How a Digital Risk Twin enables Resilient Sovereign Sustainment

Land Forces 2022

PHM Technology
Decisions better made

Our Platform: MADe MAINTENANCE AWARE DESIGN

October 2022

Presentation Structure

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Executive Summary

Sustainment represents up to 80% of Total Cost of Ownership for a platform.

The fundamental input to Sustainment is the technical risk in a platform: the hazards, defects and failures that can occur based on the configuration, how and why they develop, and the necessary actions to mitigate them when they occur (maintenance).

Resilient Sustainment infers the ability to continuously understand, forecast, optimize and supply the necessary resources and materiel required to achieve mission outcomes within prevailing operational constraints.

A Digital Risk Twin is a model-based analytics platform that enables Defence to digitize and automate the analytic processes to design and achieve Resilient Sustainment.

Sustainment – a complex decision space

Sustainment – the process, tools, materials, resources and actions used to ensure Operational Readiness of assets.

Continuous optimization of sustainment requires that evidence-based decisions are made in order to prioritize immediate and long-term maintenance actions based on:

- Operational requirements & regime
- Maintenance Requirements
- System Condition & Functional Degradation
- Logistics
- Human Resources
- Supply Chain Availability

Resilient Sustainment

Resilient Sustainment – implies the ability to adaptatively manage the risks of achieving Mission Success, in the context of the extant:

1. Processes
2. Technology
3. People
4. Data
5. Objectives
6. Supply Chain
7. Operational Constraints

Key Sustainment Risks

Operational Risks – how system condition directly impacts on Operational Availability (probability of Mission Success)

Process Risks – does organization have the necessary (policies, procedures, methods, training) to adapt and optimize Sustainment to rapidly evolving circumstances?

Technology Risks – level of Digital Transformation / Model-based Engineering, Frictionless Integration and Data Discipline

Supply Chain Risks – can industry provide the quality, volume and supply of key equipment based on variable demand?

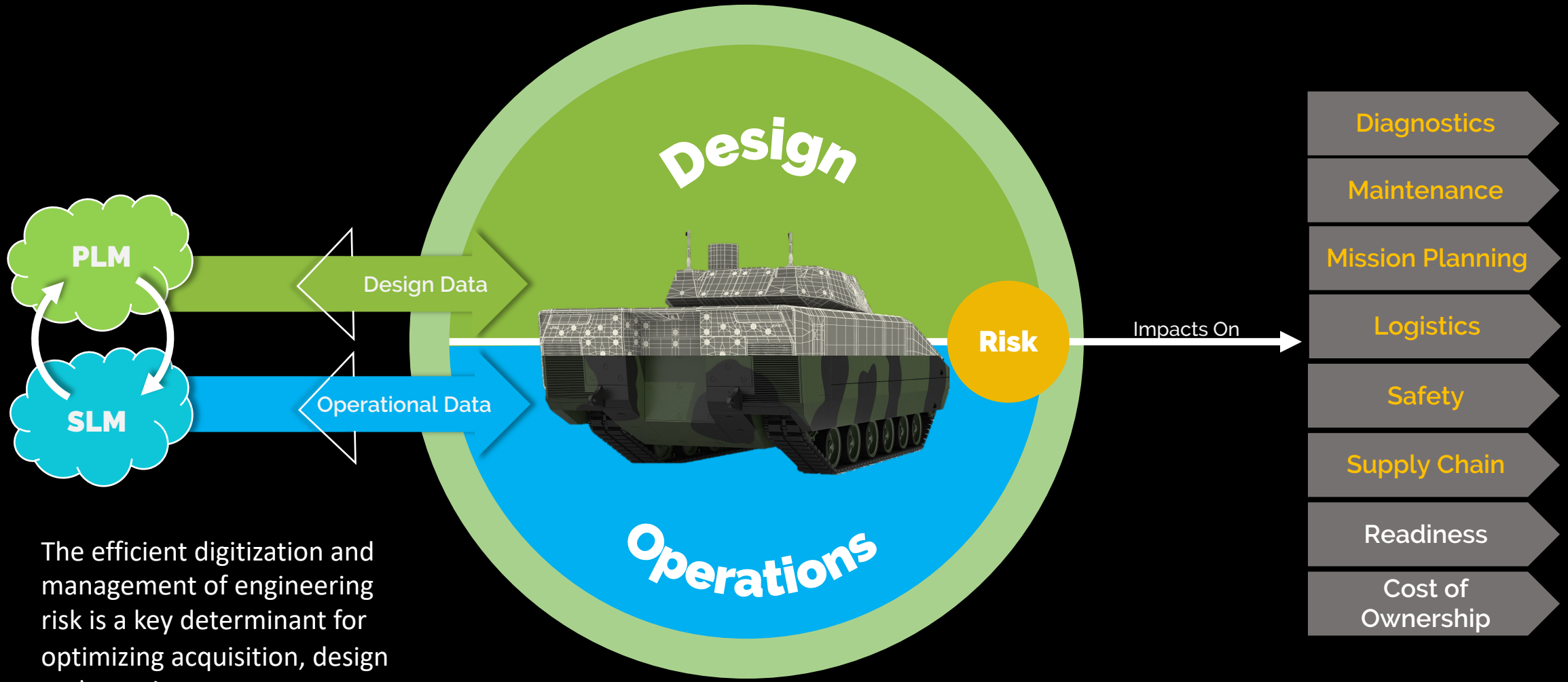
Technical Risk– the hazards, defects and failures that occur and is the key input to Sustainment actions

MOTS vs MOTSA

ADF customization of MOTS platforms requires update to any pre-existing RAMS / ILS data to reflect changes to:

