



***Overview of Consulting  
and Solution Capabilities***

May 2026

# TPM Solutions at a Glance – Consulting & Technology for the Energy Industry

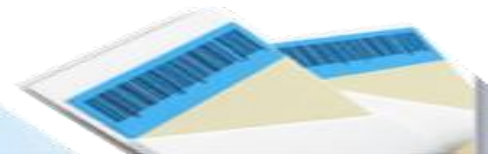
- Founded in 2005 (as R2E)
- USA-based with Singapore subsidiary – Global presence
- Highly experienced Technology & Business Consultants
- Hundreds of plants and facilities visited & reviewed
- Cutting-Edge Solutions
- **Specializing in AI-driven digital operational excellence**

- **AI-Driven Operator Advisory and Digital Asset**
- Digital Transformation / IIoT / Industry 4.0
- Connected Worker & Connected Asset
- Offshore Oil, Gas & LNG Assets
- Optimization & Control, including Energy & GHG Emissions Management
- ESG, Environmental, HSE, PSM and Control of Work
- Advanced Planning & Scheduling, including Backcasting



# TPM Consultants Heritage

Company Type	Heritage Companies
Operating Companies	Shell, Chevron/Caltex, BP, ConocoPhillips, ExxonMobil, Valero, Petronas, Citgo, Total, Pemex, Tesoro, PDVSA, Westlake/Titan, Aramco, Dow, SLNG
Technical Consultants	KBC, Solomon, Jacobs, Pace
Management Consultants	ADL, Wright Killen
System Integrators	Accenture, IBM
Software Applications & IT	Aspen Technology, Invensys, Simulation Sciences, ABB Lummus, Honeywell Process Solutions
Process Technology	UOP, Technip/KTI, Lummus, Profimatics, Sulzer Chemtech, Johnson Matthey/Intercat
Engineering Procurement & Construction	WorleyParsons, Technip, KBR, Bechtel



# TPM Consulting Examples

## People

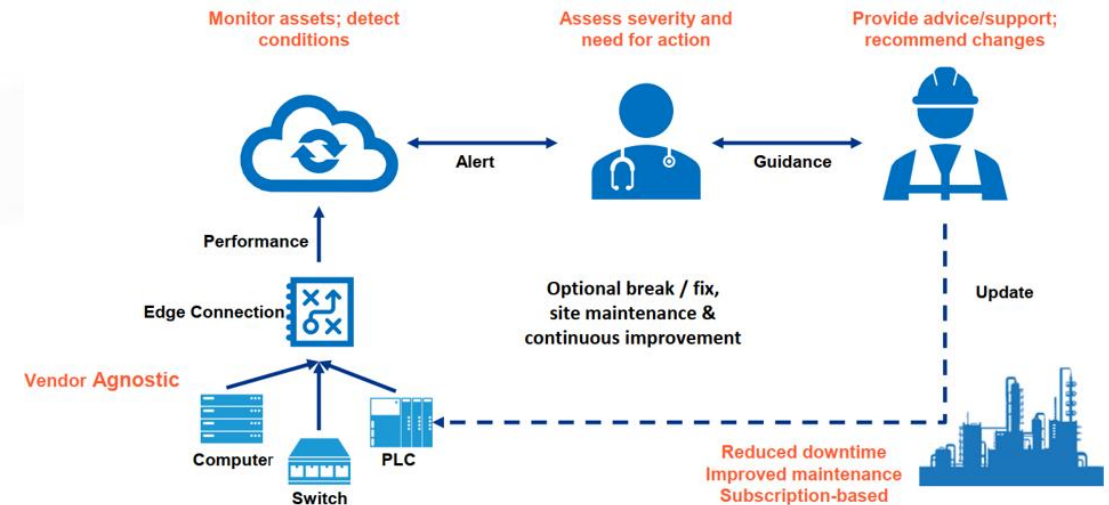
- Adapting to a Digital/AI World
- Productivity Enhancement
- Organizational Effectiveness
- Field Worker Effectiveness
- Workforce Capability
- Leadership
- Training and Development
- Specialists for Capital Projects

## Processes

- Business Process as a Service (BPaaS) for Continuous Improvement
- “As-Is” Business Process Review
- Gap Analysis
- “To Be” based on Best Practices
- Workflow Digitalization
- Business Process Blueprint for Capital Projects

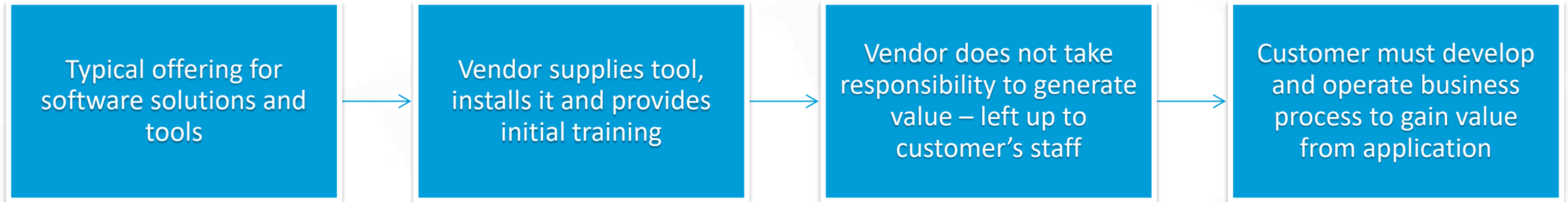
## Technology

- AI Applications
- Digital Operational Excellence
- Connected Asset
- Connected Worker
- Plantwide Optimisation
- Energy and GHG Management



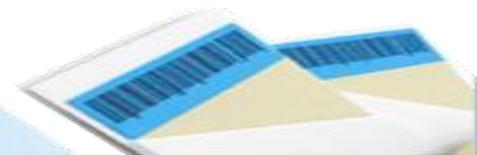
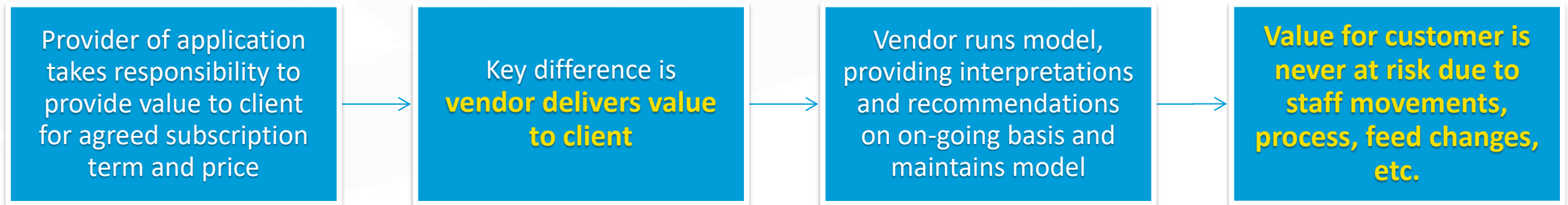
# Value Sustainment – Difference between SaaS and BPaaS

