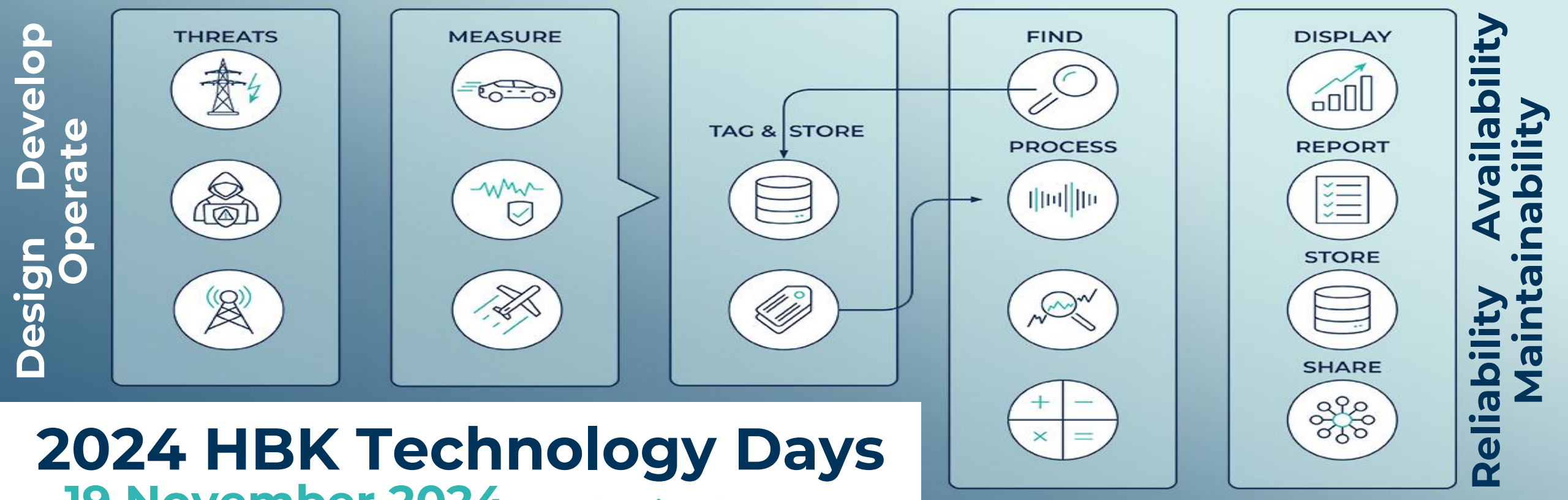


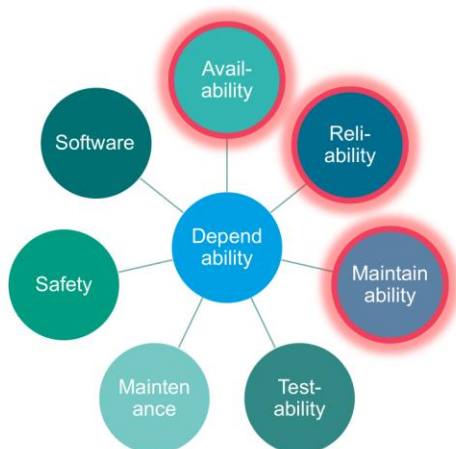


2024 HBK Technology Days

19 November 2024

Session 6:
The ...abilities – Reliability, Availability, Maintainability (RAM)
for Dependability

Dependability



- From reliability to dependability - to ensure the continuous and safe operation of technical systems

Bartlomiej Swiatek,
Senior Application Engineer – Reliability, HBK

From reliability to dependability - to ensure the continuous and safe operation of technical systems

▲ Abstract

- Dependability is the collective term describing ability of the product/process to function as required when required. The factors that influence the dependability performance are reliability, maintainability, availability, testability, maintenance, and safety. Several methods can be applied for dependability assessment and management during each life cycle phase starting from product concept, through design, development, manufacturing, product operation and utilization. This comprehensive approach requires collaborative effort of an interdisciplinary team and knowledge in the field of engineering, data preparation and analysis.
- This presentation explores tools and methods to be applied to assess and manage dependability during system operation. The special stress should be taken on data collection to support change management process and monitor effectiveness of the implemented changes. From the other side dependability tools should be integrated into companywide collaborative environment to gain insight from various departments and groups within the organization.

From reliability to dependability - to ensure the continuous and safe operation of technical systems

- ▲ About the presenter, Bartłomiej Swiatek,
Senior Application Engineer – Reliability, HBK
 - Bartłomiej Swiatek is an application engineer supporting ReliaSoft reliability software for HBK with a Master's in Power Engineering (Warsaw). He is engaged on asset life optimization and reliability projects for 10+ years. While working as an engineer at HBK in areas of automotive, aerospace, defence and oil & gas he is mentoring engineers how to implement effective reliability program.

From reliability to dependability - to ensure the continuous and safe operation of technical systems

Bartłomiej Świątek, Hottinger Bruel & Kjaer Poland Sp. z o.o.



