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Ana Kuusk

An efficient AI pathway
to intelligent HV asset
management
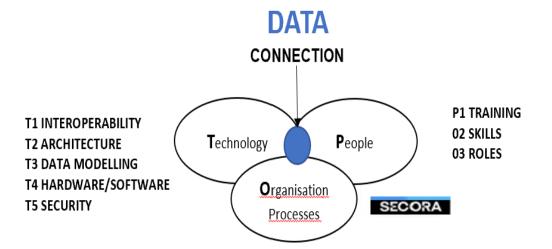
Data Convergence

Every industrial asset organisation wants........

....................A data and AI framework
...............On a dashboard, HMI, a model or a digital twin
.........That predicts & integrates in real time asset cost & failures
......Automates approvals ,compliance, integration & monitoring
...Without extra investment

SO HOW.............................THE DATA SAFARI!

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Data Convergence

- People
- Technology
- Process
- Assets

DATA

CONNECTION

Technology — People

Organisation
Processes

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T1 INTEROPERABILITY
T2 ARCHITECTURE
T3 DATA MODELLING
T4 HARDWARE/SOFTWARE
T5 SECURITY

P1 TRAINING
02 SKILLS
03 ROLES

01 RESOURCES
02 COSTS
03 PROJECT MANAGEMENT
04 RISK
05 QUALITY
06 STRATEGY ALIGNMENT

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Programming for Industrial AI

PROPENSITY AI
filters and prioritizes assets worth analyzing

PARADIGM

STATISTICAL LEARNING
SUPERVISED ML

LANGUAGES

Python, R
Scala

TOOLS/FRAMEWORKS

Scikit-learn   XGBoost

PREDICTIVE AI
forescasts future risk and costs for those assets

PARADIGM
• TIME SERIES
• DEEP LEARNING
• PROBABILISTIC

LANGUAGES

Python, R
MATLAB

TOOLS/FRAMEWORKS

AGENTIC AI
proposes or executes strategies, negotiates constraints, and learns from decisions
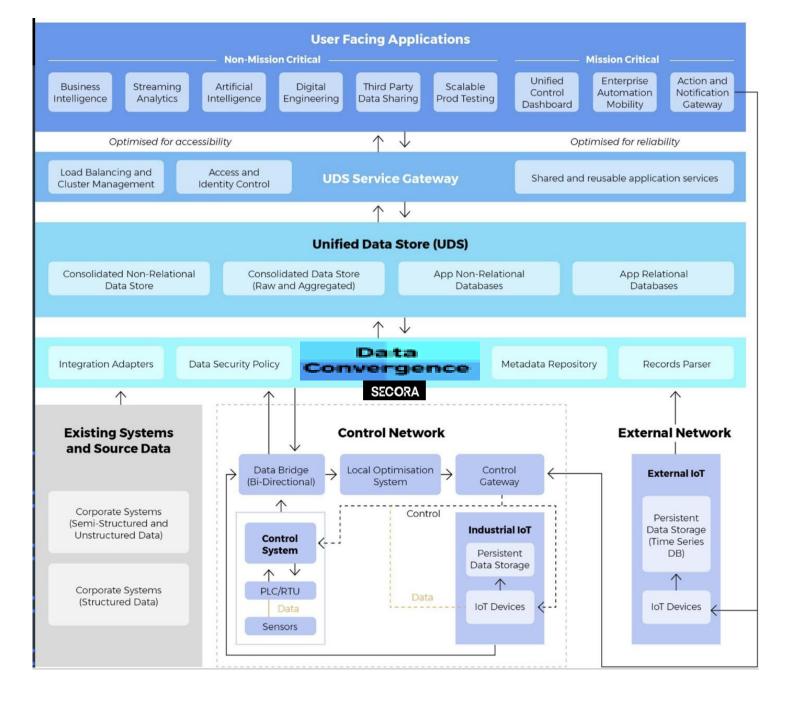
PARADIGM
• DECLARATIVE
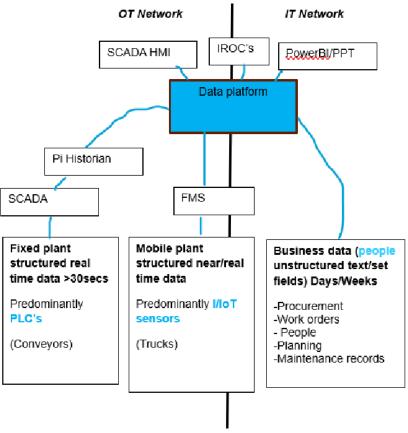• AGENT-ORIENTED
• RL, LOGIC