## Software as a Service (SaaS)



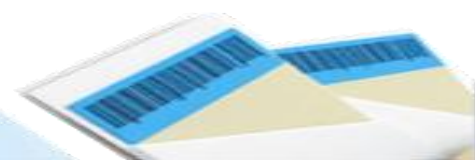
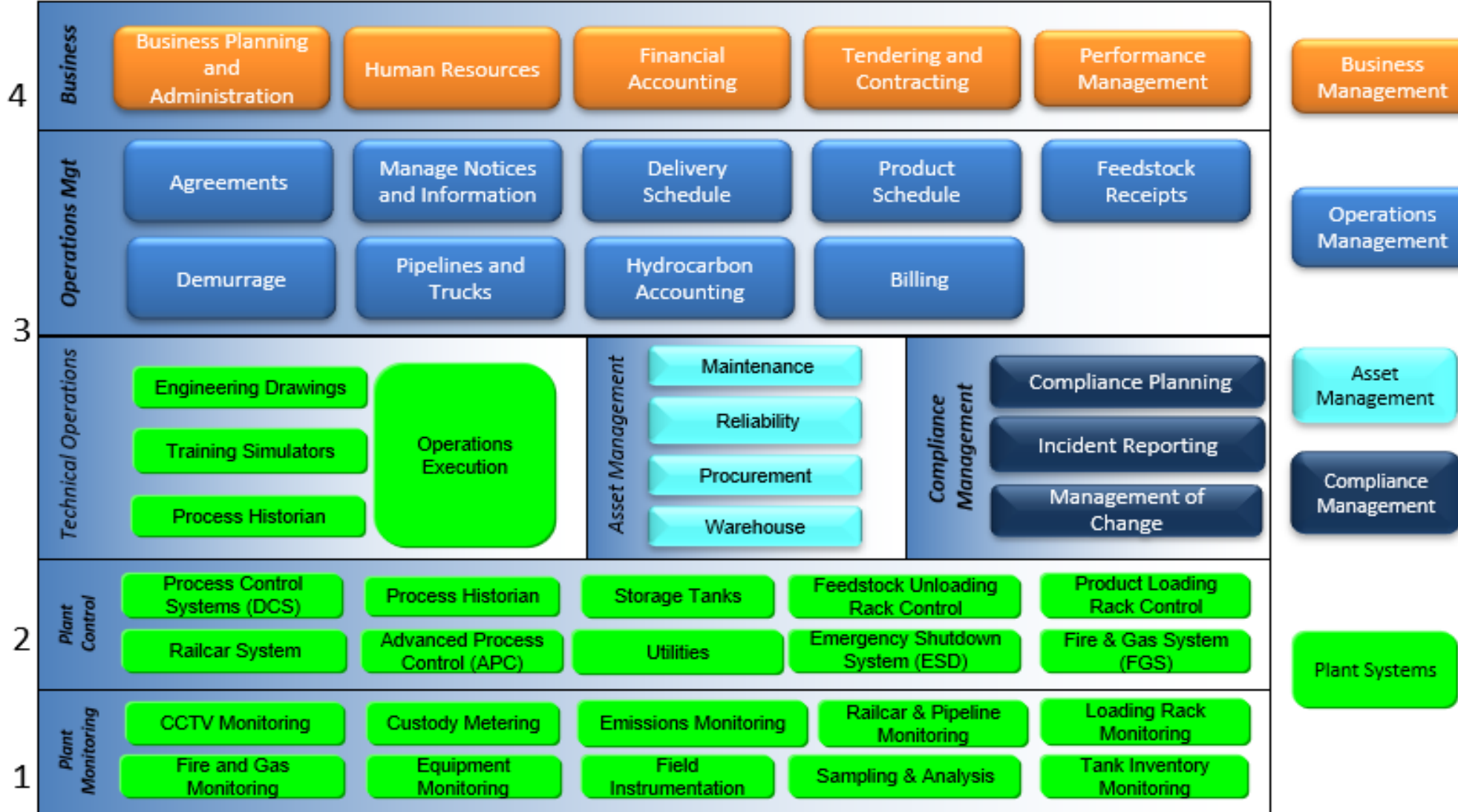
## Business Process as a Service (BPaaS)

### (TPM Business Model)



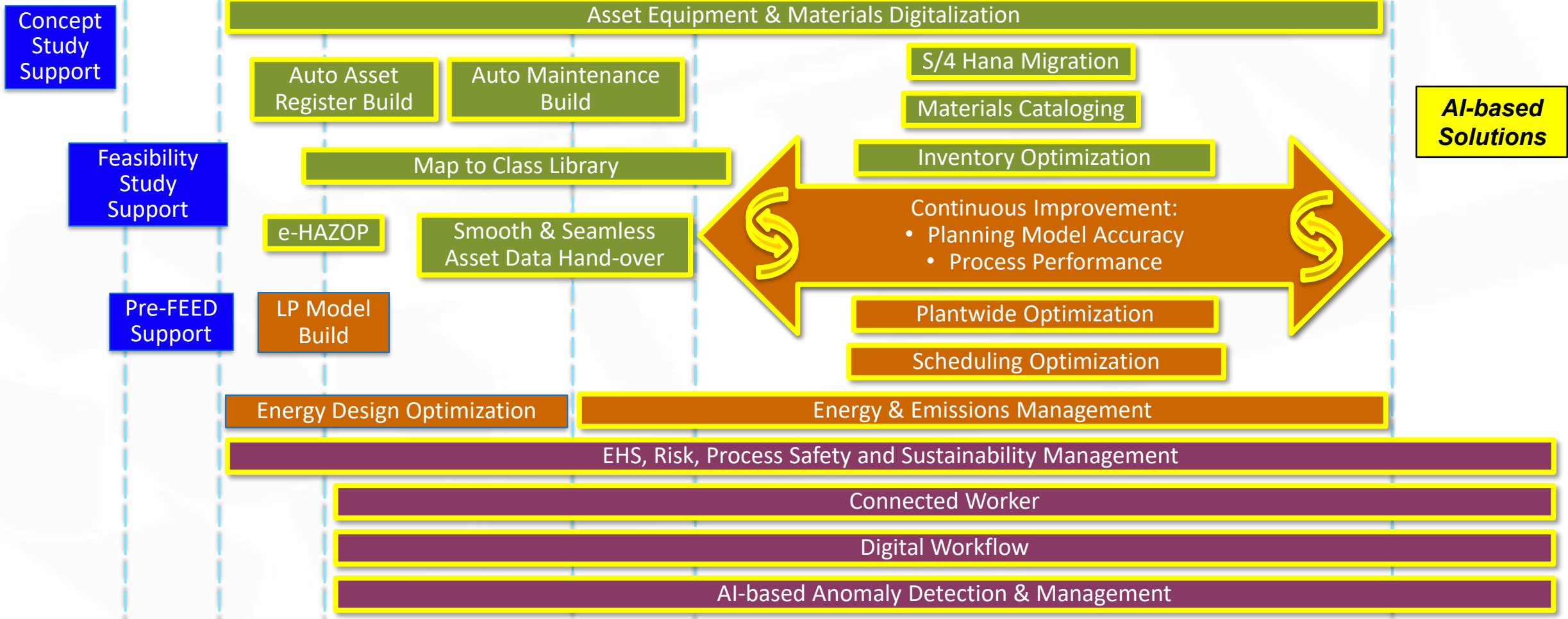
# TPM Business Process as a Service (BPaaS) Experience

