated. This usually takes place when an operator, technician or inspector identifies a problem that requires maintenance attention and initiates a work request to let Maintenance know that attention is required. Several data elements need to be identified and recorded at this point in the maintenance work process. The elements are:

- Location of problem (e.g. functional location)
- Equipment ID
- Date the request was initiated
- Malfunction Start Date
- Failure Finding Codes (e.g. Operator Routine Rounds, Inspection, etc.)
- Event Type (Failure, Repair, PM)

Step 2 - Work Request Review

Once a valid work request is created and documented, it is reviewed by both Operations and Maintenance to validate. If it is not deemed valid, the work request is rejected and then terminated. If it is deemed valid, then a work order is generated. At this point additional data needs to be recorded on the work order:

- Location of problem (e.g. functional location)
- Equipment ID
- Activity Code
- Work Order Creation Date

Once the order is created and documented, a decision is made to either plan or not plan the work order. Once the order passes through planning (if required), it is then released to Maintenance. Maintenance performs the work and turns the equipment back over to Operations upon completion.

Step 3 - Document the History

With the repair complete and the knowledge of the work in hand, it is now time to record that data. Depending on the CMMS, this is either done on the complete work order or the work request (or

notification as it is sometimes referred). This is by far the most detailed data recording that occurs. We know what the problem was and what action was taken to correct the problem. The data elements required for this phase of the work process are:

- Location ID
- Equipment ID
- Malfunction Start Date
- Failure Finding Codes
- Event Type
- Malfunction End Date
- Maintainable Item
- Damage Codes
- Primary Cause
- Primary Activity

Step 4 - Closing the Work Order

Once the event has been accurately recorded, the work order can move to a final closing after all of the cost information has been entered and is deemed business complete. Once this phase is complete, most of the recommended data required for reliability analysis should be available.

Utilizing Effective Event Recording Codes

Having a work process to collect event information is only the first step in gathering accurate event history. Without a standardized list of codes to use in your event recording, it will be almost impossible to use for analysis. There are various resources for event recording codes that range from company specific codes to international industry standards, including the one provided by ISO 14224. This is a standard that was developed for the oil and gas industry and was based on work done by the Offshore Reliability Data group OREDA.

This standard focuses on equipment as well as failure and maintenance data. It describes details related to equipment classes, types and boundaries. With respect to event recording, this standard defines codes, time stamps and remarks.

ISO 14224 covers a subset of equipment classes within the oil and gas industry, which are provided in the table below.

Combustion Engine	Heat Exchanger
Compressor	Process Sensor
Control Logic Unit	Pump
Electric Generator	Turboexpander
Electric Motor	Valve
Fire and Gas Detector	Vessel
Gas Turbine	

Within these classes of equipment, there are specific codes that can be utilized to record equipment events:

- Method of detection
- Functional loss
- Failure mode
- Maintainable item
- Failure cause
- Maintenance activity

While these codes and equipment classes are an excellent start, there are additional equipment classes and code categories that are useful in fully documenting an equipment event. Therefore, additional equipment classes are offered below as supplements to the ISO 14224 standard.

Agitator	Boiler
Fan-Blower	Fired Heater
Gas Turbine	General Equipment
Meter	Instrumentation
Piping	NPV (Tank)
Relief Device	Power Distribution
Steam Turbine	

Similarly, additional code categories are offered to supplement the code categories within ISO 14224:

- Condition
- Effect

Below are example Activity codes derived from ISO 14224:

Code	Description
ADJ	Adjust
CHK	Check
CMB	Combination
INS	Inspection
MOD	Modify
OTH	Other
OVH	Overhaul
REP	Repair
RFT	Refit
RPL	Replace
SVC	Service
TST	Test

Conclusion

A key element of a successful asset performance management process is the collection of event data required for analysis. This is especially true if you consider that without event data it is impossible to determine where your problems reside, what strategies are effective or ineffective and where we need to focus our resources for the largest improvements.

Beyond the ability to measure performance it gives us the baseline data to perform detailed reliability analysis. These techniques are very powerful when coupled with accurate and complete event data and can drive proactive behavior within the organization. The combination of quality event data, comprehensive analysis and disciplined follow-through can be the catalysts to meeting your corporation's strategic goals.



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