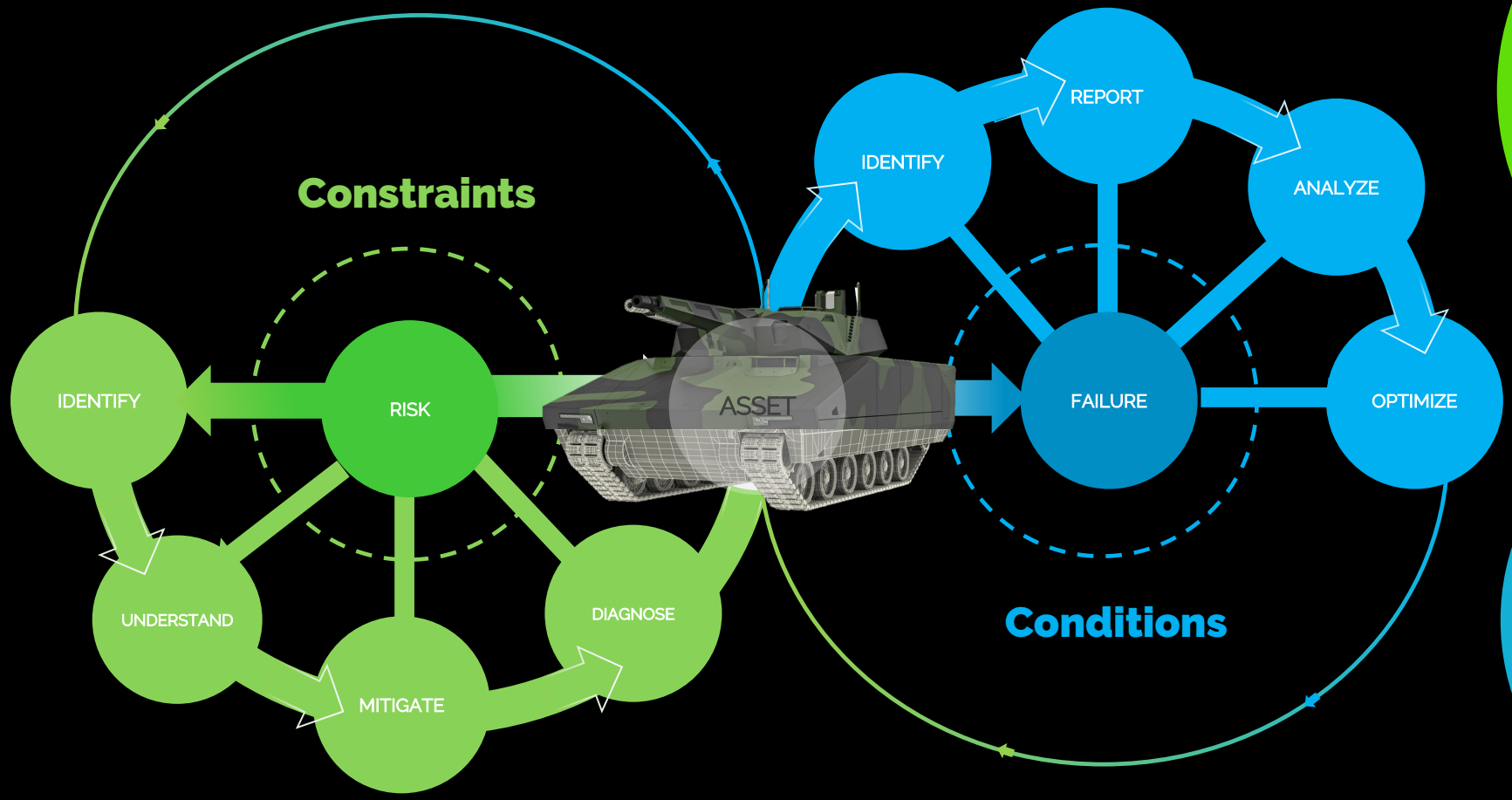
- Configuration
- Mission Profile -
- Operating Context
- Operating Environment
- Supply Chain

Technical Risk – Sustainment Impacts



The efficient digitization and management of engineering risk is a key determinant for optimizing acquisition, design and sustainment processes.

Technical Risk - Failure Lifecycle



RAMS Requirements

Digital Risk Twin
Model-based analysis
Process Consistency
PPMx Design
Frictionless Data

