Standardization of maintenance data for benchmarking and asset performance analytics

Topic: Data Collection & Storage

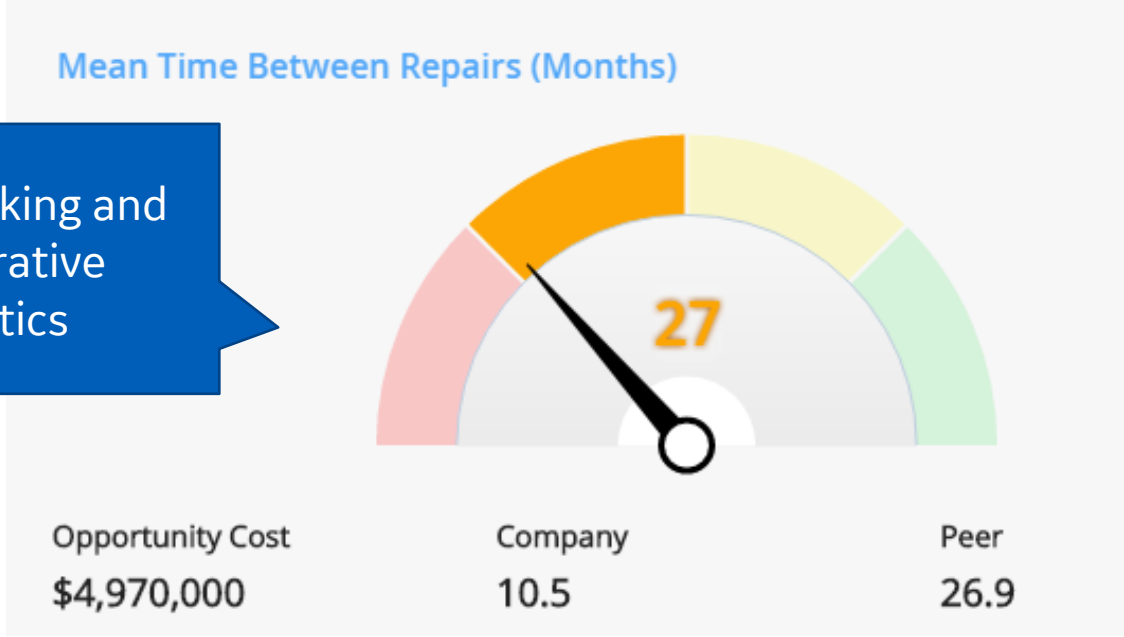
People behind the work: Manjish Naik, Erik Pijcke, **Sarah Lukens**, Xiaohui (Mark) Hu, Kittipong Saetia

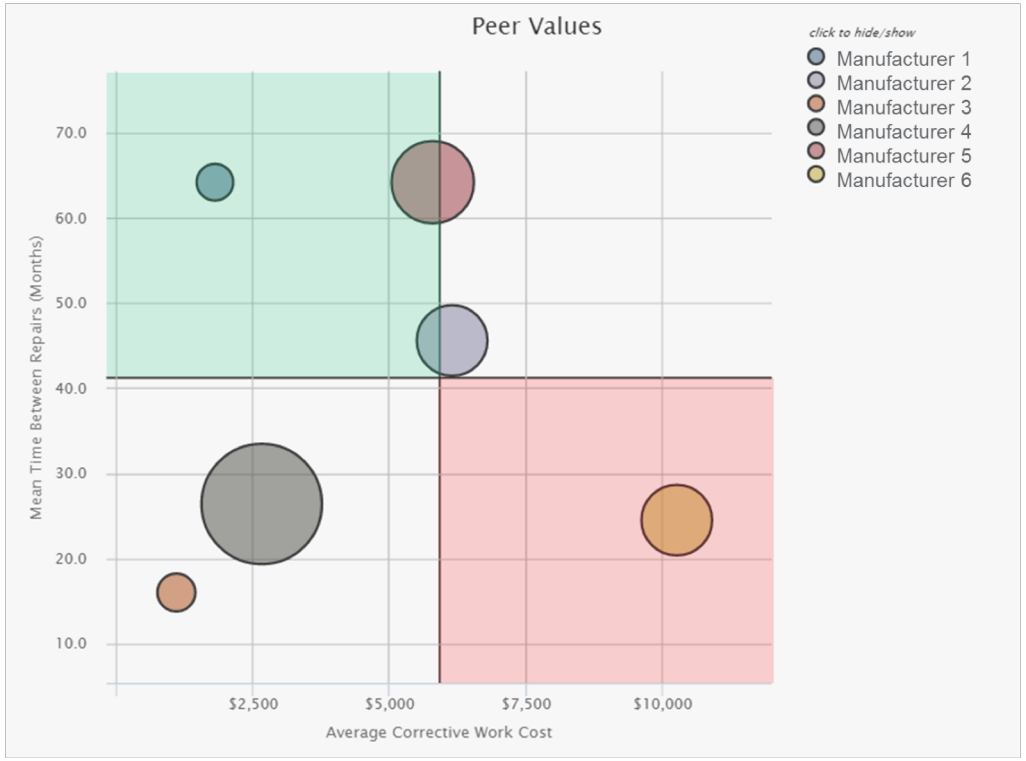
Who are we and what do we do

Software for industrial applications such as APM

Asset Answers aggregates work history data from many industrial facilities around the world by asset type, manufacturers, and many other characteristics.