Level

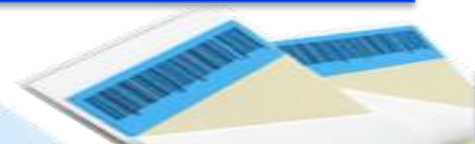


# TPM Solutions Covers the Asset Lifecycle

Consulting Optimization  
Assets Operations

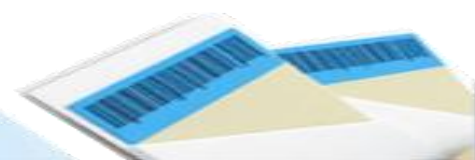
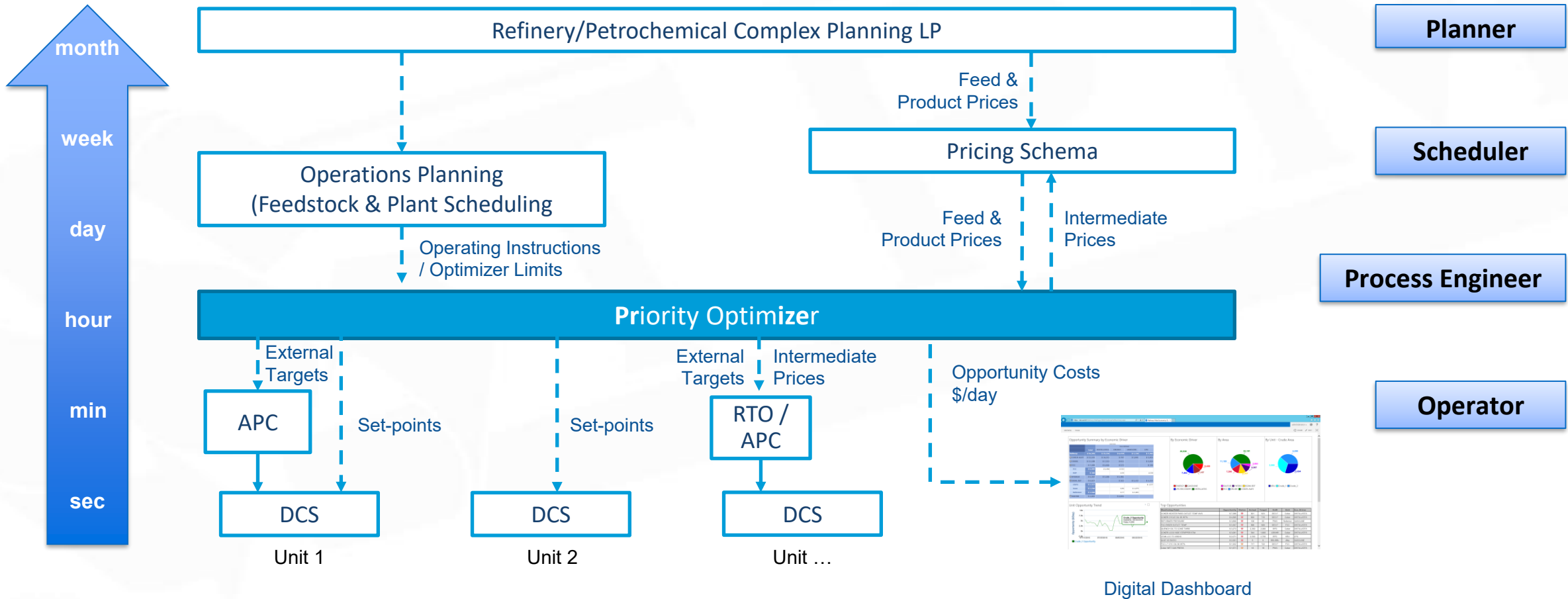


Owners' Consultant / Subject Matter Experts

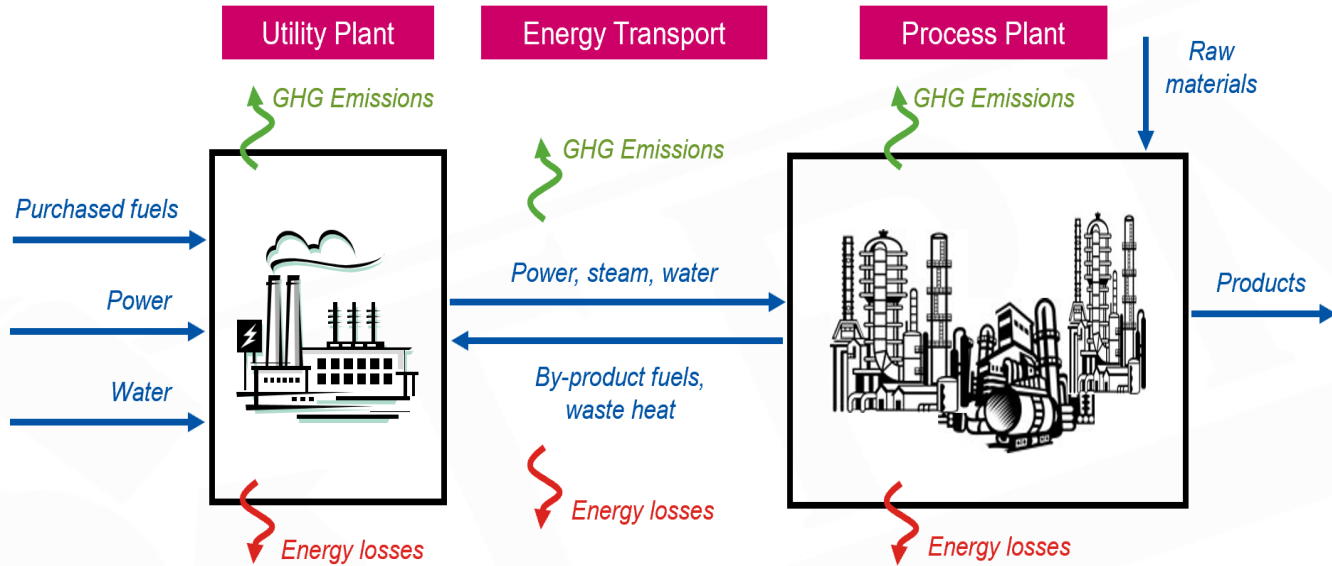


# Plant-wide & Multi-unit Optimization

- **Priority Optimizer (PRIZE) Profit Enhancer**



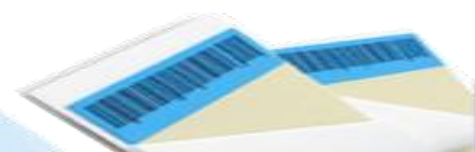
# Energy & Emissions Reduction/Management



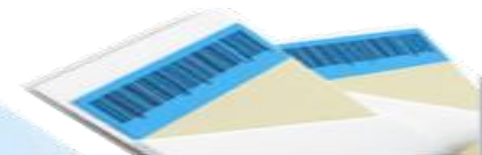
## Equipment types

- |   |  |   |
|---|--|---|
| <ul style="list-style-type: none"> <li>• Boilers</li> <li>• Steam Turbines</li> <li>• Gas Turbines</li> <li>• Generators</li> </ul> | <ul style="list-style-type: none"> <li>• Steam headers</li> <li>• Let-down turbines</li> <li>• Let-down stations / Desuperheaters</li> <li>• Fuel gas network</li> <li>• Transmission lines</li> </ul> | <ul style="list-style-type: none"> <li>• Fired Heaters</li> <li>• Heat exchangers</li> <li>• Pumps, compressors, fans, blowers, motors</li> <li>• ... <u>all process units</u></li> </ul> |
|---|--|---|

Holistic Approach Proven Methodology		
	<b>Supply Side (Utilities)</b>	<b>Demand Side (Processes)</b>
 <b>Design</b>	<b>SUPPLY AT LOWEST COST</b> <ul style="list-style-type: none"> <li>• Utilities system modeling</li> <li>• Optimize utilities system design</li> <li>• Total Site Pinch Analysis</li> <li>• Cogeneration Feasibility</li> <li>• Hydrogen system design</li> </ul>	<b>REDUCE DEMAND</b> <ul style="list-style-type: none"> <li>• Energy/yield/purity trade-off</li> <li>• Process/Column Pinch Analysis</li> <li>• New Technologies</li> <li>• Process re-sequencing &amp; optimization</li> <li>• Establish energy targets</li> </ul>
 <b>Operations</b>	<ul style="list-style-type: none"> <li>• Fuel, Steam &amp; Power optimization</li> <li>• Performance Management</li> <li>• Utilities Contract Management</li> <li>• Hydrogen &amp; Fuel gas management</li> <li>• Reduce flaring &amp; venting</li> </ul>	<ul style="list-style-type: none"> <li>• Operator Decision Support System</li> <li>• Advanced Control Systems</li> <li>• On-line Advisory Optimization Systems</li> <li>• Performance management</li> <li>• Fired heater furnace tuning</li> <li>• Heat Exchanger Monitoring</li> </ul>