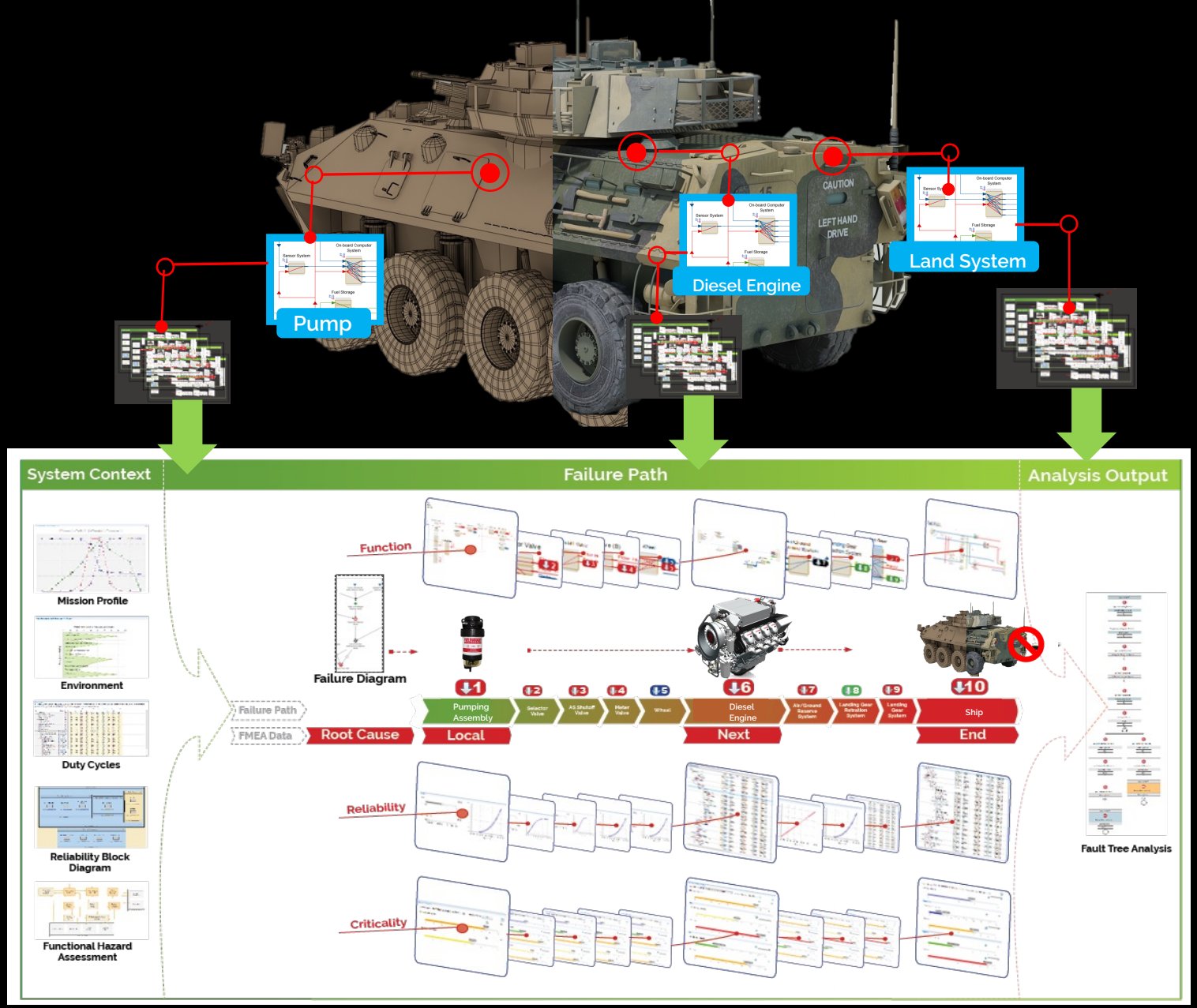
ILS Outcomes

Rapid Diagnostics
Service Decision Support
Digital Domain Knowledge
Causation-based AI
Autonomy

Digital Risk Twin

The Digital Risk Twin (DRT) uses a simulation model of a system to identify & analyse potential failures / hazards & their impacts.

Each potential risk is assessed based on configuration, context (environment, regime), cost and impact (mission / cost).

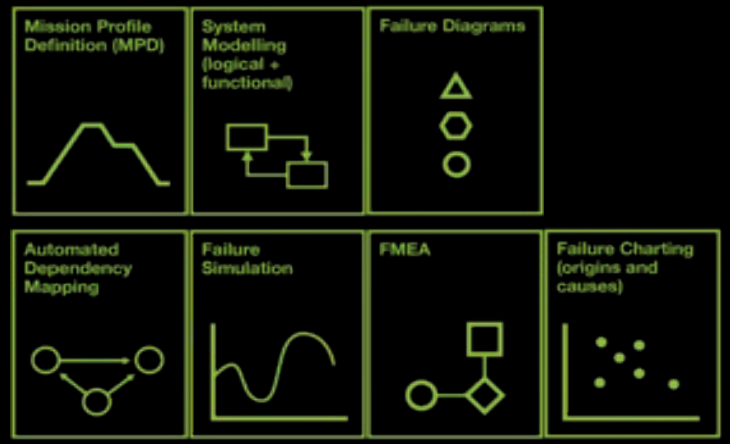


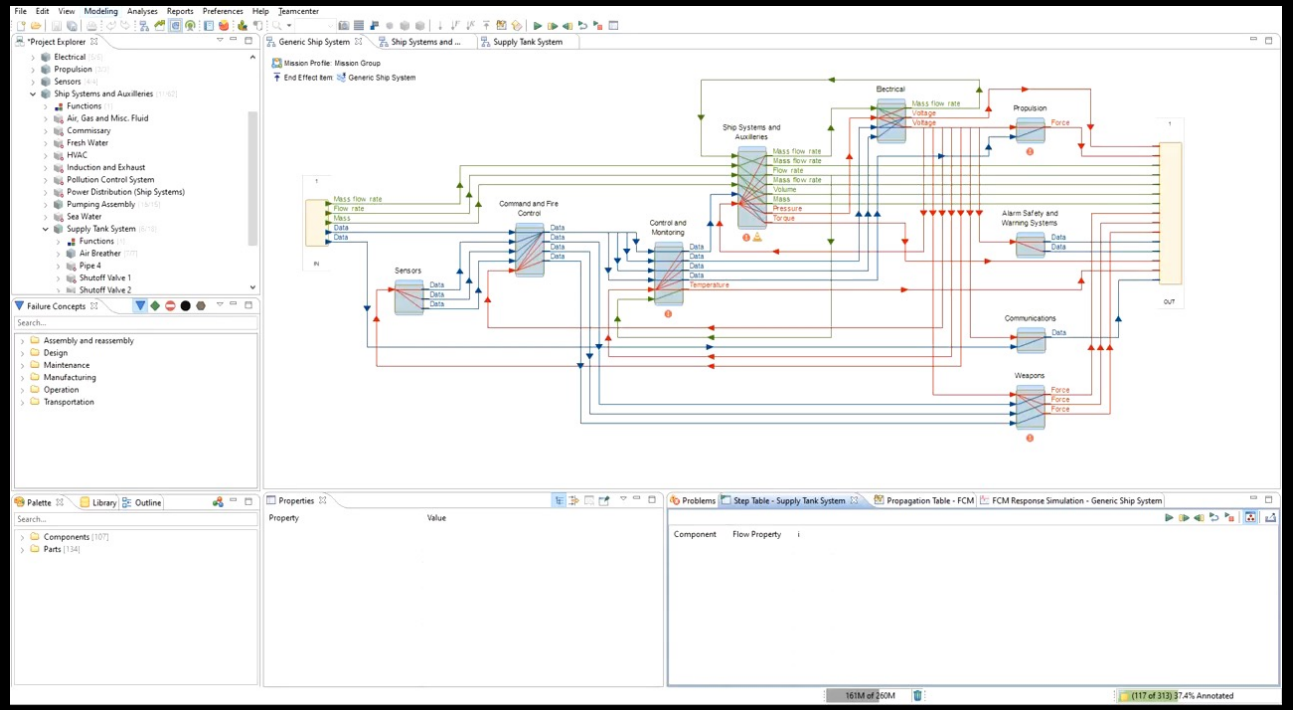
MADe – System Modelling

The MADe platform generates a Digital Risk Twin that is used to identify, analyze and mitigate the technical engineering risk in a system during design and operation.