Benchmarking and comparative analytics





Metrics and Rollups

Align with
SMRP (Society of Maintenance & Reliability Professionals) best practices

Cost

Ratio of Planned vs. Unplanned Work

- Avg. Corrective Work Cost
- Corrective Work Cost %
- Proactive Work Cost %
- Reactive Work Cost %
- Corrective Work Count %
- Proactive Work Count %
- Reactive Work Count %

Reliability

Frequency of repair and failure events

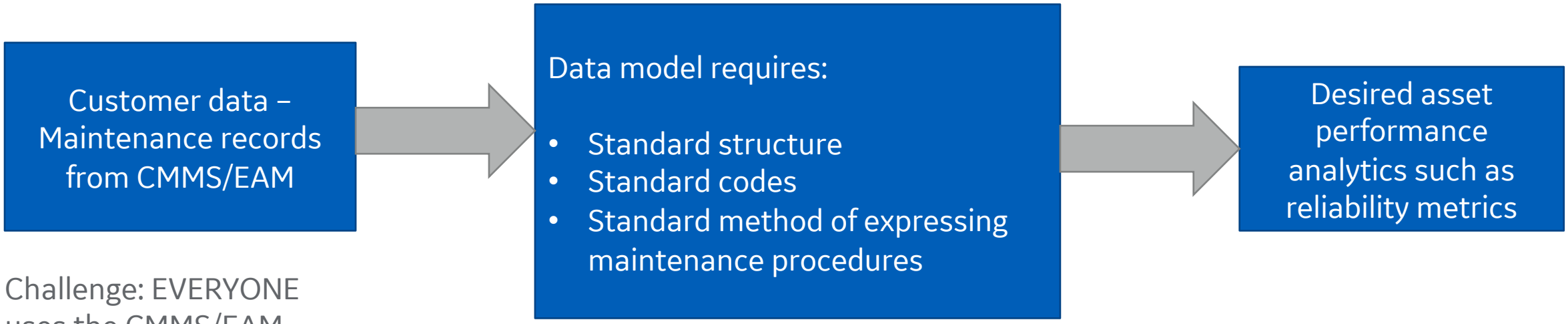
- MTBF
- MTBR
- MTTR
- Failure Rate

Availability

Availability, downtime, and maintenance effectiveness

- PM Effectiveness
- Mechanical Availability
- Mechanical Unavailability
- Mechanical Downtime