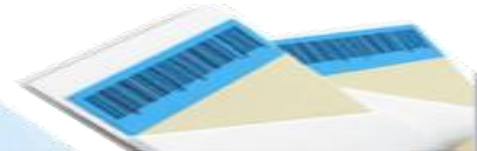
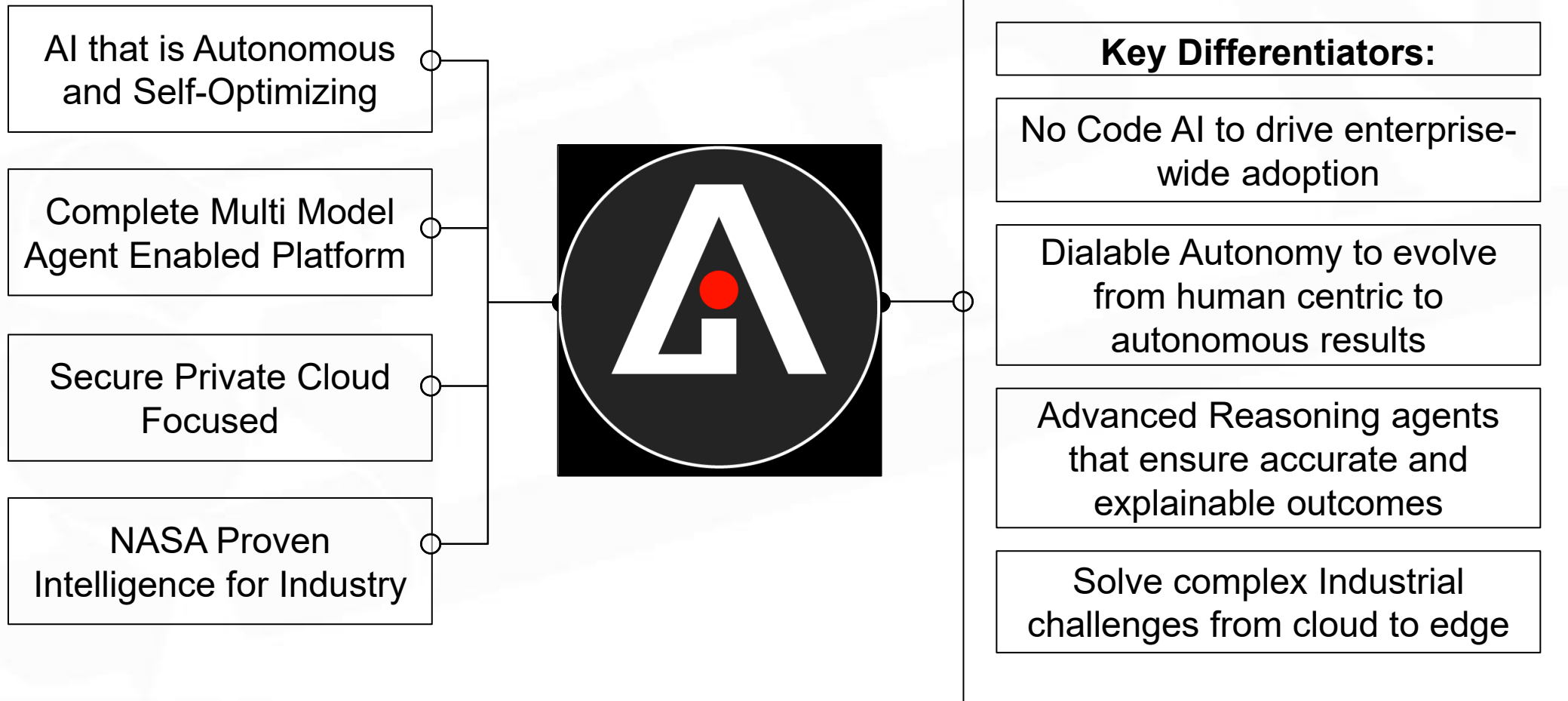
# AI & Advanced Solution Partnerships with TPM



# Beyond AI – A Leader in Industrial AI

Hybrid Agentic AI that Delivers Autonomous Intelligence at Scale

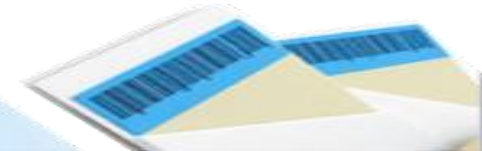
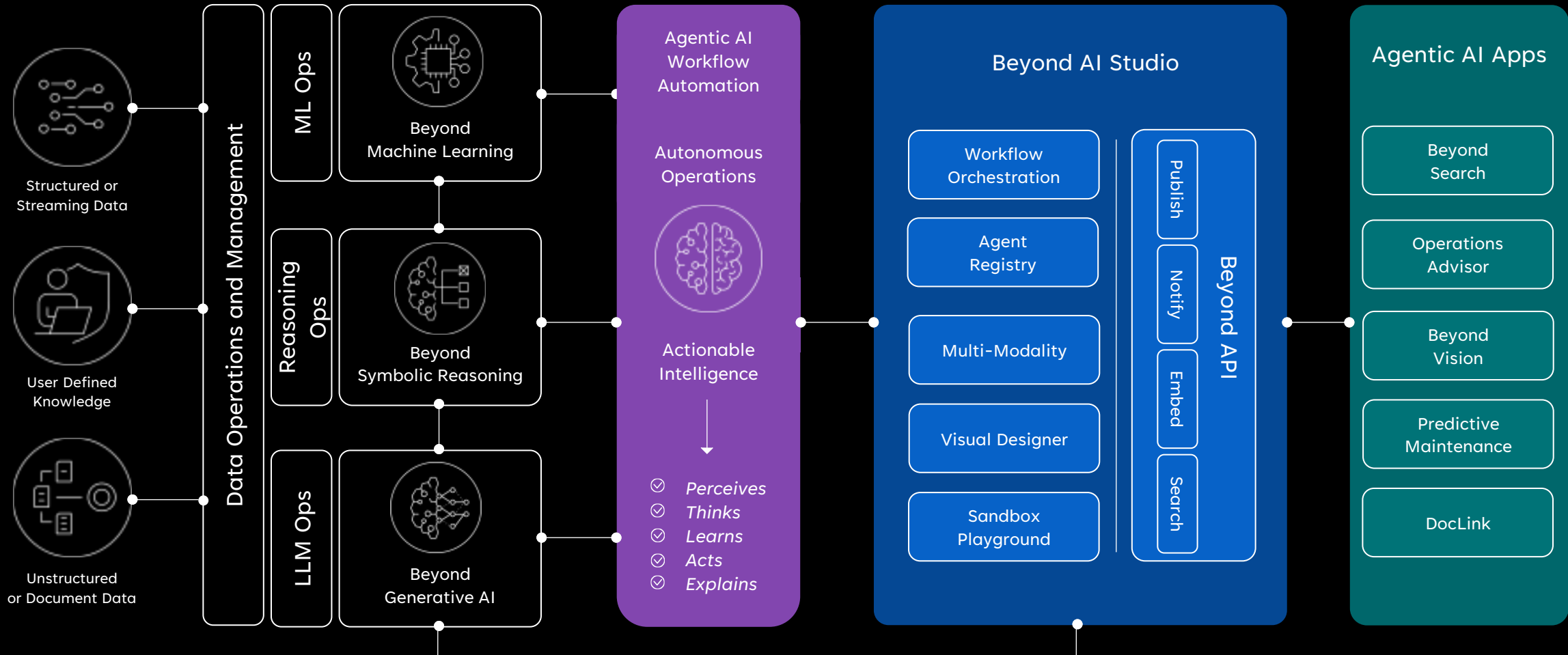
BEYOND AI