MADe
System Modelling

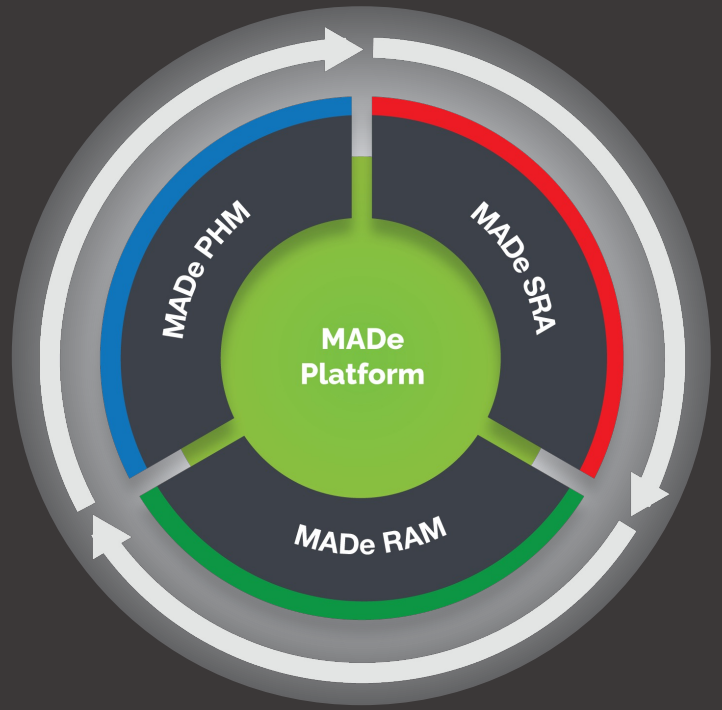
Generate the Digital Risk Twin and digitize domain knowledge ABC



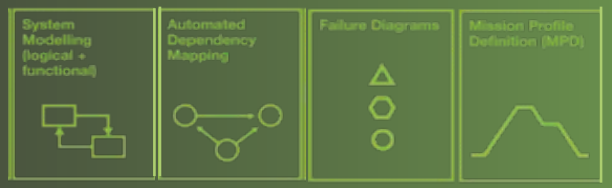


Maintenance Aware Design environment (MADe)

The MADe platform generates a Digital Risk Twin that is used to identify, analyze and mitigate the technical engineering risk in a system during design and operation.



System Modelling

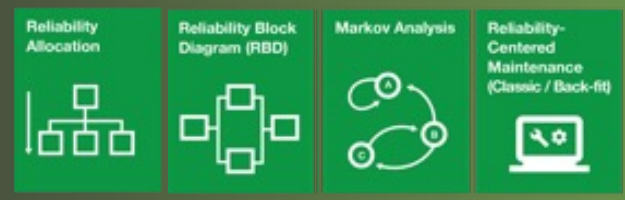


Generate the Digital Risk Twin and digitize domain knowledge ABC

Safety & Risk Assessment (SRA)

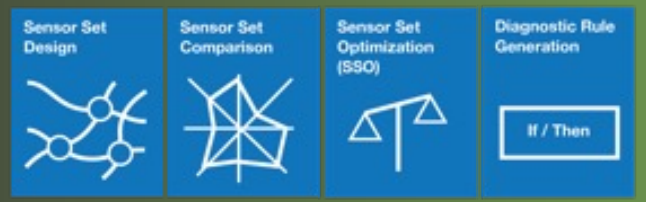
Automate and standardize failure / hazard analysis

Reliability, Availability & Maintainability (RAM)



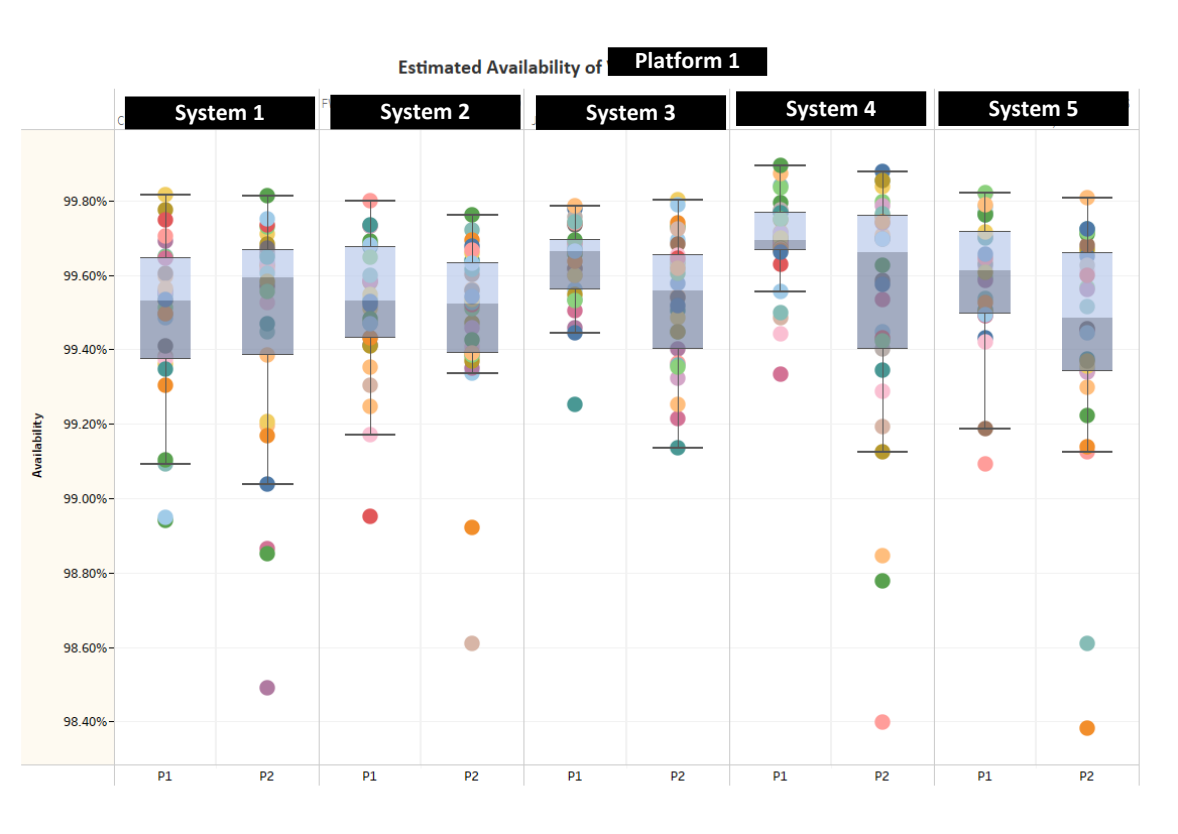
Model-based analysis enables continuous trade studies