TOOLS / FRAMEWOKS

Clingo, Gym, PDDL
ASP
Clingo

Generative & Large Language Model

```json
{"ASSET_VULNERABILITY": {
    "ELAPSED_DESIGN_LIFE": 5,
    "AVG_MONTHLY_PM01_WORK_ORDER_COUNT": 3,
    "AVG_MONTHLY_PM03_WORK_ORDER_COUNT": 3,
    "OPEN_PM01_WORK_ORDER_COUNT": 5,
    "AVG_MONTHLY_P1_DEFECT_COUNT": 5,
    "AVG_MONTHLY_P2_DEFECT_COUNT": 3,
    "AVG_MONTHLY_P3_DEFECT_COUNT": 2,
    "AVG_MONTHLY_P4_DEFECT_COUNT": 1,
    "OPEN_P1_DEFECT_COUNT": 8,
    "OPEN_P2_DEFECT_COUNT": 5,
    "OPEN_P3_DEFECT_COUNT": 3,
    "OPEN_P4_DEFECT_COUNT": 2,
    "HARSH_ENVIRONMENT": 5,
    "LEVEL_OF_SERVICE": 5
}, "FINANCIAL_RISK": {
    "AVG_MONTHLY_PM01_WORK_ORDER_COST_USD": 5,
    "AVG_MONTHLY_PM02_WORK_ORDER_COST_USD": 2,
    "AVG_MONTHLY_PM03_WORK_ORDER_COST_USD": 3,
    "AVG_MONTHLY_P1_DEFECT_COST_USD": 5,
    "AVG_MONTHLY_P2_DEFECT_COST_USD": 3,
    "AVG_MONTHLY_P3_DEFECT_COST_USD": 2,
    "AVG_MONTHLY_P4_DEFECT_COST_USD": 1,
    "REPLACEMENT_COST_USD": 5,
    "REPAIR_COST_USD": 5
}}
```

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User Facing Applications

Non-Mission Critical | Mission Critical

| Business Intelligence | Streaming Analytics | Artificial Intelligence | Digital Engineering | Third Party Data Sharing | Scalable Prod Testing | Unified Control Dashboard | Enterprise Automation Mobility | Action and Notification Gateway |

Optimised for accessibility | *Optimised for reliability*

UDS Service Gateway

| Load Balancing and Cluster Management | Access and Identity Control | | Shared and reusable application services |

Unified Data Store (UDS)

| Consolidated Non-Relational Data Store | Consolidated Data Store (Raw and Aggregated) | App Non-Relational Databases | App Relational Databases |

| Integration Adapters | Data Security Policy | **Data Convergence** SECORA | Metadata Repository | Records Parser |

Existing Systems and Source Data

Corporate Systems (Semi-Structured and Unstructured Data)

Corporate Systems (Structured Data)

Control Network

Data Bridge (Bi-Directional) → Local Optimisation System → Control Gateway

Control

Control System
PLC/RTU
Data
Sensors

Data

Industrial IoT
Persistent Data Storage
IoT Devices

External Network

External IoT
Persistent Data Storage (Time Series DB)
IoT Devices

OT Network | *IT Network*

| SCADA HMI | IROC's | PowerBI/PPT |

Data platform

Pi Historian

SCADA | FMS

Fixed plant structured real time data >30secs

Predominantly **PLC's**

(Conveyors)

Mobile plant structured near/real time data

Predominantly **I/IoT sensors**

(Trucks)

