Adopting Risk-Based Maintenance: Enabled by SAP Asset Strategy and Performance Management

Dean Fitt, Solution Manager, SAP SE

Session ID # ASUG82661

About the Speakers

Dean Fitt

- Solution Manager, SAP SE
- Dean is a member of SAP's global Enterprise Asset Management (EAM) solutions team. Dean is based at SAP Global Headquarters in Walldorf, Germany. Dean joined SAP in 1998 as a Plant Maintenance (PM) Consultant with SAP Africa, before moving to Germany in 2001.
- Fun fact: Rode the Cape Argus cycle tour 26 consecutive times

Key Outcomes/Objectives

1. A risk-based maintenance approach enables better decision-making for maintenance planning and reduces the probability of asset failure
2. Minimize environmental and safety risks
3. Enhance asset reliability and availability

Agenda

- SAP Intelligent Asset Management
- Business Background and Drivers
- Solution Overview
- Summary
- Q & A

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SAP Enterprise Asset Management Portfolio – Business Capabilities

State-of-the-art business processes

Leverage new technologies to enable new asset management business processes anywhere and anytime.

Real-time insights

Bring together information from operational and business systems using IoT for scalable transparency

Risk-based asset strategies

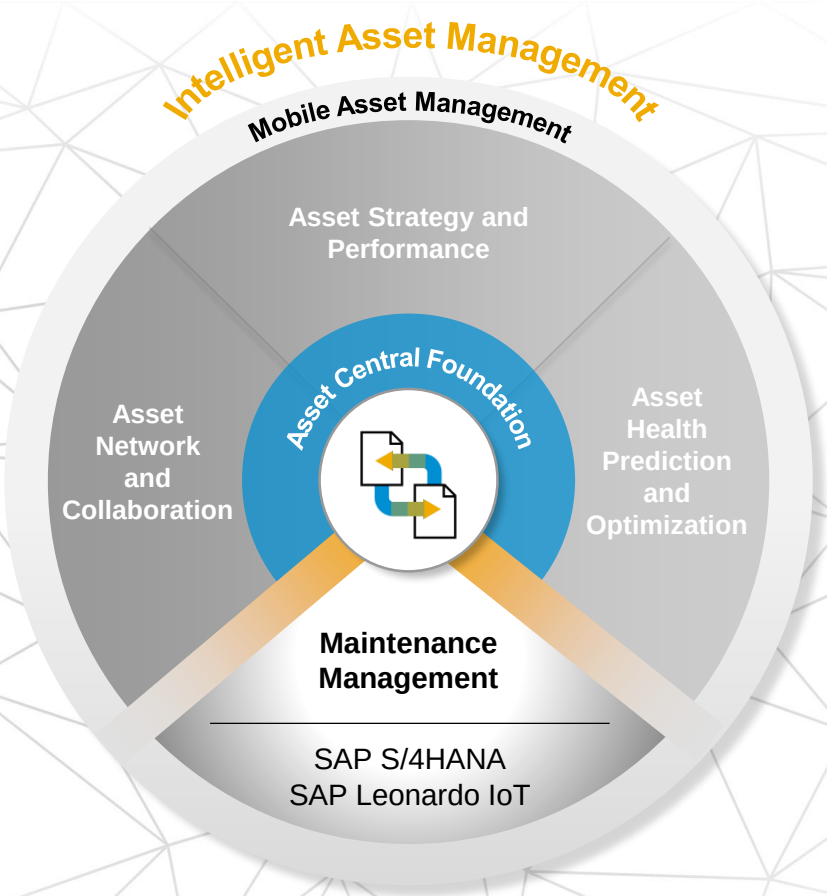
Adopt risk based approach to determine critical assets driving optimal asset strategies

The power of prediction, optimization and simulation

Drive smarter decisions, improve reliability, and reduce outages

Collaboration throughout the asset lifecycle

Share asset information, access one version of the truth, and collaborate on a cloud-based business network with integrated processes



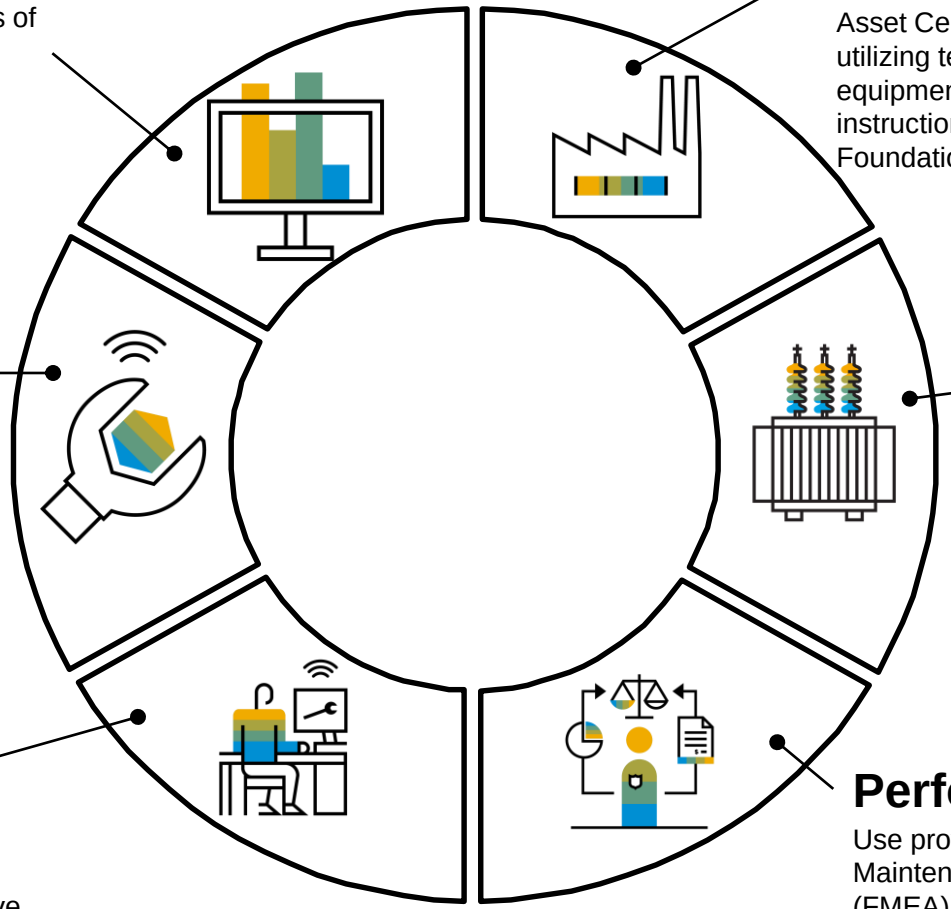
SAP Asset Strategy and Performance Management

Monitor and Improve

Continuously monitor the performance and effectiveness of the maintenance strategies

Define Systems & Assets to Analyze

Asset Central Foundation enables asset information to be modelled utilizing templates based on ISO standards e.g. ISO14224. Models, equipment, locations, systems, groups, spare parts, documents, instructions, failure modes are all included in Asset Central Foundation.



Implement Maintenance Strategies

Implement the recommended actions/tasks in the maintenance management system.

Identify Critical Assets

The Risk and Criticality assessment ranks assets by risk and criticality which can then be used as the basis for further analysis. This is achieved by setting up a matrix of consequence of failure vs probability of failure.

Develop Recommended Actions

The result of the RCM/FMEA will recommend preventive and/or corrective tasks. These tasks can use existing instructions or can trigger a new instruction to be created.

Perform Analysis

Use proven methodologies like Reliability Centred Maintenance (RCM), Failure Modes and Effects Analysis (FMEA), Preventive Maintenance Review* (PMR), Risk Based Inspection** (RBI), Root Cause Analysis* (RCA) or Checklists to identify the optimal maintenance strategies for your assets.

*planned

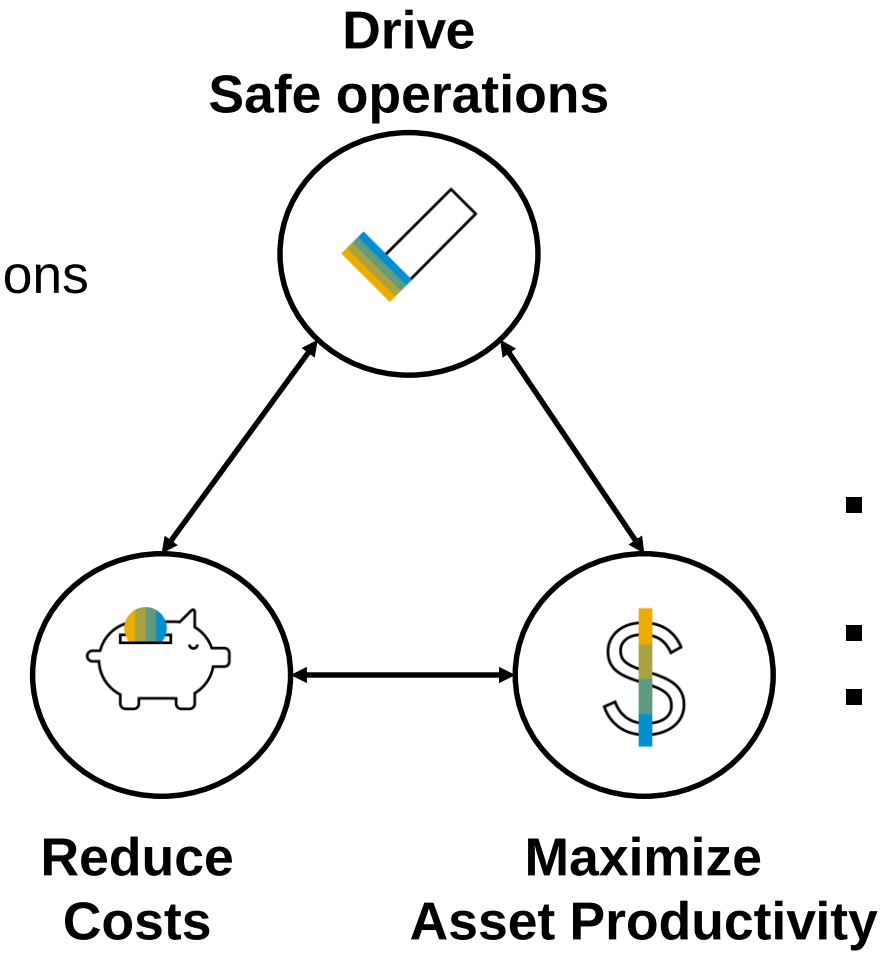
** partner planned

Business Background and Drivers

Good Asset Management

Leads to Improved Business Outcomes

- Reduction in safety incidents
- Reduction in Environmental Incidents
- Adherence to Statutory Regulations



- Reduced Annual service and maintenance cost
- Adherence to Planned maintenance budget vs. actual cost
- Reduced energy and input costs

- Increased Overall Equipment Effectiveness
- Increased Return on assets
- Reduction in Unplanned outages

Technology is changing our approach to maintenance

*Use of Maintenance Strategy – Today

*Use of Maintenance Strategy – Future

Although still relevant, **preventive** maintenance can result in over-maintaining assets and higher costs

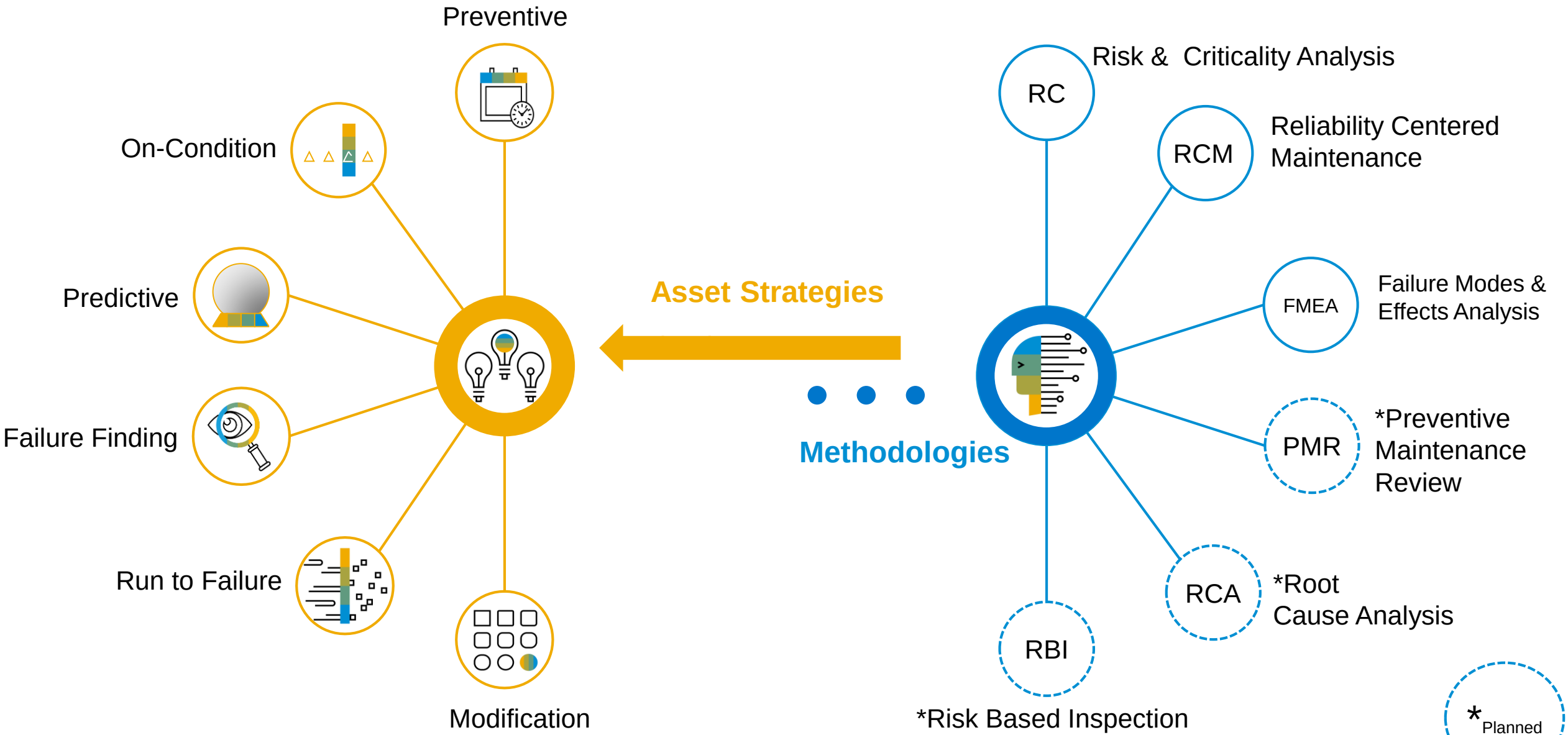
The Internet of Things is leading to increased use of **predictive** maintenance

The goal is to enable more **IT driven** (data science & rules driven) approaches to predictive maintenance in order to reduce unplanned failures and the number of overall maintenance actions

*Proportion of maintenance strategies are for illustration purposes only and will vary based on many factors

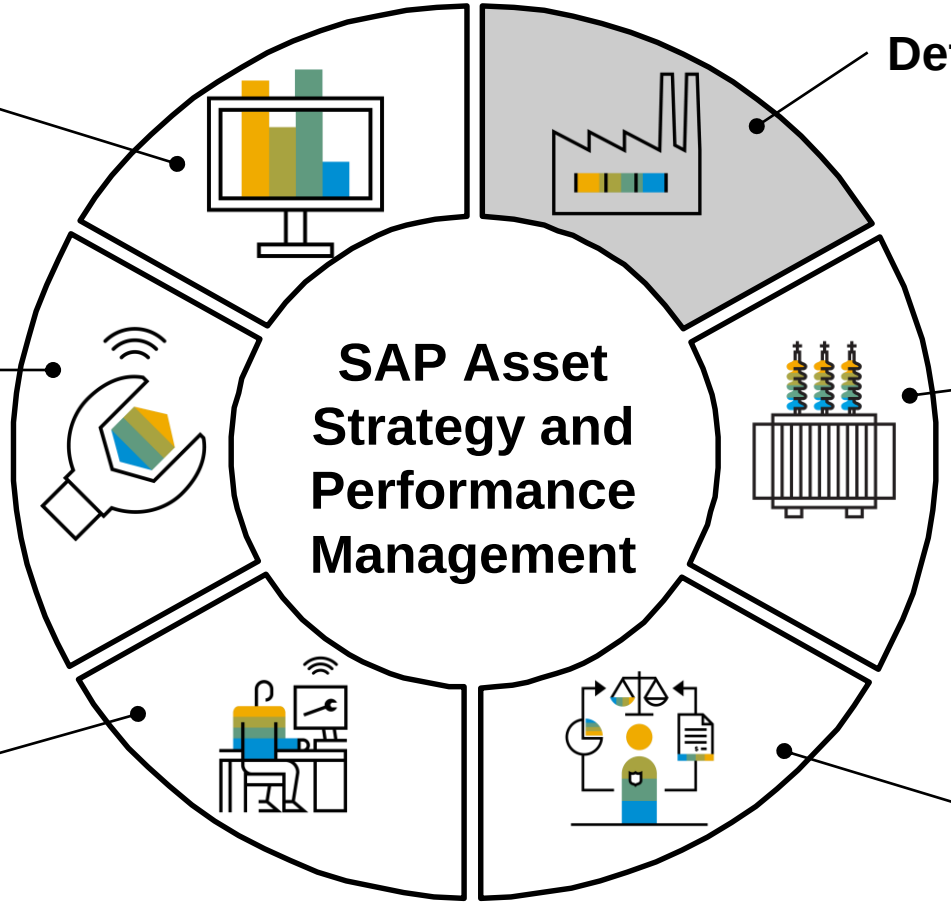
Determining the Correct Maintenance Strategy