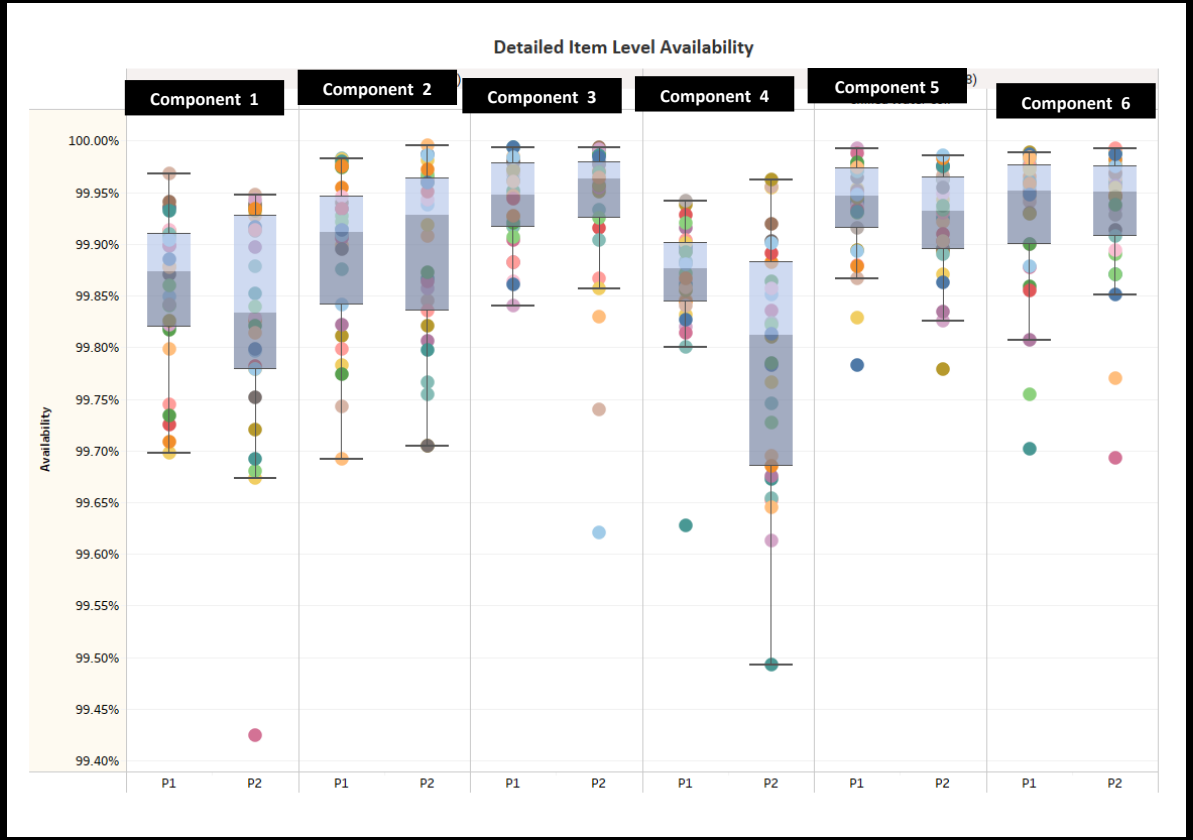
Prognostic & Health Management (PHM)



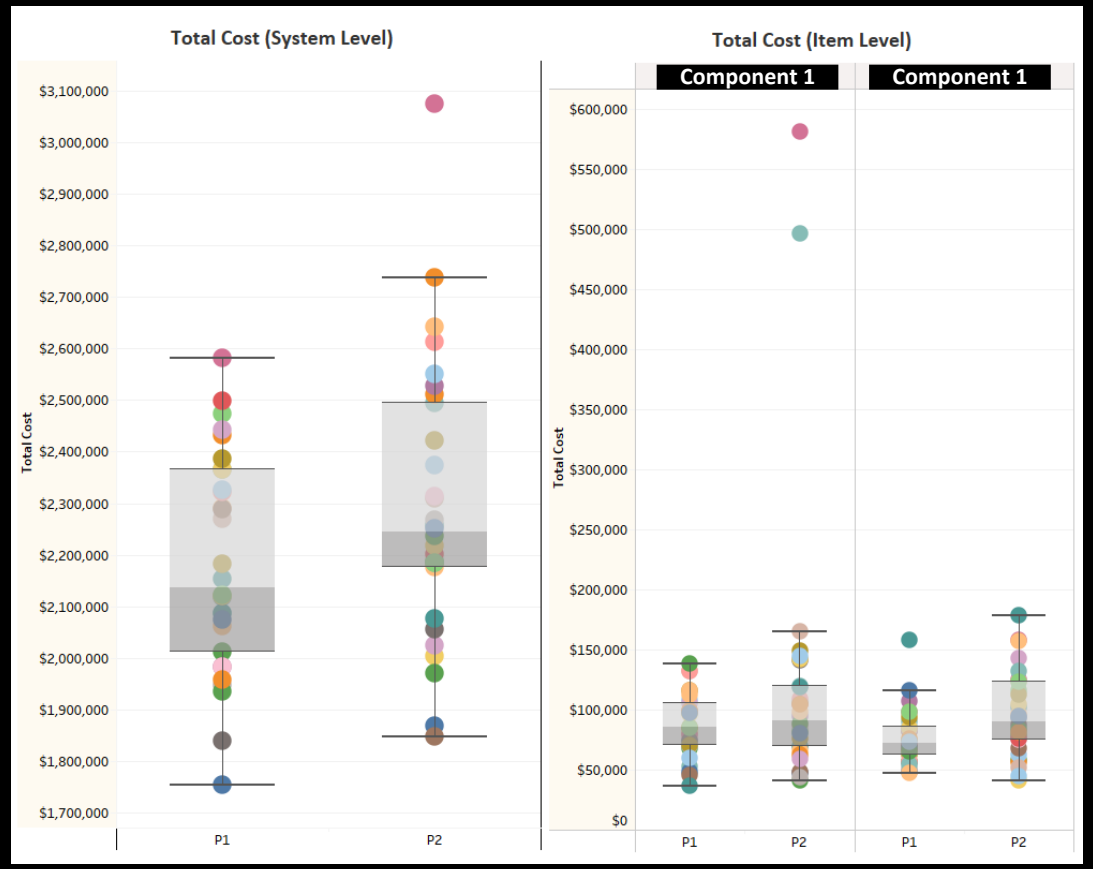
Model-based design and verification of diagnostics. PHM Trade Studies