Business data (people unstructured text/set fields) Days/Weeks

-Procurement
-Work orders
- People
-Planning
-Maintenance records

One-Page Asset Management Plan (Auto Generated)

Lifecycle Management Metric

Demonstrating the effective use of relative vulnerability and financial risk

Data filtering & user input

Dynamic interactive Heatmap of assets

Data table to enable deeper insights

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Lifecycle Management Metric

Optimisation to deliver targeted maintenance strategies and informed investment decisions

Maintenance → Production → Financial →

Vulnerability
Availability
SAP
Level of Service
Utilisation
Downtime
Residual Value
Criticality
Market Conditions

Informed Maintenance & Investment Decisions

Lifecycle Management Metric

Demonstrating the effective use of relative vulnerability and financial risk

	Performance Indicator	Relative Score ST48	Relative Score WT04
Physical Condition	Age of Asset	5.56	7.35
	Elapsed design life	4.47	7.54
	Current Asset condition	4.14	6.98
	Past Repairs and Maintenance History	6.87	10.00
	Chassis Intensity (Truck only, Excavator Equivalent)	6.43	7.89
Operational Performance	Frequency of Unscheduled Downtimes	1.00	7.13
	LOA Requirement (Required Level of Service RLS)	3.25	8.72
External Factors	Autonomous Vs Crewed (Where fitted)	1.00	10.00
Financial Impact	Remaining Economical Useful Life	3.77	8.20
Risk Factor	Criticality to Operations	Manual	Manual
	Market Conditions	Manual	Manual

WATER TRUCKS - SITE XYZ

Higher Priority

Lower Priority

Asset Vulnerability

Financial Risk

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Name plate capture

OEM data

Area
> Territory
> Geometry contour

Topology Layers
> Bathymetry Data
> Terrain Data

Model Layers
> Services Data
> Waterfront Structures
> BIM Models
> Hydrographic Data
> Cadastral Data
> Vegetation Layers
> Culture/Habitat Layers
> Navigational Markers

Operational
> Road & Rail Transport
> Electrical network
> Water Distribution
> Communications
> Partner Data
> Operational Data
> Related Supply Chains
> Traffic/Other Social

Simulations
> Tidal Variance
> Cyclonic Conditions
> Asset User Types
> Site Selection
> Layout & Configuration
> Defence Concentration
> Stakeholder Orientation
> Harbour Traffic

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Prioritised value and benefit case to ensure the application of the existing Equipment Criticality Assessment is appropriately informing decisions around the procurement and management of critical spares.

Proposed Value Case:

Challenge 1: Lack of standardised procedures and workflows for procurement and management processes.

Challenge 2: $0.5B Unassigned Inventory across the business.

Challenge 3: Lack of Alignment between Critical Spares flag assignment and Supply-Chain Critical Equipment.

Optimised Procurement

$2.1M reduction

Initial L1 impact identified by aligning the need for critical spares to support critical production paths/ for supply chain critical equipment only.

Reduction in Unassigned Spares

$5.4M savings

Opportunity identified to ensure the appropriate procurement and prioritisation decisions for critical spares.

Improved Parts Availability

~10% reduction

Opportunity to reduce excess spend on expediting delayed or missing critical parts for PM02 related work.

Challenges and Opportunity Identification:

Process Mapping Activities to understand current processes and gaps surrounding the critical spares lifecycle.
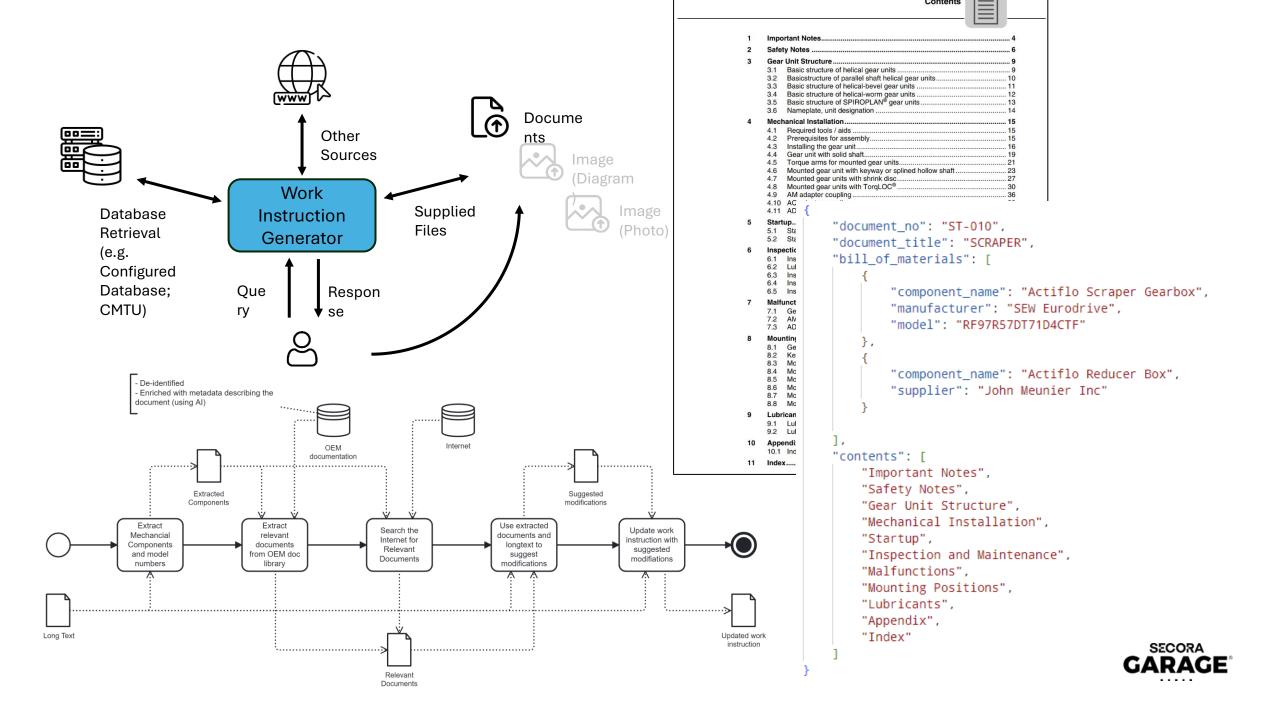
Discovery sessions conducted with site-based teams to further understand any challenges and pain points regarding the management of critical spares..

Failure Mode Effects Analysis conducted to further explore and determine the highest impacting failure points and challenges within the procedural steps + discovery sessions with site-based teams.
* Discovery session findings validated through the FMEA document

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Work Instruction Generator Diagram

Other Sources

Documents

Database Retrieval (e.g. Configured Database; CMTU)

Work Instruction Generator

Supplied Files

Image (Diagram)

Image (Photo)

Query

Response

- De-identified
- Enriched with metadata describing the document (using AI)

OEM documentation

Internet

Long Text

Extracted Components

Extract Mechanical Components and model numbers

Extract relevant documents from OEM doc library

Search the Internet for Relevant Documents

Relevant Documents

Use extracted documents and longtext to suggest modifications

Suggested modifications

Update work instruction with suggested modifiations

Updated work instruction

Contents

```json
{
    "document_no": "ST-010",
    "document_title": "SCRAPER",
    "bill_of_materials": [
        {
            "component_name": "Actiflo Scraper Gearbox",
            "manufacturer": "SEW Eurodrive",
            "model": "RF97R57DT71D4CTF"
        },
        {
            "component_name": "Actiflo Reducer Box",
            "supplier": "John Meunier Inc"
        }
    ],
    "contents": [
        "Important Notes",
        "Safety Notes",
        "Gear Unit Structure",
        "Mechanical Installation",
        "Startup",
        "Inspection and Maintenance",
        "Malfunctions",
        "Mounting Positions",
        "Lubricants",
        "Appendix",
        "Index"
    ]
}
```

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Input: Long Text Work Instruction

CWT Actiflo Mixers Gearbox Oil Change.