Standard data model needed to aggregate maintenance data

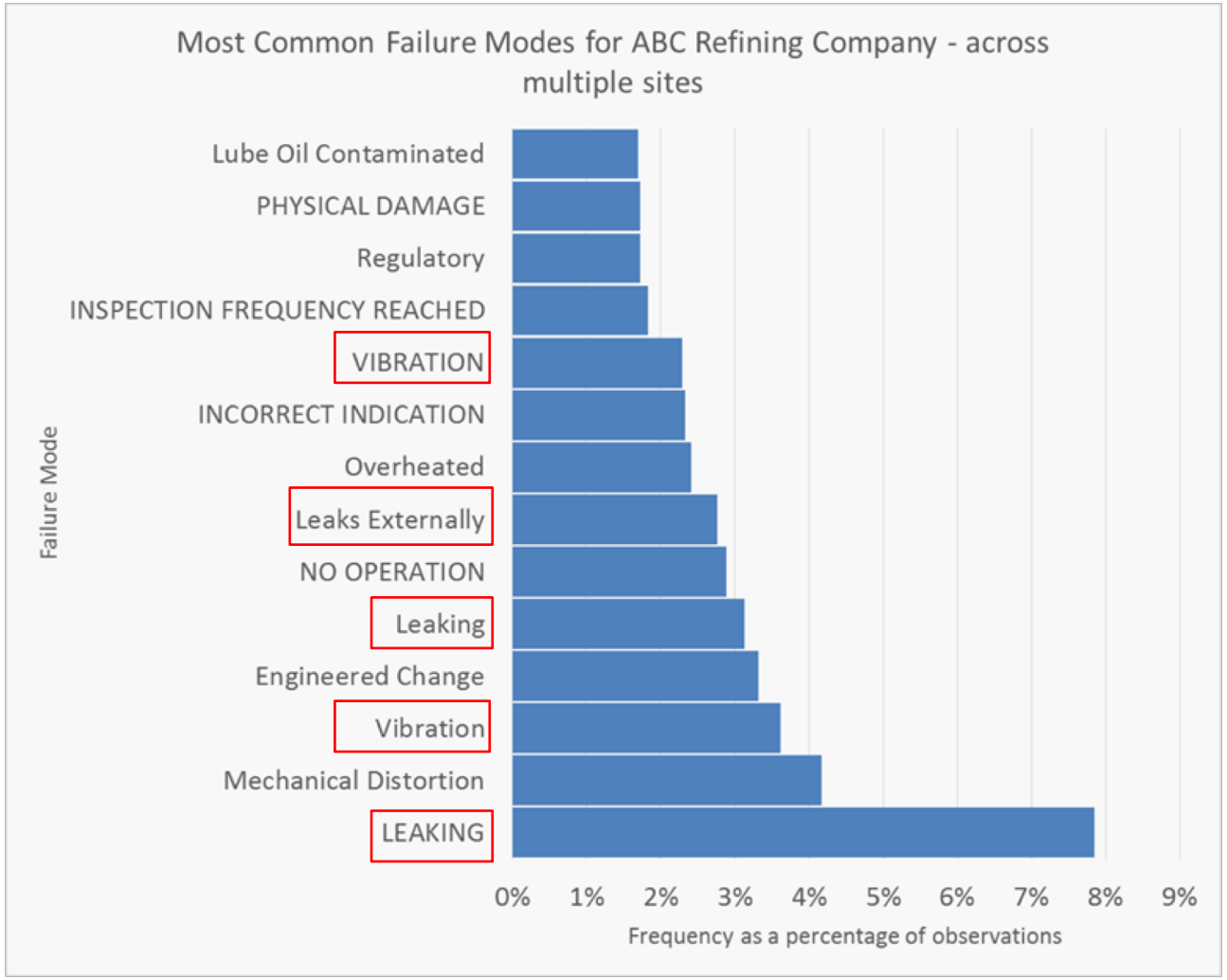


Challenge: EVERYONE uses the CMMS/EAM differently

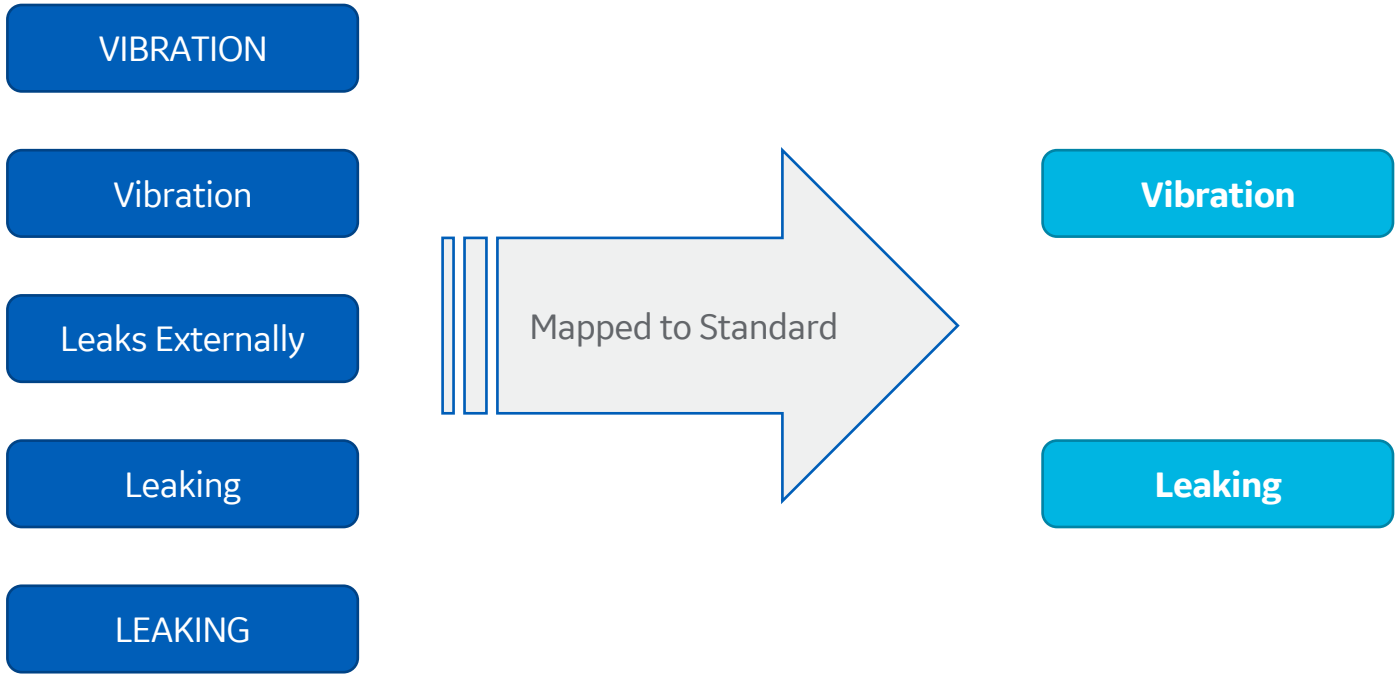
Standard data model and codes are straightforward, but in order to aggregate data we learned we needed a standard definition of different maintenance processes in order to consistently aggregate data

Standardization Woes – Example 1

Example of non-standardization of codes across one company with multiple sites.