Apply industry standard methodologies to determine optimal asset strategies



Solution overview

SAP Asset Strategy and Performance Management



Monitor and Improve

Define Systems & Assets to Analyze

Implement Maintenance Strategies

Identify Critical Assets

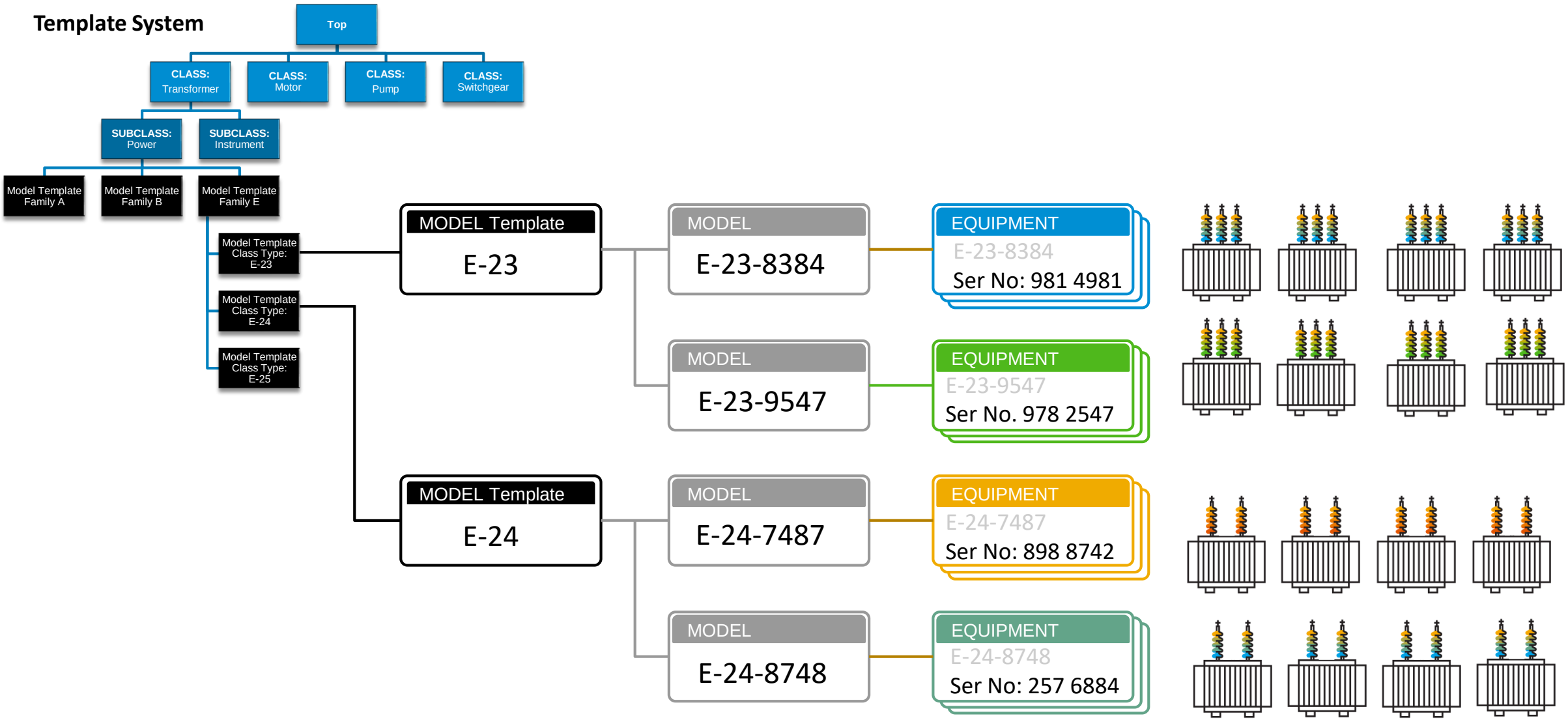
Develop Recommended Actions

Perform Analysis

SAP Asset Central Foundation

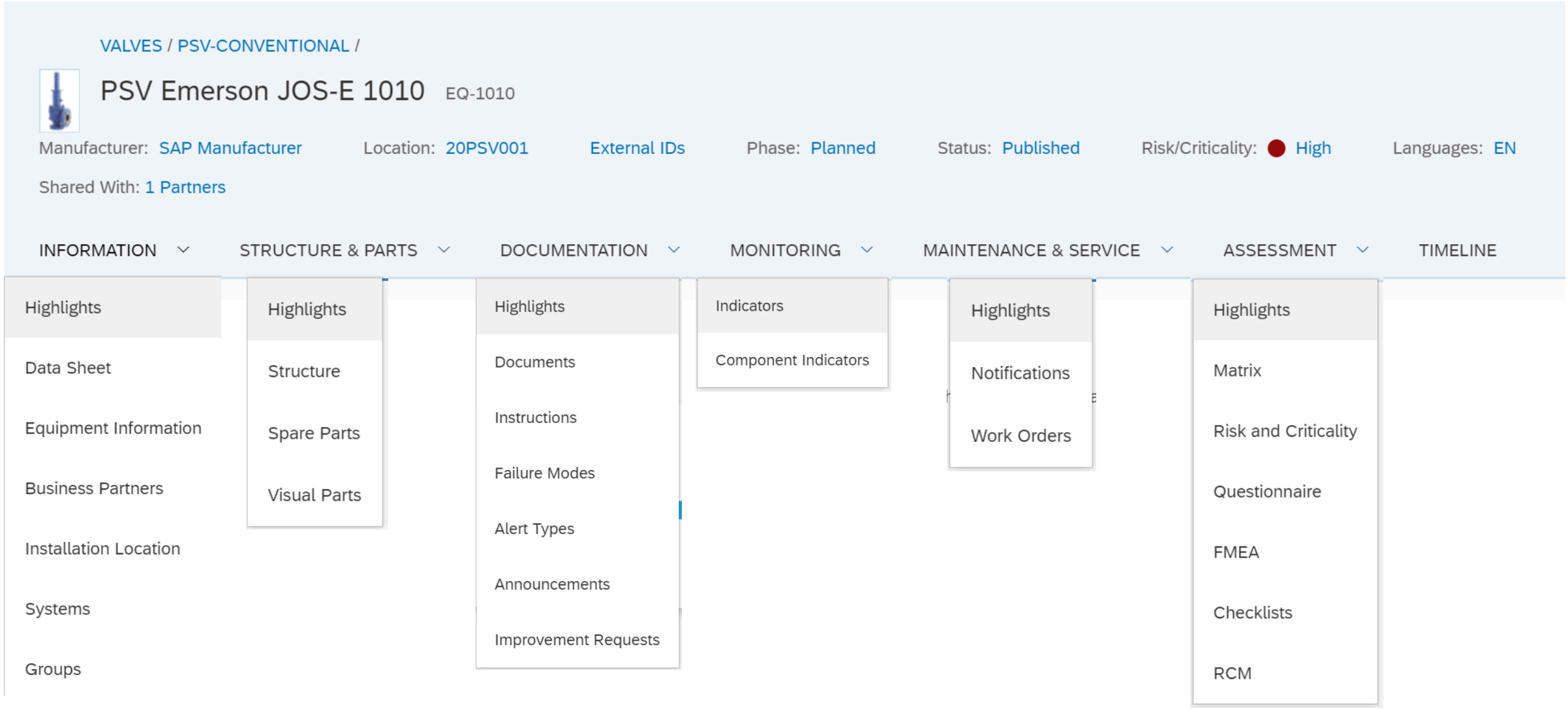
Next-Generation Master Data Layer

Models and Equipment



SAP Asset Strategy and Performance Management

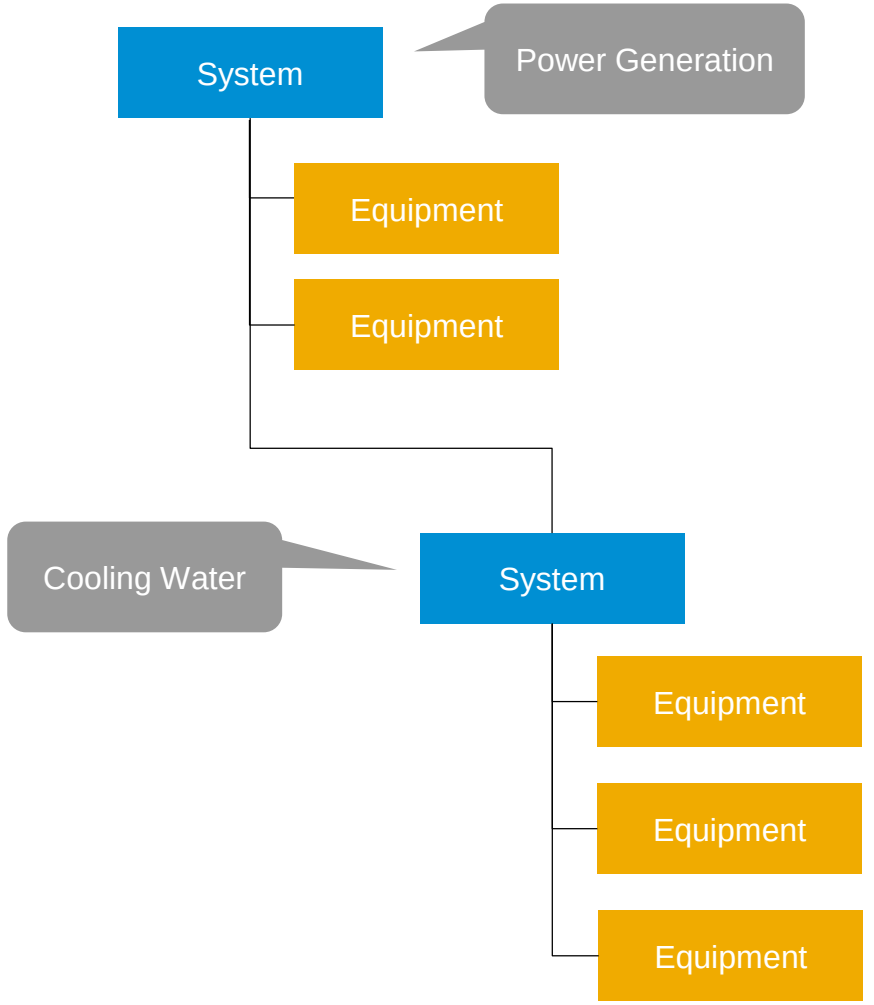
Equipment: Features

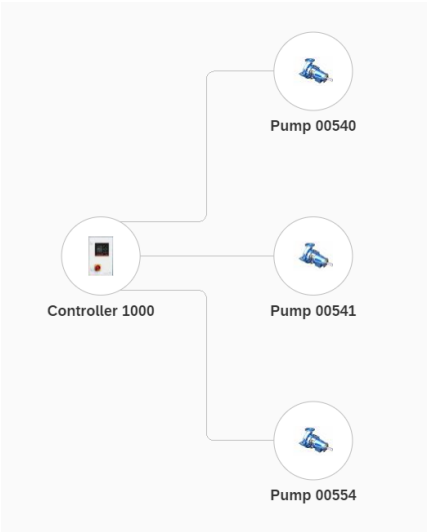


Systems:

Define the boundaries and function of the systems that contain the selected equipment

- A system is an overview with a logical structure throughout complex assets or asset structures
- Examples are fluid systems, braking systems or piping systems.
- Systems can be nested.
- In parallel the topology of a system can be visualized using the functionality of our Hilscher Net IoT partnership.