# Beyond AI – Platform Overview

# BEYOND AI







From Data to Agentic AI Solutions – Enabling humans in the-loop to fully-autonomous systems

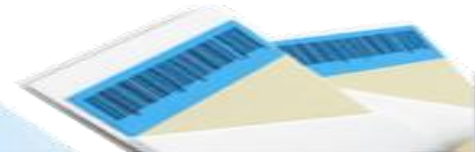


# Beyond AI – Current Products and Solutions

## Product Offerings

## Solution offerings

<p><b>Application</b></p>	 <p><b>Operations Advisor</b></p>	 <p><b>Beyond Search</b></p>	 <p><b>DocLink Hub</b></p>	 <p><b>Beyond Vision</b></p>	 <p><b>Global Optimizer</b></p>	 <p><b>Beyond Eye</b></p>
<p><b>Description</b></p>	<p>AI-driven real-time decisioning system to optimize operations, enhance asset reliability and execute autonomous actions</p>	<p>A complete platform to accelerate the development, deployment and ongoing management of Private LLM Initiatives</p>	<p>Intelligent document hub powered by vision and generative AI to automate document processes and workflows</p>	<p>Secure border control systems including airport passenger verification and land border crossing</p>	<p>Multi agent prescriptive actions solution for global supply chain and production planning optimization</p>	<p>Combines computer-vision technologies with spatial-temporal concepts to enable security, safety and inspection systems</p>
<p><b>Industry Sectors</b></p>	<p>Energy, Chemicals Manufacturing, Mining</p>	<p>Industry Agnostic</p>	<p>Industry Agnostic</p>	<p>Industry Agnostic</p>	<p>O&amp;G, energy, chemicals</p>	<p>Smart Cities, Safety, Energy</p>

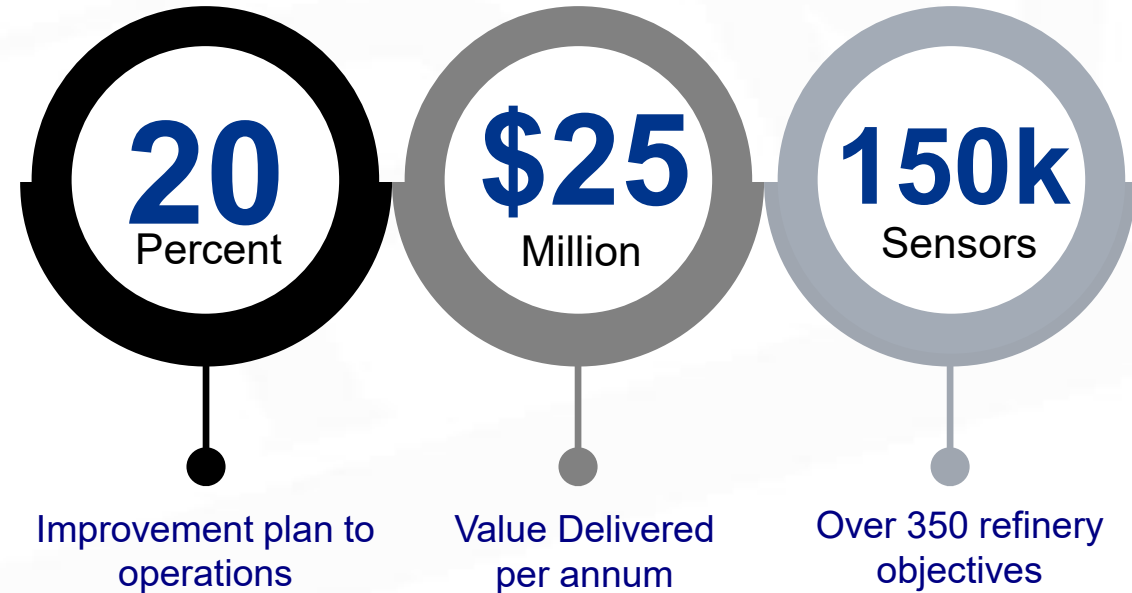


# Operations Advisor – bp Case Study

Enables Operators to Optimize production yield, increase asset utilization and improve reliability sustainably

BP Whiting Refinery posed the challenge to Beyond Limits to build solution to leverage hybrid AI to guide the operators to hit the production objectives and targets with confidence which eventually took the form of product Operations Advisor.

**Industry:** Oil & Gas **Geography:** U.S.A



## Results & Benefits

- Rapid solution adoption time of 2 month by operators
- Increased plant utilization, gasoline yield, H2 reduction
- Reduced energy usage and emissions
- Over 1,500 Users spanning operators, engineers and planners

aramco

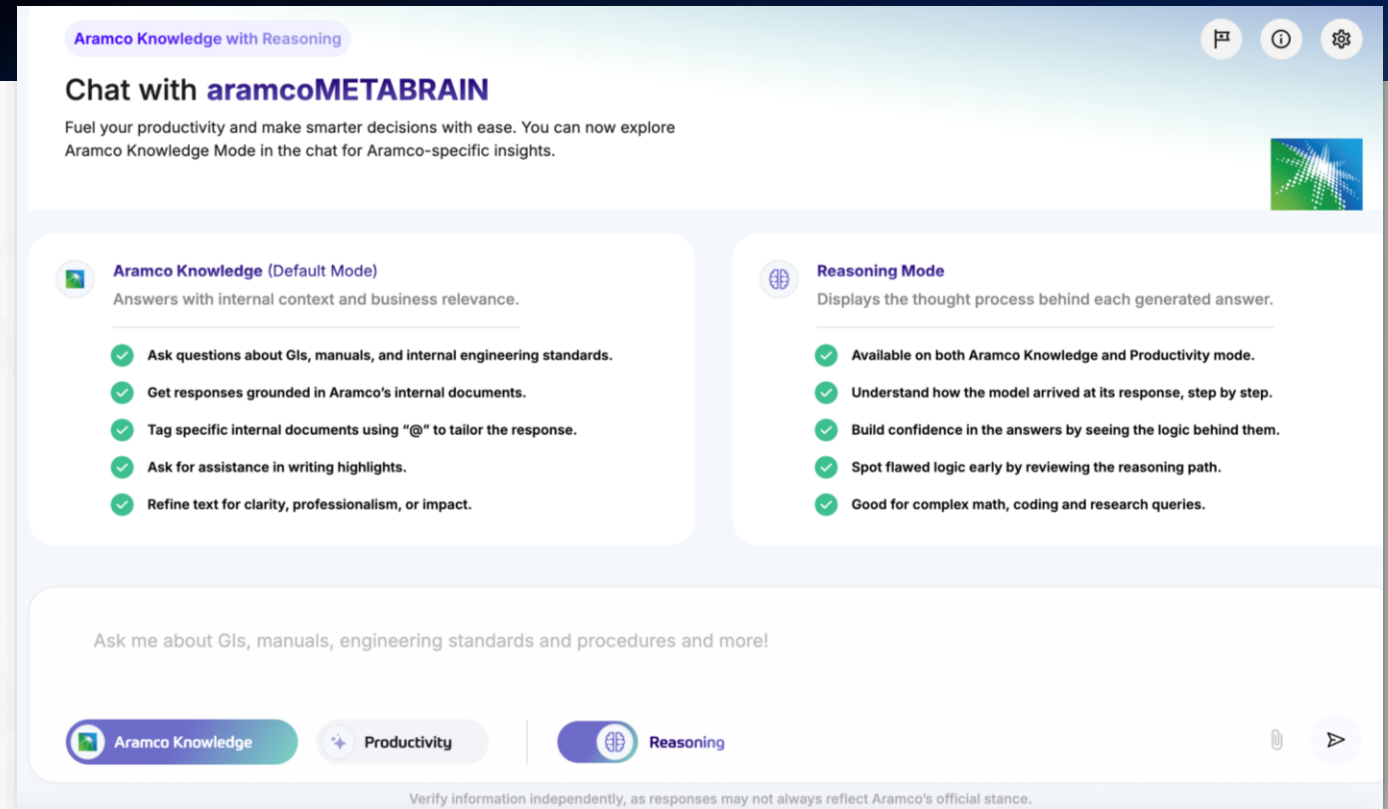


## aramcoMETABRAIN

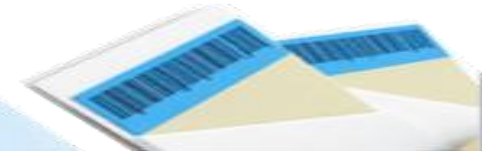
*Powered by Beyond Search GenAI Platform*