SAFETY NOTES
 OBTAIN PTW BEFORE COMMENCING WORK.
TOOLS: -
 OIL = CASTROL ALPHA 220SP
 SUITABLE SIZE OIL CATCHING TRAY
GEARBOX SPECIFICATIONS: -
COAG TANK AND INJECTION TANK MIXERS
NORD MODEL 4282 STYLE H5
OIL QUANTITY 5.4 LITRES
MATURATION TANK MIXER
NORD MODEL 6382 STYLE H5
OIL QUANTITY 18 LITRES
SLUDGE RAKE GEARBOX
SEW MODEL RF97R57DT71D46TF STYLE M5
LARGE GEARBOX OIL QUANTITY 11.2 LITRES
SMALL GEARBOX OIL QUANTITY 1.7 LITRES
LOWER GEARBOX TO BE FULLY WIPED OUT DUE
TO MOISTURE INGRESS
METHOD: -
1. DRAIN OIL FROM GEARBOX INTO SUITABLE SIZED CONTAINER. NOTE:- BE CAREFULL NOT TO
LEAK OIL INTO ACTIFLO. PLACE OIL ABSORBENT MATERIAL ARROUND AREA OF DRAIN.
2. REFILL GEARBOX WITH ABOVE QUANTITY OF OIL. LUBE = CASTROL ALPHA 220SP
3. REMOVE AND CLEAN BREATHER ON SIDE OF GEARBOX
NOTE:- IF REMOVING MOTOR(EASIEST WAY TO REFILL) RESEAL GEARBOX TO MOTOR WITH 0.8MM
OIL GASKET IN CONTAINER 3

Output: Extracted Components

The work instruction pertains to the following mechanical components:

1. Coag Tank and Injection Tank Mixers:
    - Manufacturer: Nord
    - Model Number: 4282 Style H5
    - Gearbox Oil Quantity: 5.4 litres

2. Maturation Tank Mixer:
    - Manufacturer: Nord
    - Model Number: 6382 Style H5
    - Gearbox Oil Quantity: 18 litres

3. Sludge Rake Gearbox:
    - Manufacturer: Sew
    - Model Number: RF97R57DT71D46TF Style M5
    - Large Gearbox Oil Quantity: 11.2 litres
    - Small Gearbox Oil Quantity: 1.7 litres

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Takeaways : Data Safari before Procurement

Integrate propensity modeling into asset management

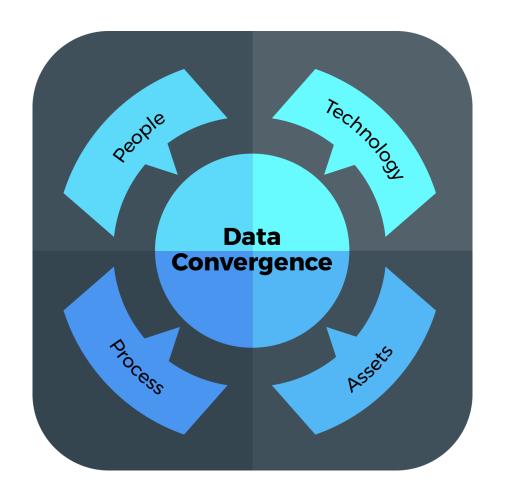**Incorporate ASP for operational logic**

Move towards autonomous AI

Focus on connecting the OT&IT data you already have to create automated, persistent pipelines