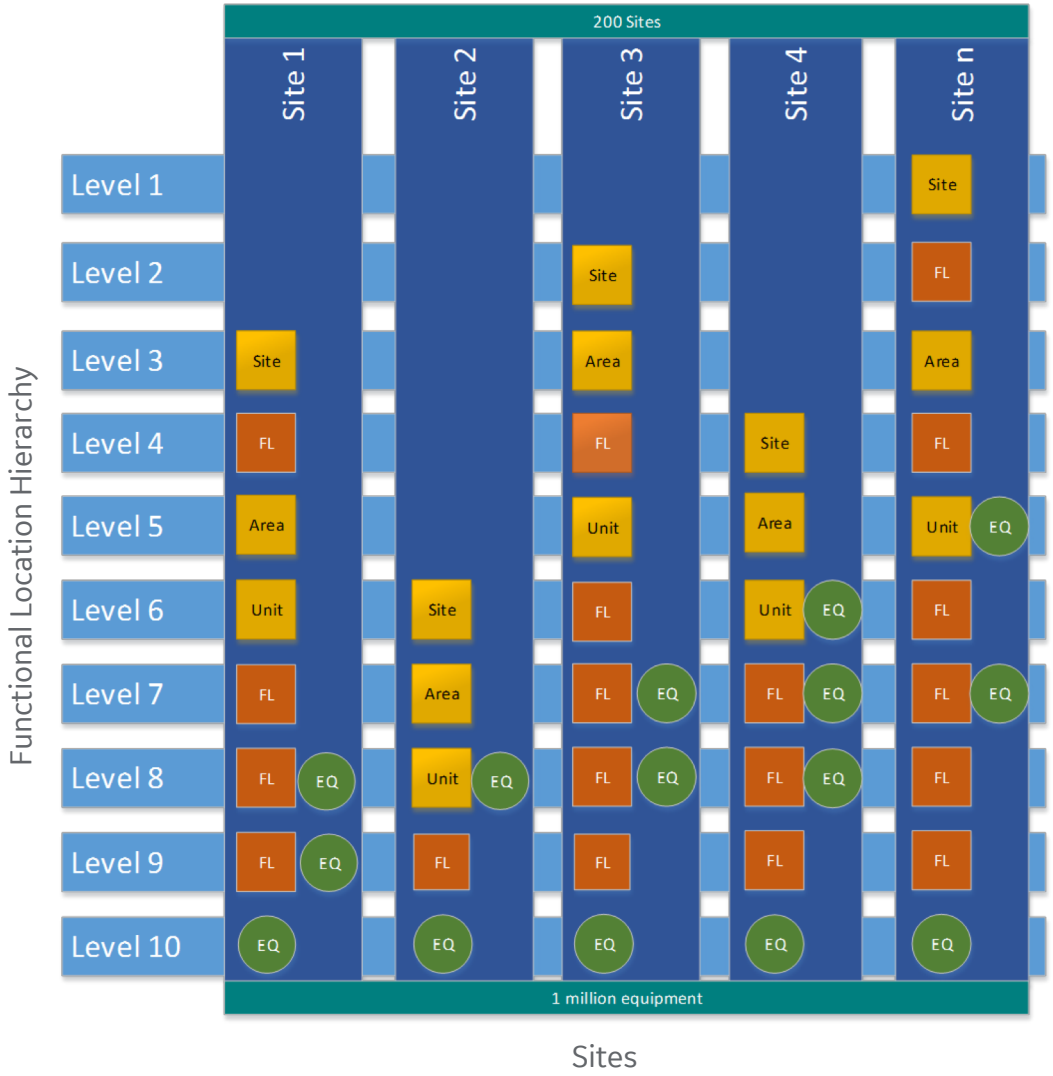


Standardization 1 Woes – Resolved

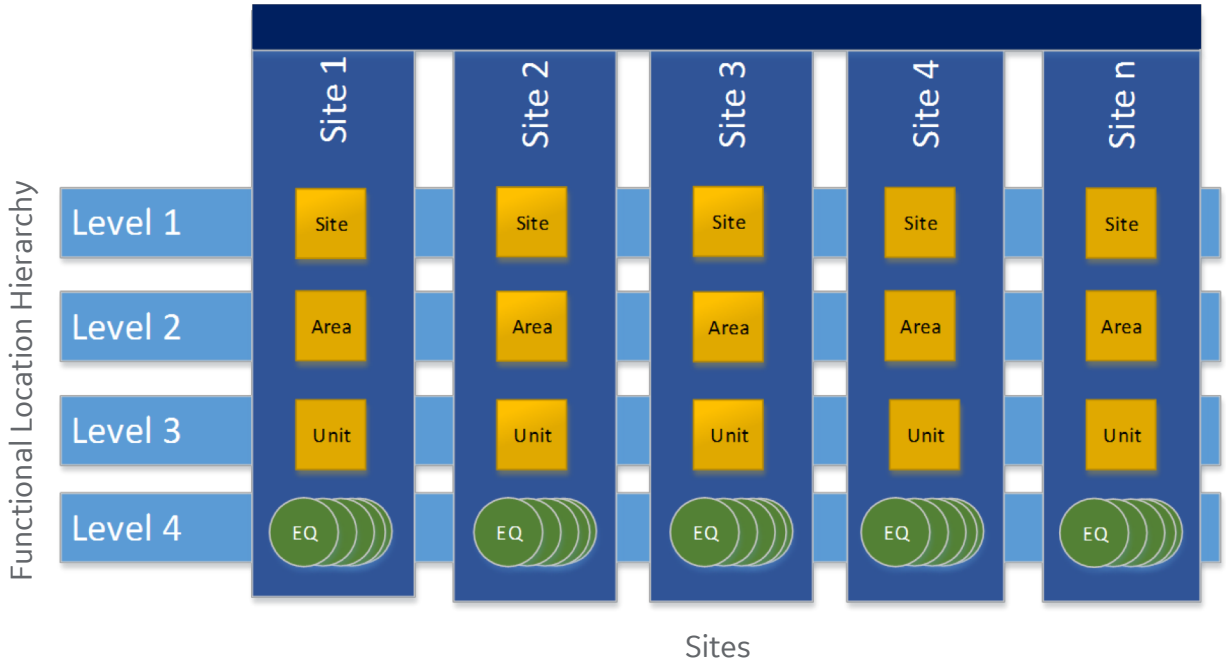


Standardization Woes – Example 2

Example of non-standardization of different levels of the functional location hierarchy.