Aramco implemented Beyond Search enterprise wide to create **aramcoMETABRAIN**, a powerful enterprise knowledge platform that transformed how their organization accesses and utilizes critical information across departments

- ✓ **Secure Knowledge Access:**  
Enabled secure, private access to enterprise knowledge without exposing sensitive data to external cloud providers
- ✓ **Reduced Search Time:**  
Decreased information retrieval time by 78%, allowing employees to find critical information in seconds rather than hours



- ✓ **Knowledge Retention:**  
Preserved institutional knowledge and expertise, making it accessible through natural language queries
- ✓ **Customized Experience:**  
White-labeled solution with custom branding and guardrails aligned with organizational policies



# About Enablon



Enablon, is the **world's leading enterprise EHS, Risk, Process Safety, and Sustainability platform.**

Our mission is to help organizations **protect people, manage risk, and achieve sustainable performance** – all from a single, integrated platform.



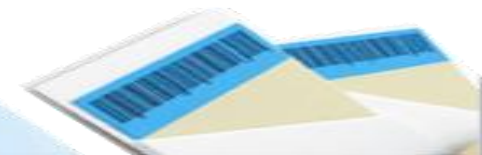
**Award-winning software** for optimizing environmental performance, improving worker safety, streamlining reporting, and achieving regulatory compliance



**Recognized as a global market leader** by third party analysts including Verdantix and Gartner



**25 years of expertise** of delivering innovative software that adapts to evolving regulations



# Integrated solutions that drive results



## ESG Excellence

Achieve net zero, improve company social responsibility, and drive shareholder value



## Environmental Management

Minimize environmental impacts to secure license to operate and increase operational efficiency



## Health & Safety Management

Provide a safe and healthy workplace for employees and contractors



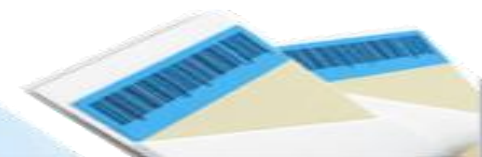
## Process Safety Management

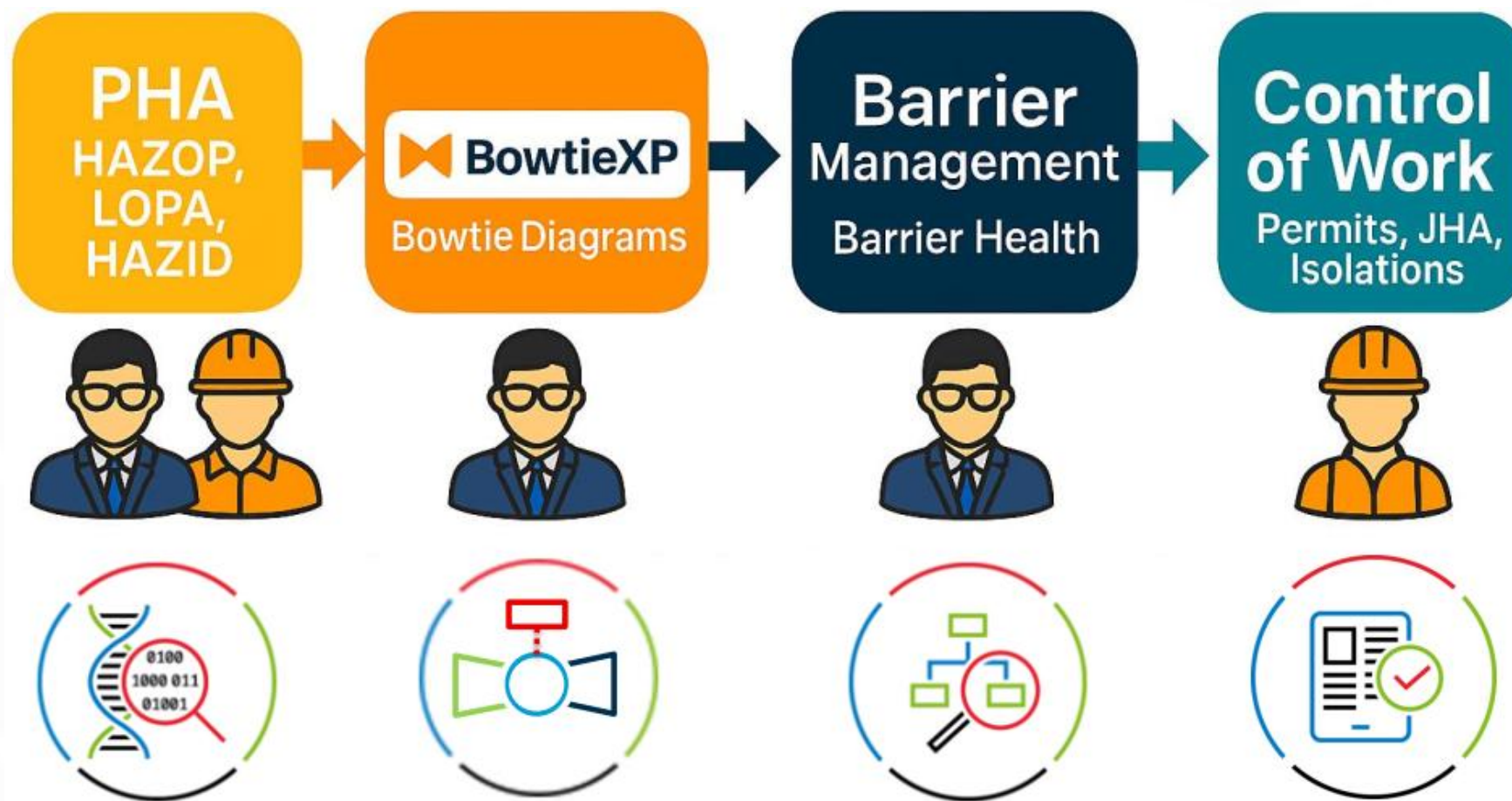
Streamline process safety management programs to meet operational integrity objectives



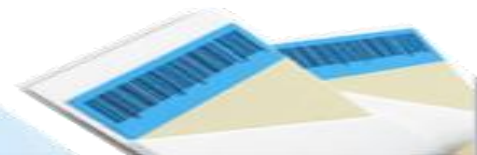
## Control of Work

Maximize Asset Performance and Workforce Efficiency while ensuring safety and compliance