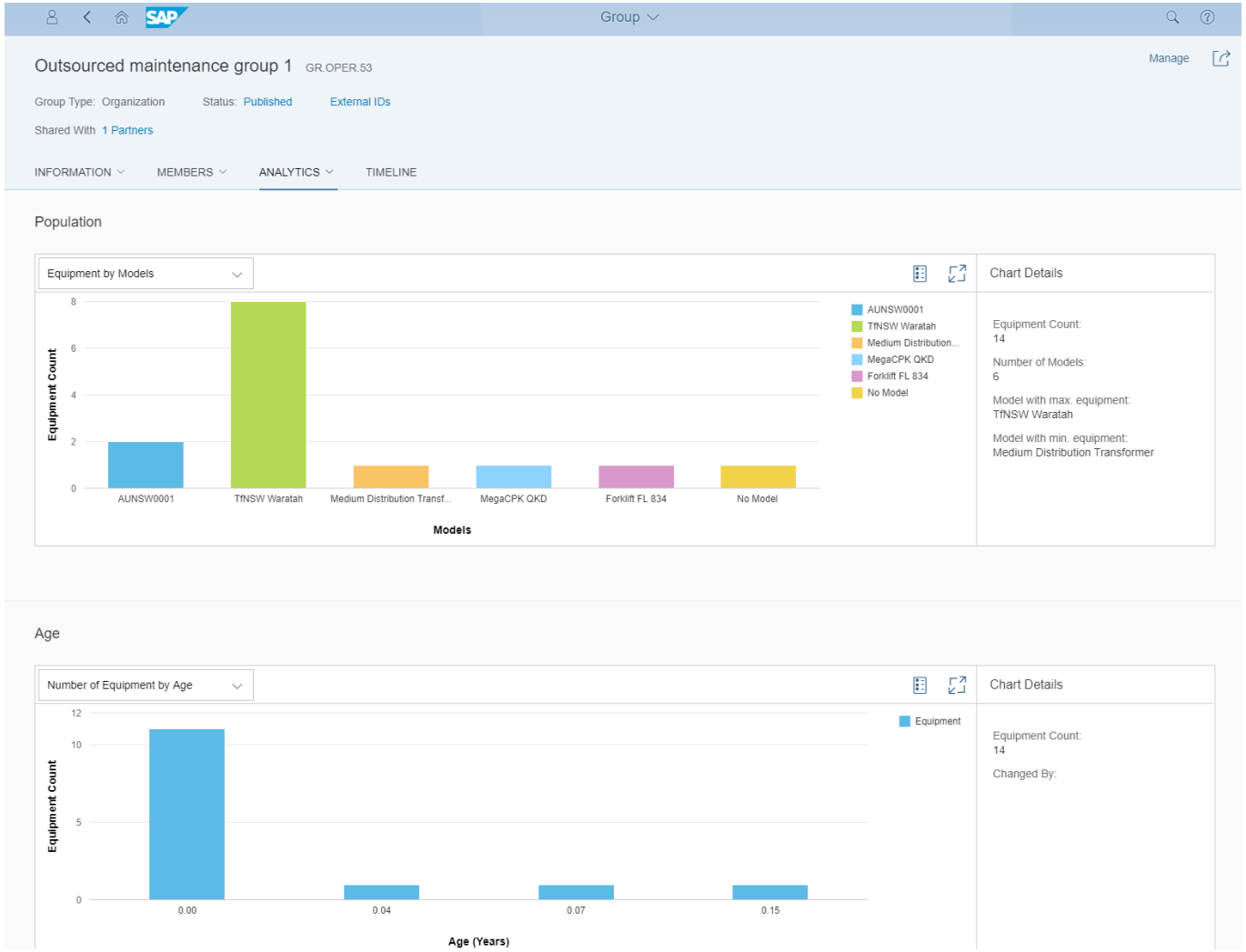




Groups

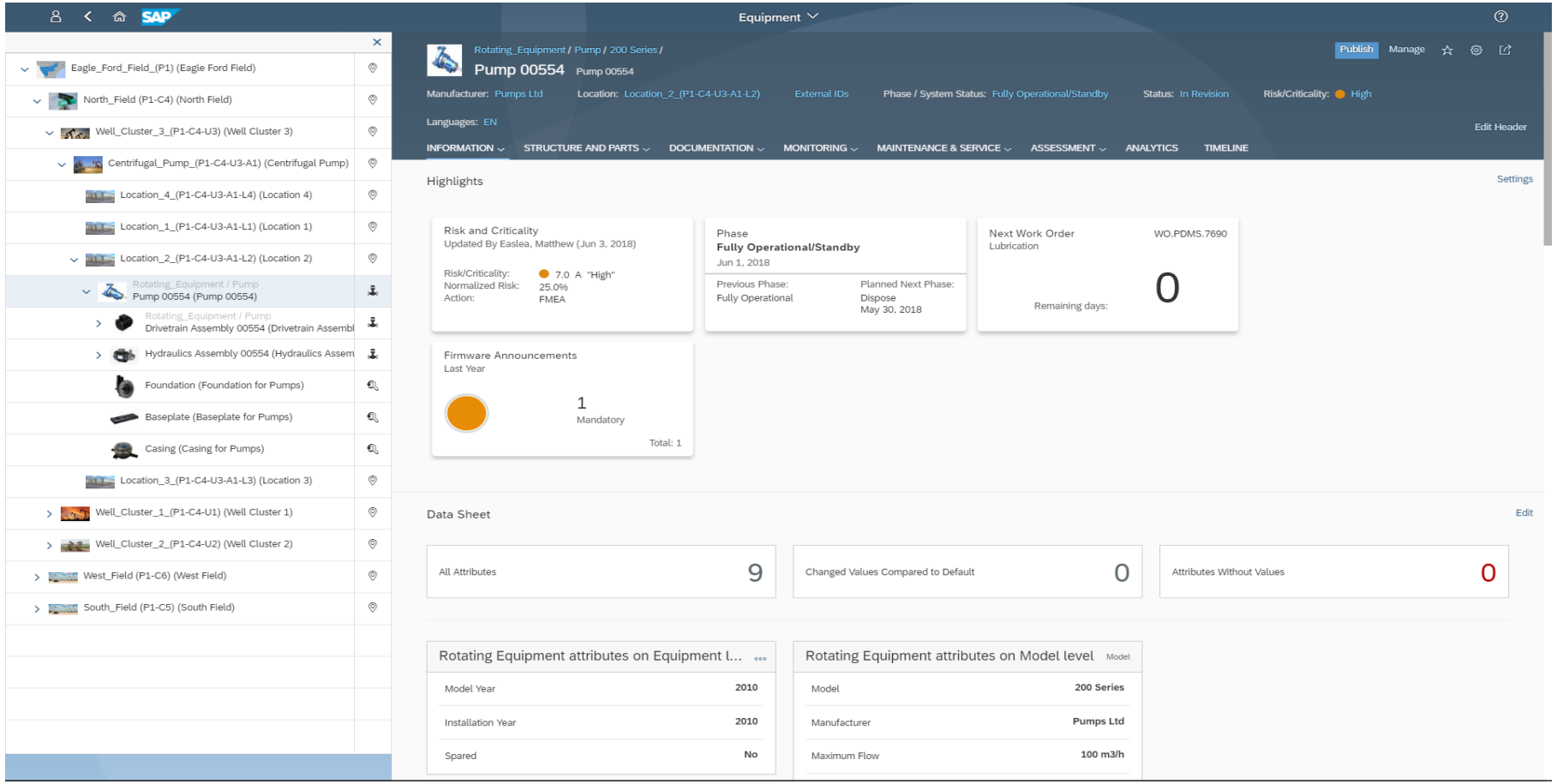
Models, Equipment and Locations

- There are different types of groups e.g. assign equipment into different groups based on risk and criticality assessment.
- Objects that are grouped can be analyzed by population or age. You can filter by all kinds of objects (Equipment, Model, Subclass, Manufacturer etc.)
- An FMEA Assessment can be performed on a group



Location

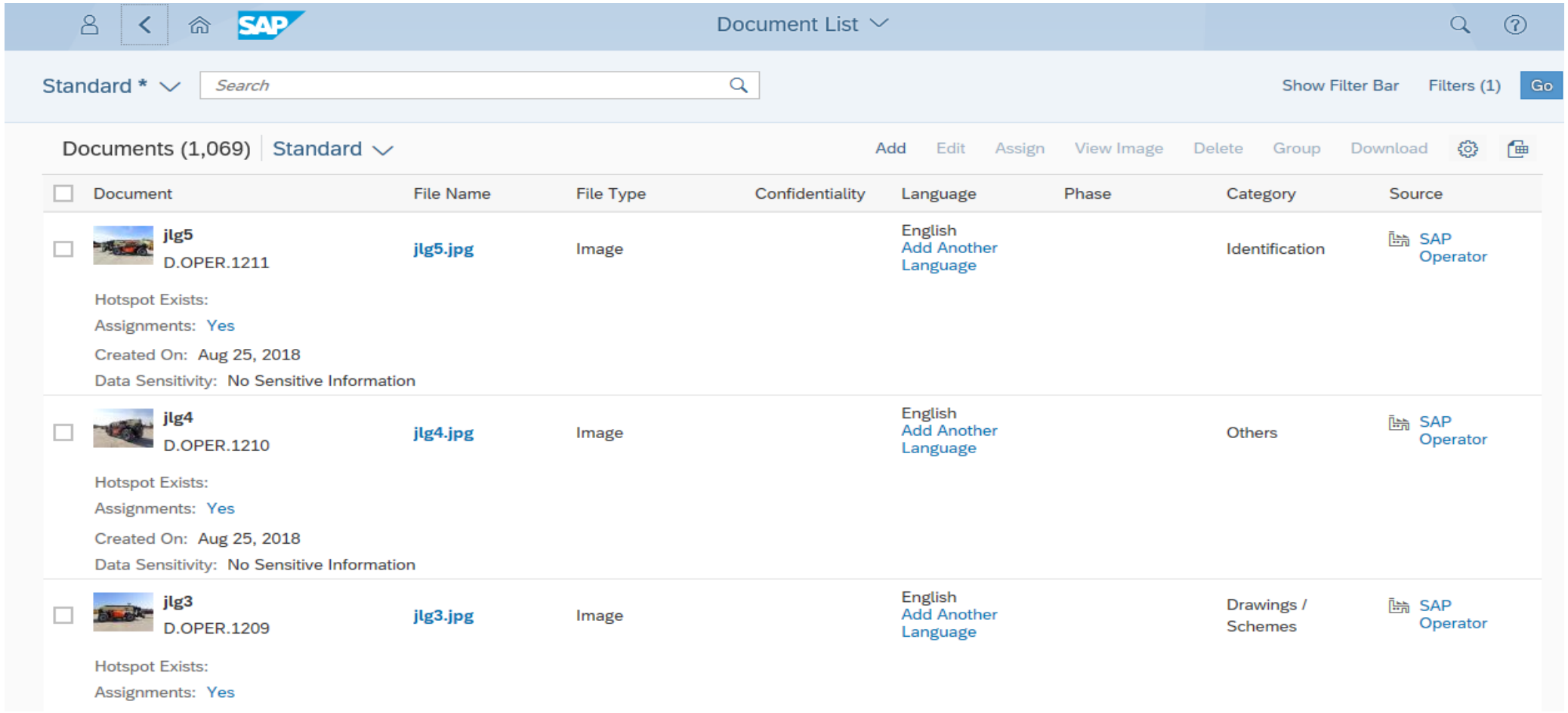
Asset Hierarchies



- Flexible configuration of naming conventions for master data standardization
- Parent/child relationships for master data inheritance

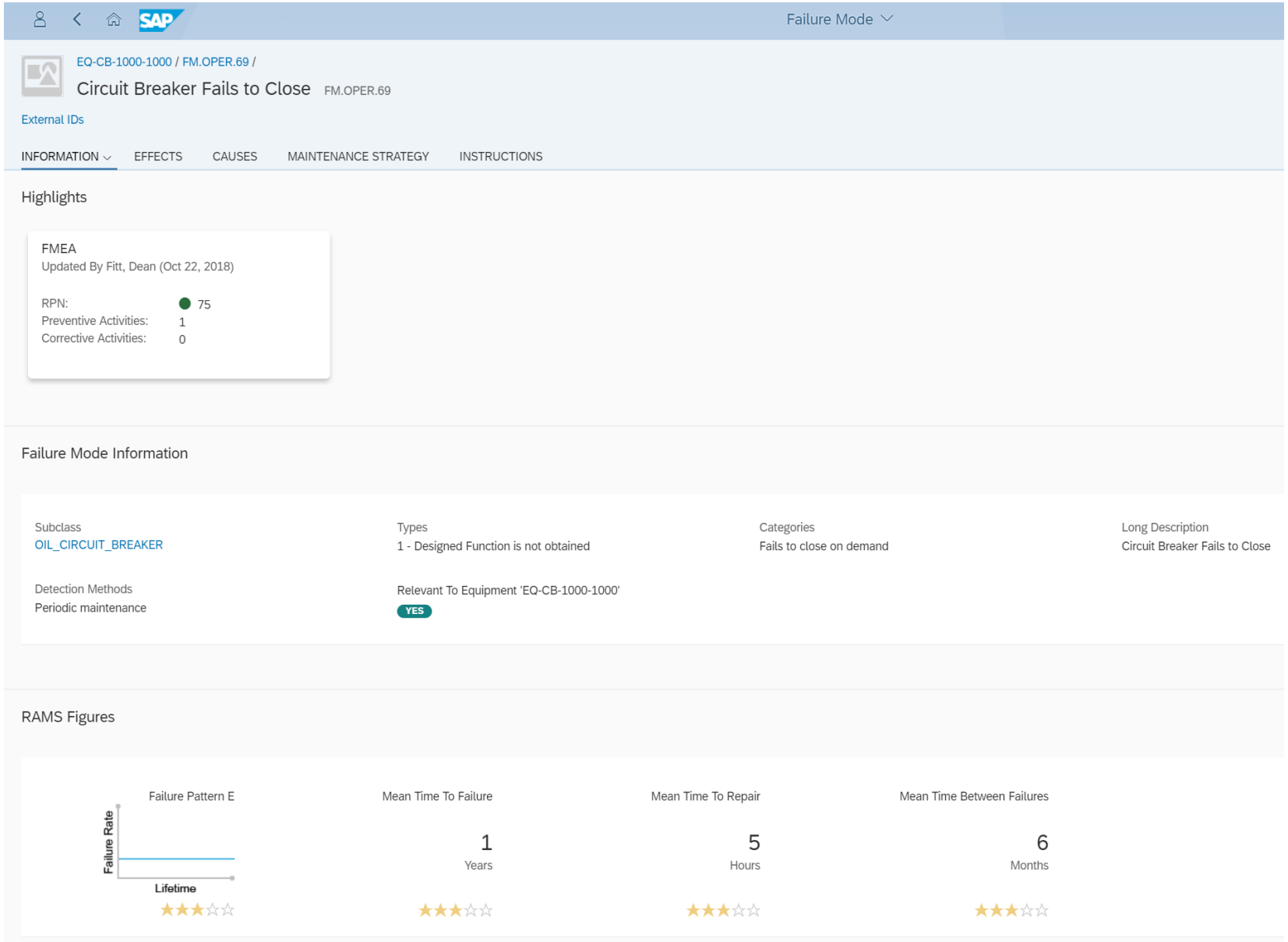
Documents

Stores and shares multiple documents across objects



Failure Modes

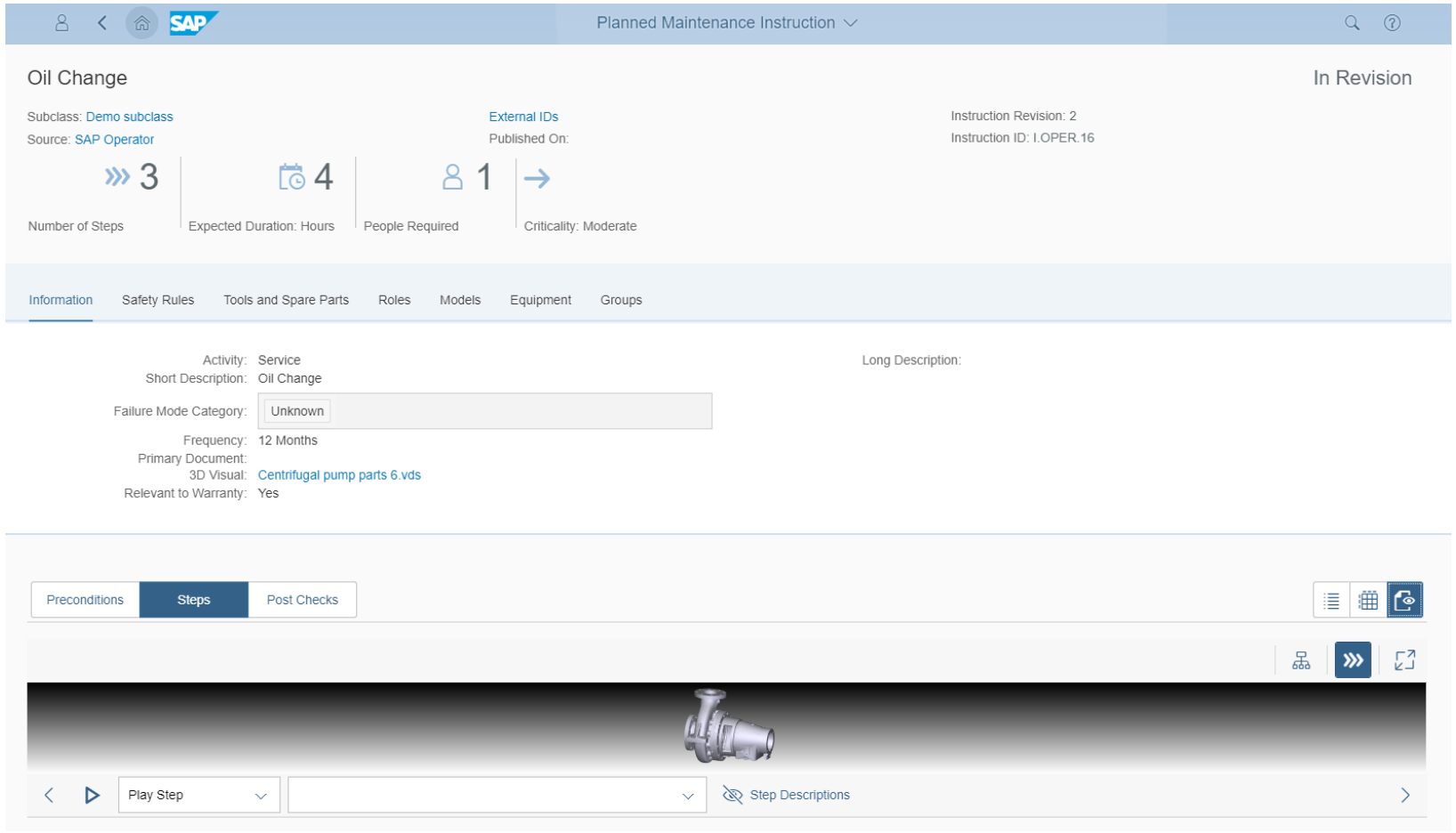
- A failure mode is a probable failure that could occur to piece of equipment
- Failure Modes can be assigned to Models, Equipment, Locations, Spare Parts and Groups.
- They are based on a subclass and have different categories and types.
- RAMS Figures (Reliability, availability, maintainability and safety) and KPIs (MTTF, MTTR, MTBF).