About the presenter

- ▲ **Bartłomiej Swiatek** is an Senior Application Engineer supporting ReliaSoft reliability software for HBK with a Master's in Power Engineering (Warsaw). He is engaged on asset life optimization and reliability projects for 10+ years. While working as an engineer at HBK in areas of automotive, aerospace, defence and oil & gas he is mentoring engineers how to implement effective reliability program.



Contents



Presentation objectives



Key definition



In-Service Dependability Management Process



Conclusions

Presentation objectives

DISCUSS OF THE MAIN STEPS OF DEPENDABILITY MANAGEMENT PROCESS FOR THE SYSTEMS DURING OPERATION:

- Performance monitoring during operation
- Report events
- Data analysis
- Change management



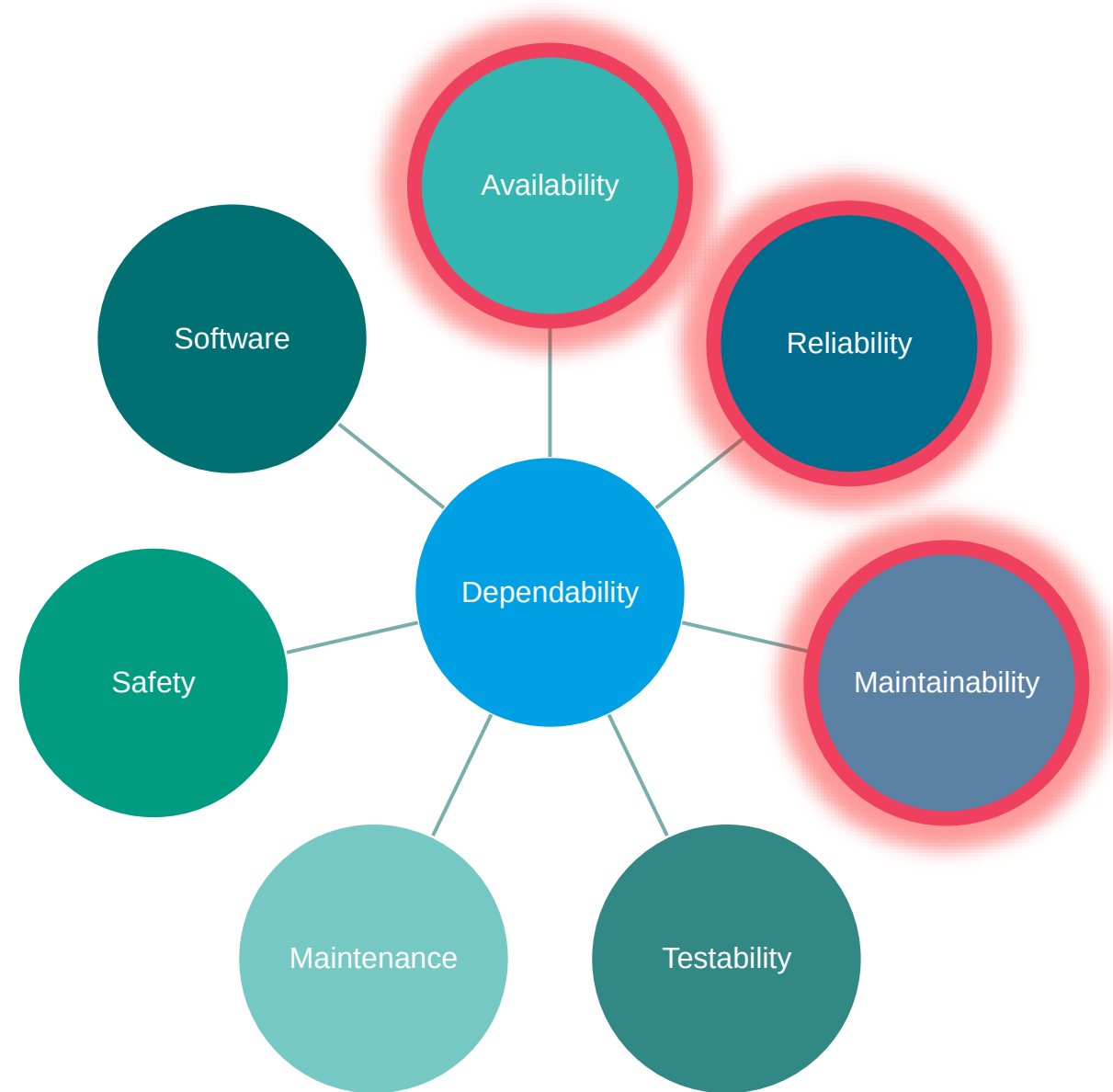


RE **LI**
DEP **END** **A** **B** **L** **E**

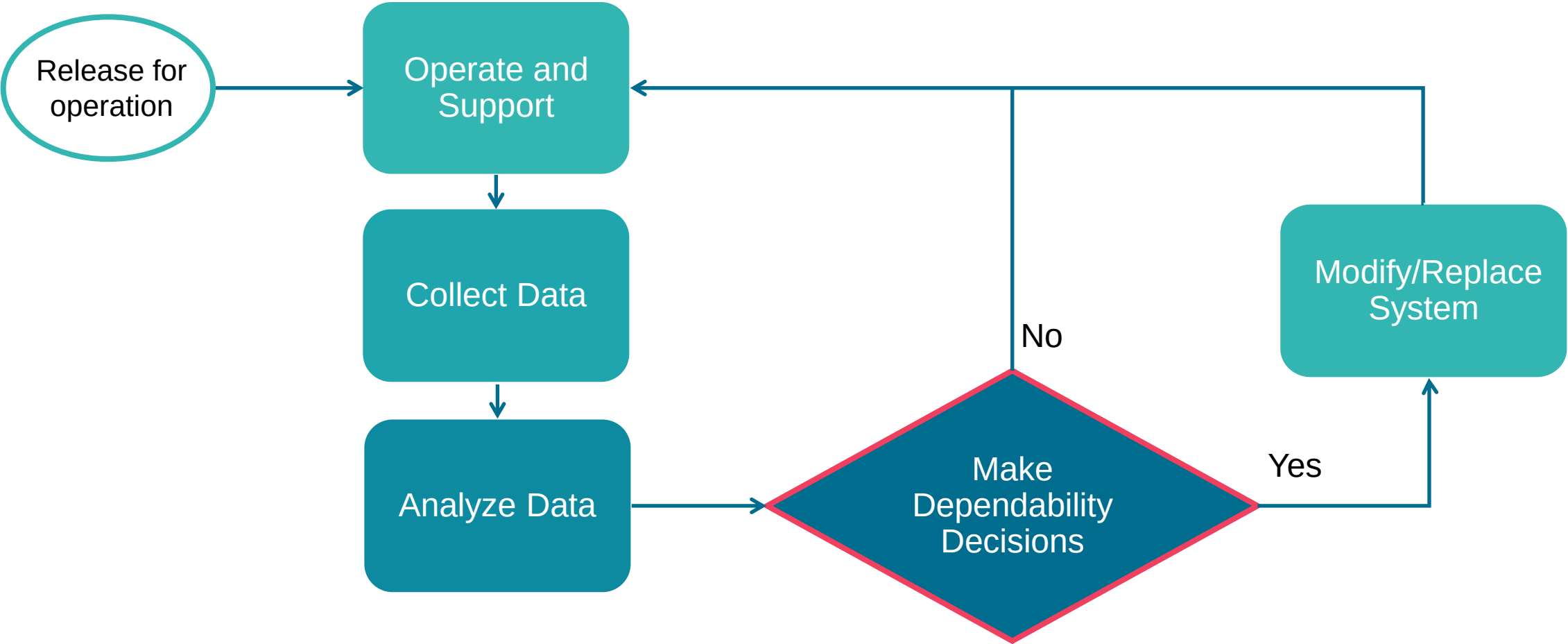
Dependability

Dependability – ability to function as required when required.

The factors that influence the dependability performance of any item are reliability, maintainability, availability, testability, maintenance, and safety.



Dependability Management Process For The Systems During Operation



Dependability Management Process For Operating Systems

PERFORMANCE MONITORING DURING OPERATION

- Quantify dependability
- Demonstrate compliance with requirements
- Bad actors identification
- Improve dependability
- Assess effectiveness of CAPA
- Assess effectiveness of maintenance
- Assess RUL

COLLECTING DATA

- Usage Data
 - Operating Time/Usage
 - Events
 - Environmental data
 - Configuration and Identifiers
- Failure Event
 - Identification and Description
 - Time of Occurrence
 - Condition at the Time of Failure
 - Detection Methods
 - Effects of Failure
 - Root Cause
 - Recovery
- Maintenance Action
 - Task Identification
 - Task Time
 - Labour and Parts Consumed