## PSM Interface Solutions for Operating Assets





Customer  
Legacy Documents

## Data Migration from Legacy Systems

**PSM Data**

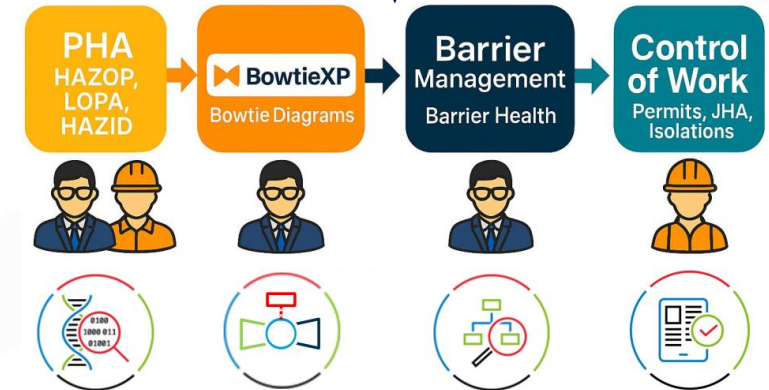
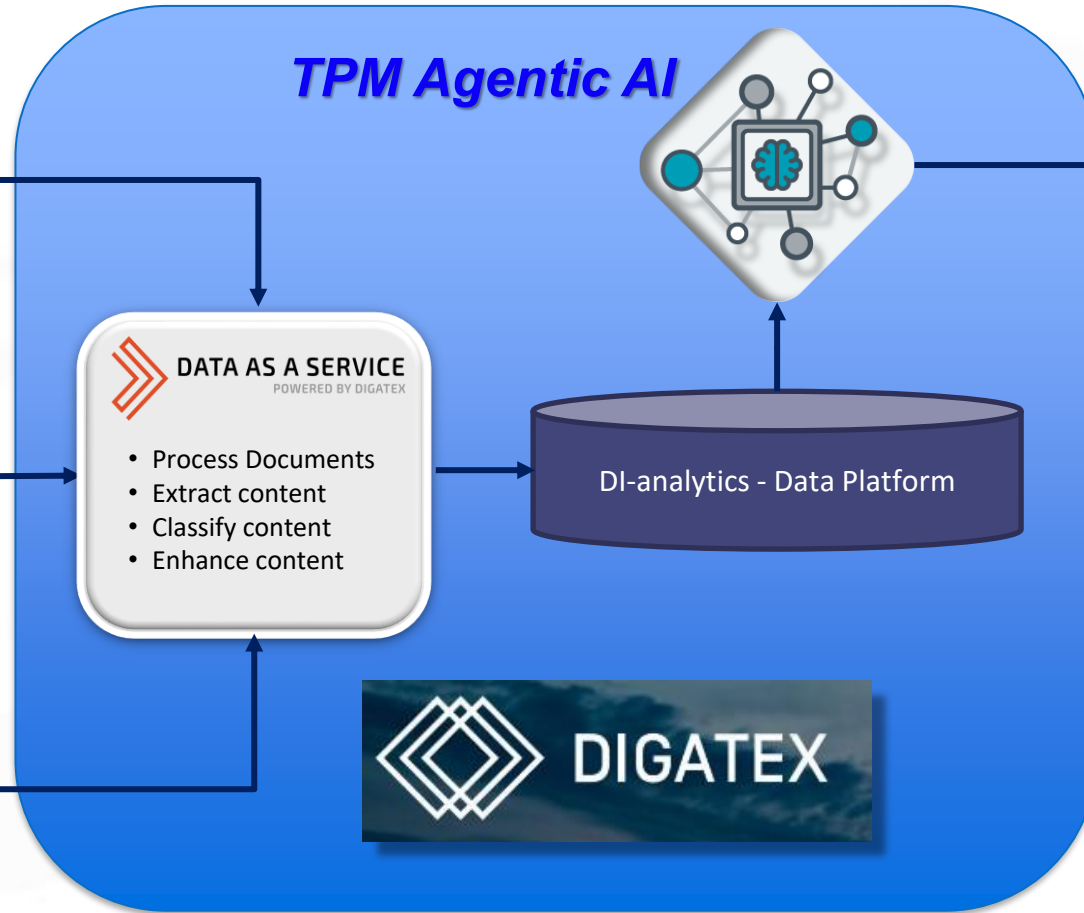
- HAZOP/HAZID Reports
- RCA Reports
- CAPA Registers
- Incident Reports
- Etc.

**Systems Data**

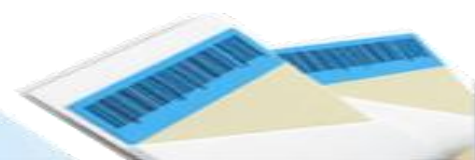
- PSM
- ERP
- CMMS
- Procurement
- Etc.

**Technical Data**

- Risk Matrices
- Consequence Schedules
- Equipment/Asset Registers
- Bowtie Barrier Taxonomy
- PM Schedule/Tasks
- Etc.



PSM Interface Solutions for Operating Assets



# Example Migration – HAZOP Report

Company : ABC  
Facility: XXXXXX  
Plant: XXXXX

node: 1 Ethylene preheater  
Intention: HP and MP Ethylene gas supply from Olefin plant  
Drawings: DWG-1,2,3  
Parameter: Flow

### Legacy HAZOP PDFs

DEVIATION	CAUSES	CONSEQUENCES	S	L	R	IPLs	SAFEGUARDS (non IPL)	S	L	R	RECOMMENDATIONS	BY	COMMENTS
High flow Ethylene line to D-1000	1. Flow transmitter FICQ-1001 error > read to low	1.1 More SI flow to D-1002 > D-1002 level high & entrain to plugging at E-1001 & E-1002 > D-1002 pressure is high due to vent line cannot release gas > D-1002 overpressure & rupture (VCE)	5	1	1	1. Level alarm LI-7000 high & BM Action (1) 2. Pressure interlock PAHH-7000 (1) 3. Safety valve PSV-7000 (2)	1. Pressure alarm PI-1012	5	5	3			
	1.2 More C2 flow to D-1001 > Pressure reactor is higher than 10 KG (C2+HX gas) due to C2 gas remaining > D-1005 pressure is higher than 10 KG (C2+HX gas) > Pool fire at D-1005	1.2.1 More C2 flow to D-1001 > Pressure reactor is higher than 10 KG (C2+HX gas) due to C2 gas remaining > D-1005 pressure is higher than 10 KG (C2+HX gas) > Overpressure at D-1002 > VCE (C2, HX, H2, Bu-1)	4	1	1	1. Pressure control PIC-001 (1) 2. Pressure PAHH-001 HI ESD (1) 3. Safety valve PSV-001 (2)	1. Gas detector & BM Action	4	5	4			
	1.3 More C2 flow to D-1001 > Pressure reactor is higher than 10 KG (C2+HX gas) due to C2 gas remaining > D-1002 pressure is higher than 10 KG (C2+HX gas) > Overpressure at D-1002 > VCE (C2, HX, H2, Bu-1)	1.3.1 More C2 flow to D-1001 > Pressure reactor is higher than 10 KG (C2+HX gas) due to C2 gas remaining > D-1002 pressure is higher than 10 KG (C2+HX gas) > Overpressure at D-1002 > VCE (C2, HX, H2, Bu-1)	5	1	1	1. Pressure control PIC-001 (1) 2. Pressure PAHH-001 HI ESD (1) 3. Safety valve PSV-001 (2)	1. Gas detector & BM Action	5	5	3			
	2. Positioner valve FV-1001 error > fail to open	2.1 More C2 flow to D-1001 > Pressure reactor is higher than 10 KG (C2+HX gas) due to C2	5	1	1	1. Pressure control PIC-001 (1) 2. Pressure PAHH-001 HI ESD (1) 3. Safety valve PSV-001 (2)	1. Gas detector & BM Action	5	5	3			