Instructions

Instructions describe how to execute maintenance

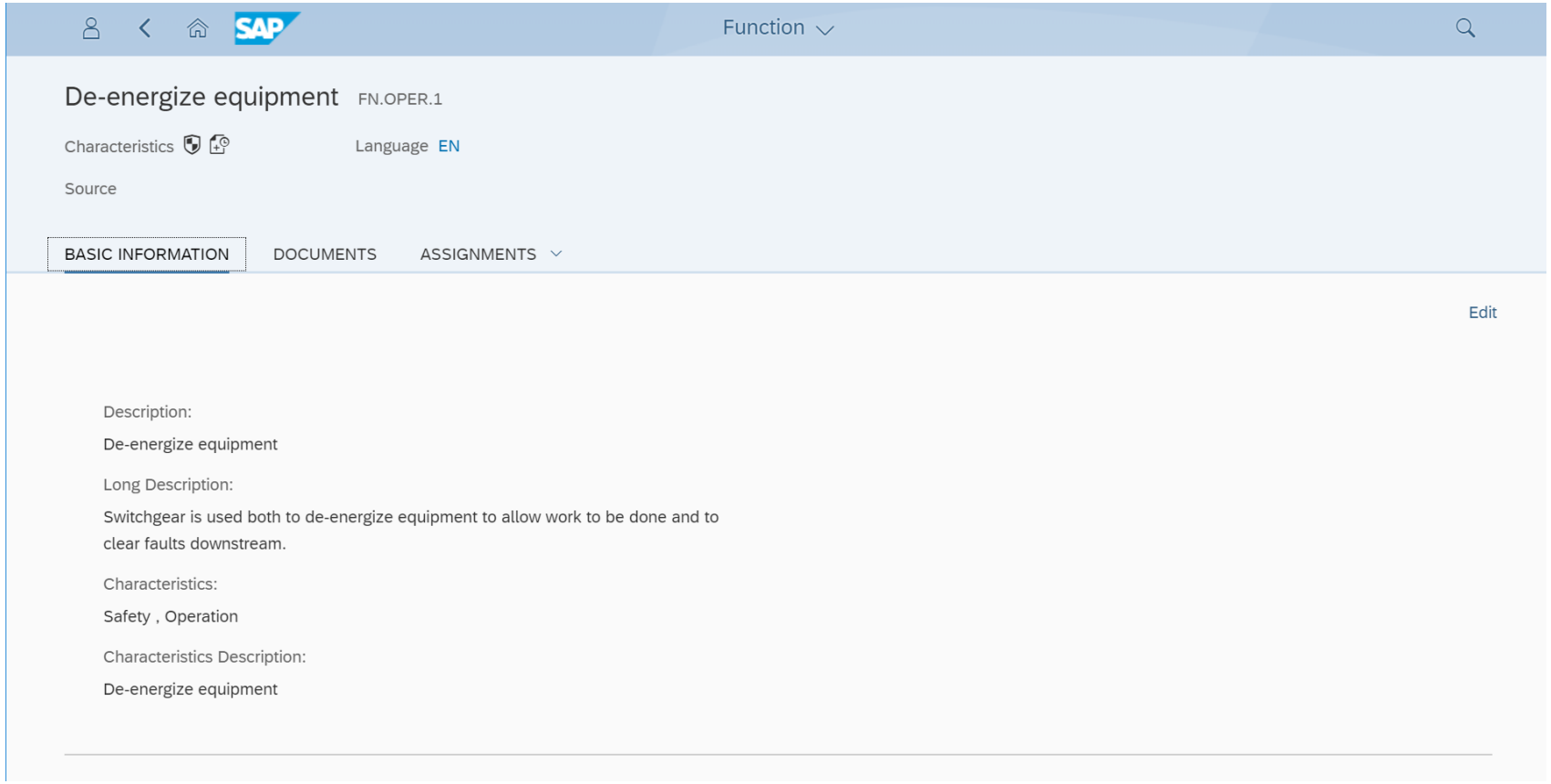
- There are different types of Instructions e.g. Breakdown, Installation, Operations, Planned Maintenance
- Instructions can be assigned to Models, Equipment and Groups
- Failure Modes can only be assigned to Breakdown Instructions.
- You can define the number of steps, duration, criticality, safety rules, tools and required spare parts.
- Additionally you can define preconditions, the steps themselves and post checks.
- You can add different documents. If you added an animated 3D file (.vds) the end user can view the sequences.



Function

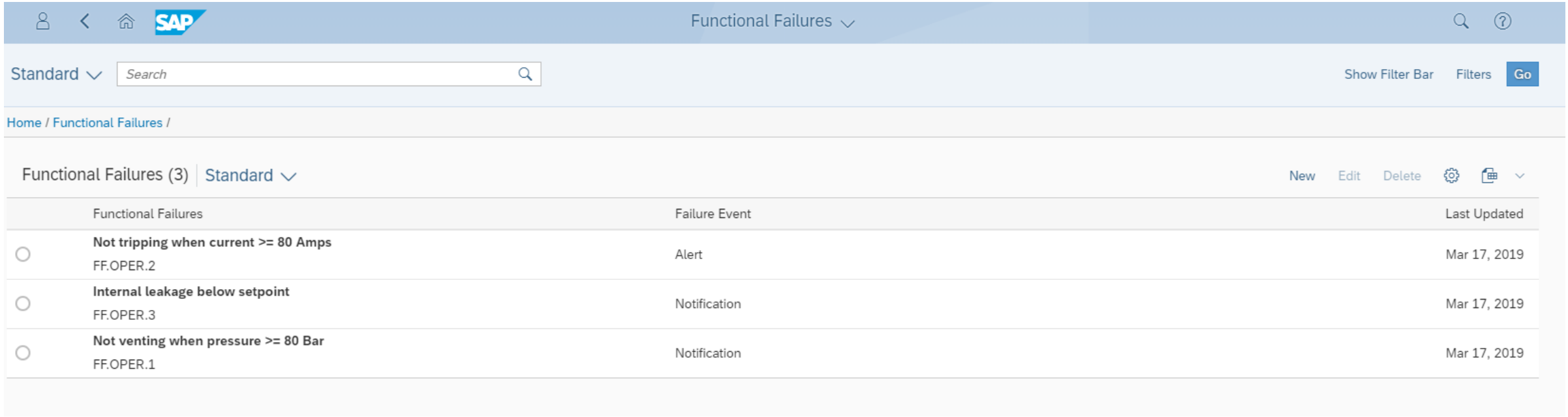
Functions are used to define how the assigned objects are intended to operate. You can assign functions to equipment, models, locations and systems.

You can currently use this feature in the Reliability Centred Maintenance (RCM) assessment.



Functional Failure

A functional failures is assigned to a function during RCM assessment

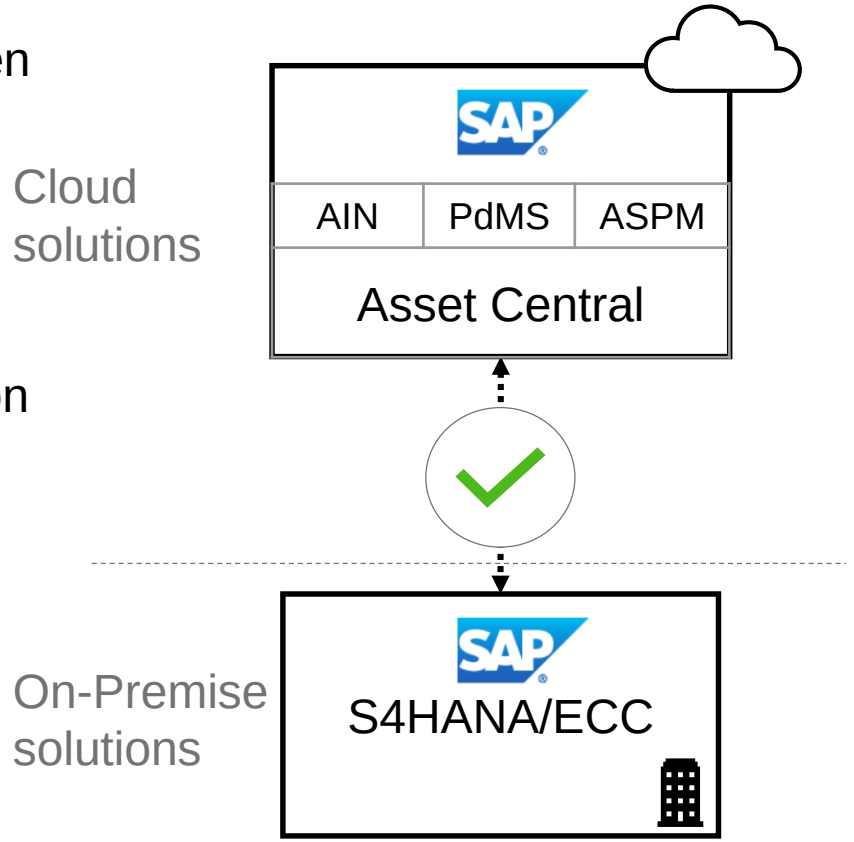


Asset Central Foundation

ERP Integration

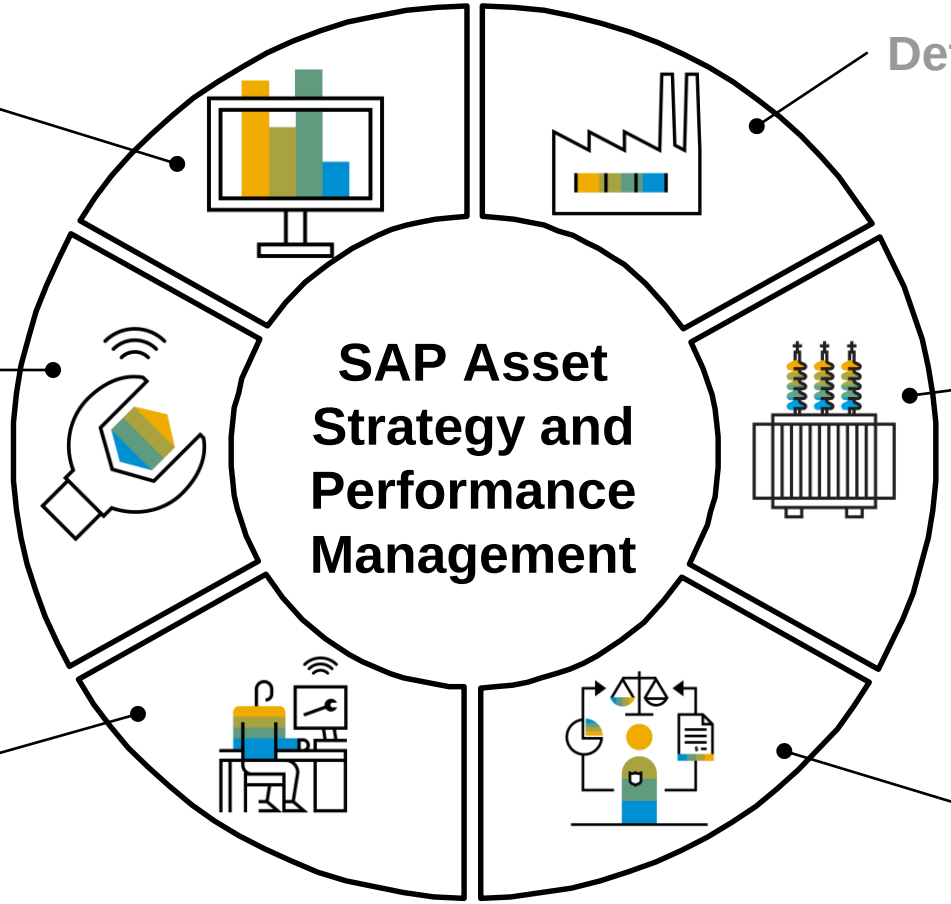
Checkout the new integration guide!

- Integration scenario ensures asset information is kept current between Asset Central (ACF) and Enterprise Asset Management (EAM).
- Integration between AC & EAM, covers both data & user experience improvements.
- Integration provides Bi-directional synchronization of asset information for technical objects –
  - Equipment
  - Functional Location
  - Documents
  - Notifications
  - Work orders



Supported Releases – **S/4 HANA On Premise 1709 & above**, **ERP Enhancement package 6 & above.**

SAP Asset Strategy and Performance Management



Monitor and Improve

Define Systems & Assets to Analyze

Implement Maintenance Strategies

Identify Critical Assets

Develop Recommended Actions

Perform Analysis

SAP Asset Strategy and Performance Management

Risk and Criticality Assessment

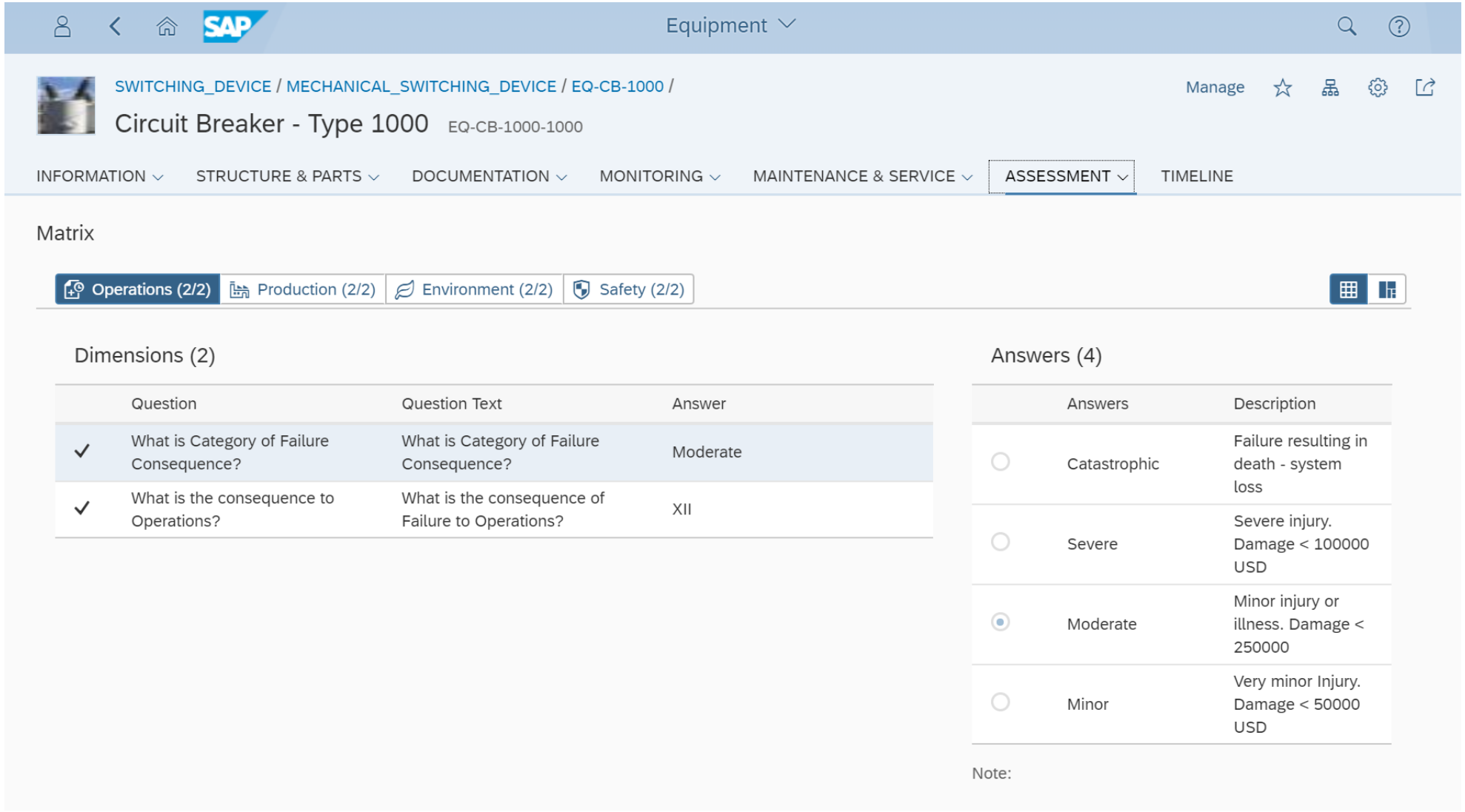
Assess which are the critical assets to determine which assets are likely to benefit most from application of RCM, FMEA or PM Review

Description:

- Assessment of asset(s) (equipment, location, group or system) criticality based on risk score.
- Calculation of risk score based on different dimensions and scales and for different impact categories.
- Supporting the selection of the most appropriate analytical process (i.e. RCM/FMEA, PM review, CM) based on the result of the criticality assessment
- Informed assessment based on historical maintenance data and relevant KPIs (EAM/PdMS integration).

