



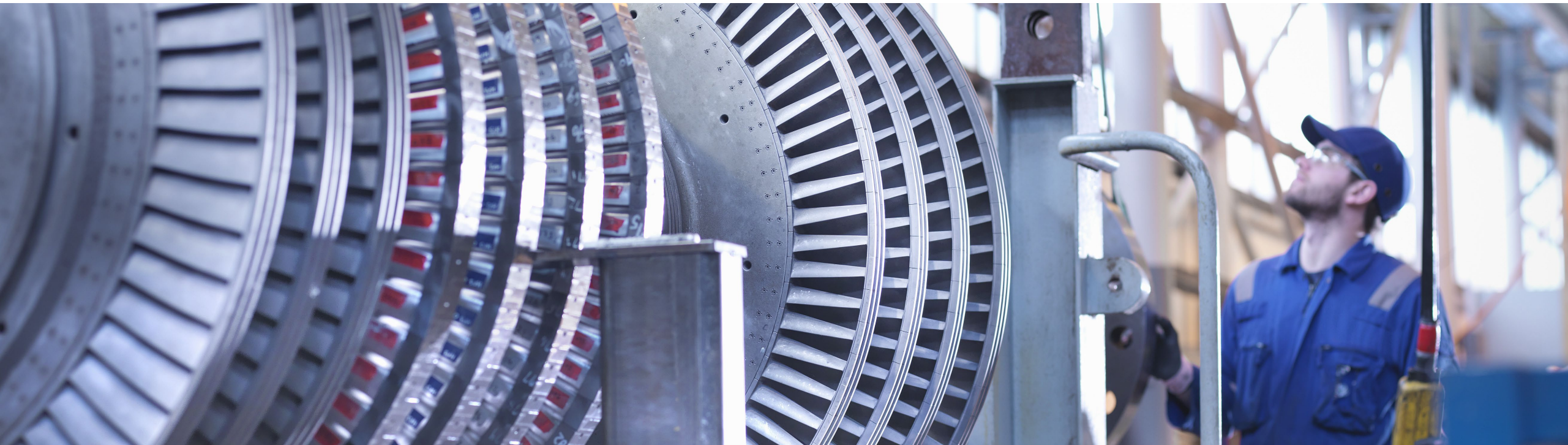
SAP Intelligent Asset Management (IAM)

Mitigating Risk and Improving Performance: The Road Ahead with SAP Asset Performance Management

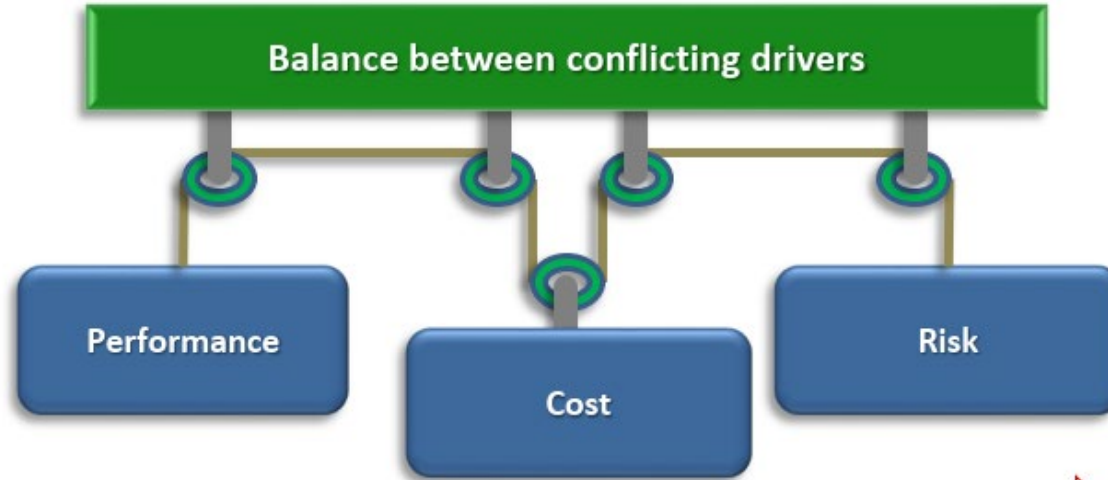
September 2022

Brian Williams, Solution Owner, Asset Performance Management, DSC&I4-Digital Assets, SAP

- How Asset Performance Management can take SAP S/4HANA Foundation to next level
- How to achieve a strategy driven Asset Management



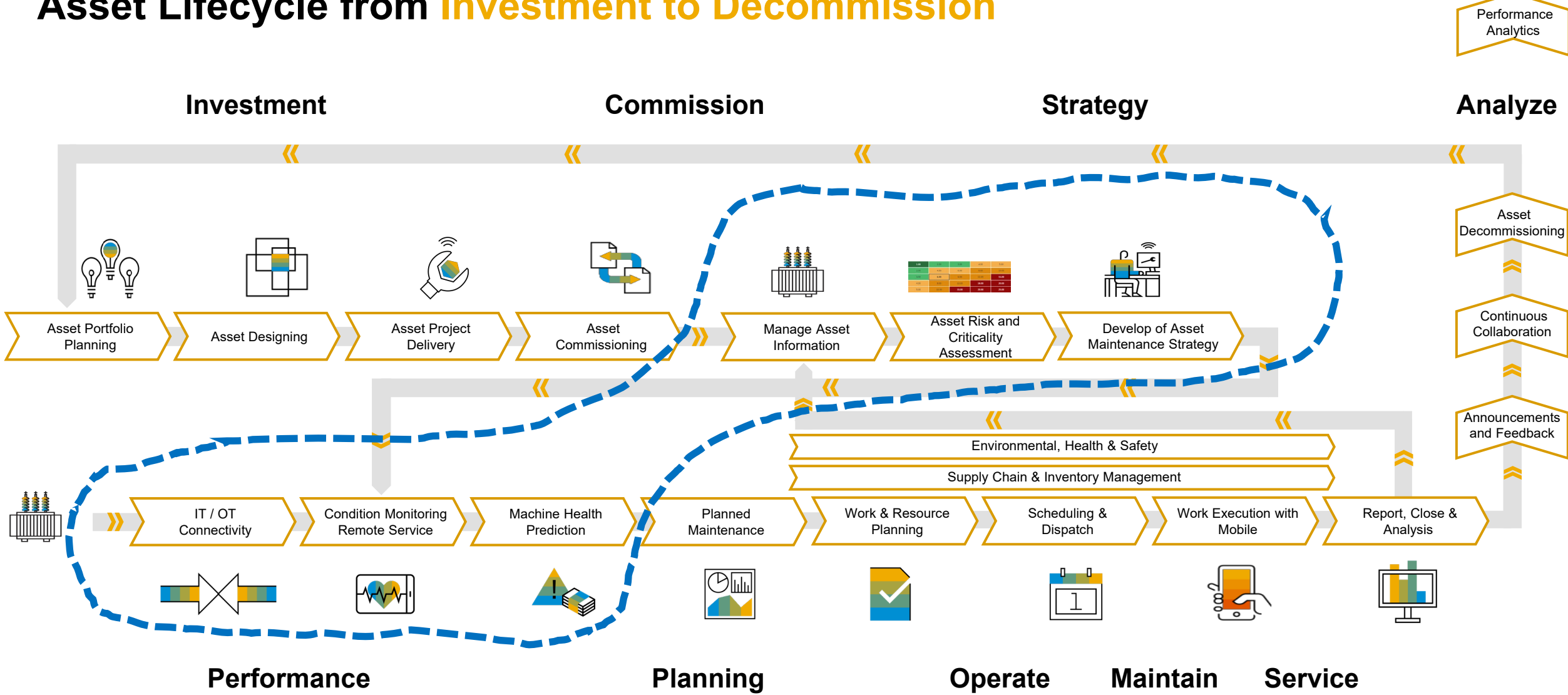
Goal: Optimizing Asset Management



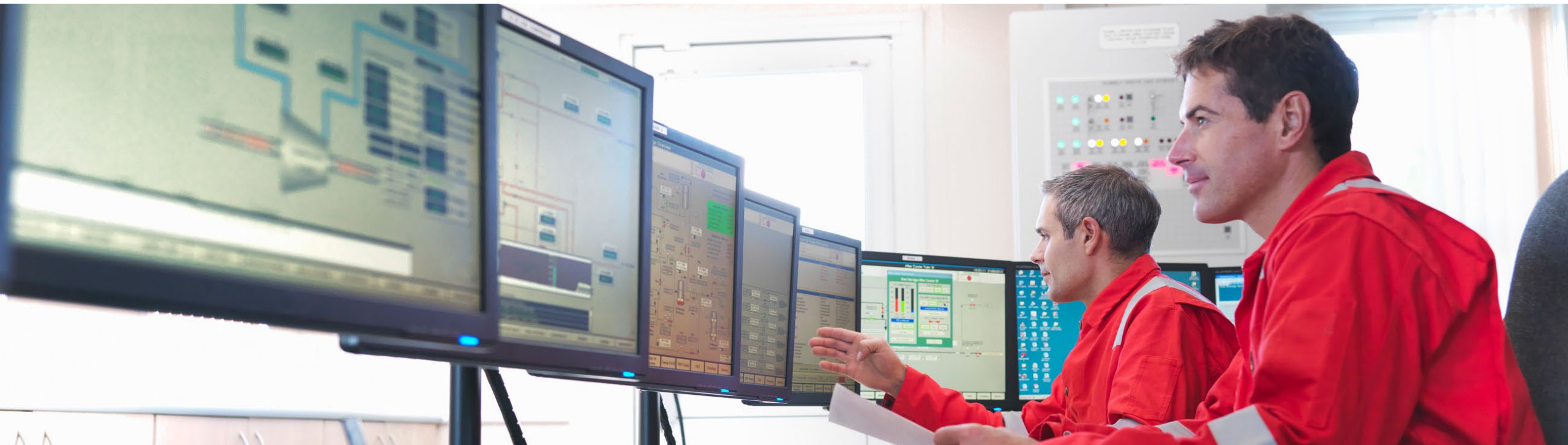
✓ Asset life cycle



Asset Lifecycle from Investment to Decommissioning



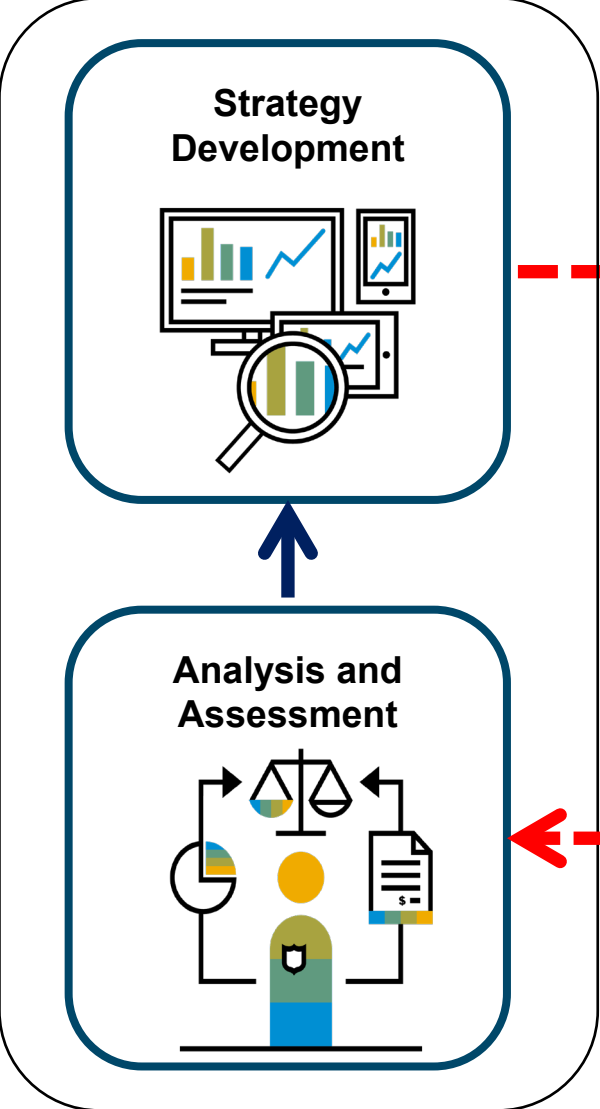
Intelligent Asset Management Overview



Status Quo

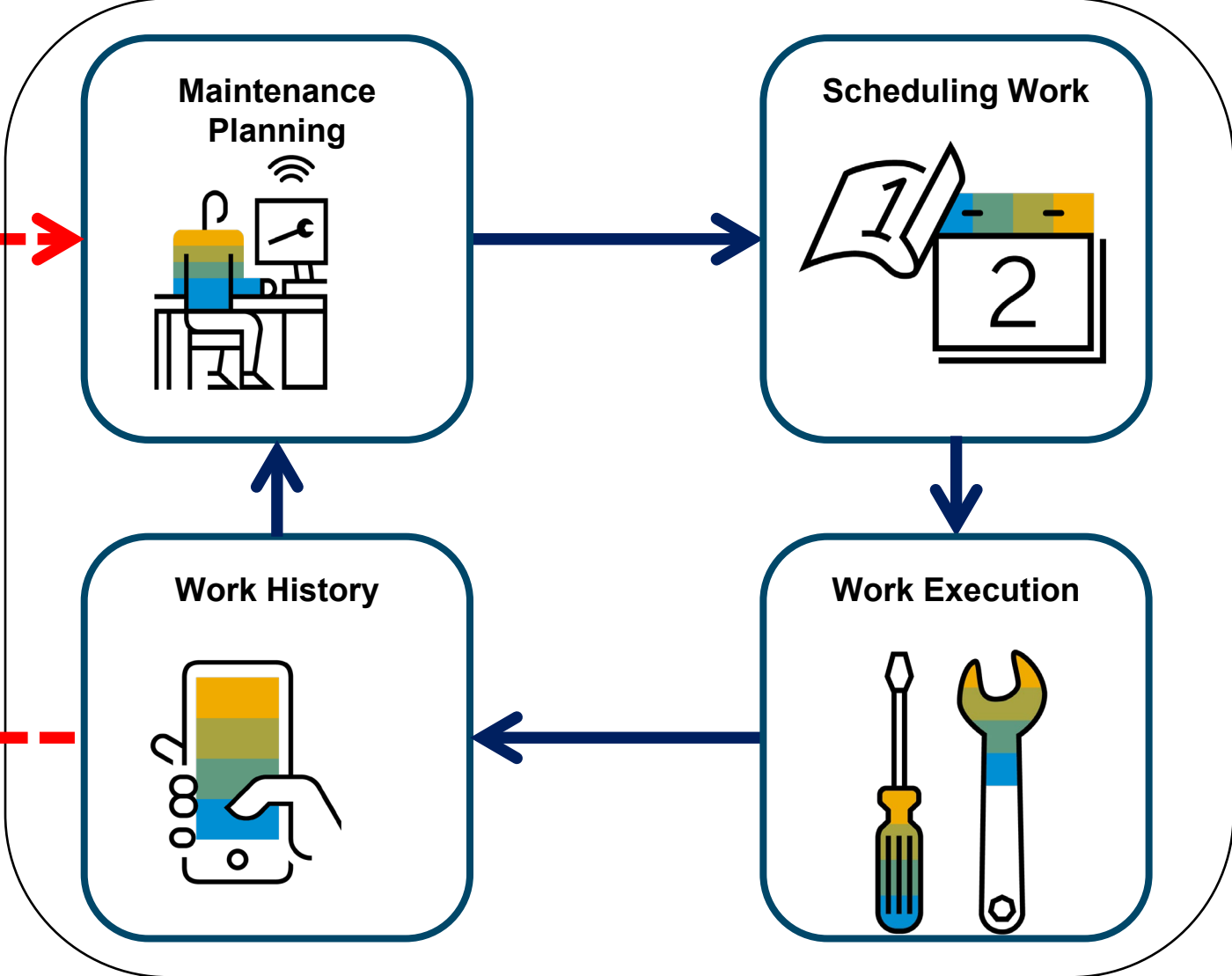
The Right Tasks

Asset Performance Management



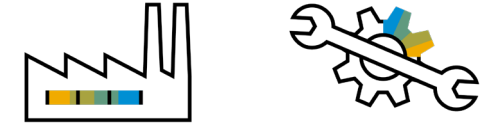
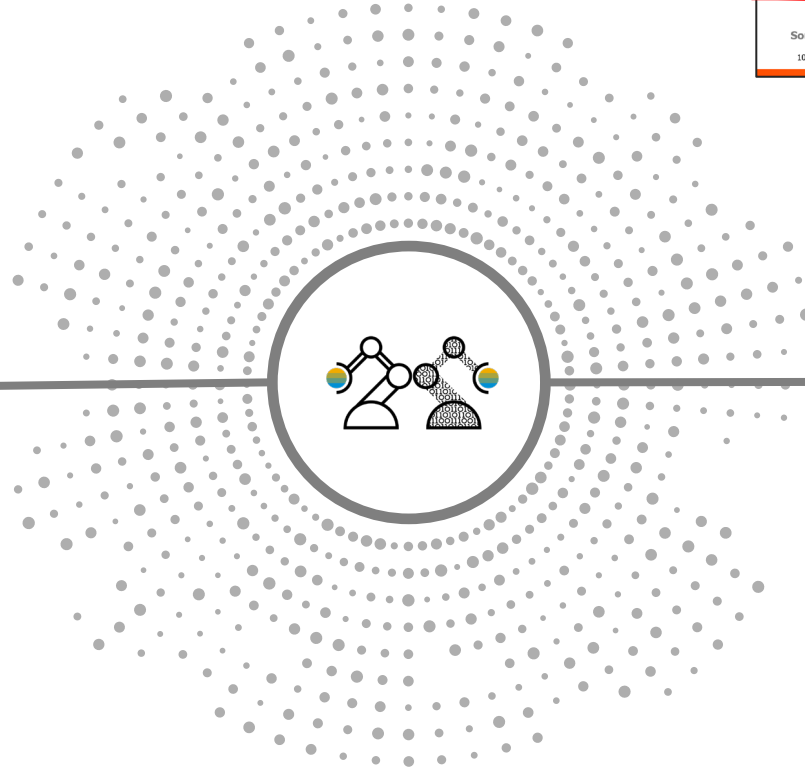
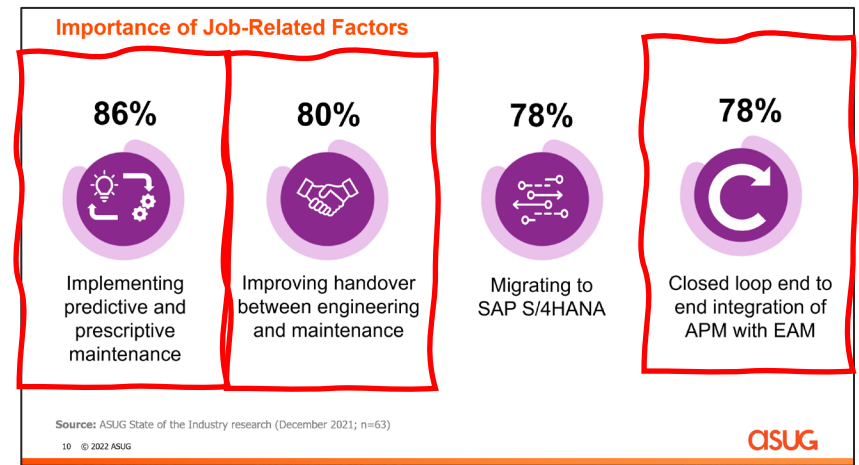
Executed Well