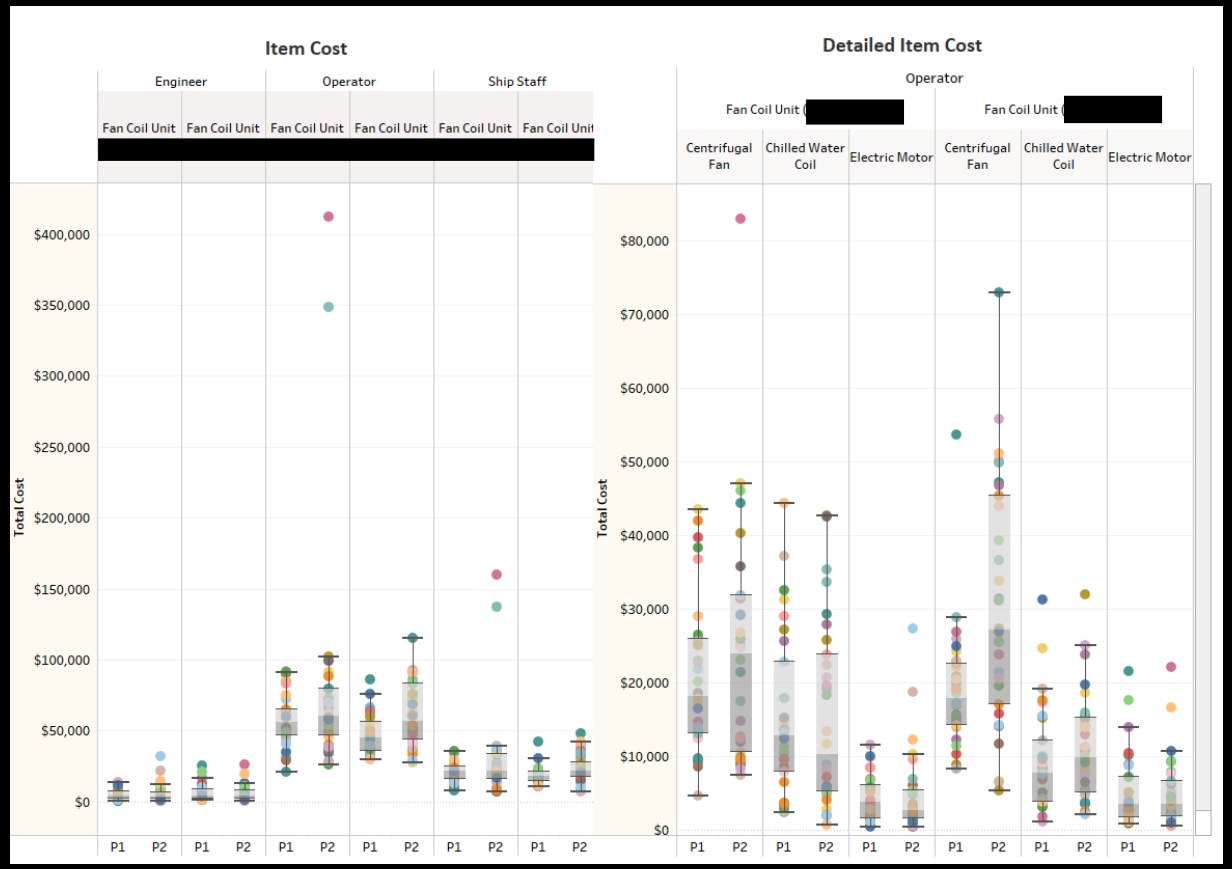
DRT based trade studies



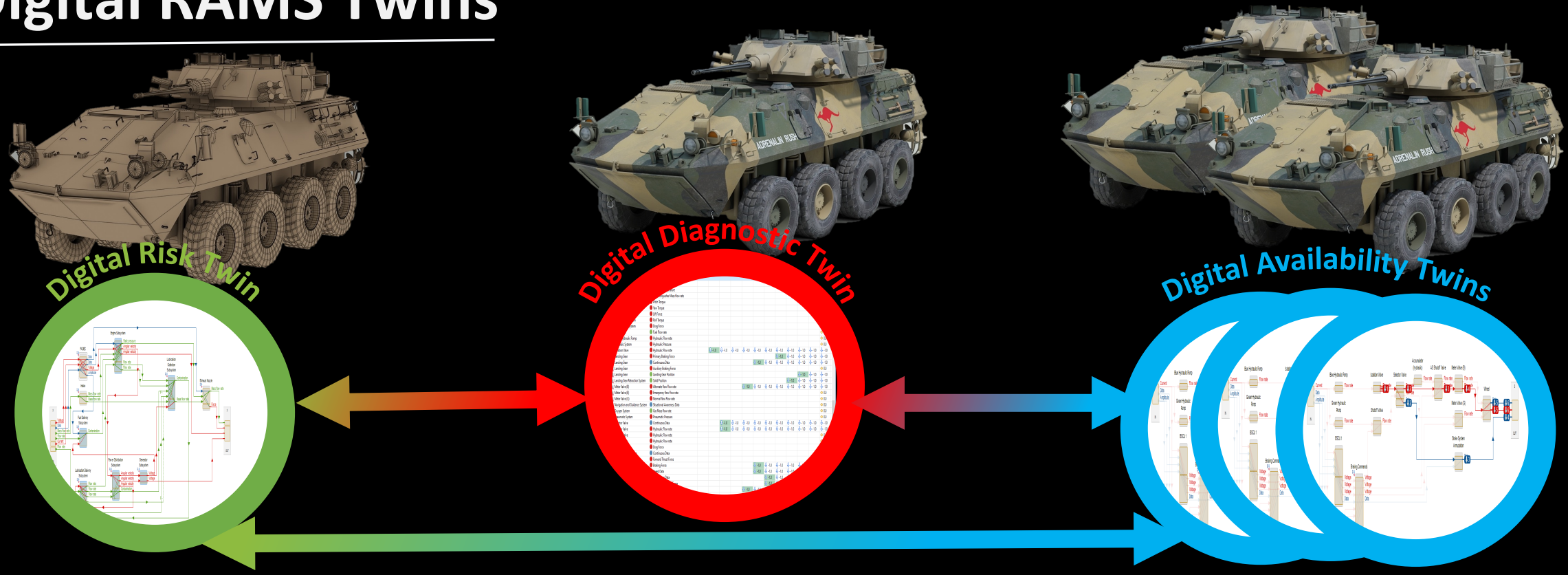


DRT driven trade studies





Digital RAMS Twins



Digital Risk Twin

Simulation model to identify and analyse failures & hazards to establish best-fit mitigations