ANALYZING DATA

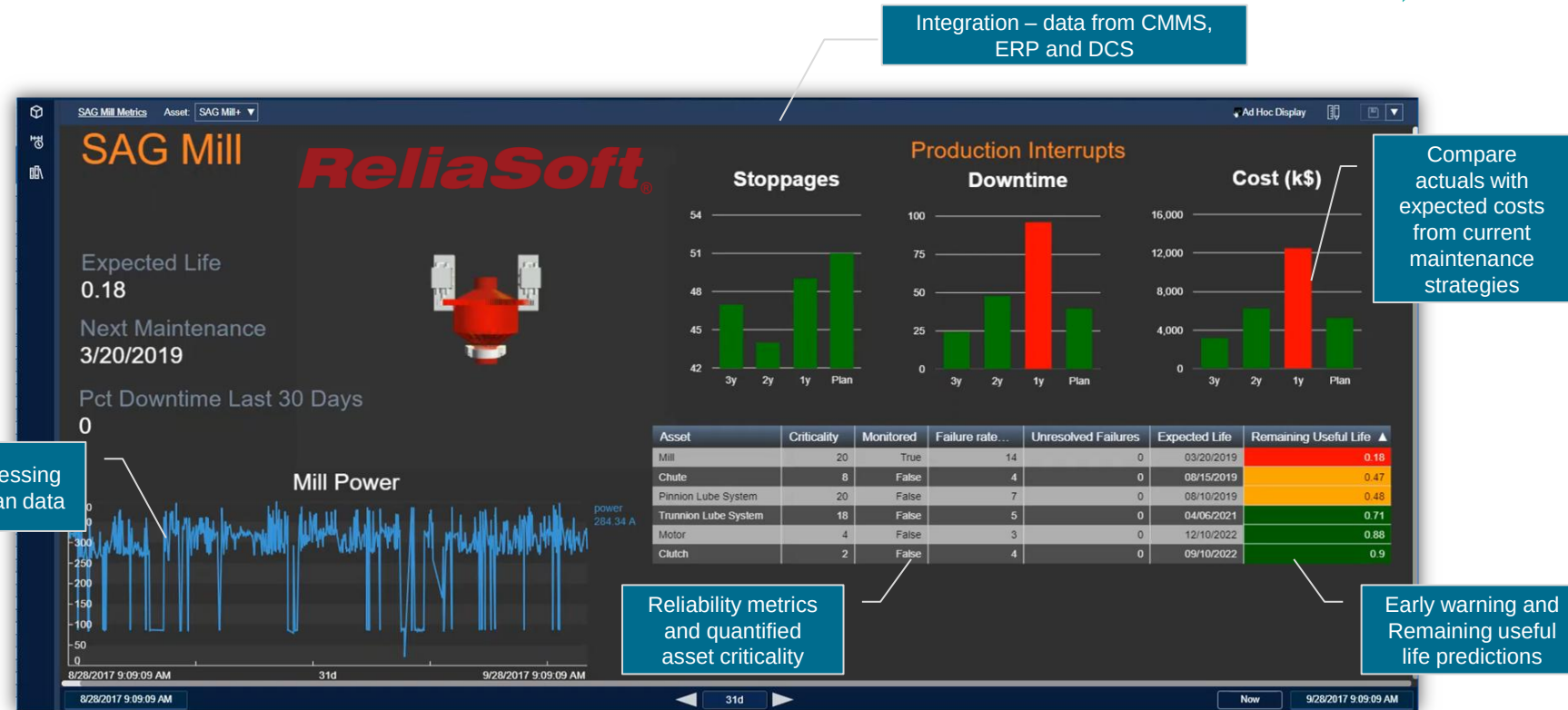
- Pareto analysis
- Scatter diagrams
- Control charting
- Weibull Analysis
- Reliability Growth Analysis
- General Renewal Process
- Reliability Block Diagrams
- Analysis of Variance

FINDING AND IMPLEMENTING ACTION

- Corrective maintenance action
- Living with dependability problems
- Maintenance improvement
- Modifications and upgrades
- Life extension
- Replacement
- RCM
- RCA