Enterprise Asset Management



The New Way: Intelligent Asset Management

Converge Strategy and Execution



Asset Performance Management

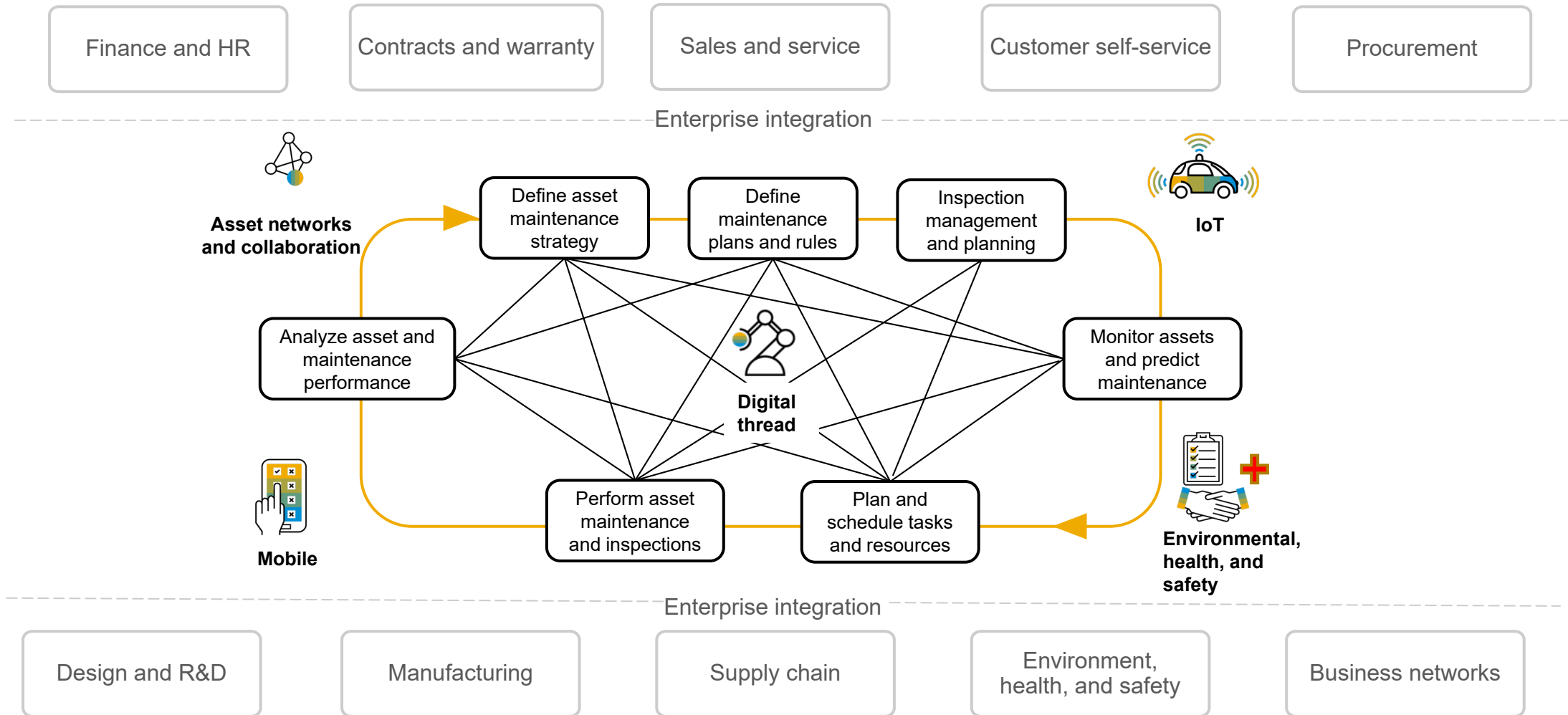
Capabilities to **constantly** assess and improve **asset availability and its output**, to extend asset life, including **risk and reliability management, predictive and prescriptive maintenance**, and **asset integrity management**.

Enterprise Asset Management

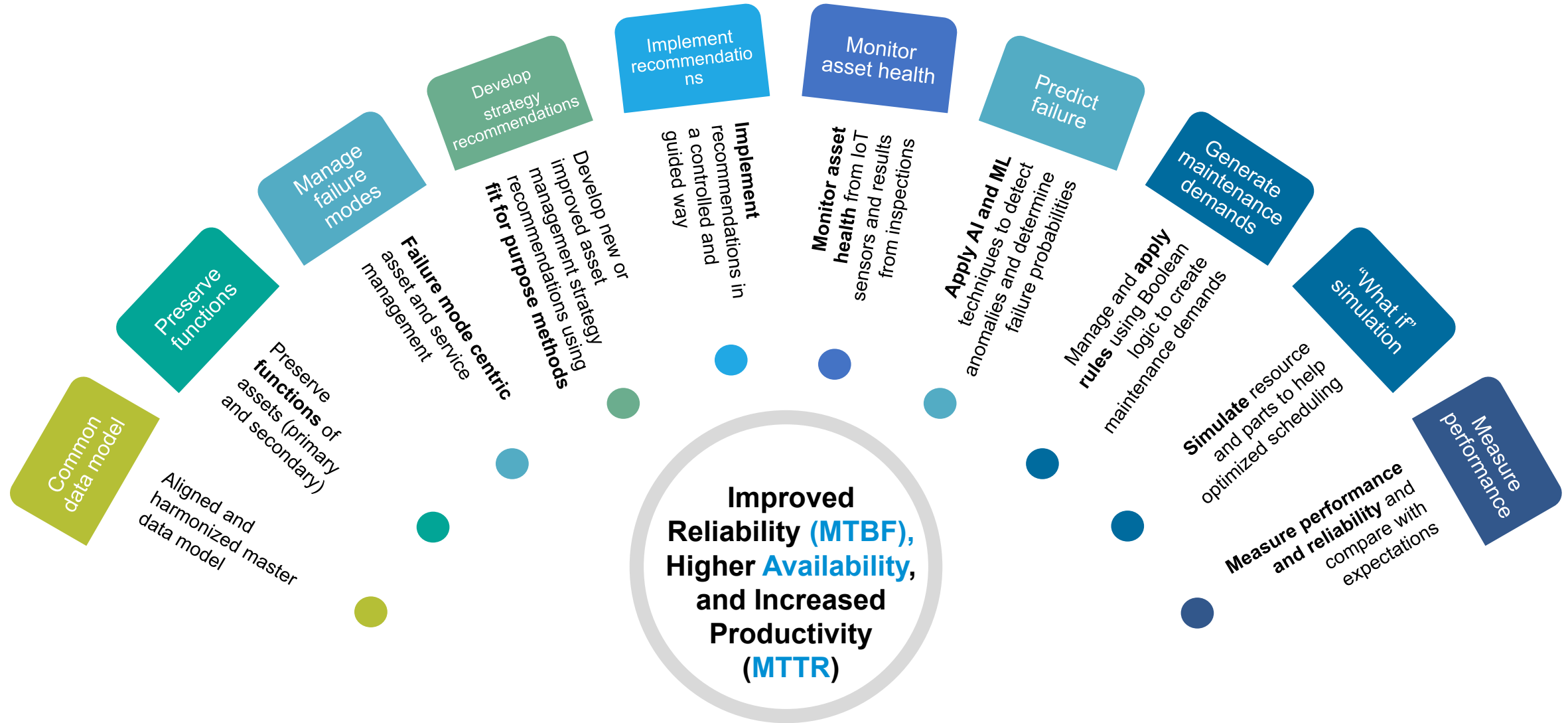
Capabilities for **managing maintenance operations** including planned and unplanned maintenance, scheduling work and resources, work order management and reporting, mobile support for maintenance technicians; it also covers solutions for asset acquisition and life cycle management, capital portfolio and project management, and environment, health and safety

Closed-loop strategy, planning, and execution

Optimizing **Asset Performance Management** and **Enterprise Asset Management** outcomes with end-to-end processes based on common data



What is Asset Performance Management ?



SAP Portfolio for Intelligent Asset Management

Increase Asset Performance, Reduce Maintenance Costs and Deliver Service Excellence



Closed-Loop strategy, planning and execution processes to optimize **Asset Performance Management**



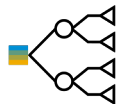
Synchronize maintenance and service across the **enterprise** for responsive customer care and supply chain **resilience**



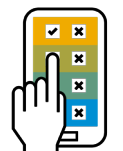
Adopt new **collaborative** processes and 'products-as-a-service' business models across **Networks**



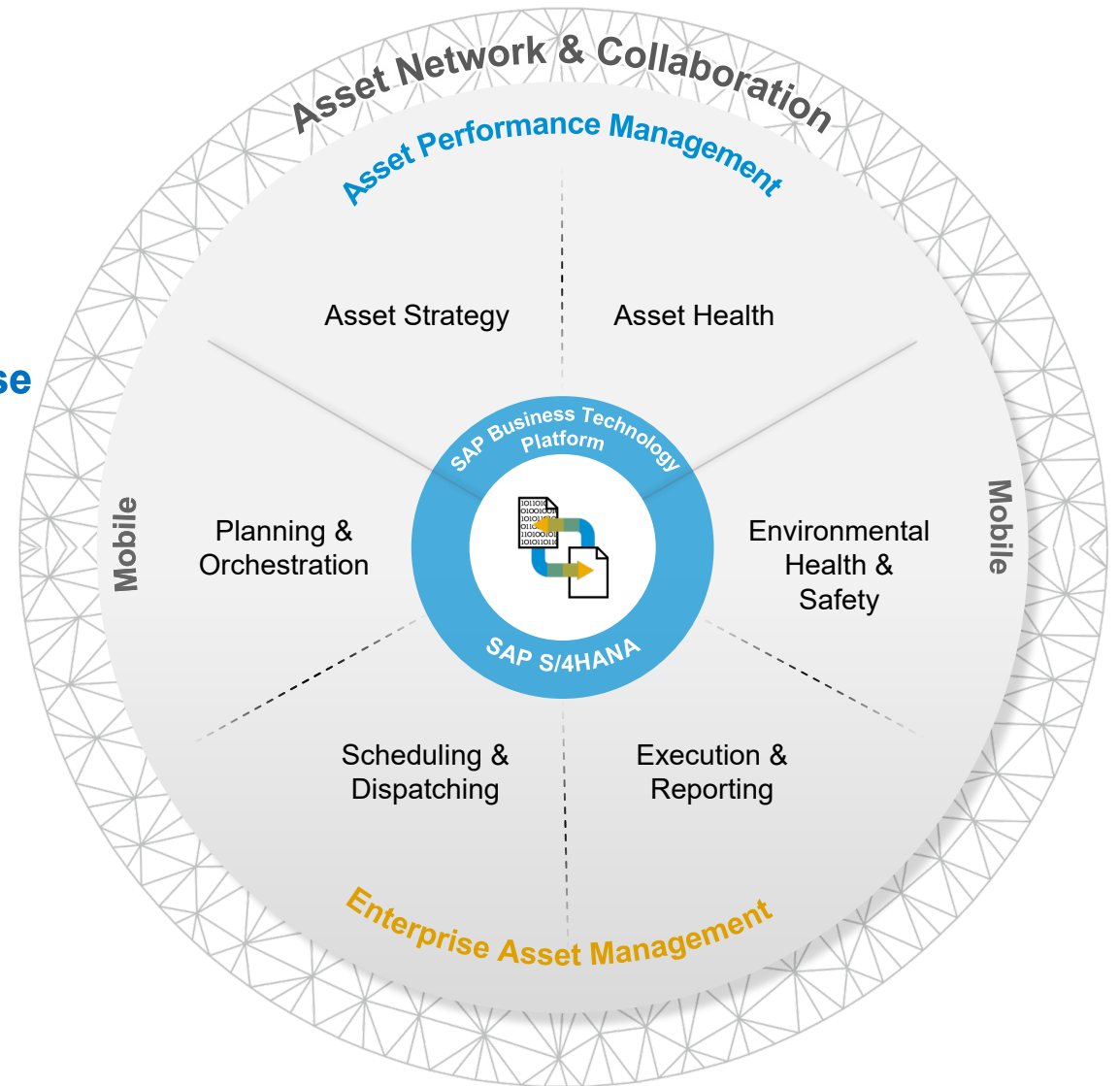
Manage asset health with **Industry4.0** for real time predictive maintenance and service



Optimize maintenance and service with **intelligent scheduling** and **crowd sourced** resource management

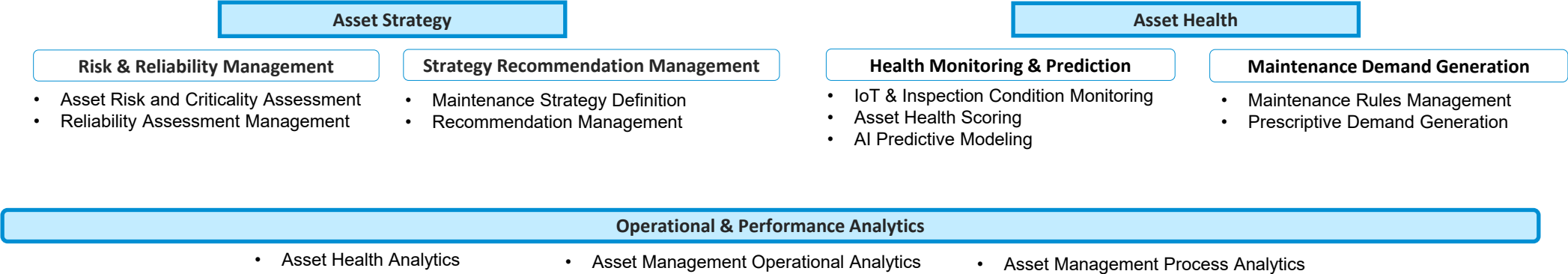


Empower users with **Mobile** asset intelligence, work automation and safe sustainable **EH&S** policies



Intelligent Asset Management Solution Capabilities

Asset Performance Management



Enterprise Asset Management



Extended Capabilities



Case Study: Improve Reliability of a Pump

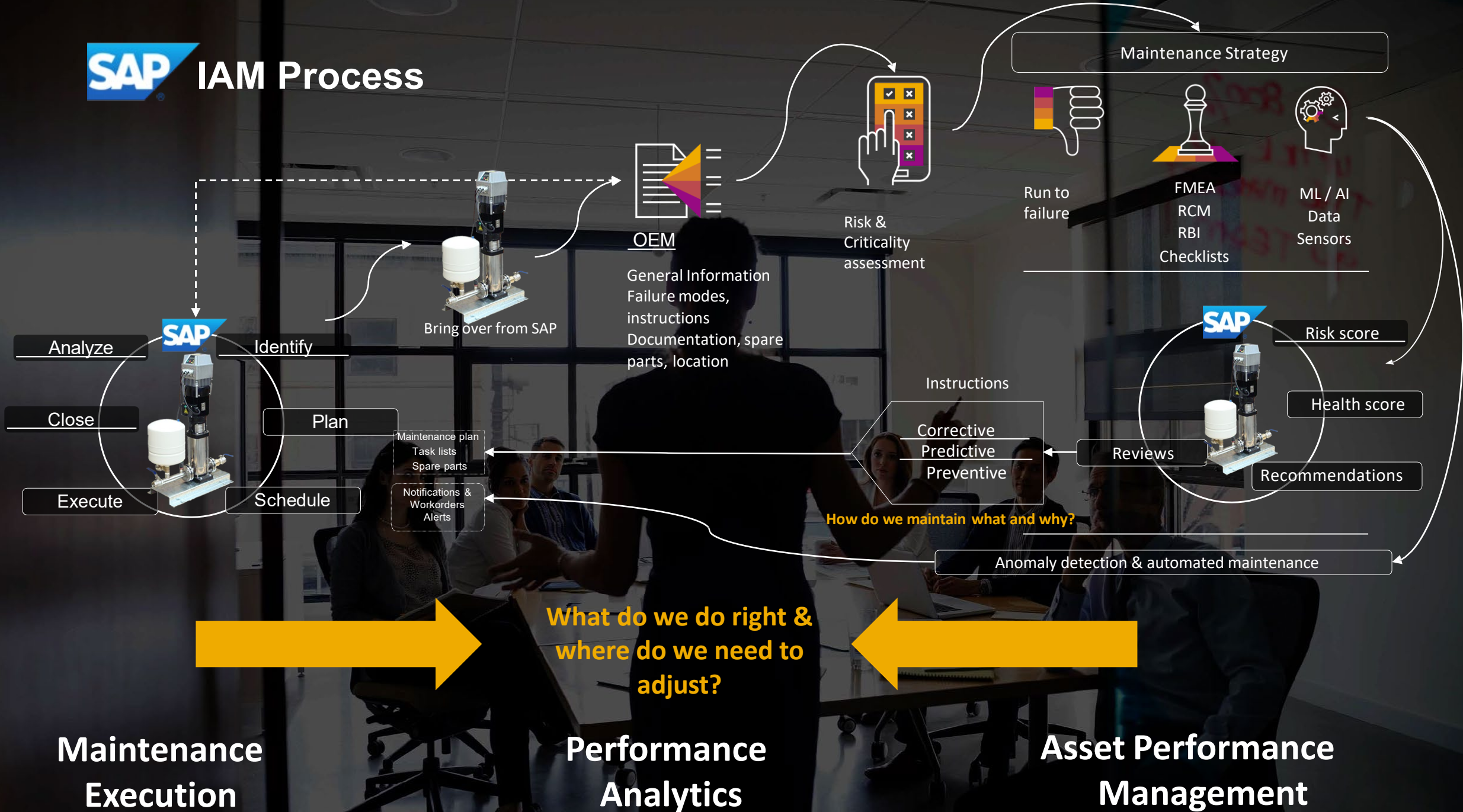


IAM Task Example: Improve Reliability of a Pump

- Assess / update information on design, attributes, vendor documents, etc.
- Build out documents via internal and external collaboration
- Risk rank the asset, and determine its Failure modes, causes, and effects
- Select risk assessment methodology , implement & generate maintenance or modification recommendations
- Based on assessment results and recommendations, develop actions such as:
 - ✓ Corrective task
 - ✓ Repetitive task
 - ✓ Predictive task
- Create changes in S/4HANA or ECC and monitor
- If predictive actions are also recommended, connect various feeds from IOT devices, plant historians, Plc's, etc. to begin predictive monitoring
 - ✓ Alert generation
 - ✓ Texts /emails
 - ✓ Auto generate maintenance notifications



SAP IAM Process

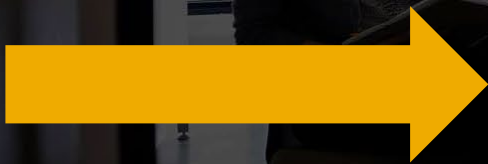
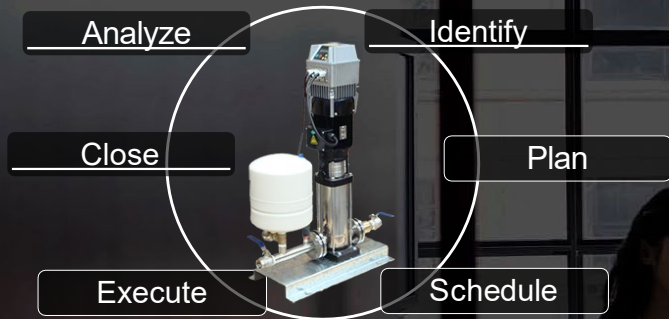




Improve Asset Reliability



Bring over from SAP



Maintenance
Execution

What do we do right &
where do we need to
adjust?