Digital Diagnostic Twin

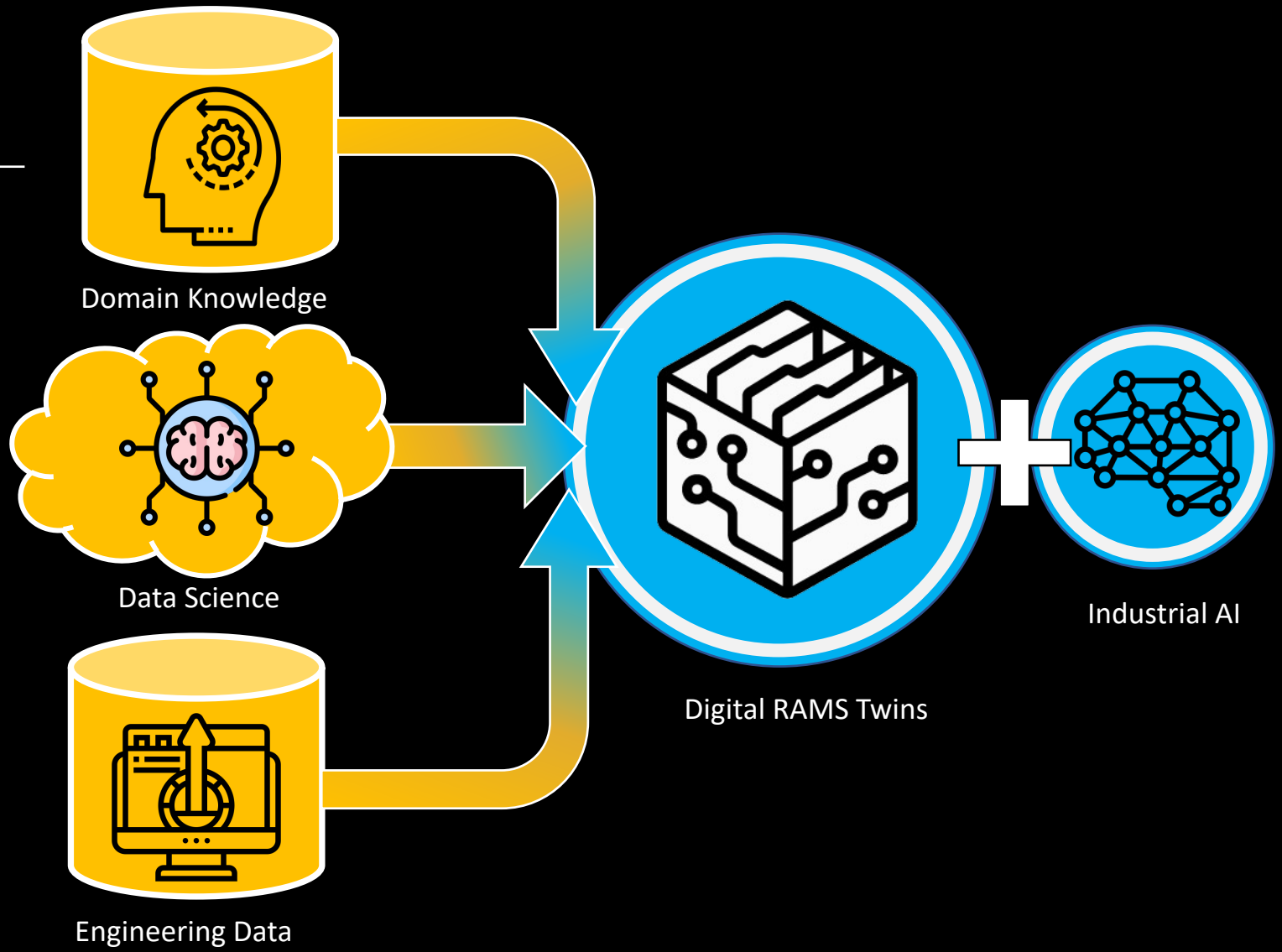
Simulation model to identify operational system responses to (incipient) failures