Standardization 2 Woes – Resolved



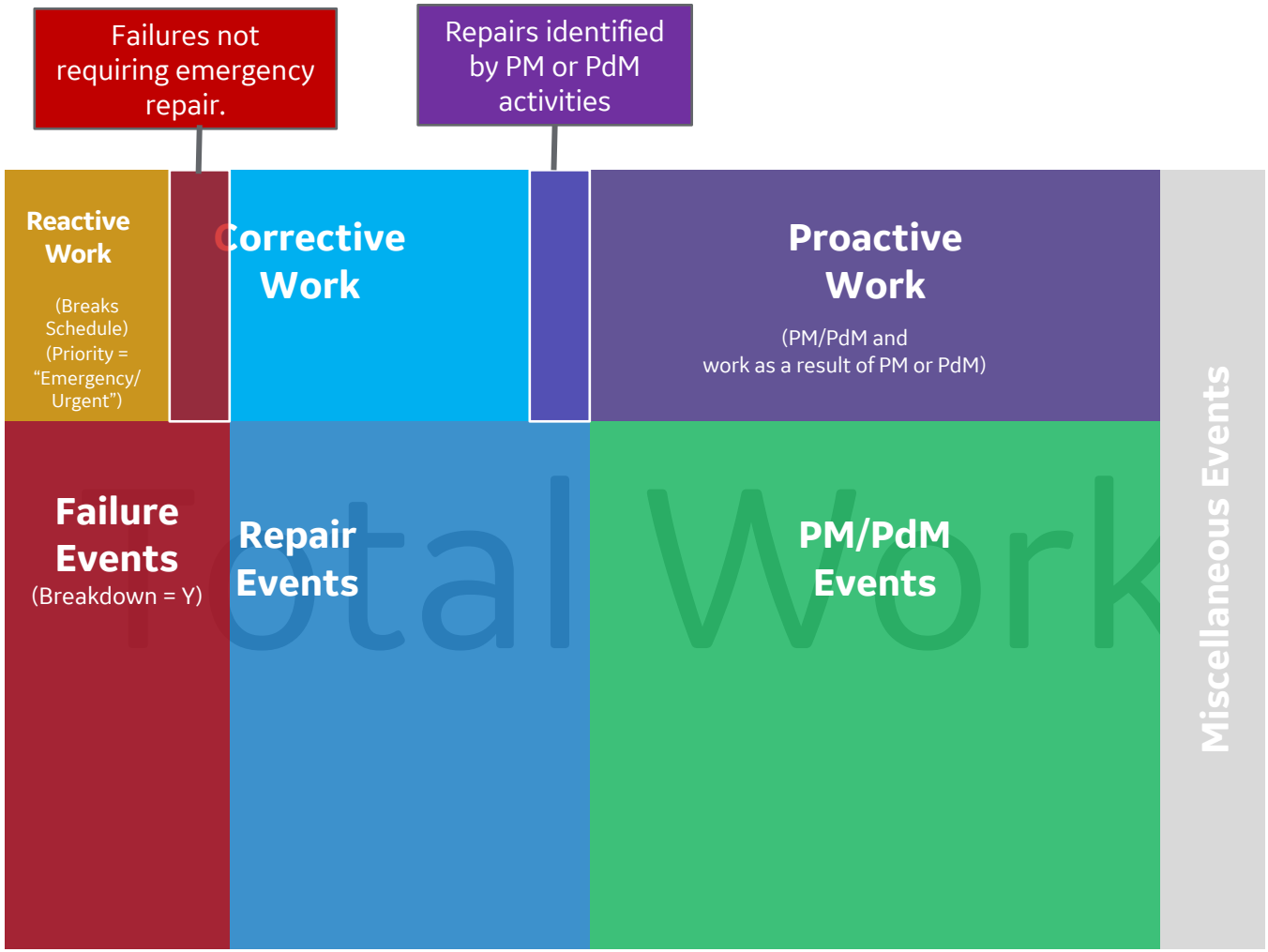
Event Type Definitions

Asset Answers standard event type definitions used for extracting CMMS/EAM data. Often, companies can have 20+ codes, or combinations of different codes which map to these 4 event types. The event type definitions are derived specifically for estimating common performance metrics and align with SMRP

Event Types	Definition
Repair	**Work required to restore an asset's intended function.**
PM/PdM	Preventive or predictive work • **Preventive: time-based** • **Predictive: condition-based monitoring.**
Miscellaneous	Capital projects and non-maintenance related activities.

Work Types	
Corrective	**Equals Repairs**
Proactive	PM/PdM and work as a result of PM or PdM
Reactive	Work that causes a break in schedule