Performance
Analytics



Asset Performance
Management

Locate asset in the structure

The screenshot displays the SAP Equipment interface for a specific asset. On the left, a tree view shows the organizational structure, with 'FPS Series-Pump 04 (FPS Series Houston)' selected. A dashed red box highlights this asset in the tree, and an arrow points to the main details pane. The main pane is divided into several sections:

- Highlights:** Contains two cards. The first, 'Risk and Criticality', shows 'Updated By Romanoski, Rachel (Sep 17, 2019)' and 'Risk/Criticality: 11.0 A "High"'. The second, 'Phase Fully Operational', shows 'Sep 17, 2019' and 'Previous Phase: Planned'.
- Data Sheet:** A summary table showing:

All Attributes	20	Changed Values Compared to Default	0	Attributes Without Values	0
----------------	----	------------------------------------	---	---------------------------	---
- Motor:** A table of technical specifications:

Insulation Class	B
Frequency	60 Hertz (1/second)
Type	3524L
Shaft Diameter	1.5875 cm
Overall Length	38.5318 cm
- Pump:** A table of technical specifications:

Suction and Discharge	1-1/4" x 1" NPT
Maximum_Flow	65 Cubic meter/Hour
Material	Cast Iron
- Tank Dimensions:** Includes a diagram of the tank structure.
- Common:** A table of safety and compliance information:

Safety System	(No) N
Hydrocarbon Exposure	(No) N
Blast Zone	(No) N
Intrinsically Safe	(Not Applicable) NA

Add / Update Functions

Equipment

3.37 k

NextEra ENERGY

Equipment

PUMP / POSITIVE_DISPLACEMENT_PUMP / 200 Series /

Pump 554 Cooling Water Circulation Pump B ✓ %

PUMP 00554

Publish Manage ☆ ⚙️ 🔗

INFORMATION ▾ STRUCTURE & PARTS ▾ DOCUMENTATION ▾ MONITORING ▾ MAINTENANCE & SERVICE ▾ ASSESSMENT ▾ ANALYTICS ▾ TIMELINE

Functions

Search Functions 🔍 Assign Remove ↑↓ ☰

<input type="checkbox"/> Function	Type	Source	From
<input type="checkbox"/> De-energize equipment FN.PDMS.1	🛡️ 📄	📄 Terrific Components	👤
<input type="checkbox"/> Distribute Cooling Water FN.PDMS.17	🛡️ 📄 📄 👤	📄 Terrific Components	📄
<input type="checkbox"/> Pressure control FN.PDMS.3	📄	📄 Terrific Components	👤

From Model
or
Equipment

Add / Update Attributes

Equipment

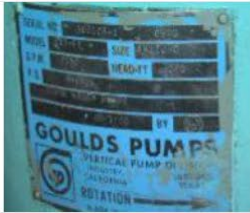
3.37 k

Equipment

Pump 554 Cooling Water Circulation Pump - Data Sheet

[Edit](#)
[Order & Visibility](#)
[Add Template](#)
[Remove Template](#)

All Attributes (16) [Show Alternate UoM](#)

Attribute	Value	Default Value
MH0110_EQUI_1 (Source : Equipment)		
Date till reservation	Dec 23, 2021	No Difference
Tablet diameter	20 µm	No Difference
Status (Source : Equipment)		
Status	True	No Difference
Rotating Model (Source : Model)		
Maximum Flow	100 m3/h	-
Maximum Temperature	210 °C	-
Maximum Pressure	50 bar	-
Maximum Head	60 m	-
Rotating Equipment attributes on Equipment level (Source : Model)		
Spared	No	-
Installation Year	2010	-
Nameplate		-
Color	-	-
EAN Number	True	-

From Equipment Template

From Model Template

Add / Update Failure Modes

Equipment

3.37 k

Equipment

PUMP / POSITIVE_DISPLACEMENT_PUMP / 200 Series /

Pump 554 Cooling Water Circulation Pump B ✓

PUMP 00554

INFORMATION STRUCTURE & PARTS DOCUMENTATION MONITORING MAINTENANCE & SERVICE ASSESSMENT ANALYTICS TIMELINE

Failure Modes

All (10) Relevant (10) Not Relevant (0)

Search Failure Modes

Assign Copy Remove

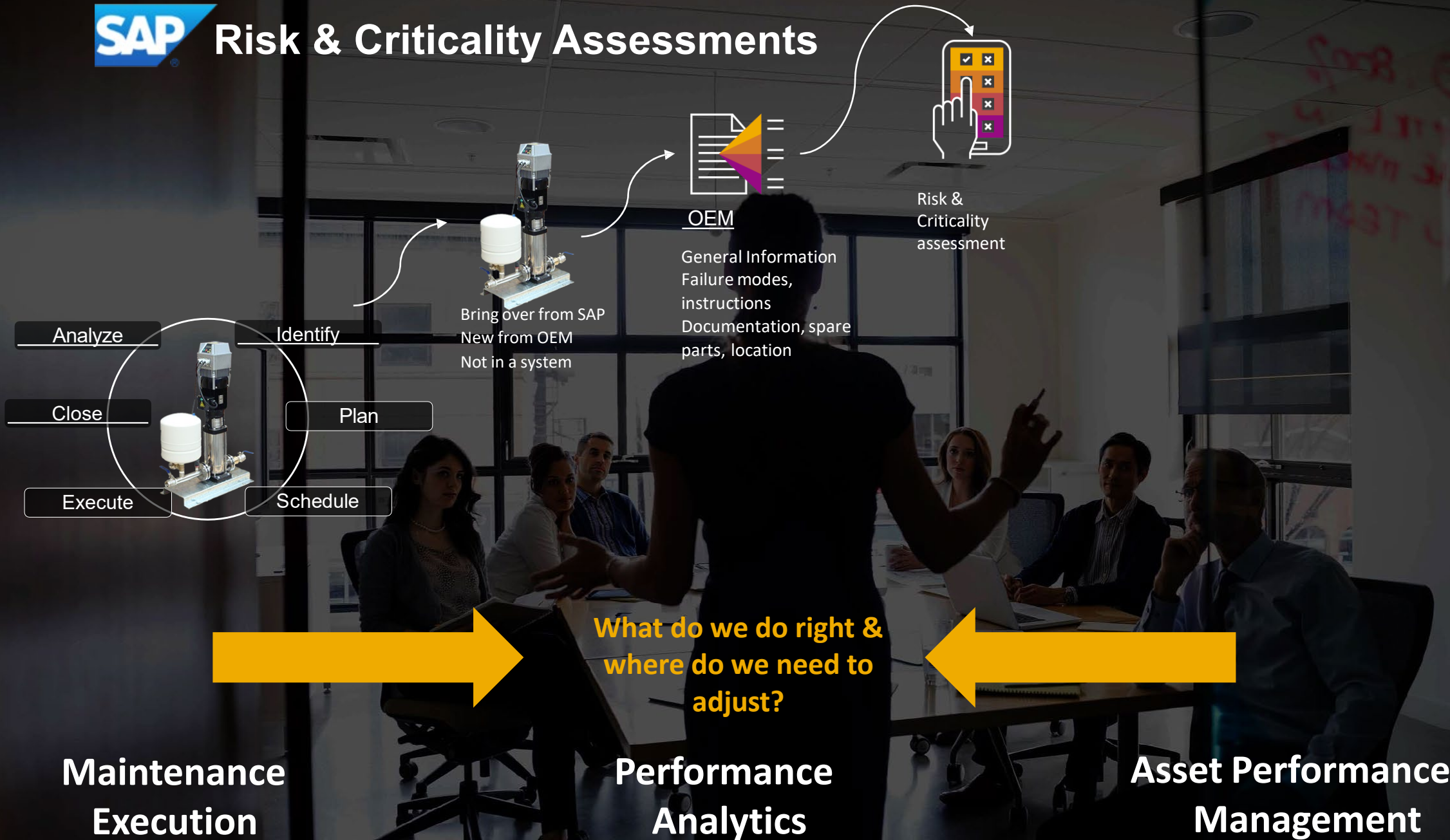
Failure Mode	Category	Detection Methods	Types	Effects	Causes	Source	From
<input type="checkbox"/> Leakage at the shaft seals FM.MANU.2	Internal leakage		Designed Function is not obtained		The shaft seals are worn or the running surfaces of the valve disks are damaged. The O-ring of the housing seal is faulty.	EVOVALVES AG	
<input type="checkbox"/> Overheating Bearing FM.PDMS.9			Non critical failures Specified function lost or outside accepted operational limit	4 hours of equipment downtime Equipment Damage Show 7 More	Contaminated lubricant Oil Seal - Design Issue Show 2 More	Terrific Components	
<input type="checkbox"/> Corrosion FM.PDMS.53	Structural deficiency		Designed Function is not obtained Specified function lost or outside accepted operational limit			Terrific Components	
<input type="checkbox"/> Over Pressure FM.PDMS.48	Fails to function on demand Fails to open on demand Show 42 More		Designed Function is not obtained Specified function lost or outside accepted operational limit		Battery discharged Water pump leaking Show 32 More	Terrific Components	
<input type="checkbox"/> Vibration Imbalance FM.PDMS.52	Other Abnormal instrument reading Show 42 More		Non critical failures Designed Function is not obtained		Vibration Sensor	Terrific Components	
<input type="checkbox"/> Seal Failure FM.PDMS.49	Other	Inspection Production interference Show 2 More	Non critical failures Specified function lost or outside accepted operational limit		Contaminated lubricant Lack of lubricant	Terrific Components	
<input type="checkbox"/> Insufficient Flow FM.PDMS.10	No output		Specified function lost or outside accepted operational limit	Increased dump body vibration Unsafe operation - may tip over Show 1 More	Impeller jammed by foreign body Water pump broken Show 2 More	Terrific Components	
<input type="checkbox"/> Overheating Bearing FM.SDCDMC.2	Structural deficiency		Specified function lost or outside accepted operational limit	Loss of Customers	Oil Seal - Design Issue Cracked casing Show 2 More	Terrific Oil & Gas	

Failure Modes

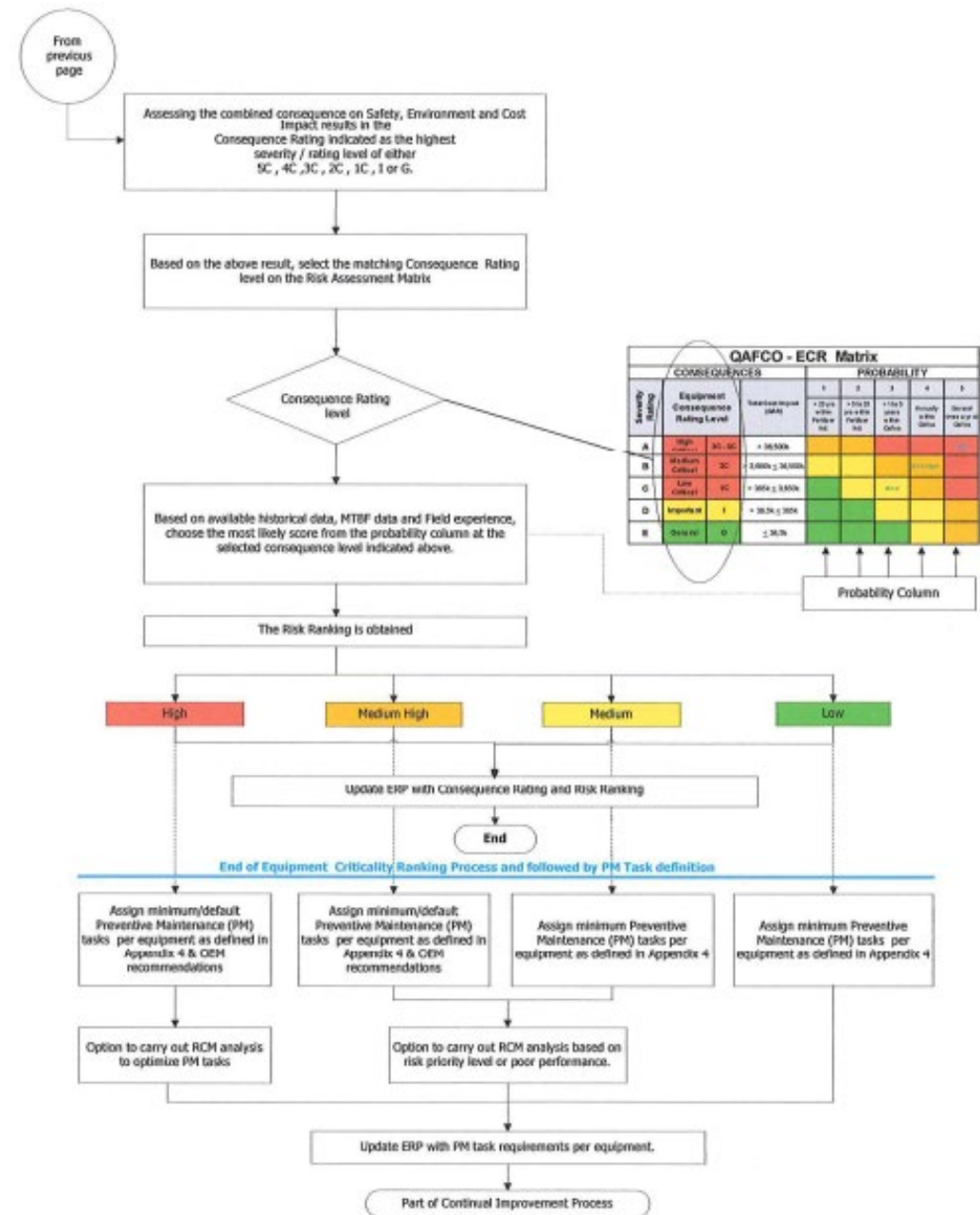
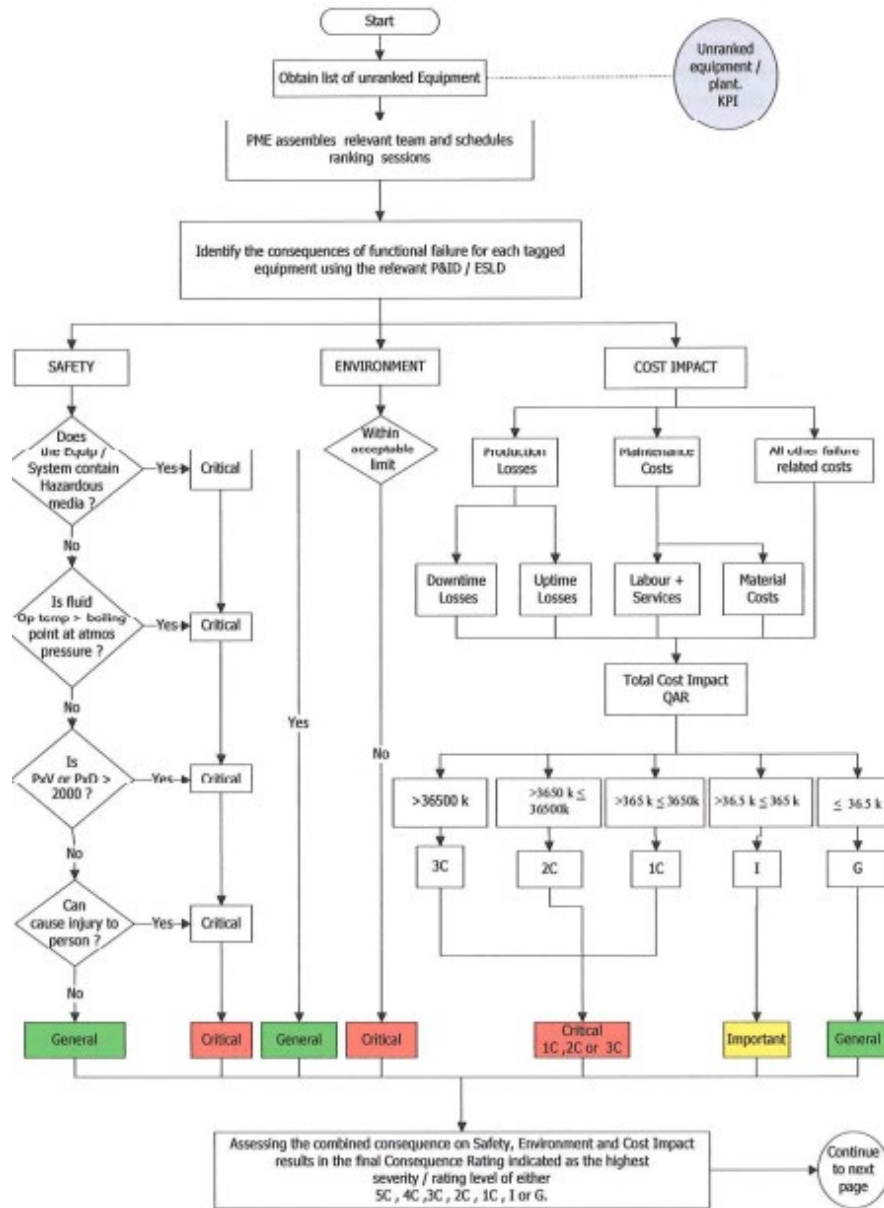
SAP Vendor Collaboration



SAP Risk & Criticality Assessments



Equipment Criticality Ranking



Severity Rating	CONSEQUENCES		PROBABILITY				
	Equipment Consequence Rating Level	Maximum impact value	1	2	3	4	5
A	High Consequence	≥ 36500k					
B	Medium Consequence	3650k ≤ 36500k					
C	Low Consequence	365k ≤ 3650k					
D	Important	36.5k ≤ 365k					
E	General	≤ 36.5k					

Review / Update R&C Assessments to Determine Criticality

Equipment

3.37k

Equipment

PUMP / POSITIVE_DISPLACEMENT_PUMP / 200 Series /

Pump 554 Cooling Water Circulation Pump B ✓

PUMP 00554

Manufacturer: Pumps Ltd Shared With: 49 Partners Location: Location_2_(P1-C4-U3-A1-L2) External IDs Status: In Revision Languages: EN

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Highlights Settings

Risk and Criticality
Updated By Socher, Benjamin (Sep 9, 2021)

Risk/Criticality: ● 25.0 B "Medium"
Normalized Risk: 20.37%
Action: FMEA

FMEA
Updated By Portelli, Phil (Apr 13, 2021)

RPN: ● 18.0
Preventive Recommendations: 0
Corrective Recommendations: 1
Others: 0

Checklists
By Status

Published: 11
Complete: 6
Incomplete: 10

RCM
Updated By Test, Test (Jan 29, 2021)

Preventive Recommendations: 0
Corrective Recommendations: 0
Others: 0

Recommendations

Action Required: 7
In Operation: 0
Others: 1

7	0	0
0	5	0
1	0	0

Total: 13

Analytics

Risk Distribution Curve Across Sub-Class: POSITIVE_DISPLACEMENT_PUMP

Normalized Risk Range	Equipment Count
0-10	0
10-20	2
20-30	3
30-40	4
40-50	4
50-60	0
60-70	1
70-80	1
80-90	0
90-100	3