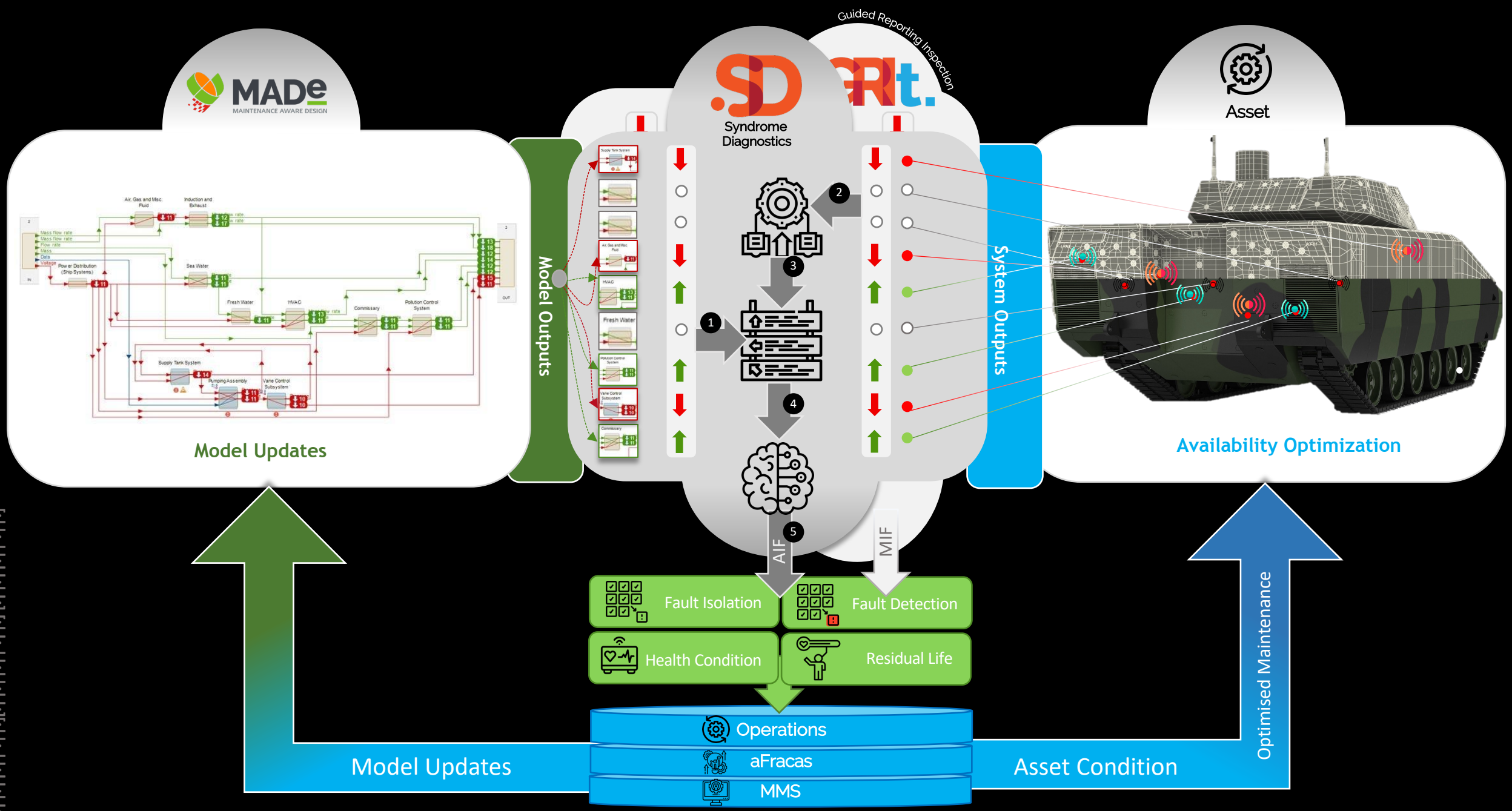
Digital Availability Twins

Simulation model to identify optimization opportunities at asset & fleet level

Definition of Causation-based AI

Causation-based AI (CbAI) is: “the synthesis of engineering domain knowledge, engineering data and data science for simulation and analysis”



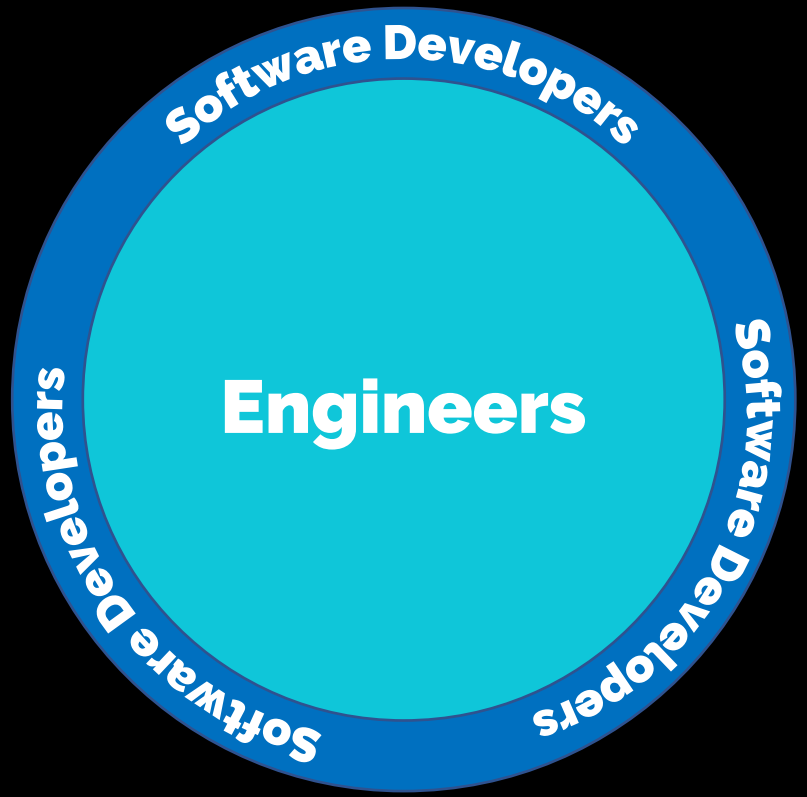

MADe
MAINTENANCE AWARE DESIGN
Model Updates
Model Outputs
Guided Reporting Inspection
SD
Syndrome Diagnostics
GRIt.
1
2
3
4
5
AIF
MIF
Fault Isolation
Fault Detection
Health Condition
Residual Life
Operations
aFracas
MMS
System Outputs
Asset
Availability Optimization
Model Updates
Asset Condition
Optimised Maintenance

The benefits of a DRT for Sovereign Sustainment

Digital RAMS Twins provide an integrated, model-based platform to digitize RAMS / ILS analysis and enables PHM / CBM, Causation-based AI & automation of analysis to optimize both design & sustainment.

Corporate Level	System Level	Analysis Level
1. Cost Reduction Continuous optimization of maintenance leads to lower cost of ownership	**1. Process improvement** Cost Benefits in RAMS process achieved through process consistency / analysis automation	**1. Analysis Automation** Data visualization & automated analyses enable rapid / shared capability
2. Supply Chain Optimization Increased accuracy of forecasting for supply chain production volumes	**2. Continuous Optimization** Digital Twins enable continuous trade studies to identify the optimal maintenance approach	**2. Optimized Risk Mitigation** Data visualization means more consistent & accurate risk identification & mitigation
3. Digital Transformation Digitalization of RAMS enables integration to Digital Thread & Supply Chain partners	**3. Knowledge Digitization** System knowledge is digitized - so it can be leveraged into Sustainment decision making	**3. Digital Twin technology** Analysis integrity and confidence using evidence-based decision making

PHM Technology



- Corporate Goal – to provide the technology to address Technical Risk in the design and sustainment of complex, safety/mission-critical systems

- 40 Staff
- Australian company (Victoria)
- Established 2006
- Privately owned (Siemens minority shareholder)
- PHM Technology develops the MADe & MODe platforms

PHMT User Community

PHM Technology
Decisions better made

Aerospace

NASA

LOCKHEED MARTIN

NORTHROP GRUMMAN

SPIRIT AEROSYSTEMS

Defence

U.S.ARMY

GENERAL DYNAMICS Land Systems

RHEINMETALL

L3HARRIS™

KBR

Maritime

PEO USC

NAVY

AUSTAL

Navantia Australia

Advanced Technology

Lam RESEARCH

ASML

SIEMENS

MITSUBISHI HEAVY INDUSTRIES

Discussion

- What does it take to establish a Digital Risk Twin?
- Who should ‘own’ the DRT for ADF platforms?
- When can / should you develop a DRT? (is it cost-effective for legacy platforms?)
- As a local supplier – does it help me to demonstrate the ‘business case’ for developing sovereign production capability to ADF?
- Will Collingwood be able to win as many close games next year and ‘win it all’?

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End

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