PERFORMANCE MONITORING DURING OPERATION

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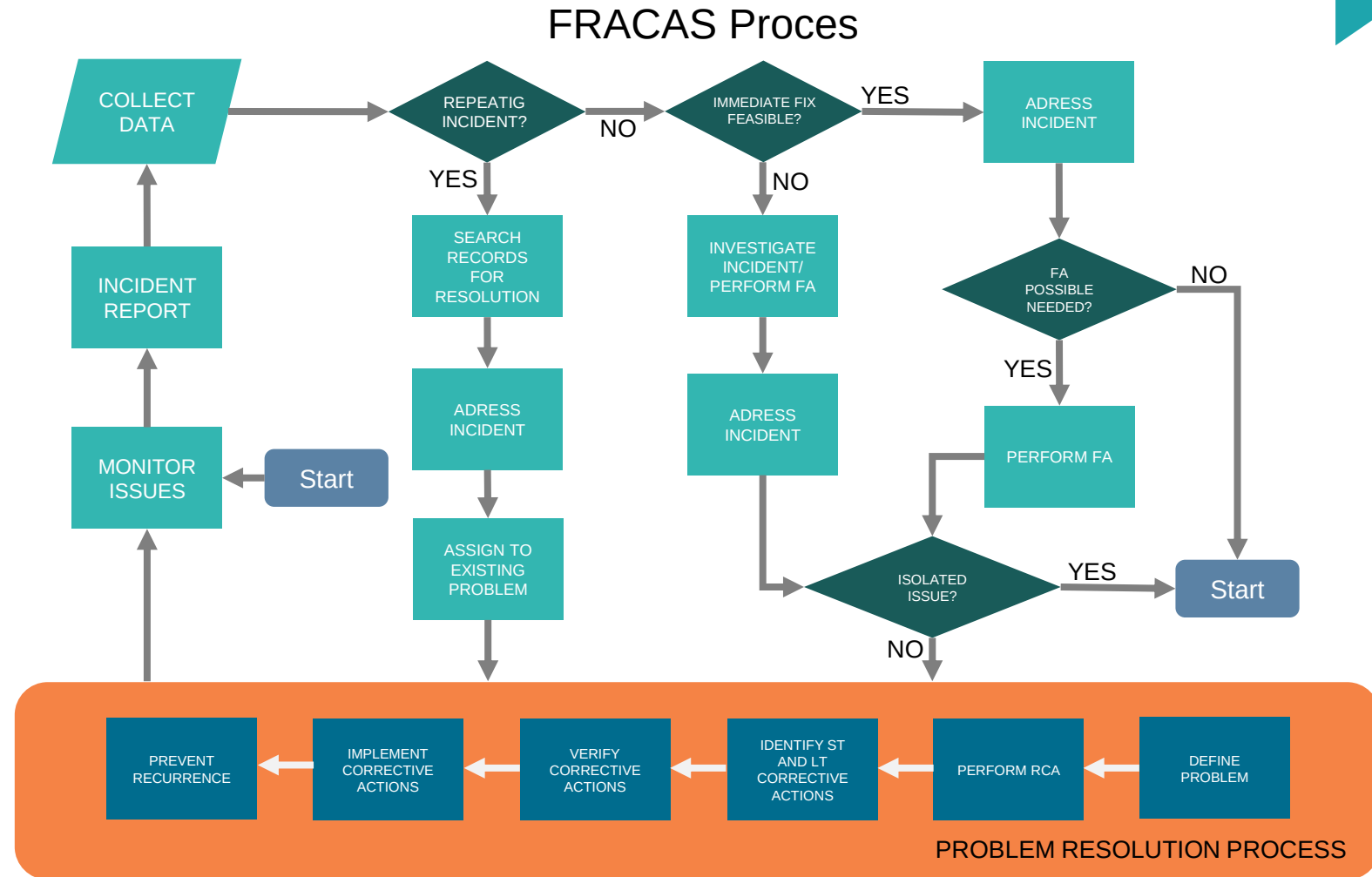
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The screenshot displays the XFRACAS software interface. The top navigation bar includes 'Home', 'System', 'Admin', and 'Options'. Below this, there are icons for 'XFRACAS', 'SEP', 'Reports', 'Charts', 'Dashboard', 'Incident', 'Problem', 'Project', and 'Customer Support'. The main content area is titled 'Reports' and lists several report types: 'Incident', 'Action', 'CSI', 'Company', and 'Failure Analysis'. Each report type has a brief description of what it generates. On the right side, there is an 'Incident Form' window. This form contains various fields for incident details, including 'Assigned to Problem?', 'System Configuration', 