Risk Distribution Curve Across All Equipment

Normalized Risk Range	Equipment Count
0-10	13
10-20	3
20-30	14
30-40	17
40-50	7
50-60	9
60-70	3
70-80	1
80-90	0
90-100	5

Checklist Trend - Checklist for Pump Casing AT.PDMS.56

R&C Assessment

Perform R&C Assessment

Risk and Criticality Assessment - Pump 554
AS.PDMS.545

Status: Published

Shared With: 49 Partners | Risk Score: 4.10 | Criticality: B "Medium" | Risk Type: Current Risk | Financial Risk: 32609.0 US Dollar | Assessment Template: AT.PDMS.173 | Assignments: 1

INFORMATION | ASSIGNMENTS | DOCUMENTATION | **QUESTIONS AND ANSWERS**

Production (2/2) | Environment (3/3) | Health & Sa... (2/2)

Financial Risk: 20,000.00 USD

What is the impact on production if this equipment fails?	Extremely Unlikely	Unlikely	Possible	Quite Likely	Certain
Nuclear	7.75	8.00	8.25	8.50	8.75
Catastrophic	7.00	7.25	7.50	7.75	8.00
Hazardous	6.25	6.50	6.75	7.00	7.25
Very High	5.50	5.75	6.00	6.25	6.50
High	4.75	5.00	5.25	5.50	5.75
Moderate	4.00	4.25	4.50	4.75	5.00
Low	3.25	3.50	3.75	4.00	4.25
Minor	2.50	2.75	3.00	3.25	3.50
Very Minor	1.75	2.00	2.25	2.50	2.75
None	1.00	1.25	1.50	1.75	2.00

Risk Details

Impact	Risk	Financial Risk (USD)
Environment	3	10,000.00
Production	6	20,000.00
Health & Safety	3.5	2,609.00
Overall Risk	4.10	32,609.00

Grid layout

Risk and Criticality Assessment - Pump 554
AS.PDMS.545

Status: Published

Shared With: 49 Partners | Risk Score: 4.10 | Criticality: B "Medium" | Risk Type: Current Risk | Financial Risk: 32609.0 US Dollar | Assessment Template: AT.PDMS.173 | Assignments: 1

INFORMATION | ASSIGNMENTS | DOCUMENTATION | **QUESTIONS AND ANSWERS**

Production (2/2) | Environment (3/3) | Health & Sa... (2/2)

Question Text	Answer
What is the Likelihood of Failure?	Possible
What is the impact on production if this equipment fails?	Very High

Answers (5)

Display Value	Scale / Answer Value	Description
<input type="radio"/> Extremely Unlikely	1	Extremely Unlikely
<input type="radio"/> Unlikely	2	Unlikely
<input checked="" type="radio"/> Possible	3	Possible
<input type="radio"/> Quite Likely	4	Quite Likely
<input type="radio"/> Certain	5	Certain

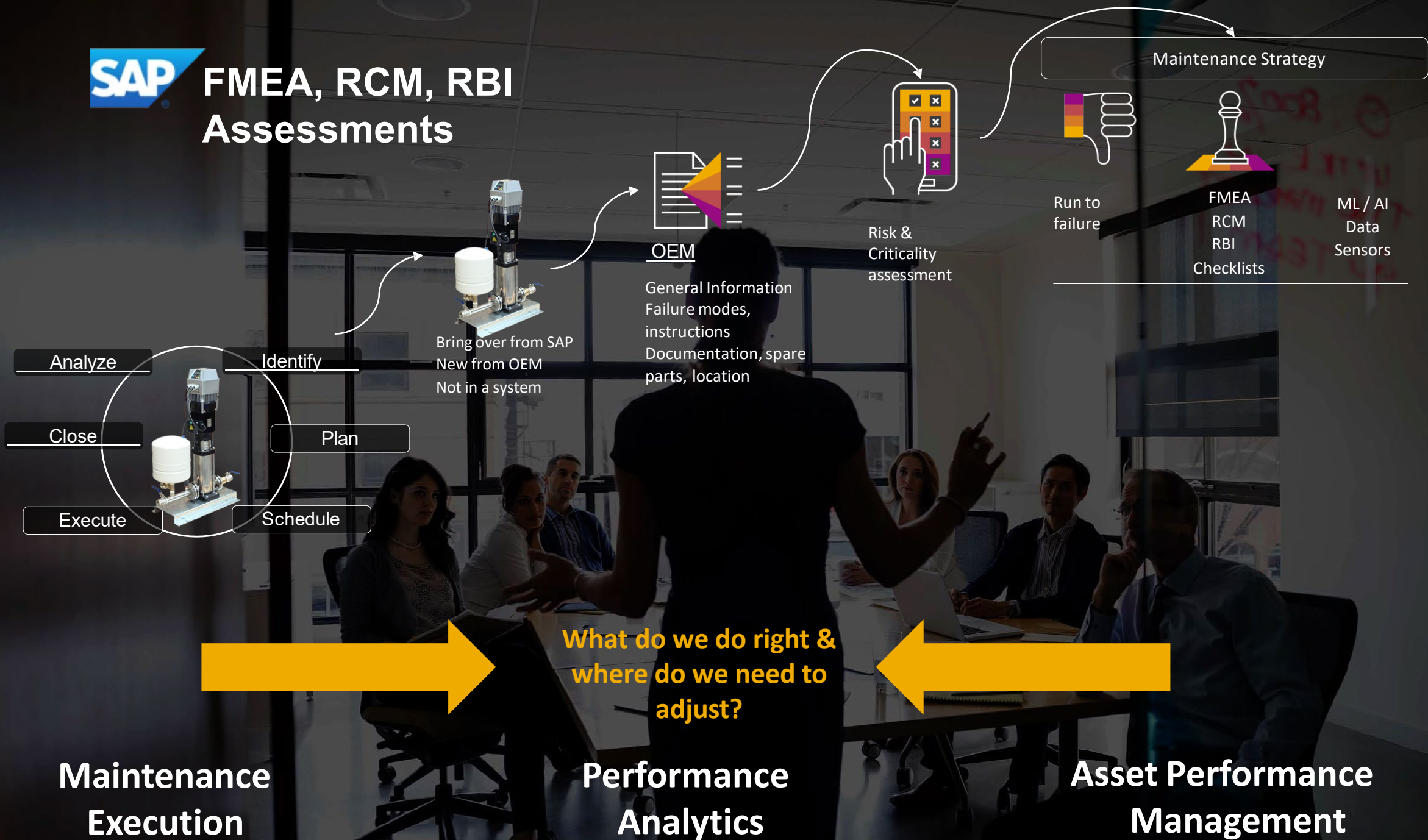
Risk Details

Impact	Risk	Financial Risk (USD)
Environment	3	10,000.00
Production	6	20,000.00
Health & Safety	3.5	2,609.00
Overall Risk	4.10	32,609.00

Table View



FMEA, RCM, RBI Assessments



Reliability Centered Maintenance & Failure Mode Analysis



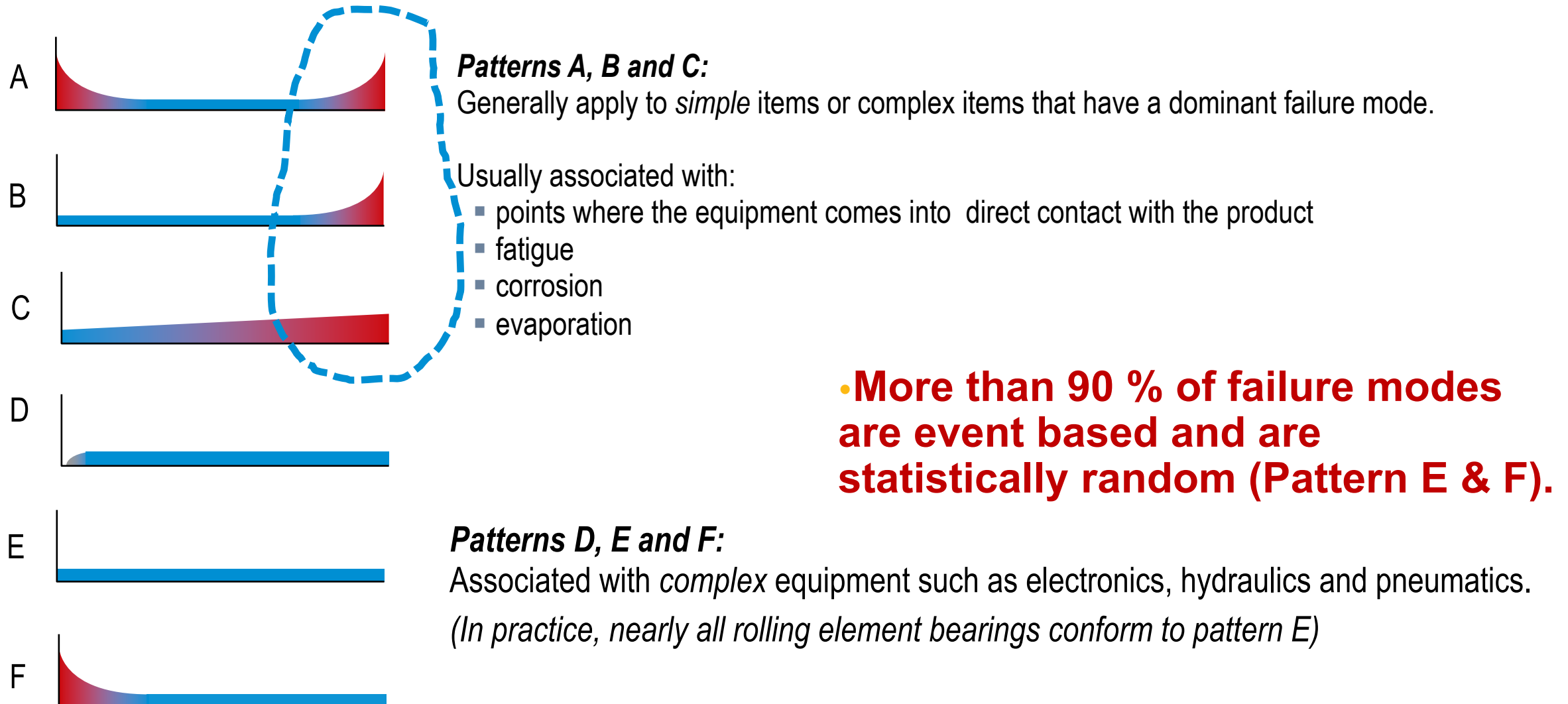
The RCM Process (RCM2 and paper based)

RCM is a process used to determine what must be done to ensure that any physical asset continues to do what its users want it to do in its present operating context.

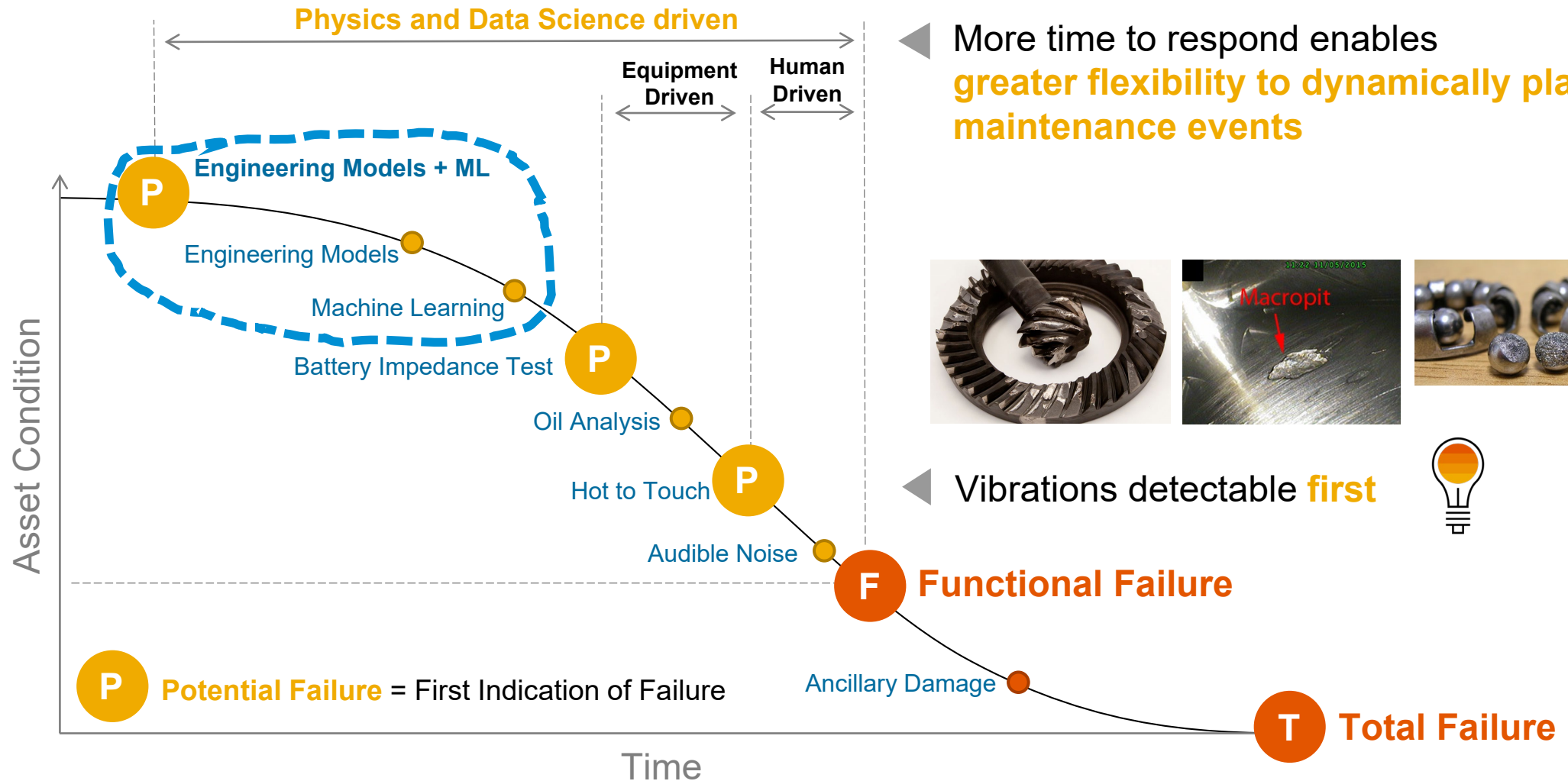
It asks the following questions:

- What are its functions (what do its users want it to do)?
- In what ways can it fail (functional failures)?
- What causes it to fail (failure modes)?
- What happens when it fails (failure effects)?
- Does it matter if it fails (consequences of failure)?
- Can anything be done to predict or prevent the failure?
- What do we do if we cannot predict or prevent the failure?

Failure Modes: The level at which we develop Asset Management Strategy



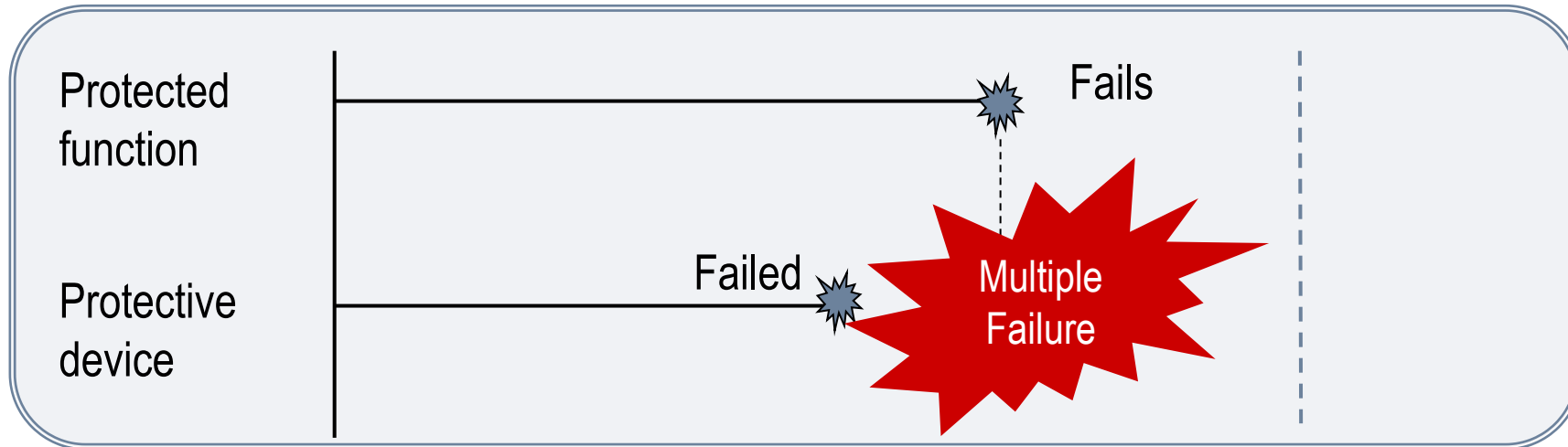
Potential Failure: Moving from time-based to condition-based maintenance



Protective Devices and Hidden Failures: How we deal with redundancy

A tolerable probability of failure for hidden failures is achieved by:

- Reducing the probability of failure of the protected function (by applying a suitable failure management strategy)



- and/or Increasing the availability of the protective device:
 - Preventing the failure of the protected function (i.e. reducing the demand rate)
 - Periodically checking whether the protective device is working and repairing it if it has failed
 - Modifying the system in some way (e.g. adding redundancy)

Science-based approach to Maintenance Strategy Development

Functions, Functional Failures, Failure Modes

Functions

1. To pump potable water at a flow rate from 0 to 20 m³/hr @ 800kPa in the presence of a standby pump.

Functional Failures

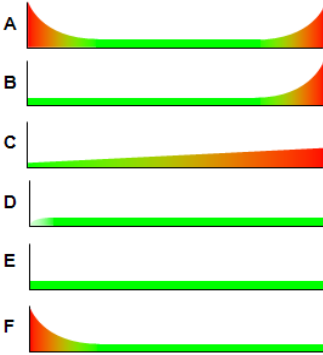
1A. Fails to pump water at all.

1B. Pumps at pressure lower than 800kPA and a flow rate less than 20 m³/hr.

Failure Modes

- 1A1. Electricity supply interrupted
- 1A2. Water supply interrupted
- 1A3. Major piping rupture due to a vehicle impact
- 1A4. Major piping rupture due to corrosion
- 1A5. Major foreign object blockage from upstream
- 1A6. Manual isolation valve left closed by operator
- 1A7. Lower pump bearing seizes due to contamination
- 1A8. Upper bearing seized due to misalignment
- 1A9. MOCV stuck fully closed
- 1A10. Standby pump removed
- 1B1. Motor controller is faulty
- 1B2. Impeller is eroded (unlikely)
- 1B3. Impeller is encrusted (calcification)
- 1B4. Manual valve left partially closed by operator
- 1B5. MOCV stuck partly closed
- 1B6. Flow meter is over reading
- 1B7. Pressure transducer is over reading

Failure Patterns



Hidden Failure Consequences

Safety and Environmental Consequences

Operational Consequences

Non-operational Consequences

H Will the loss of function caused by this failure mode on its own become evident to the operating crew under normal circumstances?

Yes

S Does this failure mode cause a loss of function or other damage which could injure or kill someone?

No

E Does this failure mode cause a loss of function or other damage which could breach any known environmental standard or regulation?