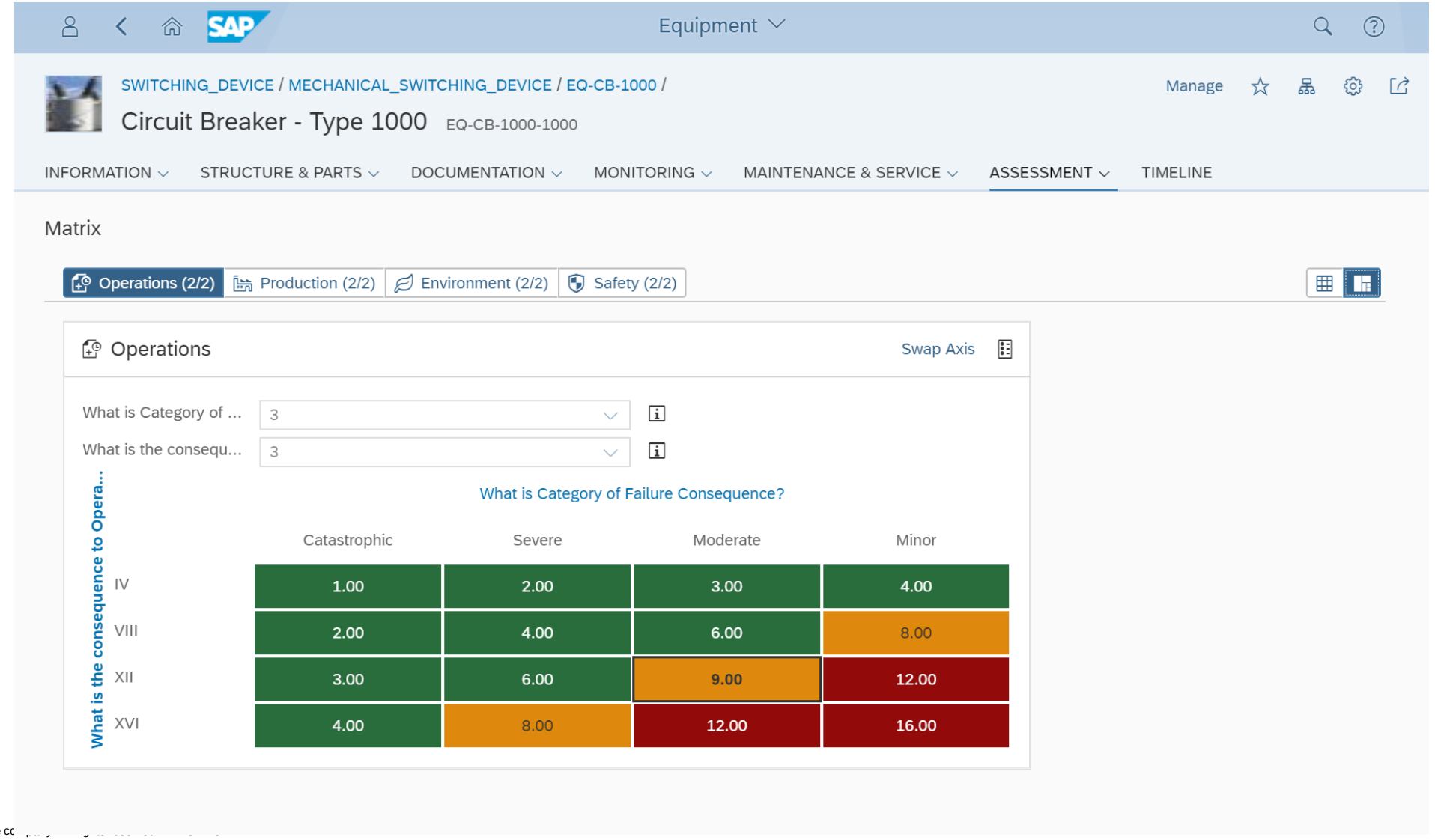
Risk and Criticality Assessment

Questions & Answers View



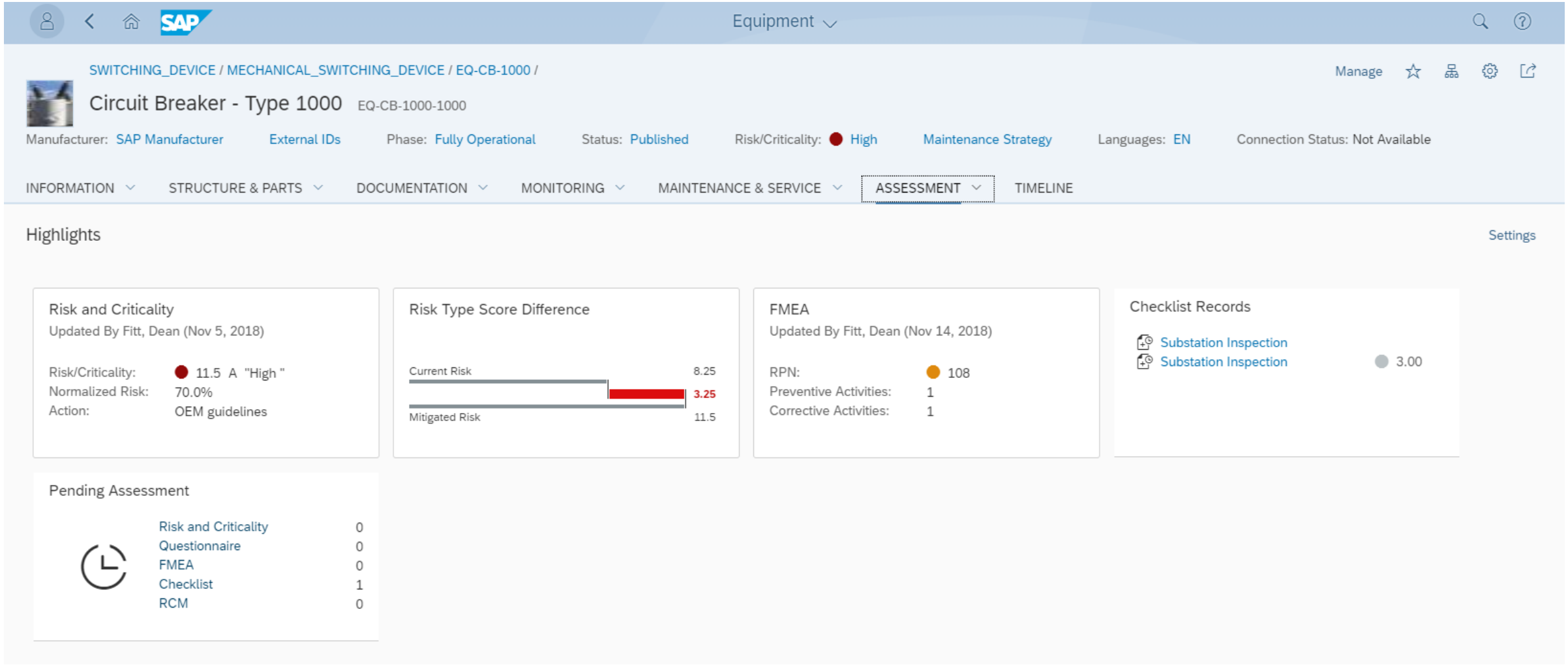
Risk & Criticality Assessment

Matrix View



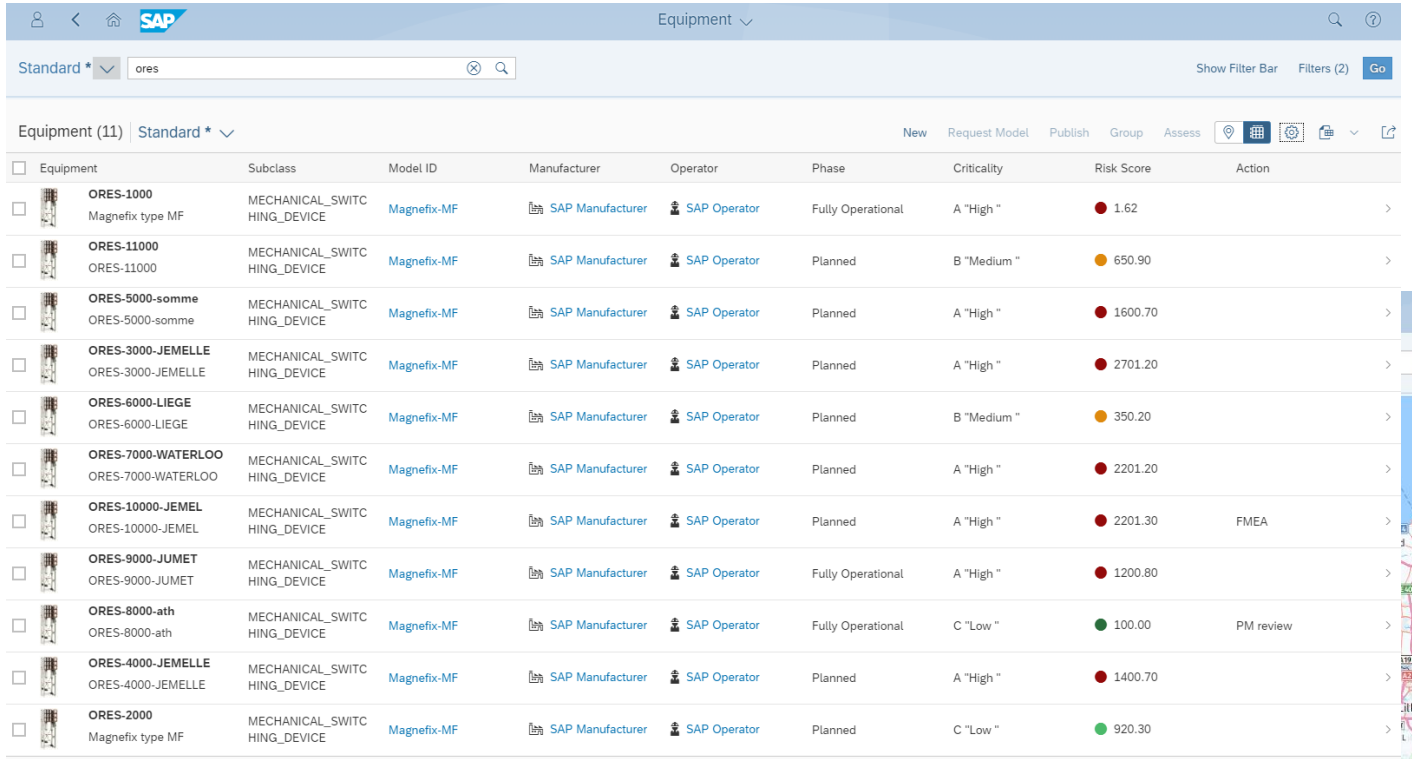
Equipment

Assessment Overview

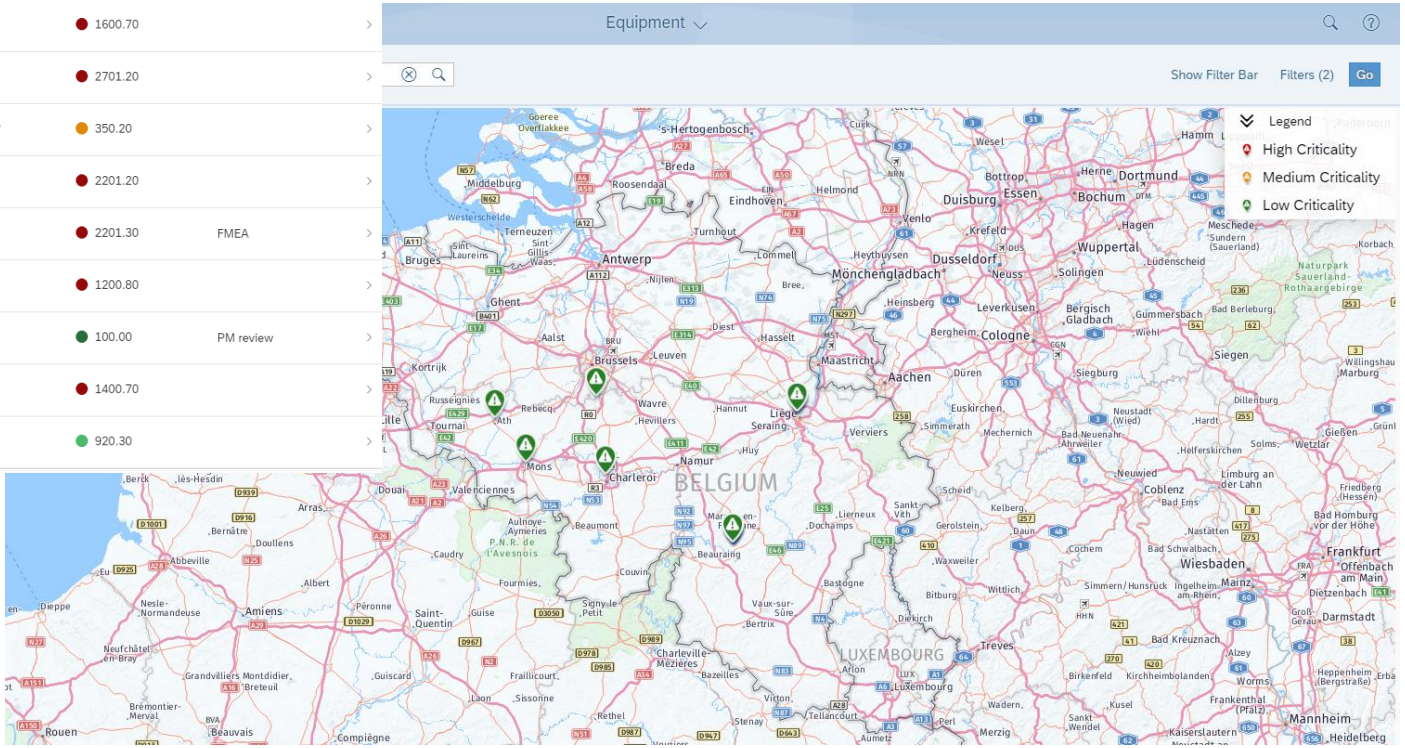


Equipment List

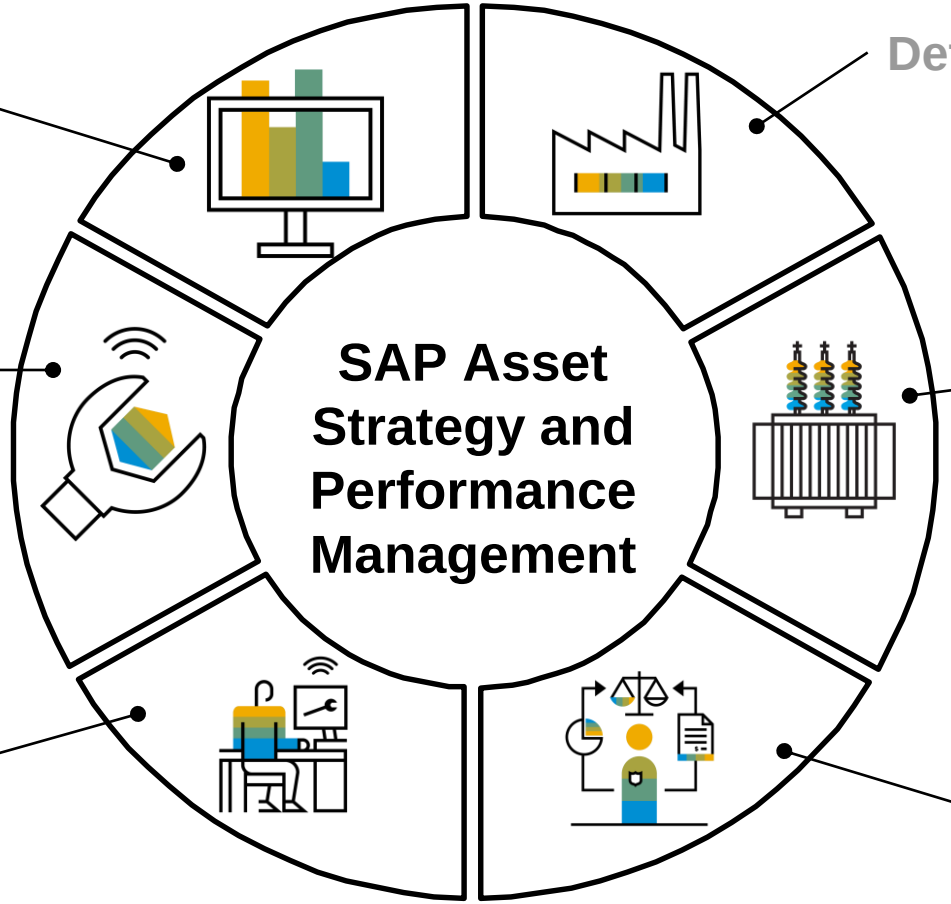
Showing Risk, Criticality and Recommended Action