Across the teams, projects and software applications you already have

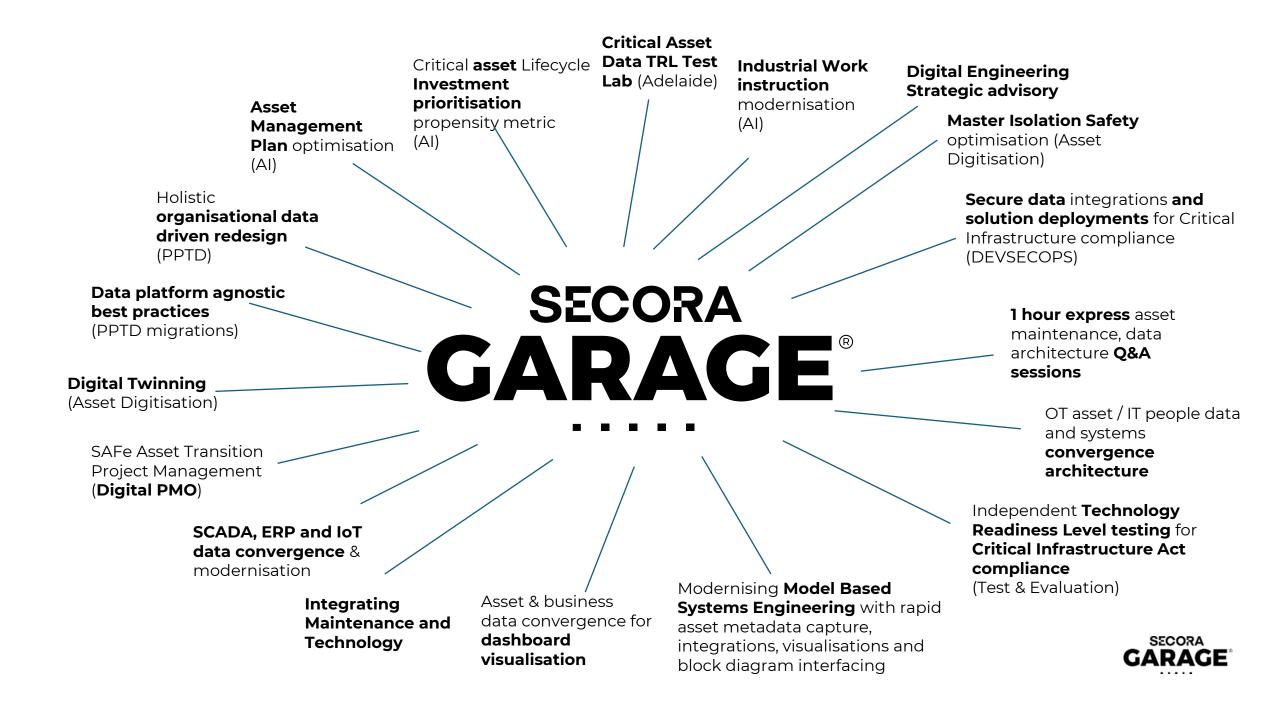By starting with what you want a screen to tell you – find the persistent, automated pipelines

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Critical **asset** Lifecycle **Investment prioritisation** propensity metric (AI)

Critical Asset Data TRL Test Lab (Adelaide)

Industrial Work instruction modernisation (AI)

Digital Engineering Strategic advisory

Asset Management Plan optimisation (AI)

Master Isolation Safety optimisation (Asset Digitisation)

Holistic **organisational data driven redesign** (PPTD)

Secure data integrations **and solution deployments** for Critical Infrastructure compliance (DEVSECOPS)

Data platform agnostic best practices (PPTD migrations)

1 hour express asset maintenance, data architecture **Q&A sessions**

Digital Twinning (Asset Digitisation)

OT asset / IT people data and systems **convergence architecture**

SAFe Asset Transition Project Management (**Digital PMO**)

Independent **Technology Readiness Level testing** for **Critical Infrastructure Act compliance** (Test & Evaluation)

SCADA, ERP and IoT data convergence & modernisation

Integrating Maintenance and Technology

Asset & business data convergence for **dashboard visualisation**

Modernising **Model Based Systems Engineering** with rapid asset metadata capture, integrations, visualisations and block diagram interfacing

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Asset Management, Utilisation & Productivity Improvement

Process Design, Process Management & Optimisation

Supply Chain Continuous Improvement & Supplier Development

Maintenance Improvement Strategies and Programs

Industrialisation & Production System Development

Lean Mining, Lean Assets, Lean Construction, Lean Utilities etc

Technology 'Readiness' and Integration

BIM, AWP, Smart ICT, Apps, ERP (SAP, Oracle)

Data Analytics, MVA, Early Event Detection

Training: Productivity & Leadership, Lean, Technology Application

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