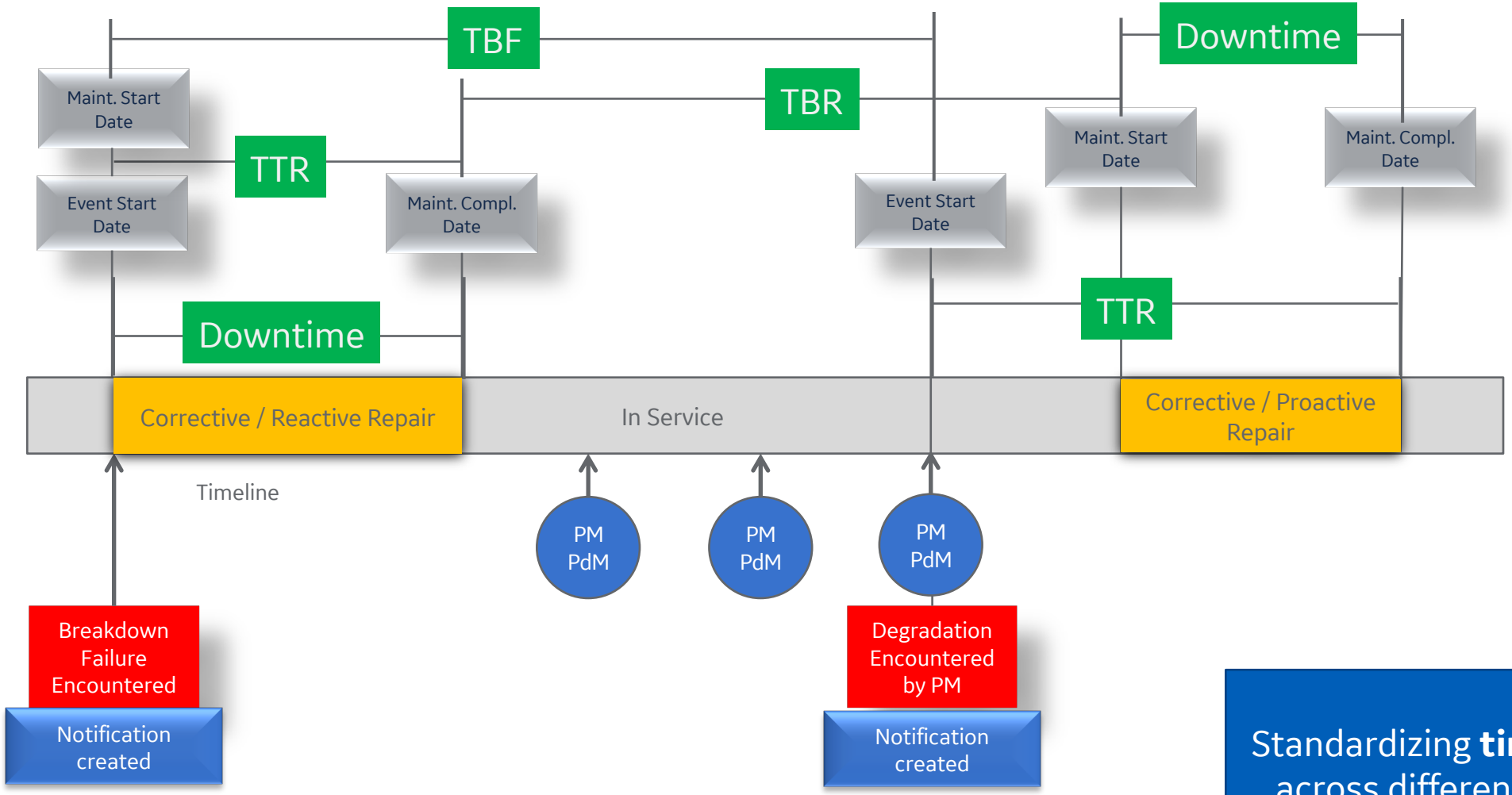
Work History Visualization



Work types needed for different performance metrics can have overlapping definitions, which we define and standardize.

For example, SMRP defines "proactive work" as either preventative work, predictive work, or corrective work identified from preventative or predictive work orders. The proactive work metric is used to measure & monitor the amount of work done to prevent failure or identify defects that could lead to failures.

Event Timing Visualization



Standardizing **time elements** across different company's CMMS/EAM