'Owner', 'Category', 'Occurrence Date', 'System Status', 'Reporting Date', 'Responsible Part', 'Downtime', 'Last Updated', 'State', 'Run Hrs / Starts / kW Hrs', 'Creator, Reporting Org', 'Unit Location', and 'Last Updated By'. The form also has sections for 'System/Component Information', 'Incident Disposition', 'Incident Repair Information', and 'Incident Details'.

ANALYZING DATA

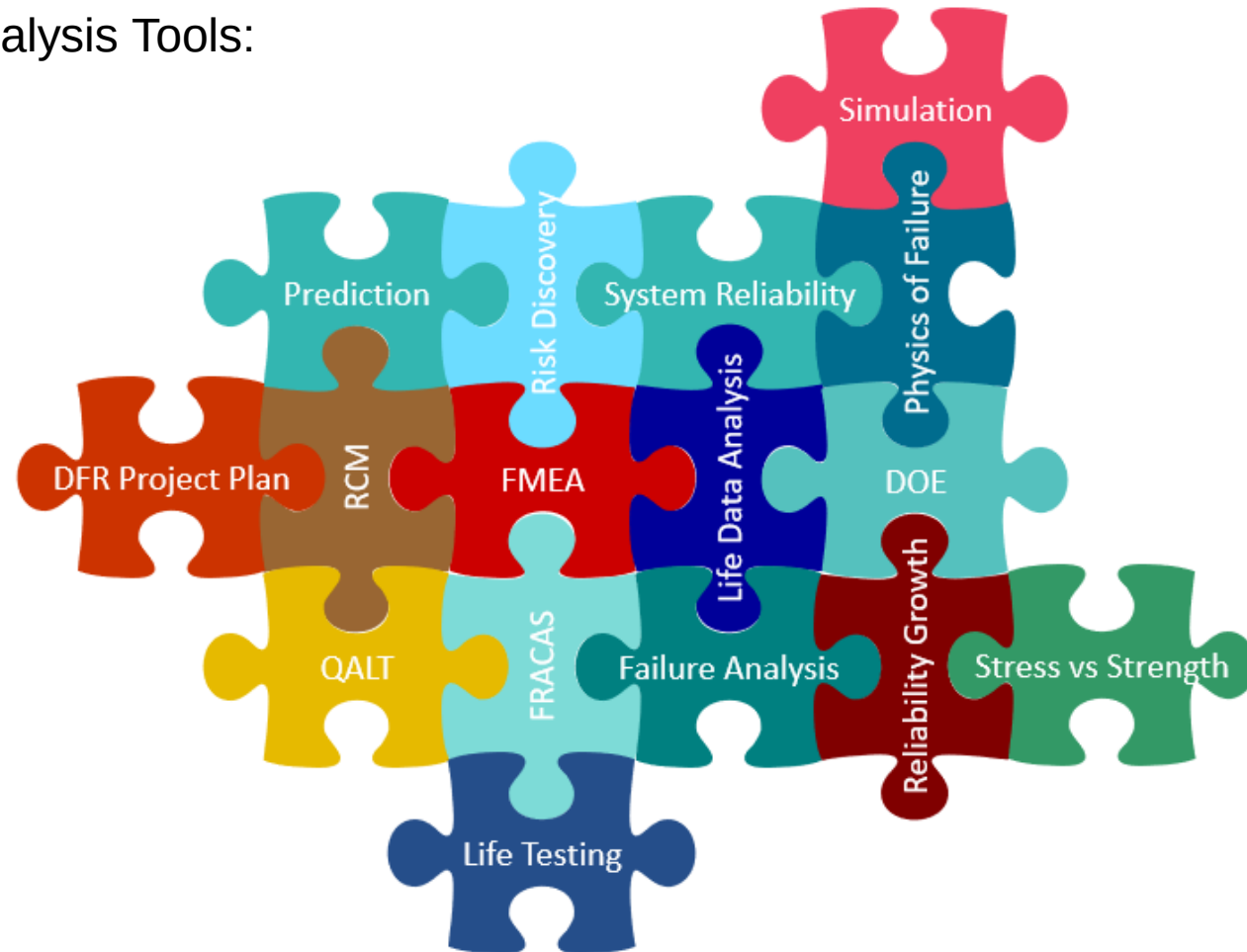
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- To **estimate** the key KPIs i.e. availability, reliability and / or maintainability of the item and to **understand trends** over a period of time.
- To **confirm** if the dependability requirements e.g. availability, reliability, maintainability, etc., as specified in the contract, have been met.
- To **assess the effectiveness of fixes**
-