No

O Does this failure mode have a direct adverse effect on operational capability (output, product quality, customer service or operating costs in addition to the direct cost of repair)?

No

H1 Is an on-condition task technically feasible and worth doing?
Is there a clear potential failure condition? What is it? What is the P-F interval? Is the P-F interval long enough to be of any use? Is it consistent? Can the task be done at intervals less than the P-F interval?
Does this task secure the availability needed to reduce the probability of a multiple failure to a tolerable level?

Yes

No

Do the on-condition task

H2 Is a scheduled restoration task technically feasible and worth doing?
Is there an age at which there is a rapid increase in the conditional probability of failure? What is it? Do most failures occur after this age? Will the restoration task restore the original resistance to failure?
Does this task secure the availability needed to reduce the probability of a multiple failure to a tolerable level?

Yes

No

Do the scheduled restoration task

H3 Is a scheduled discard task technically feasible and worth doing?
Is there an age at which there is a rapid increase in the conditional probability of failure? What is it? Do most failures occur after this age?
Does this task secure the availability needed to reduce the probability of a multiple failure to a tolerable level?

Yes

No

Do the scheduled discard task

H4 Is a scheduled failure-finding task technically feasible and worth doing?
Is it possible to check if the item has failed? Is it practical to do the task at the required intervals?
Does this task secure the availability needed to reduce the probability of a multiple failure to a tolerable level?

Yes

No

Do the scheduled failure-finding task

Redesign is compulsory

H5 Could the multiple failure affect safety or the environment?

Yes

No

No scheduled maintenance

Redesign may be desirable

S1 Is an on-condition task technically feasible and worth doing?
Is there a clear potential failure condition? What is it? What is the P-F interval? Is the P-F interval long enough to be of any use? Is it consistent? Can the task be done at intervals less than the P-F interval?
Does this task reduce the risk of failure to a tolerable level?

Yes

No

Do the on-condition task

S2 Is a scheduled restoration task technically feasible and worth doing?
Is there an age at which there is a rapid increase in the conditional probability of failure? What is it? Do all failures occur after this age? Will the restoration task restore the original resistance to failure?
Does this task reduce the risk of failure to a tolerable level?

Yes

No

Do the scheduled restoration task

S3 Is a scheduled discard task technically feasible and worth doing?
Is there an age at which there is a rapid increase in the conditional probability of failure? What is it? Do all failures occur after this age?
Does this task reduce the risk of failure to a tolerable level?

Yes

No

Do the scheduled discard task

S4 Is a combination of the above tasks technically feasible and worth doing?

Yes

No

Combination of tasks

Redesign is compulsory

O1 Is an on-condition task technically feasible and worth doing?
Is there a clear potential failure condition? What is it? What is the P-F interval? Is the P-F interval long enough to be of any use? Is it consistent? Can the task be done at intervals less than the P-F interval?
Over a period of time, will this task cost less than the cost of the operational consequences plus repair of the failures which it is meant to prevent?

Yes

No

Do the on-condition task

O2 Is a scheduled restoration task technically feasible and worth doing?
Is there an age at which there is a rapid increase in the conditional probability of failure? What is it? Do most failures occur after this age? Will the restoration task restore the original resistance to failure?
Over a period of time, will this task cost less than the cost of the operational consequences plus repair of the failures which it is meant to prevent?

Yes

No

Do the scheduled restoration task

O3 Is a scheduled discard task technically feasible and worth doing?
Is there an age at which there is a rapid increase in the conditional probability of failure? What is it? Do most failures occur after this age?
Over a period of time, will this task cost less than the cost of the operational consequences plus repair of the failures which it is meant to prevent?

Yes

No

Do the scheduled discard task

No scheduled maintenance

Redesign may be desirable

N1 Is an on-condition task technically feasible and worth doing?
Is there a clear potential failure condition? What is it? What is the P-F interval? Is the P-F interval long enough to be of any use? Is it consistent? Can the task be done at intervals less than the P-F interval?
Over a period of time, will cost of doing this task be less than the cost of repairing the failures which it is meant to prevent?

Yes

No

Do the on-condition task

N2 Is a scheduled restoration task technically feasible and worth doing?
Is there an age at which there is a rapid increase in the conditional probability of failure? What is it? Do most failures occur after this age? Will the restoration task restore the original resistance to failure?
Over a period of time, will cost of doing this task be less than the cost of repairing the failures which it is meant to prevent?

Yes

No

Do the scheduled restoration task

N3 Is a scheduled discard task technically feasible and worth doing?
Is there an age at which there is a rapid increase in the conditional probability of failure? What is it? Do most failures occur after this age?
Over a period of time, will cost of doing this task be less than the cost of repairing the failures which it is meant to prevent?

Yes

No

Do the scheduled discard task

No scheduled maintenance

Redesign may be desirable



Science-based approach to Maintenance Strategy Development

Consequence Analysis and Task Recommendation

Failure Modes

Recommended Task

Performed By

Task Freq.

1A1. Electricity supply interrupted	No Scheduled Maintenance		
1A2. Water supply interrupted	No Scheduled Maintenance		
1A3. Major piping rupture due to a vehicle impact	Modification: Barrier	Engineer	
1A4. Major piping rupture due to corrosion	Pipe Thickness NDT	Mech. Integrity	Annual
1A5. Major foreign object blockage from upstream	No Scheduled Maintenance		
1A6. Manual isolation valve left closed by operator	Modification: Procedure	Operations	
1A7. Lower pump bearing seizes due to contamination	Visually check for Contamination (consider Condition Monitoring)	Maintenance	Monthly
1A8. Upper bearing seized due to misalignment	Modification: Installation Procedure	Maintenance	
1A9. MOCV stuck fully closed	FF: Test MOCV operation	Operations	6 months
1A10. Standby pump removed	FF: Test standby pump	Operations	6 months
1B1. Motor controller is faulty	No Scheduled Maintenance		
1B2. Impeller is eroded (unlikely)	Monitor Pump Performance	Maintenance	On-line
1B3. Impeller is encrusted (calcification)	As Above + Water Chemistry/ Temp	Mtnce + Lab	Monthly
1B4. Manual valve left partially closed by operator	Modification: Procedure	Operations	
1B5. MOCV stuck partly closed	No Scheduled Maintenance		
1B6. Flow meter is over reading	FF: Calibration of Flow Meter	Lab	2 years
1B7. Pressure transducer is over reading	FF: Calibration of Pressure Trans.	Lab	2 years

Review / Update / Create FMEA* Assessment

Equipment

3.37 k

Equipment

PUMP / POSITIVE_DISPLACEMENT_PUMP / 200 Series /

Pump 554 Cooling Water Circulation Pump B ✓

PUMP 00554

Manufacturer: Pumps Ltd Shared With: 49 Partners Location: Location_2_(P1-C4-U3-A1-L2) External IDs Status: In Revision Languages: EN

INFORMATION STRUCTURE & PARTS DOCUMENTATION MONITORING MAINTENANCE & SERVICE **ASSESSMENT** ANALYTICS TIMELINE

Highlights Settings

Risk and Criticality
Updated By Socher, Benjamin (Sep 9, 2021)

Risk/Criticality: ● 25.0 B "Medium"
Normalized Risk: 20.37%
Action: FMEA

FMEA
Updated By Portelli, Phil (Apr 13, 2021)

RPN: ● 18.0
Preventive Recommendations: 0
Corrective Recommendations: 1
Others: 0

Checklists
By Status

Published: 11
Complete: 6
Incomplete: 10

RCM
Updated By Test, Test (Jan 29, 2021)

Preventive Recommendations: 0
Corrective Recommendations: 0
Others: 0

Recommendations

Action Required: 7
In Operation: 0
Others: 0

0	5	0
1	0	0

Total: 13

Analytics

Risk Distribution Curve Across Sub-Class: POSITIVE_DISPLACEMENT_PUMP

Normalized Risk Range	Equipment Count
0 - 10	0
10 - 20	2
20 - 30	3
30 - 40	4
40 - 50	4
50 - 60	0
60 - 70	1
70 - 80	1
80 - 90	0
90 - 100	3

Equipment

Normalized Risk Range	Equipment Count
0 - 10	13
10 - 20	3
20 - 30	14
30 - 40	17
40 - 50	7
50 - 60	9
60 - 70	3
70 - 80	1
80 - 90	0
90 - 100	5

Checklist Trend - Checklist for Pump Casing AT.PDMS.56

FMEA Assessment

FMEA Assessment

Failure Modes (4)

- Pump Leaking (FM.PDMS.12) Type: 2
- Overheating Bearing (FM.PDMS.9) Type: 3.2.1
- Insufficient Flow (FM.PDMS.10) Type: 2
- Intermittent Flow (FM.PDMS.11) Type: 2

Categories (1)
Structural deficiency

Detection Methods (0)

Type (3)

- Designed Function is not obtained
- Specified function lost or outside accepted operational limit
- Non critical failures

Alerts

Description	Status	Severity	Error Codes	Source
There is no data available.				

Failure modes

Effects

Effect	Impacts / Sections	Severity
4 hours of equipment downtime		7
EF.PDMS.8		6
Equipment Damage		3
EF.PDMS.6		5
Fail to provide required flow		5
EF.PDMS.5		2
Excessive pump vibration		
EF.PDMS.4		
Abnormal noise		
EF.PDMS.3		
Overheating		
EF.PDMS.2		
Oil Seal - Design Issue		
CS.PDMS.12		

Effects

Causes

Cause	RPN	Effect	Detectability	Occurrence	Recommendations
Cracked casing (CS.PDMS.1)	252	Equipment Damage	7	6	2
Contaminated lubricant (CS.PDMS.2)	105	Fail to provide required flow	5	7	1
Lack of lubricant (CS.PDMS.3)	60	Excessive pump vibration	3	4	1
Oil Seal - Design Issue (CS.PDMS.12)	6	Overheating	3	1	1

Causes

Recommendations

Recommendations from FMEA Assessment

The image displays a multi-panel SAP FMEA Assessment interface. The top panel shows the 'Effects' tab for 'Overheating Bearing' (FM.PDMS.9), listing effects such as '4 hours of equipment downtime' (Severity 7), 'Equipment Damage' (Severity 6), and 'Excessive pump vibration' (Severity 3). A large grey arrow points from this panel to the 'Recommendations' panel on the right. The 'Recommendations' panel shows two items: 'Cracked Casing Fix Field Recommendations' (CORRECTIVE, RCMD.PDMS.156, Estimated Cost: 250 Won, Status: Open, Priority: 1) and 'Rotating Pump Casing Inspection' (PREVENTIVE, RCMD.PDMS.157, Estimated Cost: 200 Won, Status: Open, Priority: 1). A yellow callout box labeled 'Recommendations' points to these items. The middle panel shows the 'Causes' tab for the same assessment, listing causes like 'Cracked casing' (RPN 252), 'Contaminated lubricant' (RPN 105), and 'Lack of lubricant' (RPN 60). The left panel shows the 'ASSIGNMENTS' overview with filters for Models, Groups, Equipment, Locations, and Systems.

Effects

Effect	Impacts / Sections	Severity
4 hours of equipment downtime EF.PDMS.8		7
Equipment Damage EF.PDMS.6		6
Fail to provide required flow EF.PDMS.5		3
Excessive pump vibration EF.PDMS.4		5
Abnormal noise EF.PDMS.19		5
Overheating EF.PDMS.20		5

Recommendations

Recommendation	Type	Code	Cost	Status	Priority
Cracked Casing Fix Field Recommendations	CORRECTIVE	RCMD.PDMS.156	250 Won	Open	1
Rotating Pump Casing Inspection	PREVENTIVE	RCMD.PDMS.157	200 Won	Open	1

Causes

Cause	RPN
Cracked casing CS.PDMS.1	252
Contaminated lubricant CS.PDMS.2	105
Lack of lubricant CS.PDMS.3	60
Oil Seal - Design Issue CS.PDMS.12	6

Corrective, Predictive, Preventive?

FMEA Assessment

FMEA for 200 Series
AS.PDMS.383

Shared With: 49 Partners
Risk Type: Current Risk
Assessment Template: AT.PDMS.49

Status: Validate
Publish...

Overheating Bearing FM.PDMS.9 2/4

CAUSES

Cause	RPN
Cracked casing CS.PDMS.1 Effect: Equipment Damage Detectability: 7 Occurrence: 6 Recommendations: 2	252
Contaminated lubricant CS.PDMS.2	105

Cracked casing
CS.PDMS.1

RECOMMENDATIONS

Recommendations

Recommendation	Type	RCMD	Estimated Cost	Status	Priority
Cracked Casing Fix Field Recommendations RCMD.PDMS.156	CORRECTIVE	RCMD.PDMS.156	250 Won	Open	1
Rotating Pump Casing Inspection RCMD.PDMS.157	PREVENTIVE	RCMD.PDMS.157	200 Won	Open	1

Recommendation

Cracked Casing Fix Field Recommendations
RCMD.PDMS.156

Information - Timeline

Failure Mode: Overheating Bearing FM.PDMS.9
Cause: Cracked casing CS.PDMS.1

Source: Description: Cracked Casing Fix Field Recommendations
Type: Planned Maintenance
Step Count: 1
Activity Type: Repair

Details

Field	Value
Description	Cracked Casing Fix Field Recommendations
Type	Corrective
Sub-Type	Upstream
Priority	2
Classification	Never Shutown
Estimated Cost (WON)	250.00
Estimated Maintenance Savings (WON)	1,000.00
Repair by Replacement	Low Reliability/High Cost
Risk	Electric Technician
Implementation Guidance	New generic task list to be created

Validity: Valid From: Nov 23, 2020
Valid To: Nov 18, 2022

Components

- Hydraulics Assembly
- Hydraulics Assembly

Spare Parts

- Casing
- Casing for Pumps

Recommendation

Dargov AF-97: Operation
RCMD.PDMS.154

Information - Timeline

Equipment: RCMD.00554
Remaining Risk: Remaining Financial Risk:
Risk/Criticality: 25.0/18 - Medium
Max. SWP: 3.8

Information - Timeline

Failure Mode: Interlocks Flow FM.PDMS.11
Cause: Water pump broken CS.PDMS.31

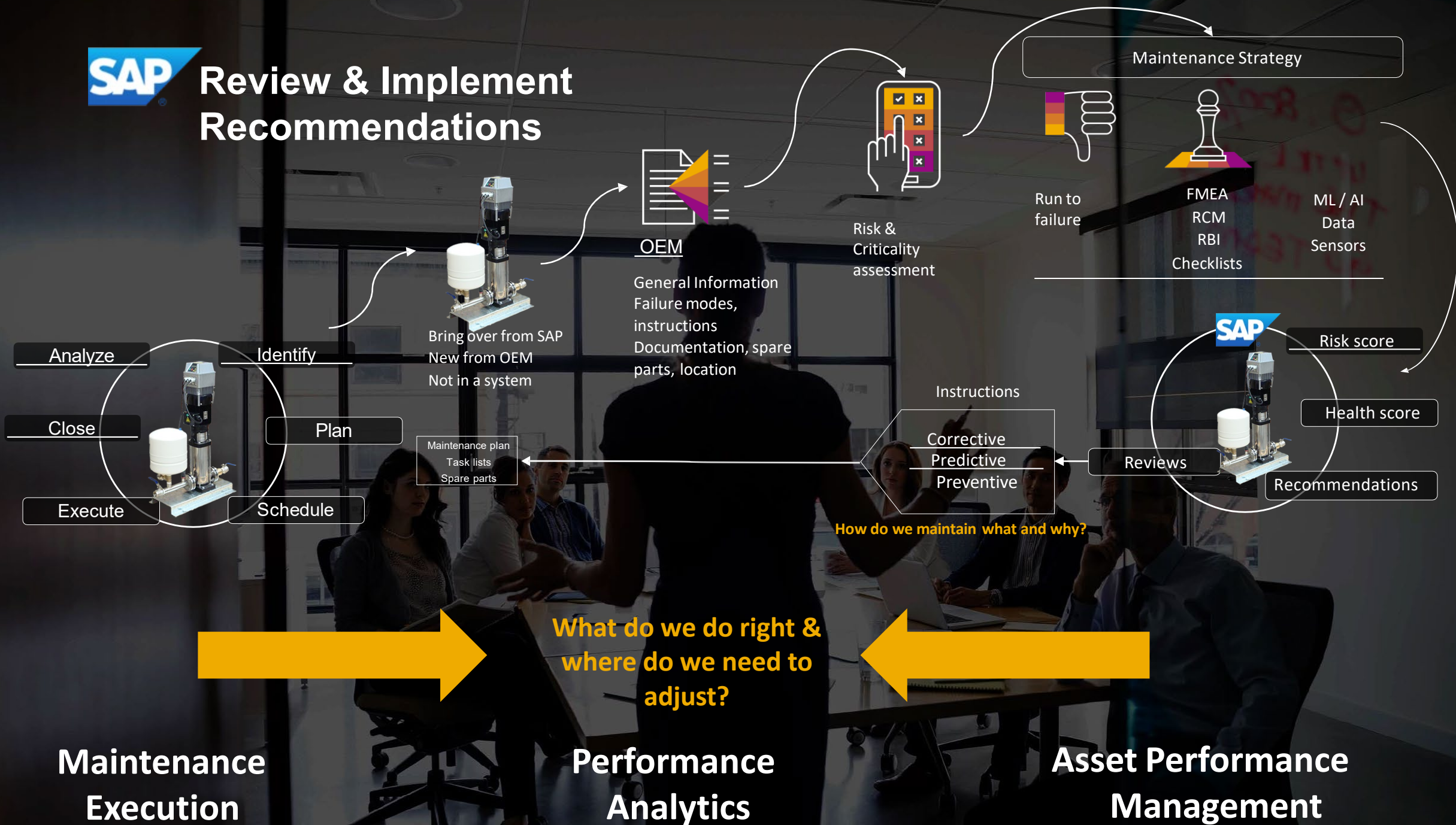
Source: Description: Dargov AF-97: Operation
Type: Operations
Step Count: 4
Activity Type: Start

Steps (4)

Step Name	Description	Tools and Spare Parts	Documents	People Required
Check underneath	<ul style="list-style-type: none"> Check coolant levels Check all levels - oil, hydraulic oil Check for broken hoses Check for air coolant lines Check for leaks Check for abnormal noises / faults Check & remove debris 	1	1	1
Check Exterior	<ul style="list-style-type: none"> Check tracks / wheels, any obvious damage, missing or bent track pads, any cracks, dents, rust? Check if fuses are checked / damaged, sharp? Safety: Before: Making sure, stop, stop work? Check sprockets - are they missing, should not be too shiny, Check track tension / not too tight or loose Check rollers / performance & tolerance Visual leaks 	1	1	1
Check Interior	<ul style="list-style-type: none"> Check brakes Check steering Check horn / safety devices Check repair tracks & controls Check mirrors Check controls, meters & gauges Check seat & seatbelt Check AC working Check doors 	1	1	1
General checklist	<ul style="list-style-type: none"> Check exhaust system Check engine Check for error codes Check fire extinguisher Check emergency escape Check fire device 	1	1	1



Review & Implement Recommendations

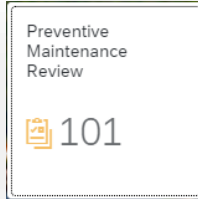


Maintenance Execution

Performance Analytics

Asset Performance Management

Review / Implement Recommendations (Preventive Maintenance Review)



The PMR app collects the recommendations from the various assessments and allows:

- The reliability engineer to track his recommendations
- The planner to receive assignments to implement

Preventive Maintenance Review

Recommendations (9) 200 Series Pump

Filtered By: Object

<input type="checkbox"/>	Recommendation	Object	Failure Mode	Effect	Estimated Cost	Current Risk	Remaining Risk	Current Financial Risk	Remaining Financial Risk	From	Status	Activity
Object: 200 Series												
<input type="checkbox"/>	Replace Oil Seal RCMD.PDMS.159 <small>CORRECTIVE</small>	200 Series	Overheating Bearing		500.00 KRW	● 500.0	● 500.0	1,000.00 KRW	1,000.00 KRW	Instruction	IMPLEMENTATION I...	Replace
<input type="checkbox"/>	Replace Oil Seal RCMD.PDMS.162 <small>CORRECTIVE</small>	200 Series	Seal Failure	Overheating	200.00 CAD	● 500.0	● 500.0	1,000.00 CAD	1,000.00 CAD	Instruction	OPEN	Replace
<input type="checkbox"/>	Replace Oil Seal RCMD.PDMS.161 <small>CORRECTIVE</small>	200 Series	Seal Failure	No Water Flow	500.00 CAD	● 1000.0	● 1000.0	1,000.00 CAD	1,000.00 CAD	Instruction	OPEN	Replace
<input type="checkbox"/>	Valve Insert Removal and Seal Replacemen RCMD.PDMS.163 <small>PREVENTIVE</small>	200 Series	Seal Failure	Overheating	500.00 CAD	● 500.0	● 500.0	1,000.00 CAD	1,000.00 CAD	Instruction	OPEN	
<input type="checkbox"/>	Cracked Casing Fix Field Recommendations RCMD.PDMS.156 <small>CORRECTIVE</small>	200 Series	Overheating Bearing		250.00 KRW	● 1000.0	● 1000.0	1,000.00 KRW	1,000.00 KRW	Instruction	OPEN	
<input type="checkbox"/>	Valve Insert Removal and Seal Replacemen RCMD.PDMS.160 <small>PREVENTIVE</small>	200 Series	Overheating Bearing		400.00 KRW	● 1000.0	● 1000.0	1,000.00 KRW	1,000.00 KRW	Instruction	OPEN	
<input type="checkbox"/>	Oil Condition Analysis RCMD.PDMS.158 <small>CORRECTIVE</small>	200 Series	Overheating Bearing		500.00 KRW	● 1000.0	● 1000.0	1,000.00 KRW	1,000.00 KRW	Instruction	OPEN	Test
<input type="checkbox"/>	Rotating Pump Casing Inspection RCMD.PDMS.157 <small>PREVENTIVE</small>	200 Series	Overheating Bearing		200.00 KRW	● 1000.0	● 1000.0	1,000.00 KRW	1,000.00 KRW	Instruction	OPEN	Inspection
Object: 200 Series-Equipment 06_26_1105												
<input type="checkbox"/>	Quarterly Inspection RCMD.PDMS.211 <small>PREVENTIVE</small>	200 Series-Equipment 06_26_1105	Overheating Bearing		250.00 USD					Instruction	IMPLEMENTATION I...	Inspection

Available Actions

Sample Action - Update / Create / Delete Maintenance Plans

Create Maintenance Plan



SAP Create Maintenance Plan: Single-Cycle Plan %000000000001

Check Entries Additional Functions You can also

Maintenance Plan: %000000000001 Description: Yearly PM on Aux Boiler controllers Maintenance Plan For: Maintenance Order Scheduling Indicator: Time

Items Planning Data Classification

Item	Item Description	Technical Object	Order Type	Plant	Work Center	Plant of Wo...	Planner Gro...	Business Area	Task List
%0000000000000000	Yearly PM on Aux Boiler controllers	NPP-00-064-M-BO-001	Maintenance order	UG02	MECH	UG02	MME		T/9/1

Details for item

General Data Object List Location Data

Long Text: Perform PM on controllers to verify correct setup

Technical Object: NPP-00-064-M-BO-001 Auxiliary Boiler- #1

Identifying Assets: XYZ Simple PWR Nuc Power Plt / ... / Auxiliary Boiler-Mech-Boiler

Superior Technical Object: NPP-00-064-M-BO Auxiliary Boiler-Mech-Boiler

Material:

Maintenance Activity Type: PM Preventive Maintenance

Do Not Release Immediately:

Task List

Task List: T/9/1 Aux Boiler PM - Controllers Remove Task List Assignment


Save

Asset / Order Details

Linked task list

Sample Action - Update / Create / Delete Task Lists (cont'd)

Change Task List



Change General Maintenance Task List: A/113/2

Read Only | Check Entries | Additional Functions

Task List: A/113/2 | Description: Pump Inspection Maintenance Strategy | Group: 113 | Counter: 2 | Valid From Date: 08/18/2021 | Key Date: 09/17/2021 | 1 Document(s)

General Data | **Operation Data** | Maintenance Packages | Documents | Permits

Operations

PM-1 | New | Assign Visual Instructions | Display Visual Instructions

Op...	Sub...	Description	Lo...	Control K...	Work Ce...	Plant	C..	Work	U..	Capac...	Duration	U..	Technical Object	Activit...	M..	Price	Curre...	Cost Element	Purchasing ...	Purchasing ...
<input checked="" type="checkbox"/>	0010	Check Bearing Temperature	⊕	PM01	M-MC	US01			0.5	HR	0	0.0		MACH		0.00	USD			
<input type="checkbox"/>	0020	Check Lubricant	⊕	PM01	M-MC	US01			0.3	HR	0	0.0		MACH		0.00	USD			
<input type="checkbox"/>	0030	Inspect Bearings	⊕	PM01	M-MC	US01			0.5	HR	0	0.0		MACH		0.00	USD			
<input type="checkbox"/>	0040	Wash Out Bearings	⊕	PM01	M-MC	US01			1.0	HR	0	0.0		MACH		0.00	USD			
<input type="checkbox"/>	0050	Replace Bearing Grease	⊕	PM01	M-MC	US01			0.5	HR	0	0.0				0.00	USD			
<input type="checkbox"/>	0060	Check Packing	⊕	PM01	M-MC	US01			0.6	HR	0	0.0		MACH		0.00	USD			
<input type="checkbox"/>	0070	Take Vibration Reading	⊕	PM01	M-MC	US01			0.4	HR	0	0.0		MACH		0.00	USD			
<input type="checkbox"/>	0080	Check Shaft for Scoring	⊕	PM01	M-MC	US01			0.6	HR	0	0.0		MACH		0.00	USD			
<input type="checkbox"/>	0090	Check Pump Alignment	⊕	PM01	M-MC	US01			10.0	HR	0	0.0		MACH		0.00	USD			
<input type="checkbox"/>	0100	Inspect Piping	⊕	PM01	M-MC	US01			0.5	HR	0	0.0		MACH		0.00	USD			

Details: Operation 0010, Check Bearing Temperature

Operation Details | Materials | Relationships | Production Resources/Tools | External Data | Service Packages | Limits | Additional Fields

Long Text:

Operation: 0010

System Condition:

Calculation Key:

Work/Unit: 0.5 HR

Technical Object:

Operation Description: Check Bearing Temperature

Activity Type: MACH Labor

Required Capacities: 0

Duration/Unit: 0.0

Technical Object Type:

Save

Detailed list of steps

Risk & Model Data are Replicated in S4/HANA or ECC Equipment Masters

Display Equipment : Assessments (AS)

Object info... Address... Partners Structure list Class overview Measuring points/count... AllMeasDocs More

Equipment: 10000038 Category: M Machines

Description: Cooling Water Pump No 2

Status: AVLB

Valid From: 25.07.2019 Valid To: 31.12.9999

General Location Structure Classific. Asset Central **Assessments (ASPM)**

Header Information

Model ID: MegaCPK QKD **Model Info**

Description: Standardised chemical pump CPK QKD **Equipment Info**

Manufacturer: SAP Manufacturer

Template: PIPELINES

Calibration Date: 01.01.2017

No Spareparts Date: 01.02.2018

Order Stop Date: 31.12.2018

Service Exp Date: 16.12.2018

Risk and Criticality

Assessment	Description	Group ID	Assessment ...	RPN	Risk Type	Status
AS_OPER.882	Risk & Critica		Asset Criticali	4.15	Current Risk	Published
AS_OPER.865	risk and crit a		Asset Criticali	2.4	Current Risk	Published
AS_OPER.841	Risk Assess...		Asset Criticali	5.0	Current Risk	Published
AS_OPER.840	Risk & Criticalit		Asset Criticali	3.82	Current Risk	Published

Monitor “Bad Actors” by Running Risk Reports

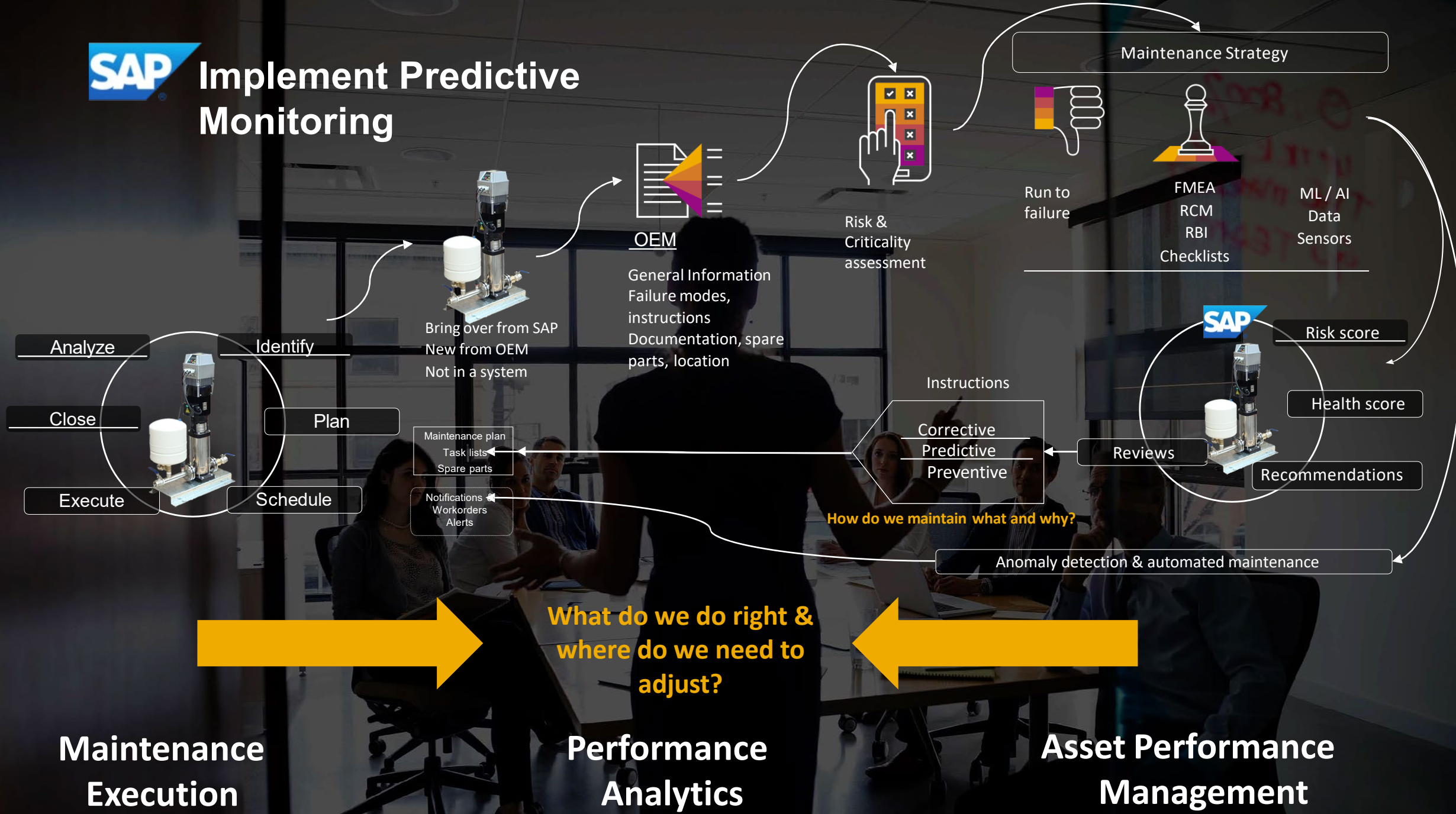
Equipment

3.37 k

NextEra Energy Equipment													
R-2 Risk Ranking Report-200 Series Pumps													
Equipment (17) PM-1 Risk													
Equipment	Subclass	Model ID	Manufacturer	Operator	Phase	Created On	Published On	Status	Criticality	Normalized Risk	Risk Score	RPN	Serial Number
<input type="checkbox"/> PUMP 00554 Pump 554 Cooling Water Circulation Pump	POSITIVE_DISPLACEMENT_PUMP	200 Series	Pumps Ltd	Terrific Components	Fully Operational	Aug 13, 2020	Sep 17, 2021	In Revision	B "Medium"	20.37%	25.00	18	
<input type="checkbox"/> 200 Series-Equipment 06_26_1105 200 Series 06_26_1105	POSITIVE_DISPLACEMENT_PUMP	200 Series	Pumps Ltd	Terrific Components	Planned	Jun 26, 2021	Jun 26, 2021	Published	A "High"	34.17%	9.20	252	
<input type="checkbox"/> Cooling Water Pump Pump 01	POSITIVE_DISPLACEMENT_PUMP	200 Series	Pumps Ltd	Terrific Components	Planned	Feb 9, 2021	Jun 23, 2021	In Revision	A "High"	100.00%	25.00	252	
<input type="checkbox"/> 99-P-1001-A Pump 554 Cooling Water Circulation Pump	POSITIVE_DISPLACEMENT_PUMP	200 Series	Pumps Ltd	Terrific Components	Fully Operational	Aug 13, 2020	Dec 2, 2020	In Revision	A "High"	25.00%	30.00	256	861532
<input type="checkbox"/> Cooling Water Pump_1 Cooling Water Pump_1	POSITIVE_DISPLACEMENT_PUMP	200 Series	Pumps Ltd	Terrific Components	Fully Operational	Jan 13, 2021	Feb 9, 2021	Published	A "High"	100.00%	25.00		
<input type="checkbox"/> Pump 00194 Pump 00194	POSITIVE_DISPLACEMENT_PUMP	200 Series	Pumps Ltd	Terrific Components	Fully Operational	Feb 12, 2020	Feb 12, 2020	In Revision	B "Medium"	19.44%	24.00		SN-444755
<input type="checkbox"/> Pump 00163 Pump 00163	POSITIVE_DISPLACEMENT_PUMP	200 Series	Pumps Ltd	Terrific Components	Fully Operational	Feb 12, 2020	Feb 12, 2020	In Revision	A "High"	33.33%	39.00		SN-388843
<input type="checkbox"/> Pump 00143 Pump 00143	POSITIVE_DISPLACEMENT_PUMP	200 Series	Pumps Ltd	Terrific Components	Fully Operational	Feb 12, 2020	Feb 12, 2020	In Revision	C "Low"	50.00%	3.00		SN-461756
<input type="checkbox"/> Pump 00071 Pump 00071	POSITIVE_DISPLACEMENT_PUMP	200 Series	Pumps Ltd	Terrific Components	Fully Operational	Feb 12, 2020	Feb 12, 2020	In Revision	C "Low"	50.00%	3.00		SN-012346
<input type="checkbox"/> Pump 00277 Pump 00277	POSITIVE_DISPLACEMENT_PUMP	200 Series	Pumps Ltd	Terrific Components	Fully Operational	Feb 12, 2020	Feb 12, 2020	In Revision	A+ "Very High"	79.17%	20.00		SN-051558
<input type="checkbox"/> Pump 00092 Pump 00092	POSITIVE_DISPLACEMENT_PUMP	200 Series	Pumps Ltd	Terrific Components	Fully Operational	Feb 12, 2020	Feb 12, 2020	In Revision	A+ "Very High"	60.83%	15.60		SN-967966
<input type="checkbox"/> Pump 00552 Pump 00552	POSITIVE_DISPLACEMENT_PUMP	200 Series	Pumps Ltd	Terrific Components	Planned	Nov 12, 2020	Nov 12, 2020	Published	B "Medium"	46.91%	8.66		
<input type="checkbox"/> Pump 110 200 Series	POSITIVE_DISPLACEMENT_PUMP	200 Series	Pumps Ltd	Terrific Components	Planned	Nov 1, 2020	Nov 1, 2020	In Revision	B "Medium"	46.91%	8.66		
<input type="checkbox"/> 200_CTNR_001 200 Series Centrifugal PUMP SPP WO TEMPLATE	POSITIVE_DISPLACEMENT_PUMP	200 Series	Pumps Ltd	Terrific Components	Planned	Jun 17, 2020	Jun 16, 2020	In Revision	A+ "Very High"	100.00%	76.25		PUMP/CP/61601
<input type="checkbox"/> 963334022 200 Series Pump in Parkes	POSITIVE_DISPLACEMENT_PUMP	200 Series	Pumps Ltd	Terrific Components	Planned	Jun 4, 2020	Jun 4, 2020	In Revision	C "Low"	39.80%	7.50		
<input type="checkbox"/> 10091892 ESP system (ASPM Pump)	POSITIVE_DISPLACEMENT_PUMP	200 Series	Pumps Ltd	Terrific Components	Planned	May 12, 2020	May 12, 2020	Published	A "High"	29.90%	23.50		
<input type="checkbox"/> 20200107 Pump 200107	POSITIVE_DISPLACEMENT_PUMP	200 Series	Pumps Ltd	Terrific Components	Planned	Dec 17, 2019	Dec 17, 2019	Published	A "High"	35.90%	8.00		