Key information often present in unstructured fields

Failure Mode information in unstructured field:

Free Text Work Order Description	Failure Mode	What I want to see:
Need to re-grout base to reduce long time vibration problem	Unknown	Vibration
Clear blocked piping/pump	Unknown	Plugged/Choked
The stuffing box was replaced not long ago because of a water leak in the drive head, the leak is back	Unknown	Leakage

Data Quality Problem: Incorrectly coded work orders

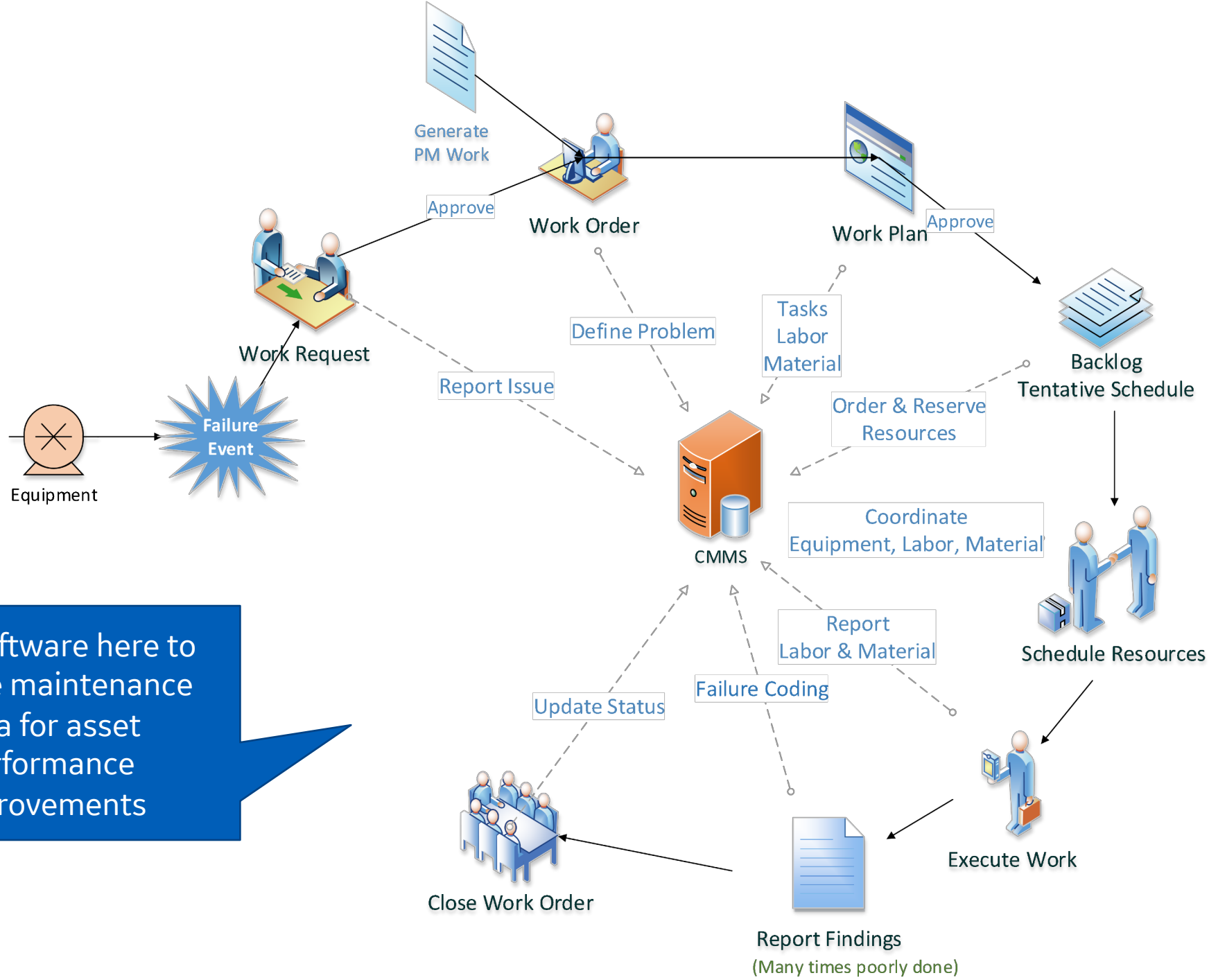
Free Text Work Order Description	Event Type	What I want to see:
Repair leaking safety valve	PM	Repair
Daily Inspection of Analyzers	Repair	PM