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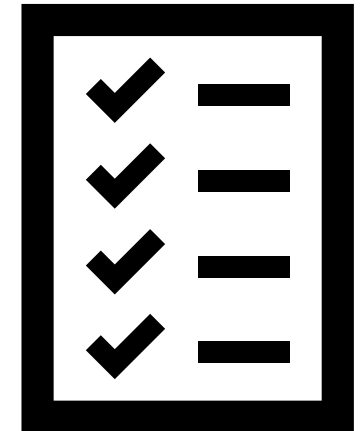
Reliability Analysis Tools:



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Examples of criteria to identify dependability improvements worth to implement:

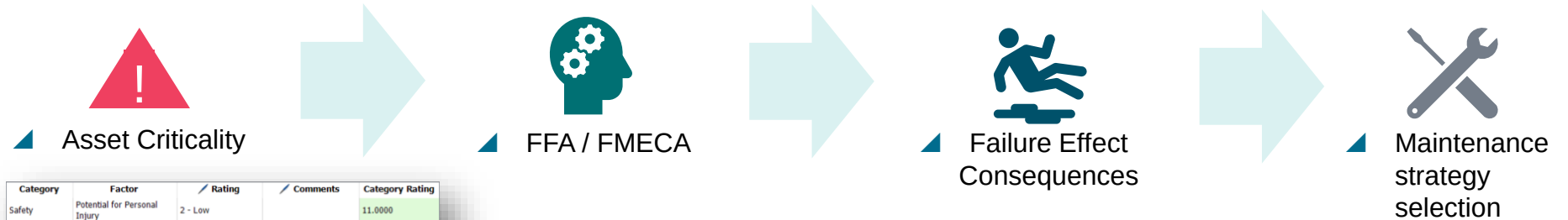
- Safety impact
- RUL
- Failure rate
- Operational impact
- Maintenance cost
- Increase cost effectiveness
- Change is likely to be successful
- ...



FINDING AND IMPLEMENTING ACTION

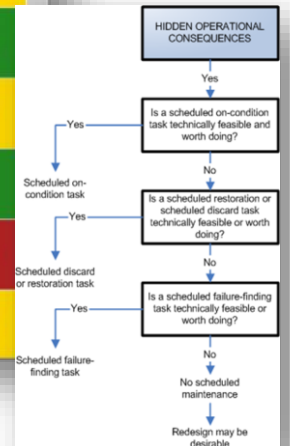
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Failure management policy change with Reliability Centered Maintenance methodology:



Category	Factor	Rating	Comments	Category Rating
Safety	Potential for Personal Injury	2 - Low		11.0000
	Severity of Personal Injury	1 - None		
	Health Hazards	4 - Significant		
Maintenance	Fire / Explosion Event Possible	4 - Very Unlikely		
	Downtime Impact	1 - None		
	Repair Costs	2 - Minimal		
Operations	Spare Parts Availability	2 - 1 to 2 weeks		
	Affected Downtime Area	2 - Area A		
	Capacity Reduction Impact	1 - None		
Environmental	Regulatory Requirements	1 - No		
	Impact on Energy Consumption	1 - No		
	Impact on Scrap	5 - Yes		
Quality Control	Failure Frequency Potential	2 - > Semi-Annually		
	Spill/Release Haz. Material	1 - No		
	Pollution Control Device	5 - Yes		
	Env. Impact Potential	2 - Minimal		
	Radiation Detection	5 - Yes		
	Quality Impact Potential	1 - None		
	Quality Severity	2 - Minimal		
	Missed Delivery	2 - 2 to 5 day delay		
	Customer Claim Possible?	5 - Yes		