Implement Predictive Monitoring



Failure-Mode-Specific Health Monitoring


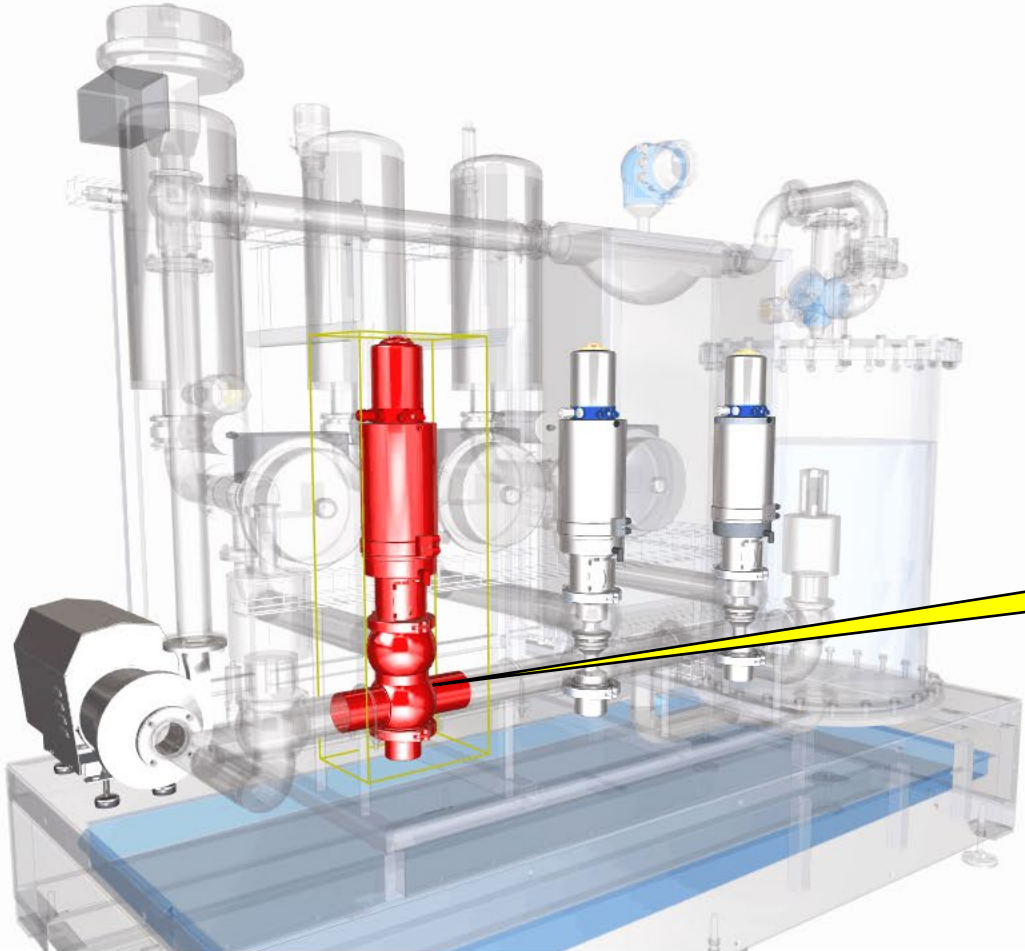
SAP Viewer

EvoMixx_Operate_HMI2020.2

Structure Browser Properties Analytics

Intelligent Asset Management

ASPM Criticality



37.5%

62.5%

High Low

High		
<input type="checkbox"/>	Name	Status
<input checked="" type="checkbox"/>	Double Seat Valve ML 1	Published
<input type="checkbox"/>	Pump H1CP 180	Published
<input type="checkbox"/>	Double Seat Valve ML 2	Published
<input type="checkbox"/>	Double Seat Valve ML 3	Published
<input type="checkbox"/>	Mechanical Seal H1CP...	Published

Failure-Mode-Specific Health Monitoring

INFORMATION ▾ STRUCTURE & PARTS ▾ DOCUMENTATION ▾ MONITORING ▾ MAINTENANCE & SERVICE ▾ ASSESSMENT ▾ **ANALYTICS** ▾ TIMELINE

Top 5 Failure Modes

All Failure Modes

Jun 13, 2019 - Jun 12, 2020



Go

Failure Mode	Occurs in Notifications	Compared to Model Occurs	MTTR	MTTF	MTBF
Leakage at outlet FM.PDMS.12	33 Times	↑ 450% More Than Average	0 Hours	302.9 Hours	302.9 Hours
Valve not Opening FM.PDMS.9	31 Times	↑ 416.67% More Than Average	0 Hours	337.8 Hours	337.8 Hours
Insufficient Flow FM.PDMS.10	26 Times	↑ 420% More Than Average	0 Hours	381.9 Hours	381.9 Hours
Intermittent Flow FM.PDMS.11	19 Times	↑ 375% More Than Average	0 Hours	488 Hours	488 Hours

Failure Modes

Leading Indicators

Failure Mode

Leakage at outlet



Indicators (26/29)

Conditions (3/4)

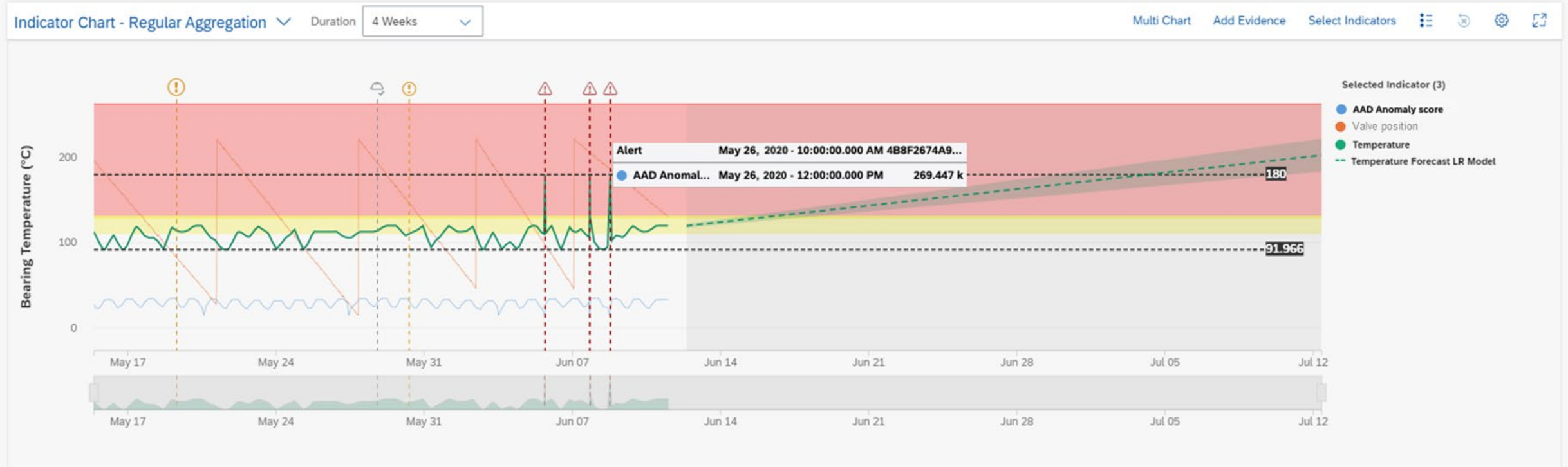
Top Indicators (Ranked)	Indicator Strength	Failure Mode
Inflow_Temperature Rotating_Equipment_Measurements.Inflow_Temperature_AVG	● 1	Leakage at outlet
Inflow_Temperature Rotating_Equipment_Measurements.Inflow_Temperature_MIN	● 0.98	Leakage at outlet
Inflow_Temperature Rotating_Equipment_Measurements.Inflow_Temperature_MIN_PT3H_PT05	● 0.974	Leakage at outlet
Inflow_Temperature Rotating_Equipment_Measurements.Inflow_Temperature_MAX	● 0.962	Leakage at outlet
Inflow_Temperature	● 0.895	Leakage at outlet

Failure-Mode-Specific Health Monitoring & Alerting

INFORMATION ▾ STRUCTURE & PARTS ▾ DOCUMENTATION ▾ **MONITORING** ▾ MAINTENANCE & SERVICE ▾ ASSESSMENT ▾ ANALYTICS ▾ TIMELINE

Indicator Chart

Refresh



Alerts

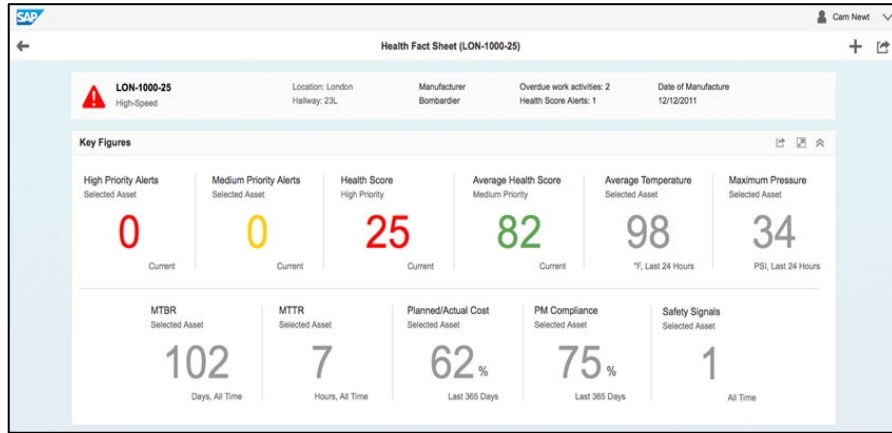
Refresh

Alerts (4) SAP Standard ▾

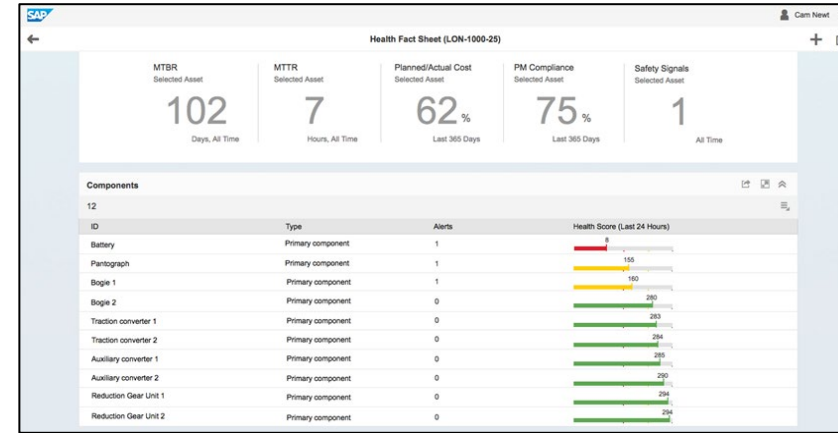
Set in Process Set to Completed Set Processor Create Notification Add Evidence ⌕ ⚙️

<input type="checkbox"/>	Type	Alert Description	Equipment	Top Equipment	Operator	Country ID	Created On	Severity	Status	Processor	Notification
<input type="checkbox"/>	double_se...	Double seat valve anomaly	Double_Seat_Valve_ML-Eq...		SAP America		May 1, 2020, 6:00:00 PM	Warning	New		

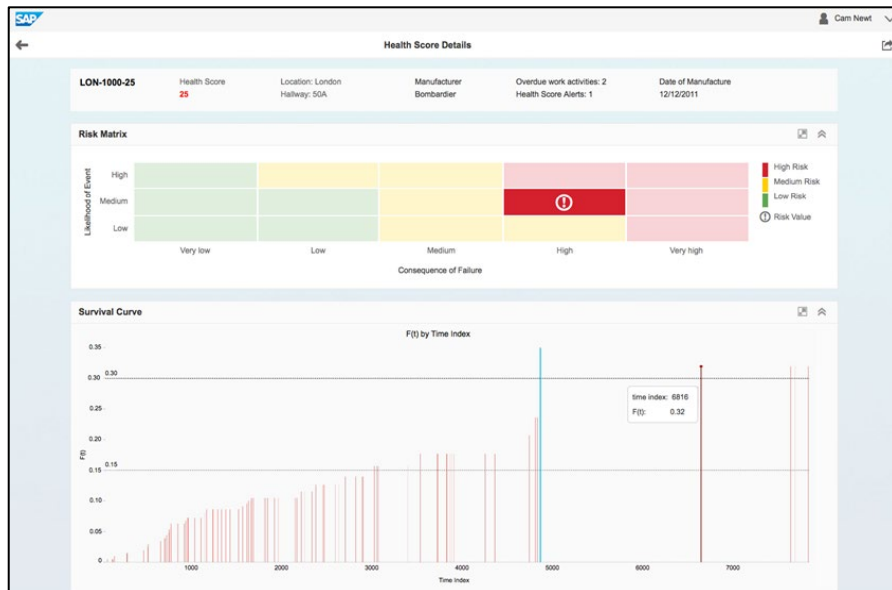
Data Science – Predictive Maintenance Applications



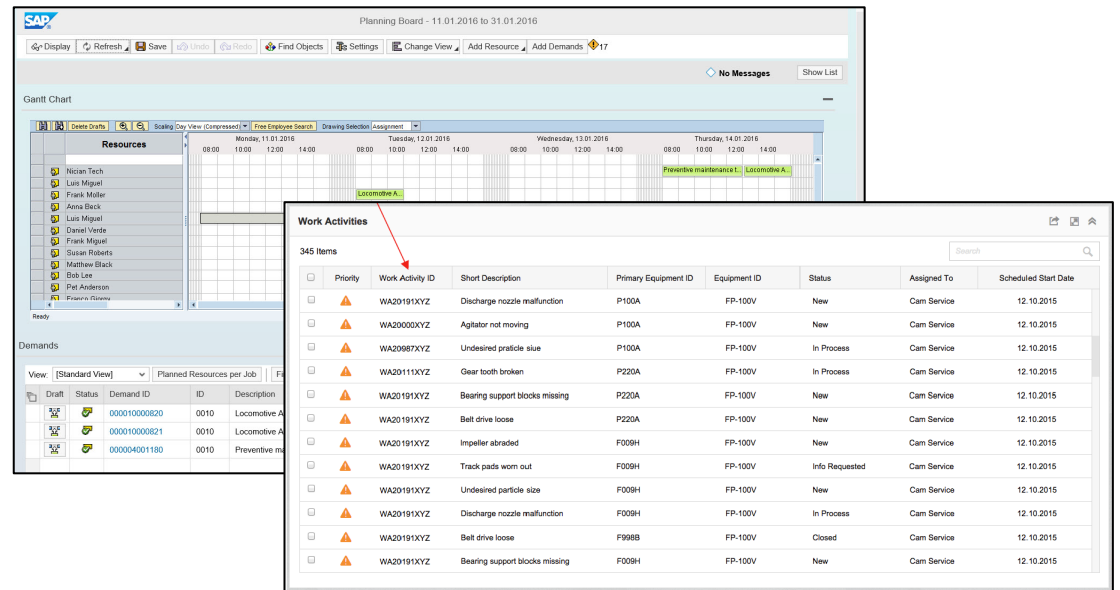
Health Fact Sheet



Health Fact Sheet by Components

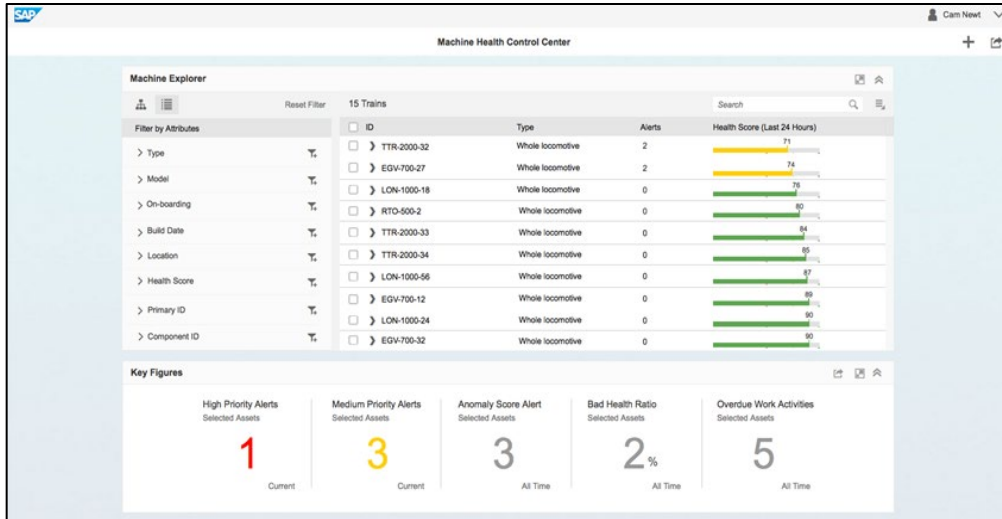


Risk Matrix and Survival Curve

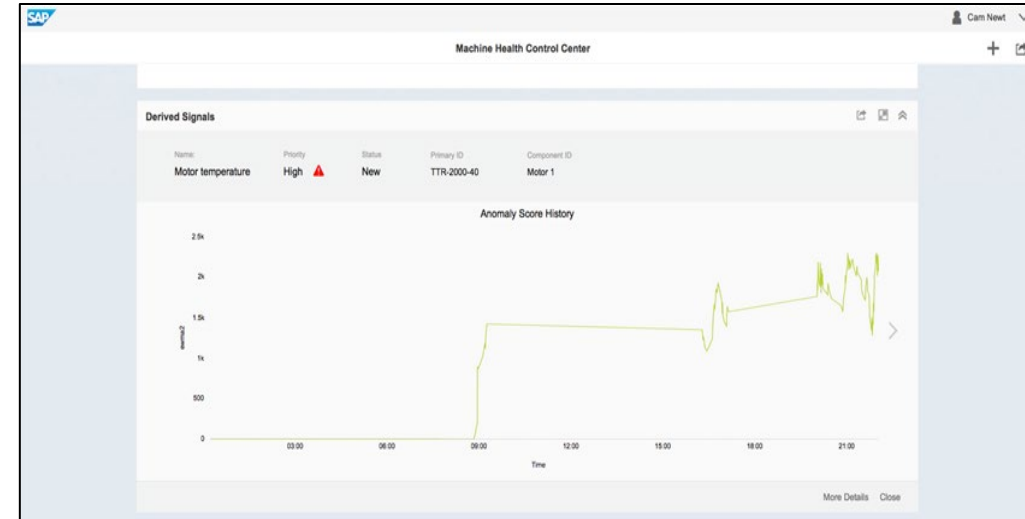


MRS Planning board with Rescheduled Maintenance

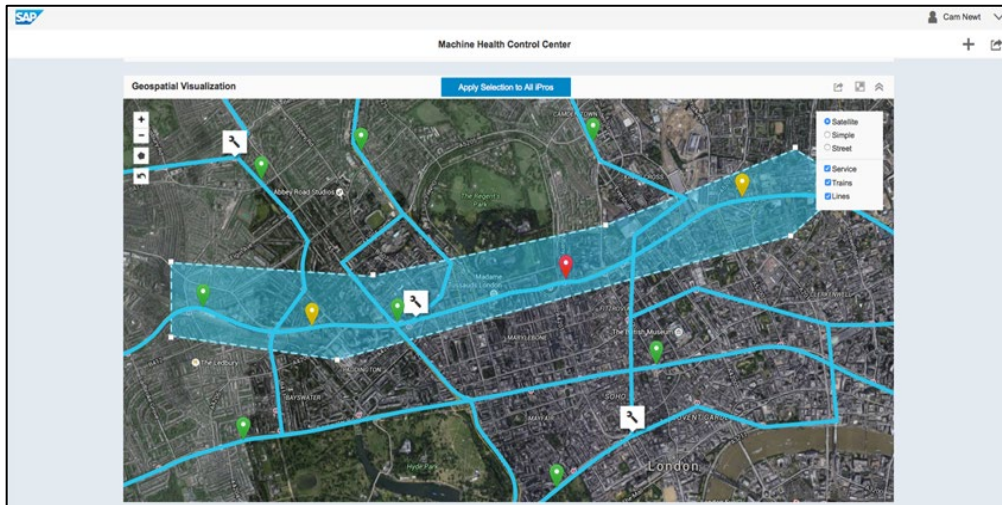
Data Science – Predictive Maintenance Applications