Equipment	Subclass	Model ID	Manufacturer	Operator	Phase	Criticality	Risk Score	Action
ORES-1000 Magnefix type MF	MECHANICAL_SWITCHING_DEVICE	Magnefix-MF	SAP Manufacturer	SAP Operator	Fully Operational	A "High "	1.62	
ORES-11000 ORES-11000	MECHANICAL_SWITCHING_DEVICE	Magnefix-MF	SAP Manufacturer	SAP Operator	Planned	B "Medium "	650.90	
ORES-5000-somme ORES-5000-somme	MECHANICAL_SWITCHING_DEVICE	Magnefix-MF	SAP Manufacturer	SAP Operator	Planned	A "High "	1600.70	
ORES-3000-JEMELLE ORES-3000-JEMELLE	MECHANICAL_SWITCHING_DEVICE	Magnefix-MF	SAP Manufacturer	SAP Operator	Planned	A "High "	2701.20	
ORES-6000-LIEGE ORES-6000-LIEGE	MECHANICAL_SWITCHING_DEVICE	Magnefix-MF	SAP Manufacturer	SAP Operator	Planned	B "Medium "	350.20	
ORES-7000-WATERLOO ORES-7000-WATERLOO	MECHANICAL_SWITCHING_DEVICE	Magnefix-MF	SAP Manufacturer	SAP Operator	Planned	A "High "	2201.20	
ORES-10000-JEMEL ORES-10000-JEMEL	MECHANICAL_SWITCHING_DEVICE	Magnefix-MF	SAP Manufacturer	SAP Operator	Planned	A "High "	2201.30	FMEA
ORES-9000-JUMET ORES-9000-JUMET	MECHANICAL_SWITCHING_DEVICE	Magnefix-MF	SAP Manufacturer	SAP Operator	Fully Operational	A "High "	1200.80	
ORES-8000-ath ORES-8000-ath	MECHANICAL_SWITCHING_DEVICE	Magnefix-MF	SAP Manufacturer	SAP Operator	Fully Operational	C "Low "	100.00	PM review
ORES-4000-JEMELLE ORES-4000-JEMELLE	MECHANICAL_SWITCHING_DEVICE	Magnefix-MF	SAP Manufacturer	SAP Operator	Planned	A "High "	1400.70	
ORES-2000 Magnefix type MF	MECHANICAL_SWITCHING_DEVICE	Magnefix-MF	SAP Manufacturer	SAP Operator	Planned	C "Low "	920.30	



SAP Asset Strategy and Performance Management



Monitor and Improve

Define Systems & Assets to Analyze

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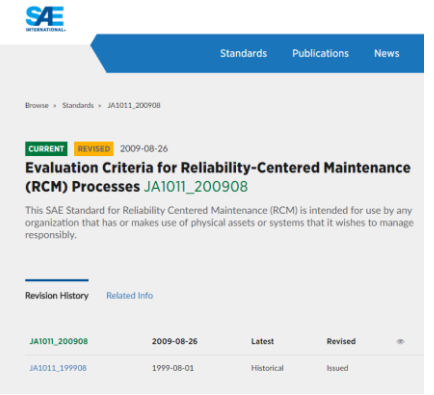
Reliability Centered Maintenance (RCM)

The purpose of the standard SAE JA1011, published in 1999, is to set out the criteria that any process must comply with in order to be called "RCM." The twelve pages' document, revised in august 2009, describes the minimum criteria for a process to be considered an RCM-compliant method. The standard provides the criteria to establish if a given process follows the creeds of RCM as originally proposed. It can also serve as a guide for organizations seeking RCM training, facilitation or consulting.

Document SAE JA1011, AUG 2009, establishes that **for a Process be acknowledged as RCM it must follow the seven steps in the order shown below:**

1. What are the functions and associated desired standards of performance of the asset in its present operating context (**functions**)?
2. In what ways can it fail to fulfill its functions (**functional failures**)?
3. What causes each functional failure (**failure modes**)?
4. What happens when each failure occurs (**failure effects**)?
5. In what way does each failure matter (**failure consequences**)?
6. What should be done to predict or prevent each failure (**proactive tasks and task intervals**)?
7. What should be done if a suitable proactive task cannot be found (**default actions**)?



* Reliability Centered Maintenance (RCM) is a process standardized through SAE JA 1011 - SAP ASPM supports asset centric companies to apply this standard and allow partners & customers to enrich and extend complying with more specific RCM processes like RCM 3™ by the Aladon Network

Reliability Centered Maintenance (RCM*)

7 + 1 Questions

0. Which Assets or Systems do I want to Analyze?
   Scope – ***Switchgear System***

1. What are the desired functions and performance in it's operating context?
   Functions – ***Switchgear is used both to de-energize equipment to allow work to be done and to clear faults downstream.***

2. In what ways does it fail to fulfil its functions?
   Functional Failures – ***Not tripping when current >= 80 Amps***

3. What causes each functional failure?
   Failure Modes – ***Circuit Breaker Fails to Close***

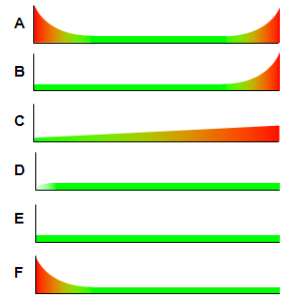
4. What happens when each failure occurs?
   Failure Effects – ***Loss of Power***

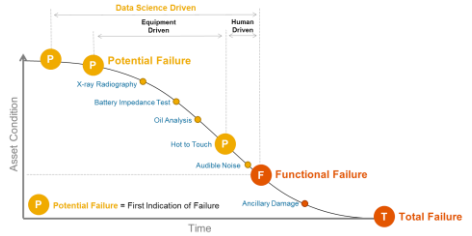
5. In what way does each failure matter?
   Failure Consequences – ***Network operation impacted***

6. What can be done to predict or prevent each failure?
   Proactive Tasks & Task Intervals – ***Yearly inspection to check for water ingress***

7. What can be done if the failure cannot be predicted or prevented?
   Default Actions – ***Replace switchgear***

Failure Mode Library & Patterns …..





Result: Recommendations

- Preventive Tasks
- Corrective Tasks

= **'Maintenance Strategy'**

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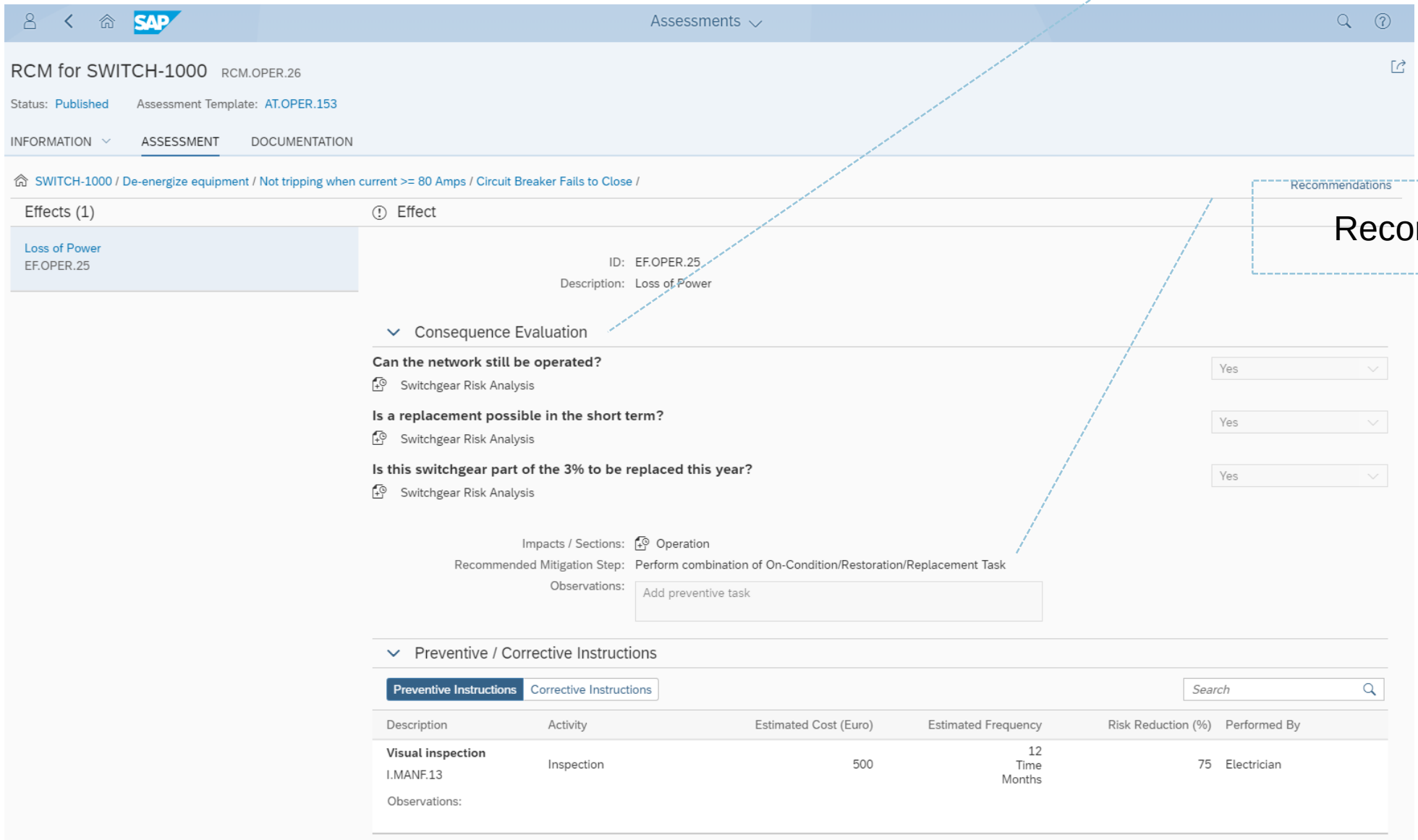
Reliability Centered Maintenance (RCM):
RCM Assessment

Consequence Evaluation is Decision Diagram

Recommended Task



Decision Diagram (Advanced Check List)

Checklist Template

Switchgear Risk Analysis AT.OPER.132

Simulate Manage

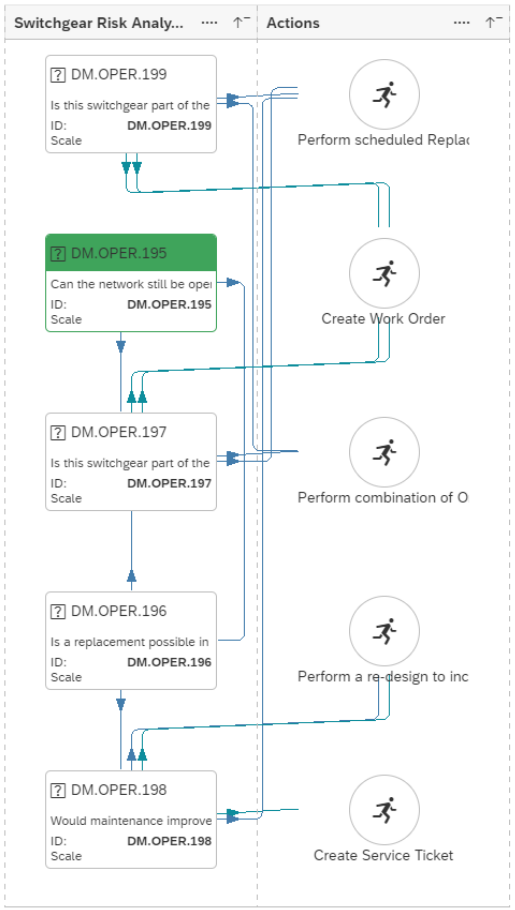
Checklist Type: Advanced Long Description Status: Published Assignments: Sections: 1 Trigger: DM.OPER.195

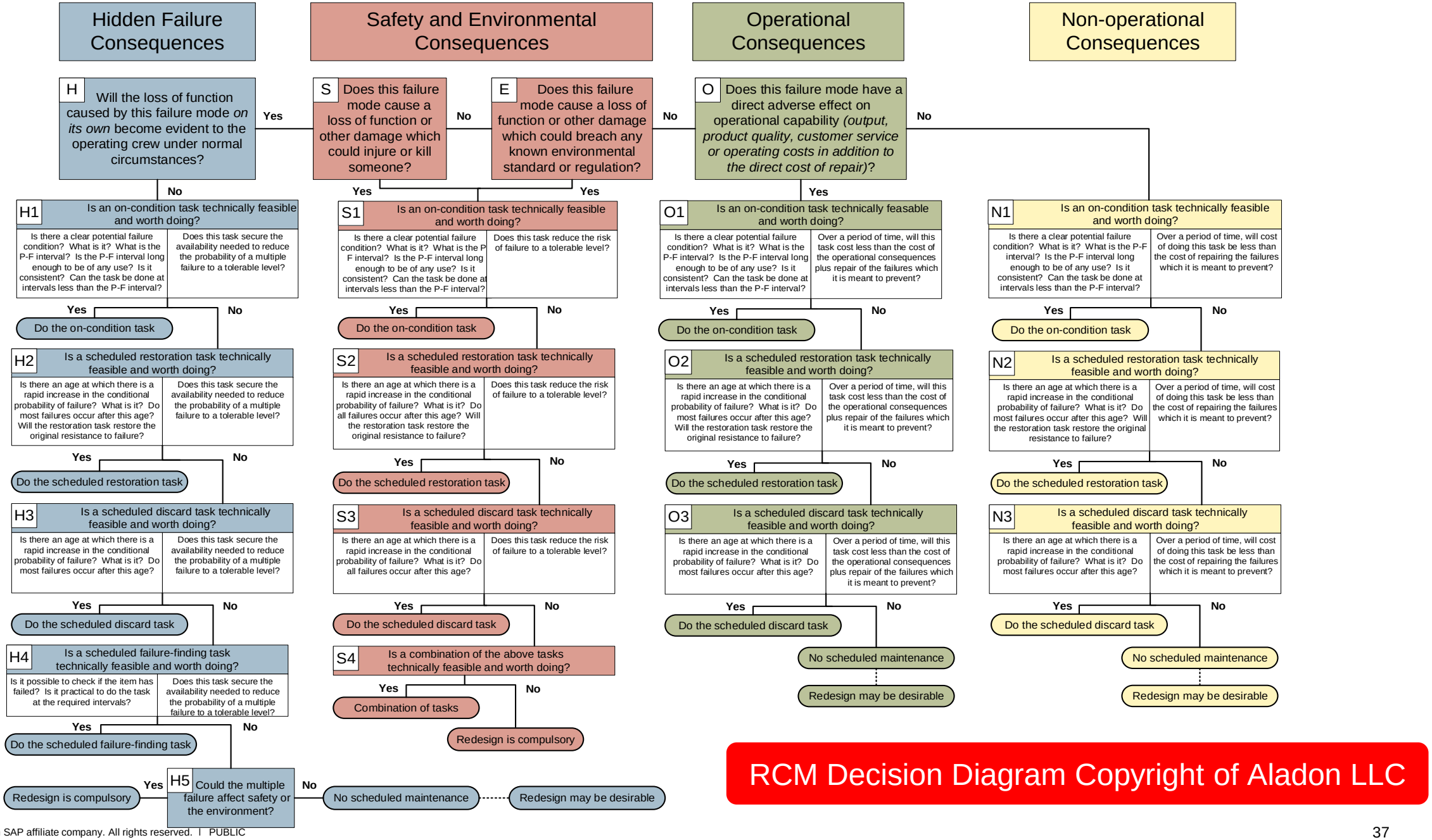
INFORMATION ASSIGNMENTS QUESTIONS TIMELINE

Switchgear Risk Analysis (5)