Function	Functional Failure	Effect	Si	Failure Mode	Oi	Di	RPNI
1 Move a given fluid while maintaining an acceptable leak rate at the Shaft	Functional Failure: External leak rate at the Shaft is above the acceptable rate Failure Mode: Packing worn	Loss of fluid to the ground / sewer	4	Packing Gland too tight or loss of lubrication	5	3	60
2 Move a given fluid while maintaining an acceptable leak rate at the Shaft	Functional Failure: External leak rate at the Shaft is above the acceptable rate Failure Mode: Packing worn	Loss of fluid to the ground / sewer	4	Incorrect installation	1	4	16
3 Move a given fluid while maintaining an acceptable leak rate at the Shaft	Functional Failure: External leak rate at the Shaft is above the acceptable rate Failure Mode: Packing worn	Loss of fluid to the ground / sewer	4	Wear Out - Normal wear	4	2	32
4 Move a given fluid while maintaining an acceptable leak rate at the Shaft	Functional Failure: Leak rate at the Shaft is below the acceptable rate Failure Mode: Packing mis-adjusted (too tight)	Packing prematurely worn	5	Packing bolts over tightened	1	1	5
5 Move a given fluid while maintaining an acceptable leak rate at the Shaft	Functional Failure: Catastrophic failure of the Shaft Seal Failure Mode: Seal/Packing blowout	Process impact and Loss of fluid to the ground / sewer	8	Induced - Gland Follower corrosion / failure	9	5	360
6 Move a given fluid while maintaining an acceptable leak rate at the Shaft	Functional Failure: Catastrophic failure of the Shaft Seal Failure Mode: Seal/Packing blowout	Process impact and Loss of fluid to the ground / sewer	8	Induced - Gland Follower stress / failure	4	4	128



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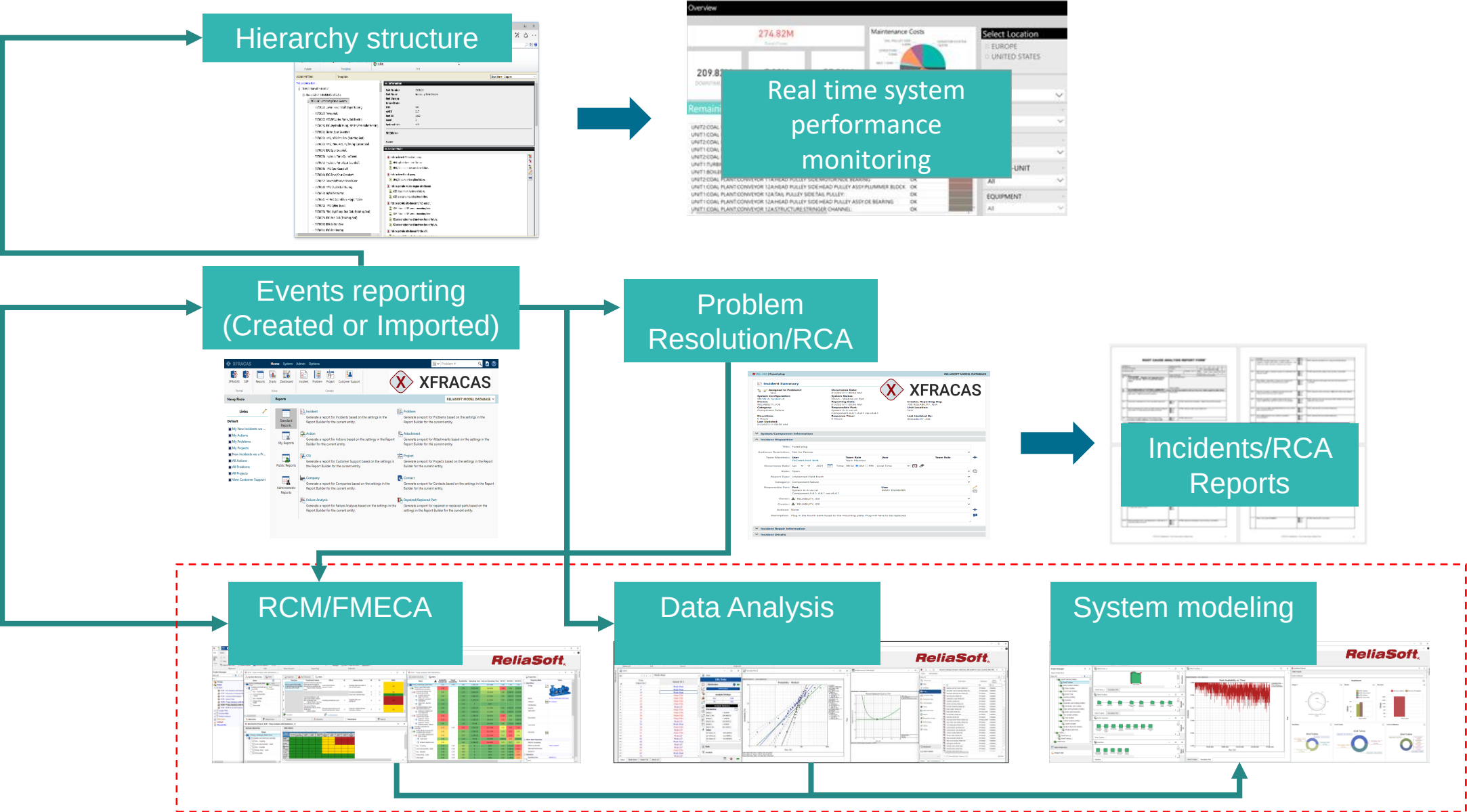
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Analaysis Integration