Recording when a failure occurred:

Free Text Work Order Description	Breakdown?
WATER PUMP FAILURE. Water pump has failed and has leaked all the coolant out through the tattle hole	FALSE
Sump level sensor has failed. Cannot run plant without this sensor.	FALSE
Compressor lube box oil seal has failed. Requires seal replacement ASAP	FALSE

Supporting slides

Maintenance management work process



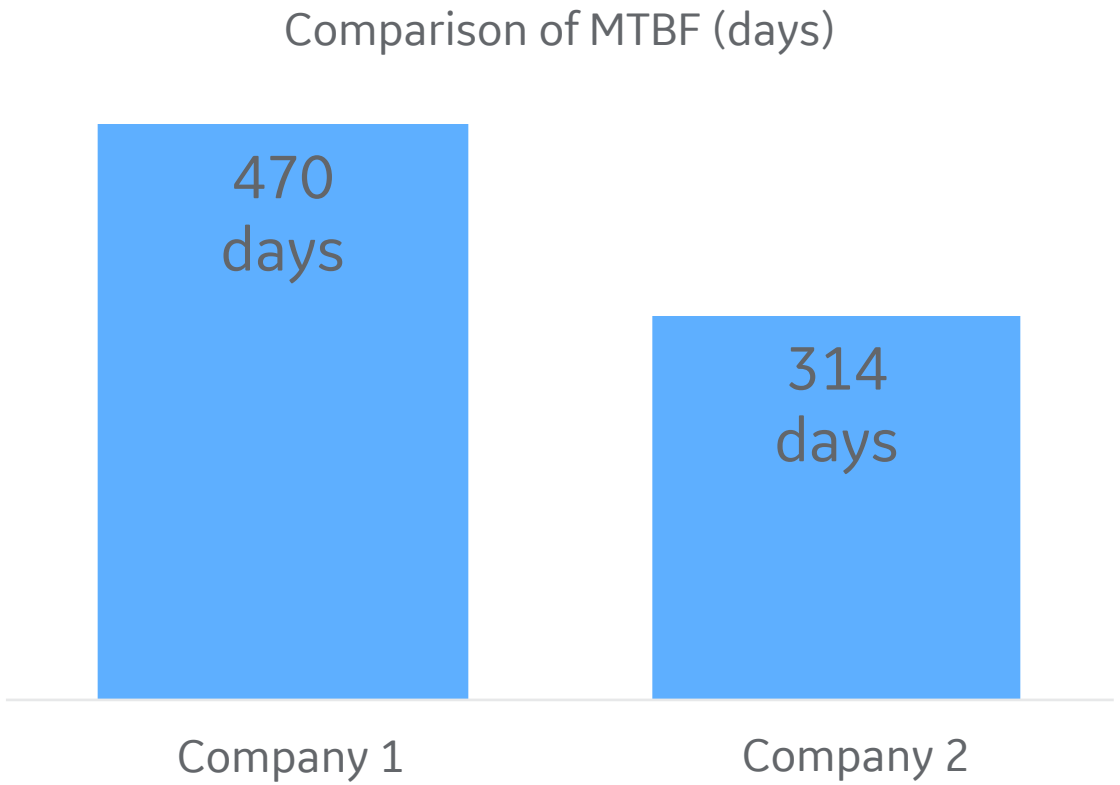
APM software here to analyze maintenance data for asset performance improvements

Comparison of reliability estimates - before and after

Before: inability to calculate Mean Time Before Failure (MTBF)

After NLP applied to maintenance data: Benchmarking comparison of MTBF is possible

Work description	BEFORE: Breakdown indicator	AFTER: Is A Failure?
Seal is leaking badly	FALSE	True
Block valve is broken open and inoperable	FALSE	True
00120-Pump 1 Work Request	FALSE	False
Check impeller size	FALSE	False



Example of using NLP approaches to characterize failures