Search

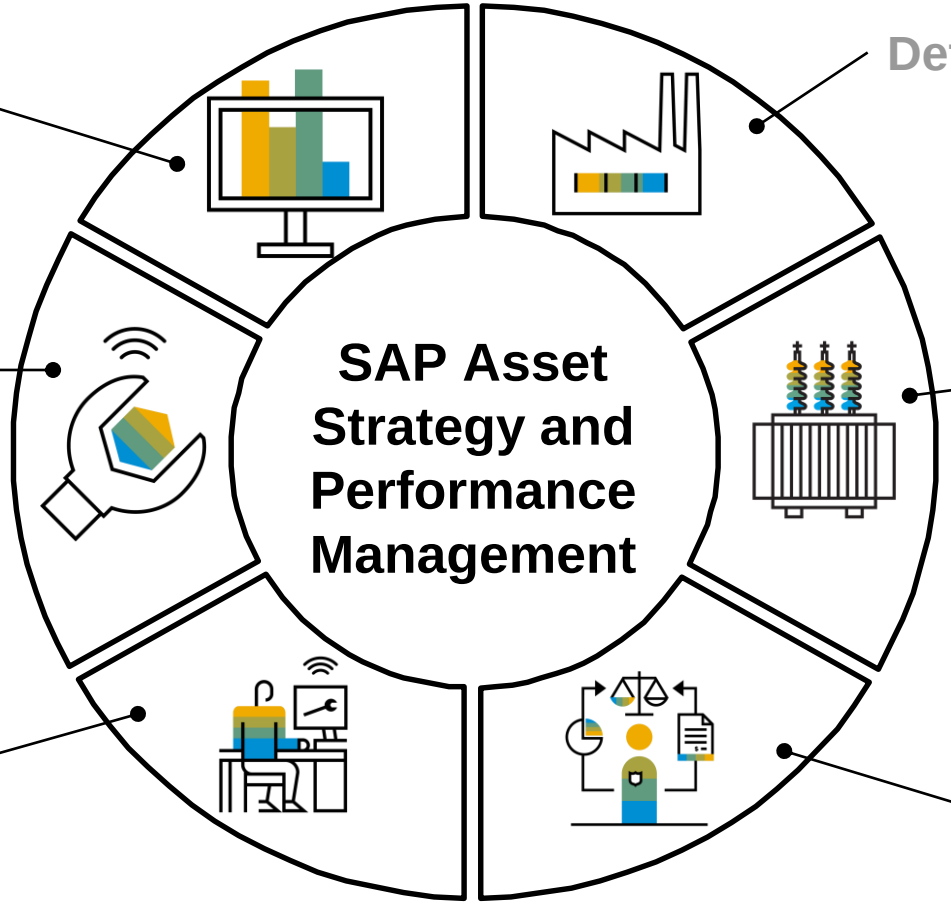
Question	Question Text	Answers	Next Step	Secondary Step
DM.OPER.195	Can the network still be operated?	No	Is this switchgear part of the 3% to be replaced this year?	
		Yes	Is a replacement possible in the short term?	
DM.OPER.196	Is a replacement possible in the short term?	No	Would maintenance improve the durability of the switchgear?	
		Yes	Is this switchgear part of the 3% to be replaced this year?	
DM.OPER.197	Is this switchgear part of the 3% to be replaced this year?	No	Perform scheduled Replacement Task	Create Work Order
		Yes	Perform combination of On-Condition/Restoration/Replacement Task	Create Work Order
DM.OPER.198	Would maintenance improve the durability of the switchgear?	No	Perform a re-design to increase Availability	Create Service Ticket
		Yes	Perform scheduled Replacement Task	Perform a re-design to increase Availability
DM.OPER.199	Is this switchgear part of the 3% to be replaced this year?	No	Perform scheduled Replacement Task	Create Work Order
		Yes	Perform combination of On-Condition/Restoration/Replacement Task	Create Work Order





RCM Decision Diagram Copyright of Aladon LLC

SAP Asset Strategy and Performance Management



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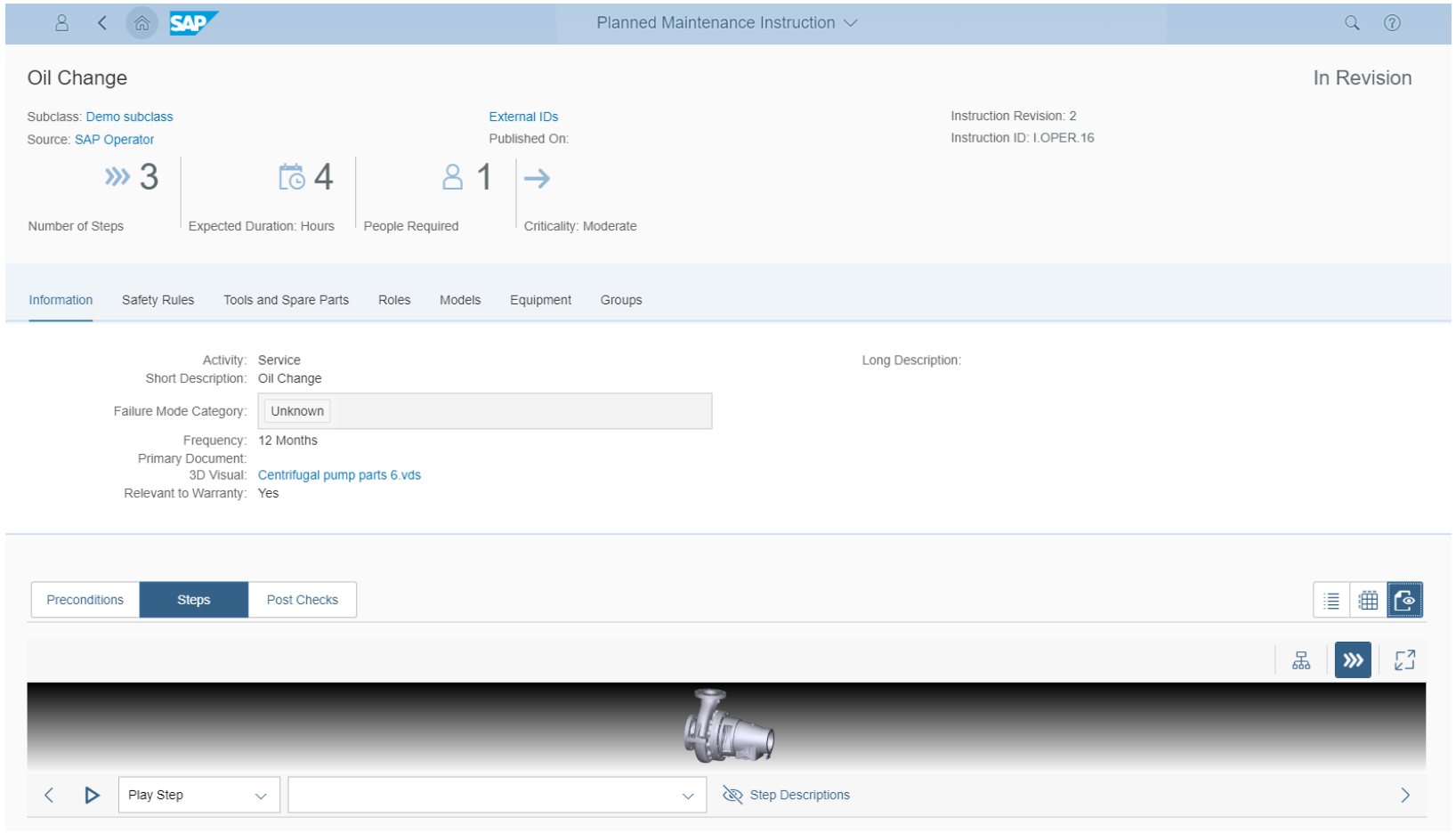
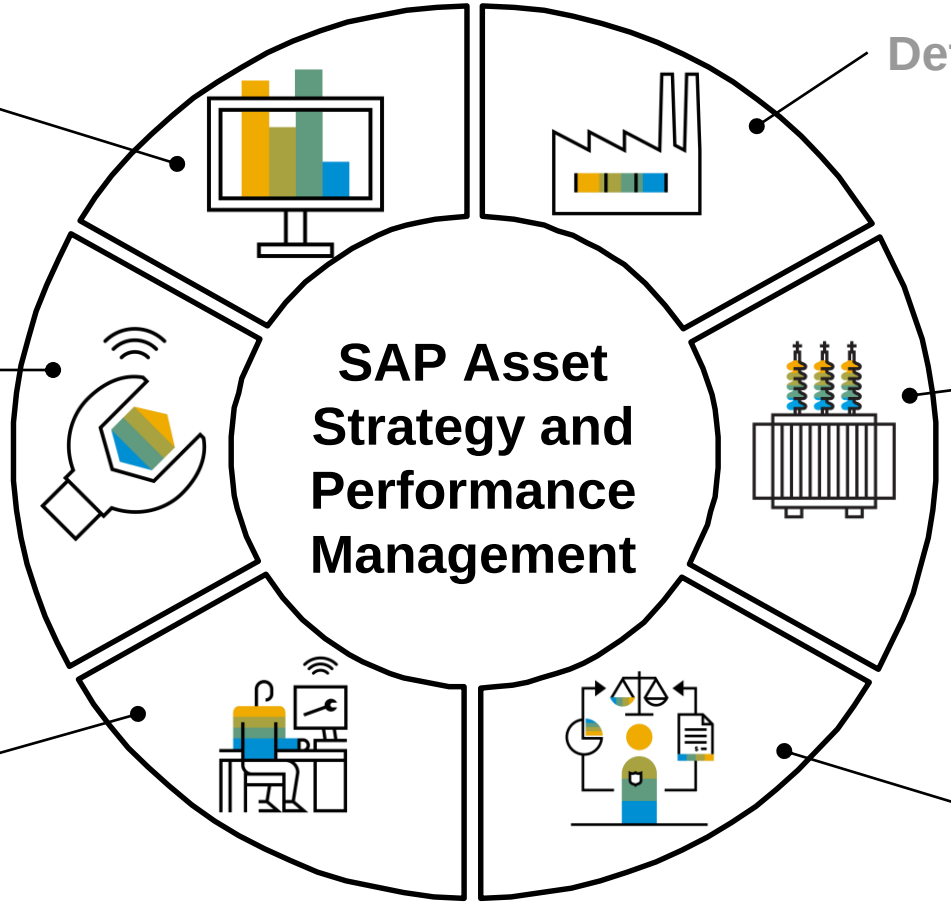
- Additionally you can define preconditions, the steps themselves and post checks.
- You can add different documents. If you added an animated 3D file (.vds) the end user can view the sequences.



SAP Asset Strategy and Performance Management



Monitor and Improve

Define Systems & Assets to Analyze

Implement Maintenance Strategies

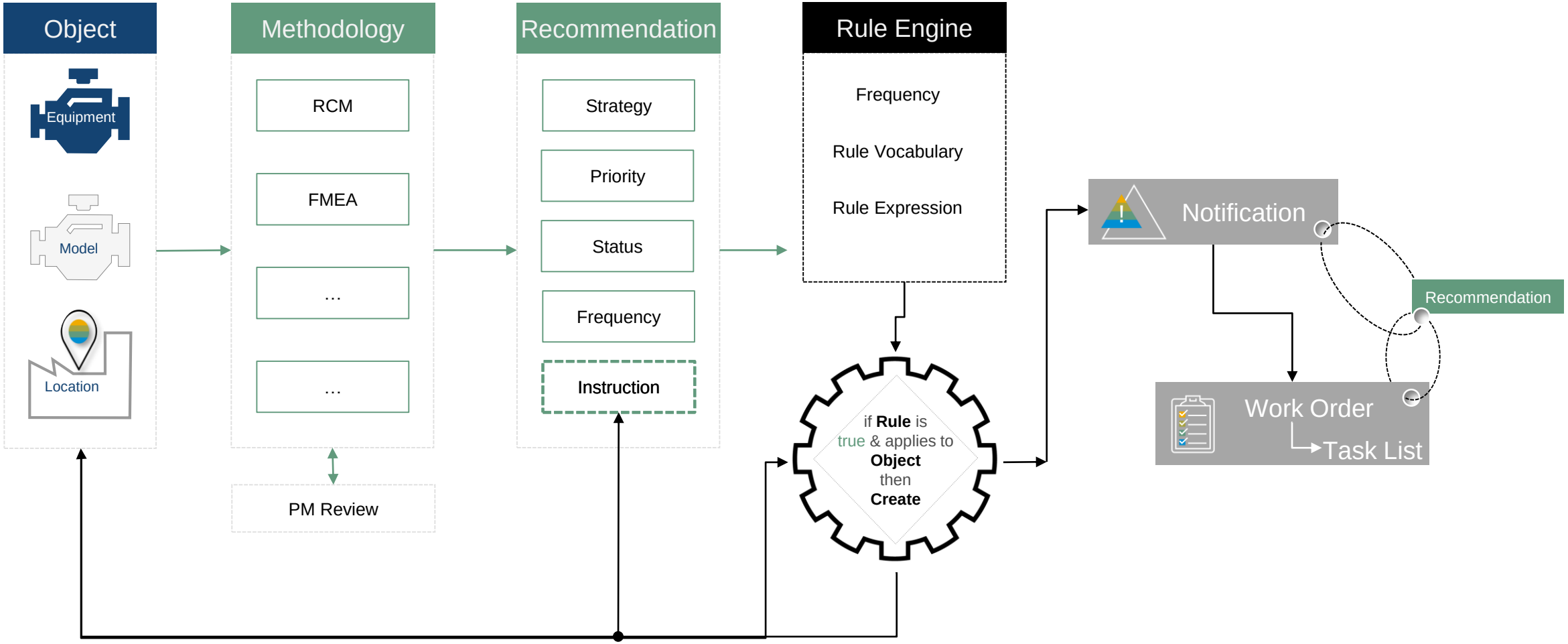
Identify Critical Assets

Develop Recommended Actions

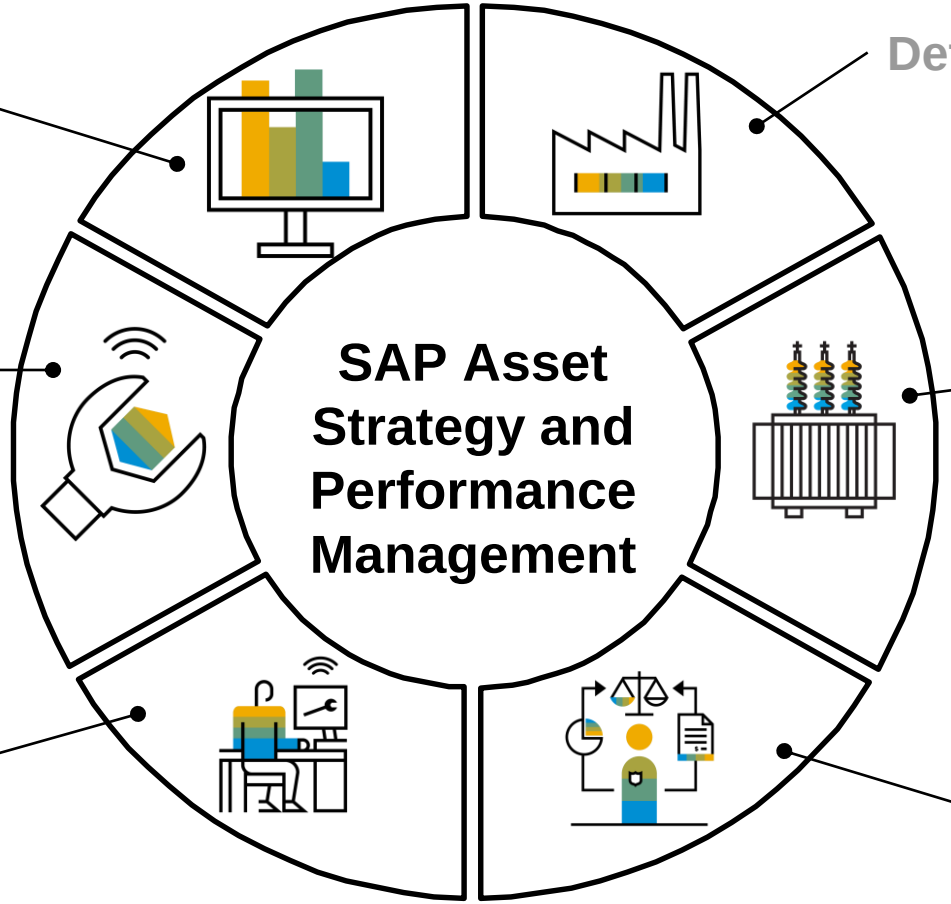
Perform Analysis

Implement RCM/FMEA Recommendations

Lab Preview



SAP Asset Strategy and Performance Management



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SAP Predictive Maintenance and Service