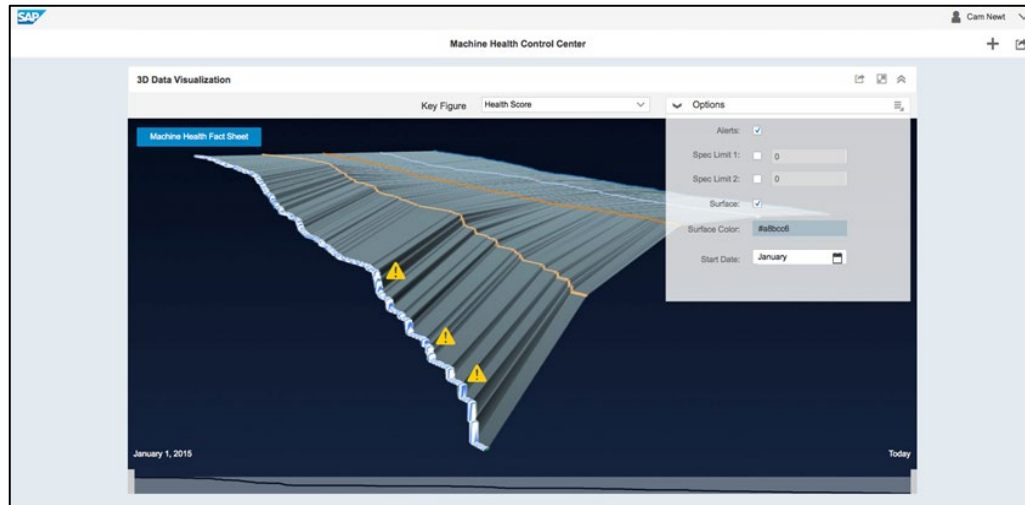
Machine Health Control Center - Machine Explorer



Machine Health Control Center - Anomaly Score History

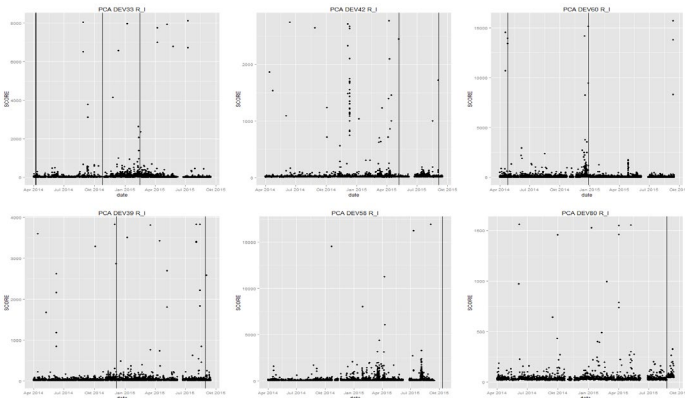


Machine Health Control Center - Geospatial Visualization

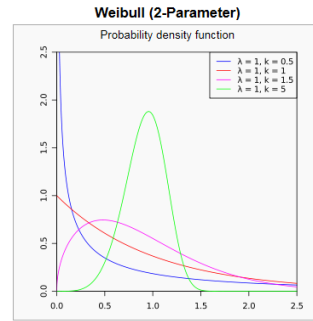


Machine Health Control Center - 3D Data Visualization

Many Data Science Algorithms are used in Predictive Maintenance

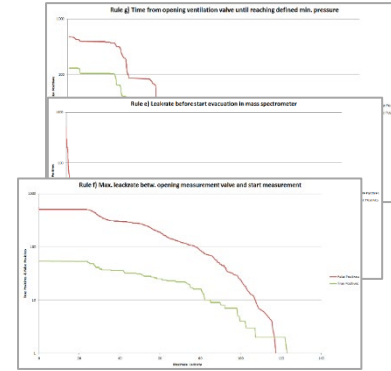


Principal Component Analysis of Switches

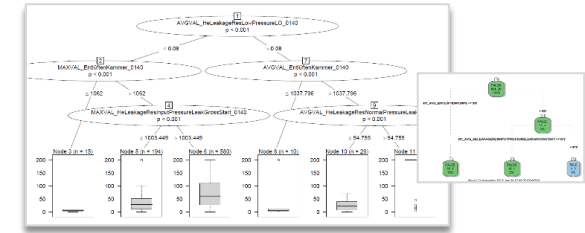


Weibull Remaining Useful Life Estimation

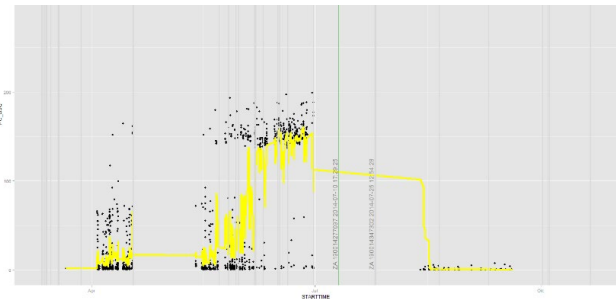
$$f(x; \lambda, k) = \begin{cases} \frac{k}{\lambda} \left(\frac{x}{\lambda}\right)^{k-1} e^{-(x/\lambda)^k} & x \geq 0, \\ 0 & x < 0, \end{cases}$$



Expert Rule Validation



Automatic Rule Extraction with Decision Trees



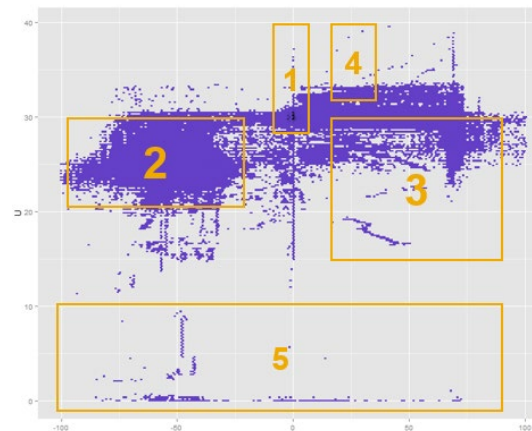
Anomaly Detection with Principal Component Analysis scores

$$\text{Var}[a^T X] = \frac{1}{n} \sum_{i=1}^n \left\{ a^T \left(X_i - \frac{1}{n} \sum_{j=1}^n X_j \right) \right\}^2 = a^T V_{XX} a$$

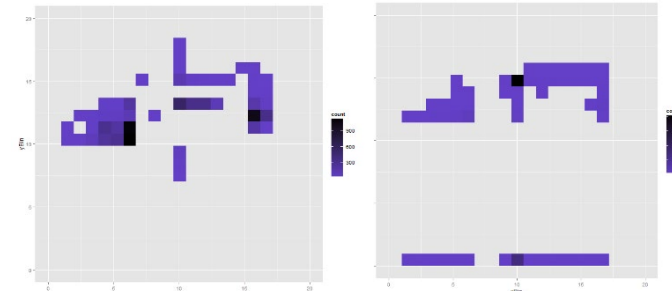
where

$$V_{XX} = \frac{1}{n} \sum_{i=1}^n \left(X_i - \frac{1}{n} \sum_{j=1}^n X_j \right) \left(X_i - \frac{1}{n} \sum_{j=1}^n X_j \right)^T$$

PCA



Battery behavioural groupings

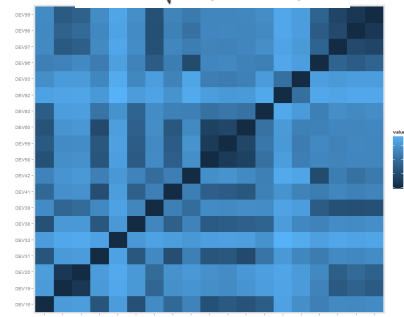
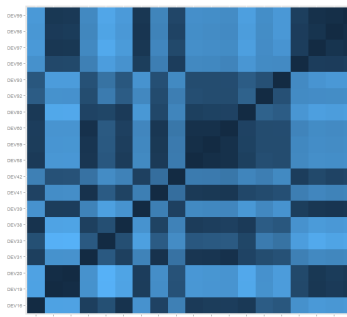


$$W(P, Q) = \min \left\{ \sum_{x \in M, y \in N} \text{dist}(x, y) \cdot T(x, y) \mid T: M \times M \rightarrow [0, 1] \text{ with } \sum_{y \in N} T(x, y) = P(x), \sum_{x \in M} T(x, y) = Q(y) \right\}$$

Wasserstein Metric for battery performance analysis

$$W_p(\mu, \nu) := \left(\inf_{\gamma \in \Gamma(\mu, \nu)} \int_{M \times M} d(x, y)^p d\gamma(x, y) \right)^{1/p}$$

$$H(P, Q) = \sqrt{\frac{1}{2} \int \left(\sqrt{\frac{dP}{d\lambda}} - \sqrt{\frac{dQ}{d\lambda}} \right)^2 d\lambda}$$



K-Mediod cluster analysis to partition the population into classes of similar devices

Failure-Mode-Specific Health Monitoring & Corrective Action

INFORMATION ▾ STRUCTURE & PARTS ▾ DOCUMENTATION ▾ MONITORING ▾ **MAINTENANCE & SERVICE ▾** ASSESSMENT ▾ ANALYTICS ▾ TIMELINE

Highlights

Settings

Equipment Model

Work Orders by Progress



Work Orders by Type



Work Orders by Priority



Notifications

Notifications

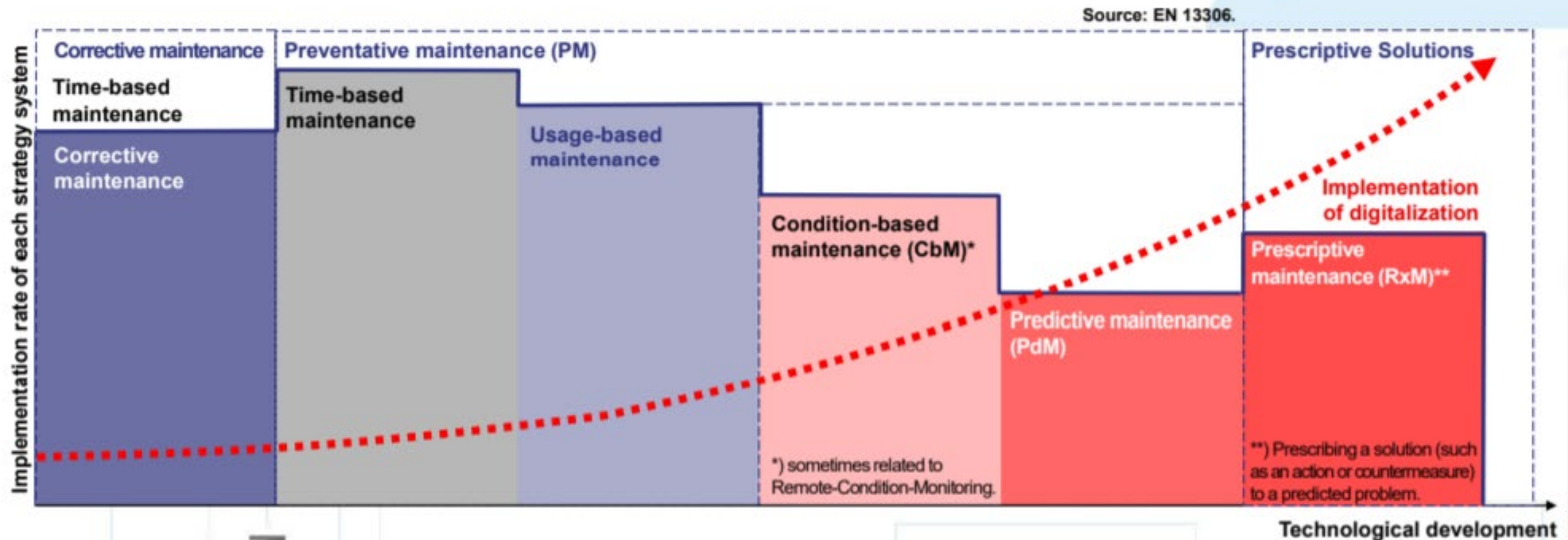
All (287) Pending (287) Planned (0) Completed (0)

Search Notifications Add Evidence New ↑↓ [≡] ▾

Notification	Type	Priority	Status	Breakdown	Required Start Date / End Date	Malfunction Start Date / End Date	Failure Mode
NO.OPER.393 Leakage Recognized	Maintenance Request	!! Very High	New	No	Apr 27, 2020 Apr 28, 2020	Apr 7, 2020	Leakage at outlet
NO.OPER.392 Leakage Recognized	Maintenance Request	!! Very High	New	No	Apr 26, 2020 Apr 27, 2020	Apr 8, 2020	Leakage at outlet
NO.OPER.391 Leakage Recognized	Maintenance Request	!! Very High	New	No	Apr 21, 2020 Apr 23, 2020		Leakage at outlet
NO.OPER.390 Double Seat Valve Leakage	Maintenance Request	!! Very High	New	No	Apr 8, 2020		
NO.OPER.389 Double Seat Valve Leakage	Maintenance Request	!! Very High	New	No	Apr 7, 2020		
NO.OPER.388 Double Seat Valve Leakage	Maintenance Request	!! Very High	New	No	Apr 6, 2020		
NO.OPER.384 DOUBLE_SEAT_VALVE_LEAKAGE	Maintenance Request	!! Very High	New	No	Feb 26, 2020		
NO.OPER.382 DOUBLE_SEAT_VALVE_LEAKAGE	Maintenance Request	!! Very High	New	No	Feb 14, 2020		
NO.OPER.381							

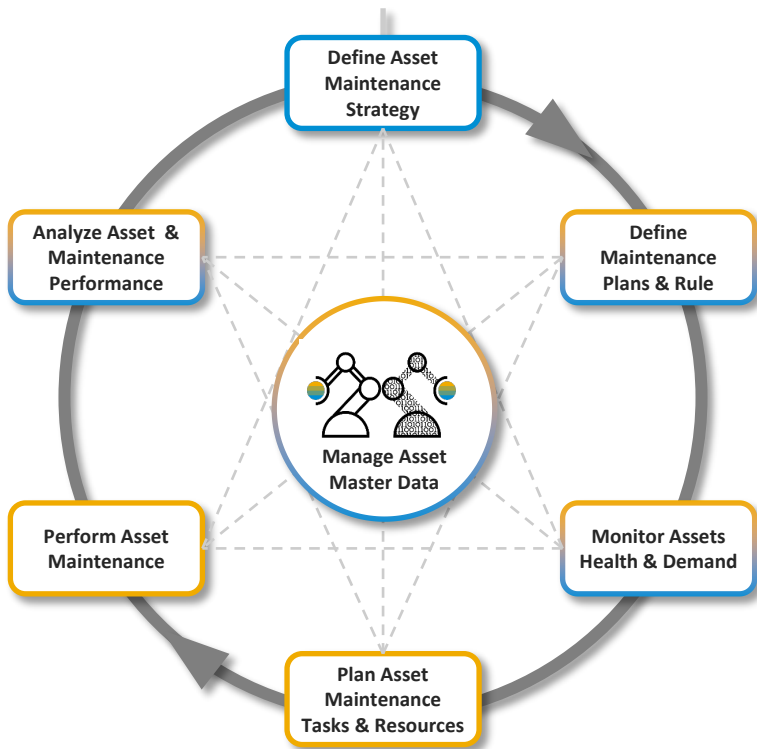
Intelligent blend (mix) of maintenance strategies for assets

to optimize customer comfort, availability and cost reduction.



Intelligent Asset Management: Mitigating Risk & Improving Performance

Seamlessly extend **Enterprise Maintenance Management & Service** with **Asset Performance Management** along end-to-end processes to close the loop between maintenance strategy and execution to **define, implement, execute and monitor** the **optimal asset maintenance**.



Improved Reliability (MTBF)

Higher Availability

Improved Productivity (MTTR)

KPIs

Additionally:-
 Mitigate consequences of failure of:

- Pressure vessels, pipelines
- Rotating equipment
- Safety instrument systems

Avoid breaking the law:

- environmental regulations
- Safety rules

Value from more production from higher availability (at quality)

Additionally:-
Reduction in Labor/ Services Costs:

- Less travel time, information searching, parts searching

Reduction in Parts Costs:

- Optimized spare parts, tools policies

Mitigate Risk by:

- Condition monitoring to detect onset of failure
- Inspections to measure deterioration
- Functional checks to assure redundancy

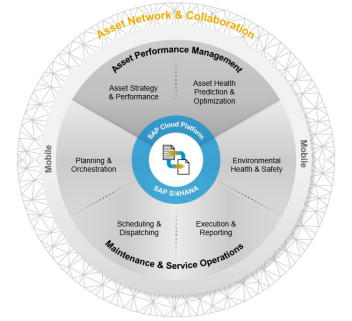
Result is reduced train/ unit failure/ trip rate and **improved availability and unit performance**.

Productivity benefits from better planning of:

- Maintenance demand
- Technician/ Operator skills
- Parts/ Services

SAP Intelligent Asset Management and service

Increase asset performance, reduce maintenance costs, and deliver service excellence



Closed-loop strategy, planning and execution processes to optimize **asset performance management**



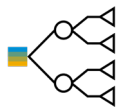
Synchronize maintenance and service across the **enterprise** for responsive customer care and supply chain **resilience**



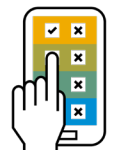
Adopt new **collaborative** processes and 'products-as-a-service' business models across **networks**



Manage asset health with **Industry4.0** for real-time predictive maintenance and service



Optimize maintenance and service with **intelligent scheduling** and **crowd-sourced** resource management



Empower users with **mobile** asset intelligence, work automation, and safe sustainable **EH&S** policies

25% lower maintenance cost

where majority of maintenance work orders are generated predictively or condition-based

SAP Performance Benchmarking, n = 94

47% lower recordable accident frequency

where standardized regulatory reports are available and there is full visibility into all regulatory violations.

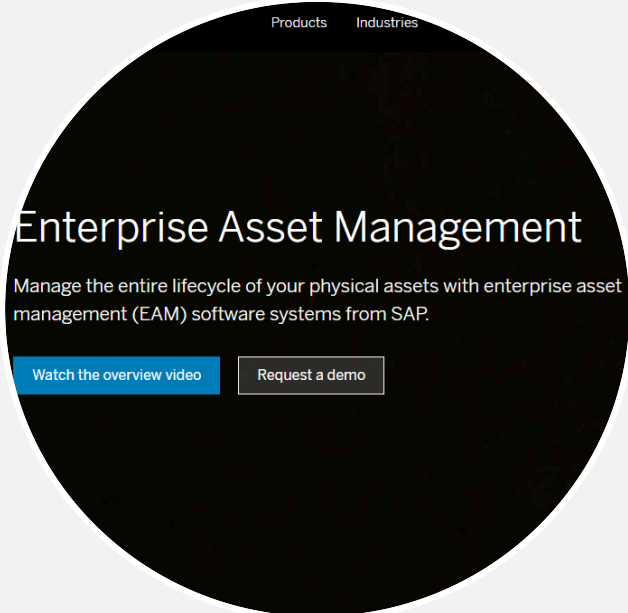
SAP Performance Benchmarking, n = 81

40% decrease in work order processing

time where mobile asset management is used in the field to streamline engineer tasks and reporting

SAP Reference Example: Metropolitan Utilities District

For more information:



The screenshot shows the SAP Enterprise Asset Management landing page. At the top, there are links for "Products" and "Industries". The main heading is "Enterprise Asset Management". Below it, the text reads: "Manage the entire lifecycle of your physical assets with enterprise asset management (EAM) software systems from SAP." There are two buttons: "Watch the overview video" and "Request a demo".

Refer to intelligent asset management at sap.com/iam

Refer to SAP's strategy paper for intelligent asset management at sap.com

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- 17 Ecosystem Strategy: Open IAM Platform for Partner Content, Apps and Extensibility



Intelligent Asset Management Strategy

Thank you.

Brian Williams, Solution Owner, Asset Performance Management

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[linkedin.com/in/sapiam](https://www.linkedin.com/in/sapiam)

<https://www.sap.com/products/scm/apm.html>



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