Conclusions



In order to ensure safe and continuous operation, it is necessary to define an appropriate decision-making process for changes aimed at improving system dependability.



Collecting data and analysing it is crucial for making accurate decisions.



A multifaceted approach requires the actions of an interdisciplinary team and knowledge in the fields of engineering, as well as data preparation and analysis.

Case Study: NAVAIR

A FLEET DELIVERING QUALITY DATA TO INCREASE MISSION CAPABLE AIRCRAFT READINESS



CHALLENGE

Solutions with the challenge of creating a common **Failure Reporting Analysis and Corrective Action System (C-FRACAS+)** tool across 33 NAVAIR programmes.



SOLUTION

HBK's Engineering Solutions team built a powerful **Asset Performance Framework based on ReliaSoft XFRACAS**, and has partnered with SMX to successfully meet US Navy requirements.



RESULT

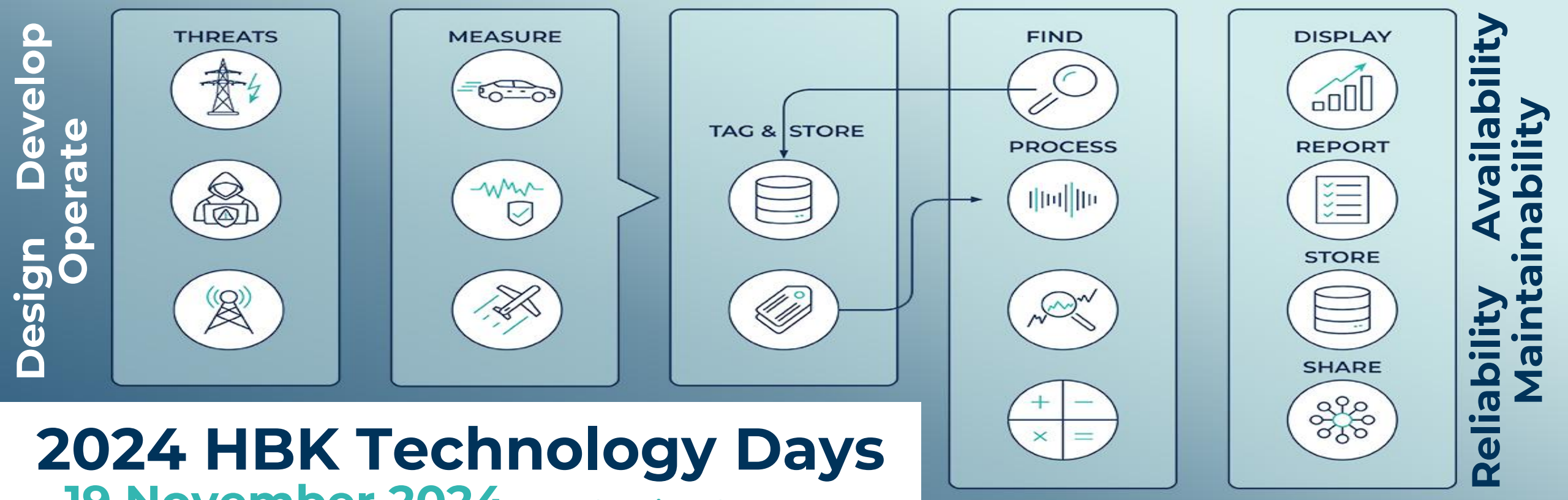
A 20% increase in naval aircraft readiness. The success of the project, including C-FRACAS+ implementation, led NAVAIR partners to win the prestigious 2022 Department of the Navy Information Technology Excellence Award.



Q & A

Bartłomiej Świątek HBK



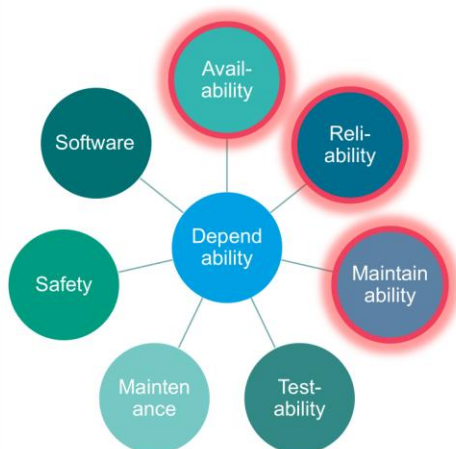


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