Advanced analytics to support maintenance execution and strategy decisions

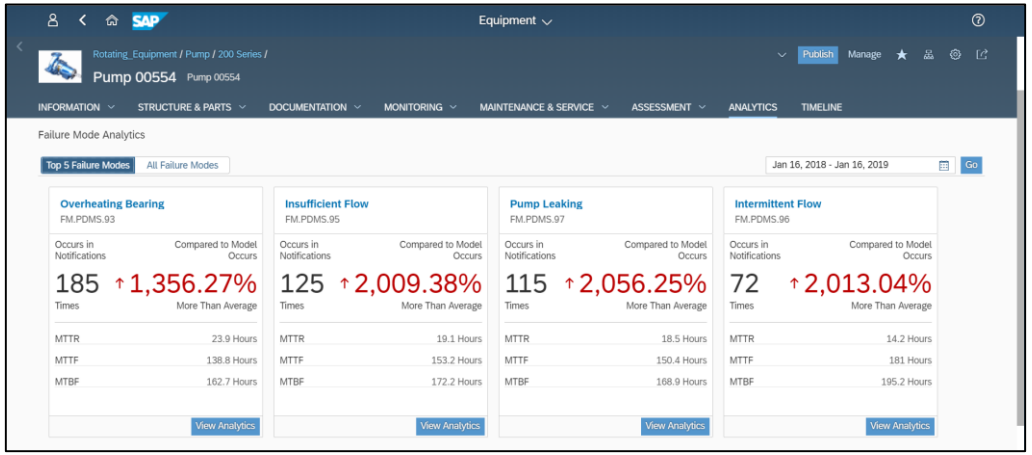
Capability Highlights

Failure Mode Analytics
Utilizes machine learning to generate KPIs around documented failure modes

Fingerprint Management
A visual approach to capturing asset reference states. Used for visual comparison to current operating performance. (i.e., trend analysis)

IT/OT Data Fusion Views
Equipment lists and geospatial views combining model data and sensor based health indicators to prioritize maintenance actions and support strategy decisions

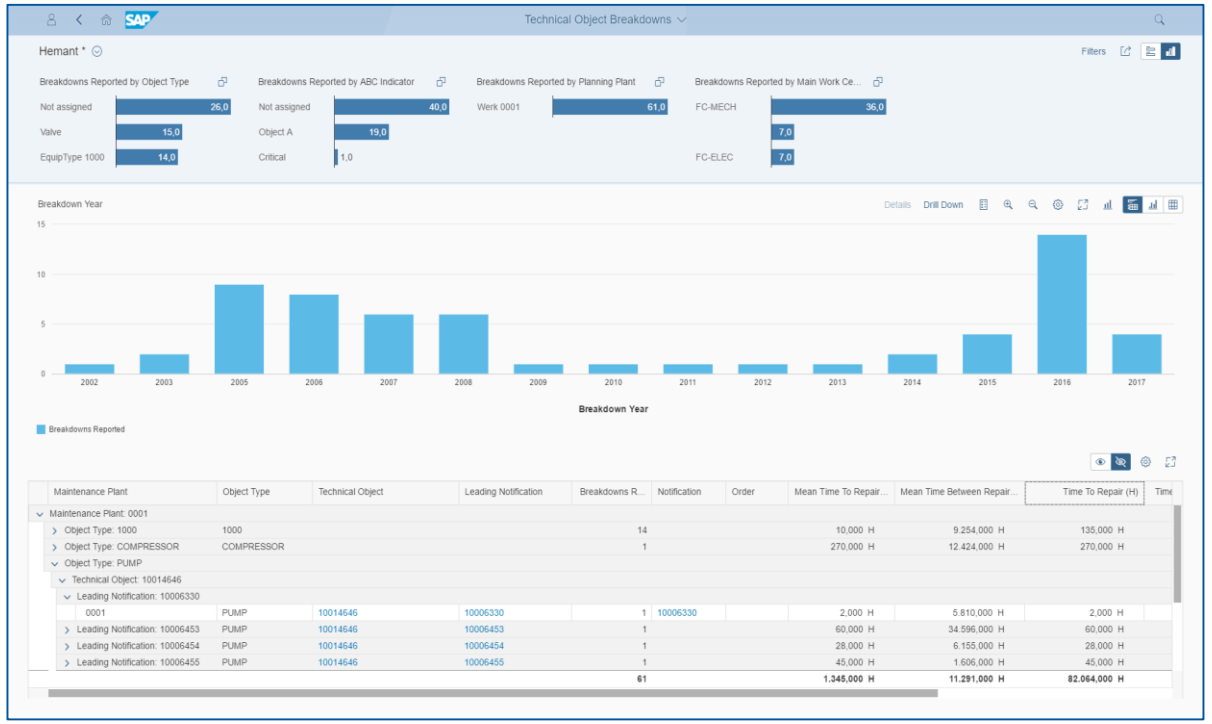
Advanced Rule-based Alert Creation
Generate value added alerts for maintenance professionals through an intuitive and flexible rules engine



SAP S/4HANA Maintenance Management

Technical Object Breakdowns

- Analyze Breakdown and its impact on Reliability
- Evaluate effective time to repair and time between repair
- Evaluate Mean and Total time between repair as well time to repair
- Real time evaluation of statistical KPIs without storing aggregates
- identify where the equipment was installed if the breakdown is identified after the equipment was dismantled.
- Identify equipment that fails often or long time to repair
- Identify location where equipment fails quite often
- Compare reliability of the equipment from different manufacturers
- Identify repair frequencies for a type or make of an equipment



SAP S/4HANA Maintenance Management

Damage Analysis

Main KPIs

- Detailed failure mode analysis
- Number of damages recorded, related causes and activities
- Covers all the features covered by MCI5 / IW69

High-level innovation description

For malfunction report and activity reports, it is critical to records parts that were observed as damaged. Number of damages and corresponding causes could help in analyzing reliability of equipment.

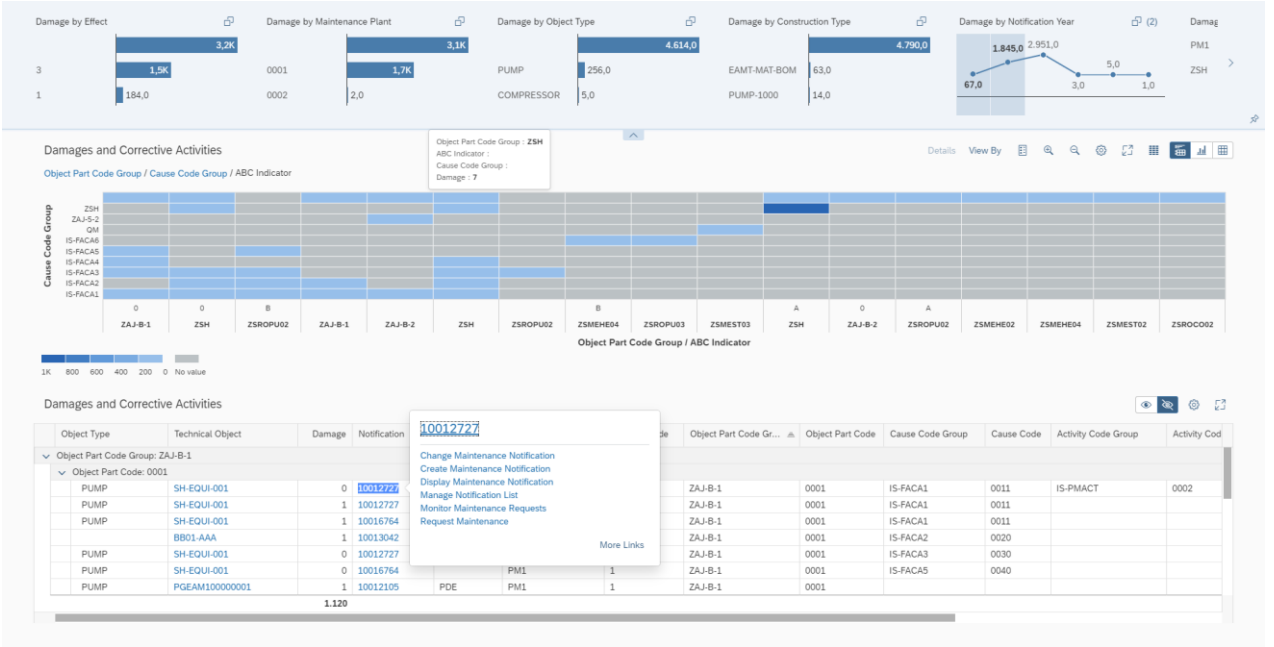
Value Proposition

Increased reliability due to

- Identify failure modes of an equipment
- Identify parts that gets damaged and activities that are needed to repair or replace them
- Identifying main causes observed by technicians and plan preventive or inspections activities to avoid future unplanned breakdown.
- Identify parts that are over maintained and remove them from preventive activities.

Capabilities

- Analyze frequent offenders that create reliability issues for an equipment
- Identify relation between Failure mode, damages, causes and effect it has on operation of asset



Improvements over PMIS

- Calculation and aggregation is in real time with transactional data and not stored in S-structure.
- KPIs can be aggregated at equipment type, manufacturer, model or any other critical attributes.
- Much easy navigation that lets user drill down to notification or order and get better visibility for historical failures.

SAP S/4HANA Cloud for Asset Management

Actual Cost Analysis

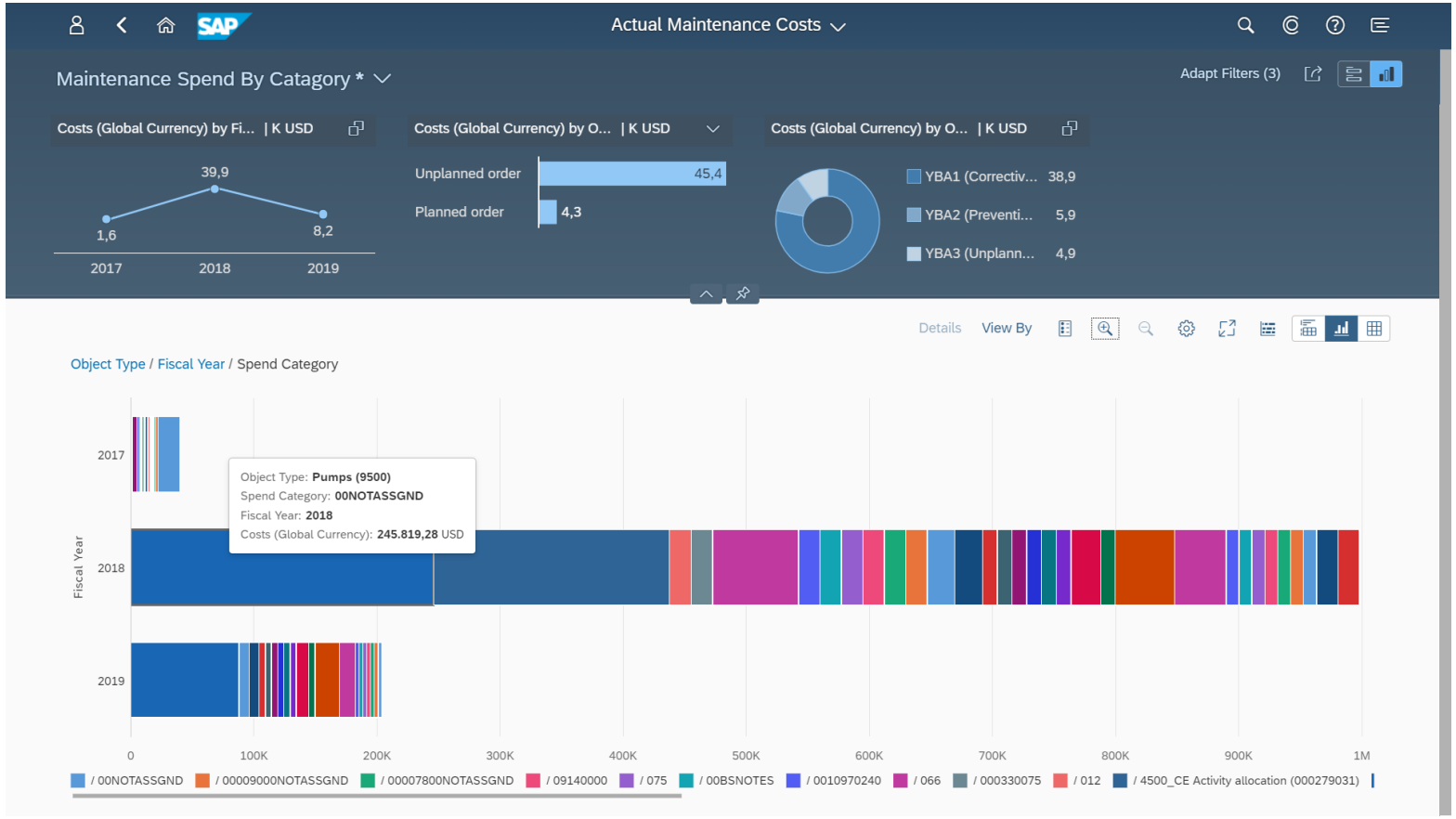
The SAP Fiori app *Actual Cost Analysis* supports the *Maintenance Planner* in monitoring and evaluating actual costs resulting from current maintenance orders.

Value Proposition

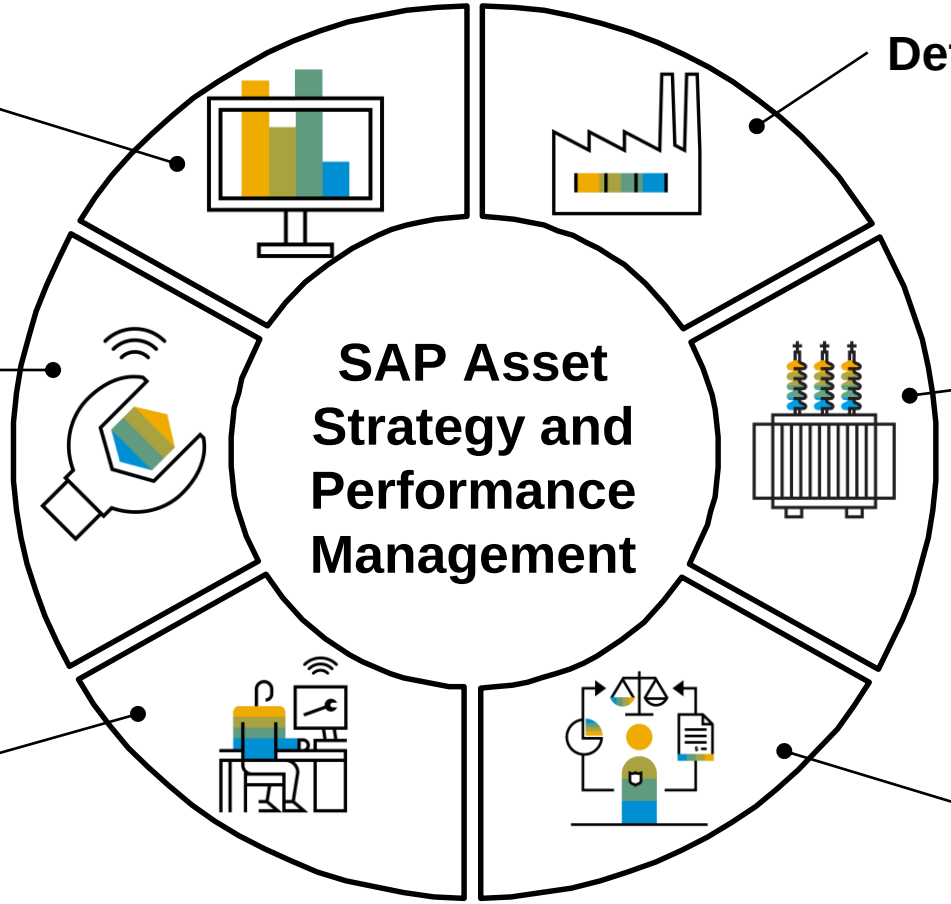
- Easily identify the maintenance activities leading to the highest costs or parts of the asset that were particularly costly on inspections
- Evaluate actual maintenance costs stored in the Universal Journal Entry
- Seamless navigation within one page that combines transactional and analytical data using chart and table visualization

Capabilities

- Analyze the actual costs for materials and labor in maintenance
- Compare the total maintenance cost for unplanned, corrective and preventive maintenance activities
- Filters allow you to analyze critical costs in a fiscal year from different perspectives, such as the order type, the construction type, the location, the planner group or the manufacturer



Summary



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Presentation Materials

Access the slides from 2019 ASUG Annual Conference here:

http://info.asug.com/2019-ac-slides

Q&A

For questions after this session, contact me at dean.fitt@sap.com

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