Agentic AI Extraction

### Past HAZOP Reports Processed and Stored

Tree view | Table view | Hierarchies | Hide all | Save changes | Actions | File name: SCG Chem Hazop Example-1.pdf | Page: 1 / 4 | Quality: medium

Hierarchy: aHAZOP Hierarchy

- Root
- Nodes
  - Node 1: Ethylene preheater
    - Parameter 1-1: Flow - Deviations
      - 1. High flow Ethylene line to D-1000
        - Causes 1-1.1
          - 1. Flow transmitter FICQ-1001 error > read to low
          - 2. Positioner valve FV-1001 error > fail to open
          - High flow Ethylene line to D-1000
        - 2. High flow Ethylene line to D-1021
      - Parameter 1-2: Pressure - Deviations
    - Node 2: Bu-1 Preheater

Parent: Child: Add multiple nodes

Object data: Set as child | No... | Set as parent

Class: Deviation | Class: Deviation

High flow Ethylene line to D-1000 | High flow Ethylene line to

**Objects Identified & Extracted by AI**

TPM Agentic AI Loading

Value	Severity (S)	Likelihood (L)
1	Negligible	Rare
2	Minor	Unlikely
3	Moderate	Possible
4	Major	Likely
5	Catastrophic	Frequent

TPM Agentic AI Mapping



### Likelihood

Likely to occur	F1	R4	R2	R2	R1	R1
	F2	R4	R3	R2	R2	R1
	F3	R4	R4	R3	R2	R1
	F4	R4	R4	R4	R3	R2
	F5	R4	R4	R4	R4	R3
Extremely unlikely to occur		C1	C2	C3	C4	C5

Minor | Severe

	A	B	C	D
Node	Node Type	Drawings / References	Design Intent	
1	Ethylene preheater	Flow	DWG-1,2,3	HP and MP Ethylene gas supply from Olefin plant
2	Ethylene preheater	Flow	DWG-1,2,3	HP and MP Ethylene gas supply from Olefin plant

TPM Agentic AI Transformation

PEOPLE		A	B	C	D	E
		Very unlikely	Unlikely	Possible	Likely	Very likely
1	No injury	A1	B1	C1	D1	E1
2	Slight injury	A2	B2	C2	D2	E2
3	Minor injury	A3	B3	C3	D3	E3
4	Major injury	A4	B4	C4	D4	E4
5	Single fatality	A5	B5	C5	D5	E5
6	Multiple fatalities	A6	B6	C6	D6	E6

ASSETS		A	B	C	D	E
		Very unlikely	Unlikely	Possible	Likely	Very likely
1	No Damage	A1	B1	C1	D1	E1
2	Slight Damage	A2	B2	C2	D2	E2
3	Minor Damage	A3	B3	C3	D3	E3
4	Major Damage	A4	B4	C4	D4	E4
5	Complete loss of Asset	A5	B5	C5	D5	E5
6	Multiple Assets Lost	A6	B6	C6	D6	E6

ENVIRONMENT		A	B	C	D	E
		Very unlikely	Unlikely	Possible	Likely	Very likely
1	No Impact	A1	B1	C1	D1	E1
2	Slight Impact	A2	B2	C2	D2	E2
3	Minor Impact	A3	B3	C3	D3	E3
4	Major Impact	A4	B4	C4	D4	E4
5	Severe Impact	A5	B5	C5	D5	E5
6	Catastrophic Impact	A6	B6	C6	D6	E6

REPUTATION		A	B	C	D	E
		Very unlikely	Unlikely	Possible	Likely	Very likely
1	No Impact	A1	B1	C1	D1	E1
2	Slight Impact	A2	B2	C2	D2	E2
3	Minor Impact	A3	B3	C3	D3	E3
4	Major Impact	A4	B4	C4	D4	E4
5	Severe Impact	A5	B5	C5	D5	E5
6	Catastrophic Impact	A6	B6	C6	D6	E6

enablion



# AI-based Asset Digitalization

What business challenges are we addressing ?



20% of time is spent looking for data\*



\* McKinsey et al

That's one in every FIVE employees

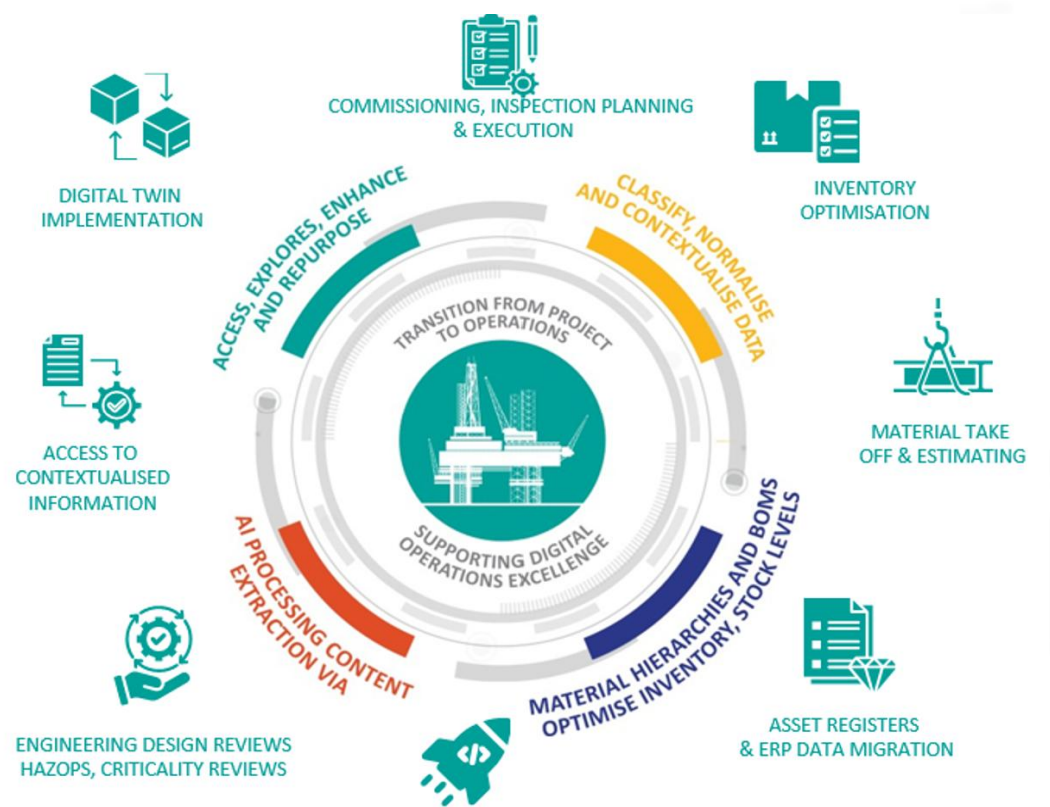
We solve this problem by



Enabling Digital Twins by transforming 2D legacy data



By leveraging AI technology – Services with no people



DATA AS A SERVICE



KNOWLEDGE HUB

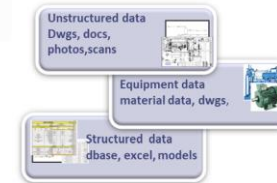


ENGINEERING HUB



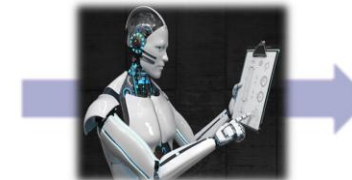
INVENTORY HUB

Unconnected Inconsistent Mis-information



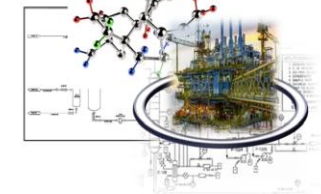
Data Anarchy

Data as a Service



DIGATEX - DI-analytics [Artificial Intelligence Platform]

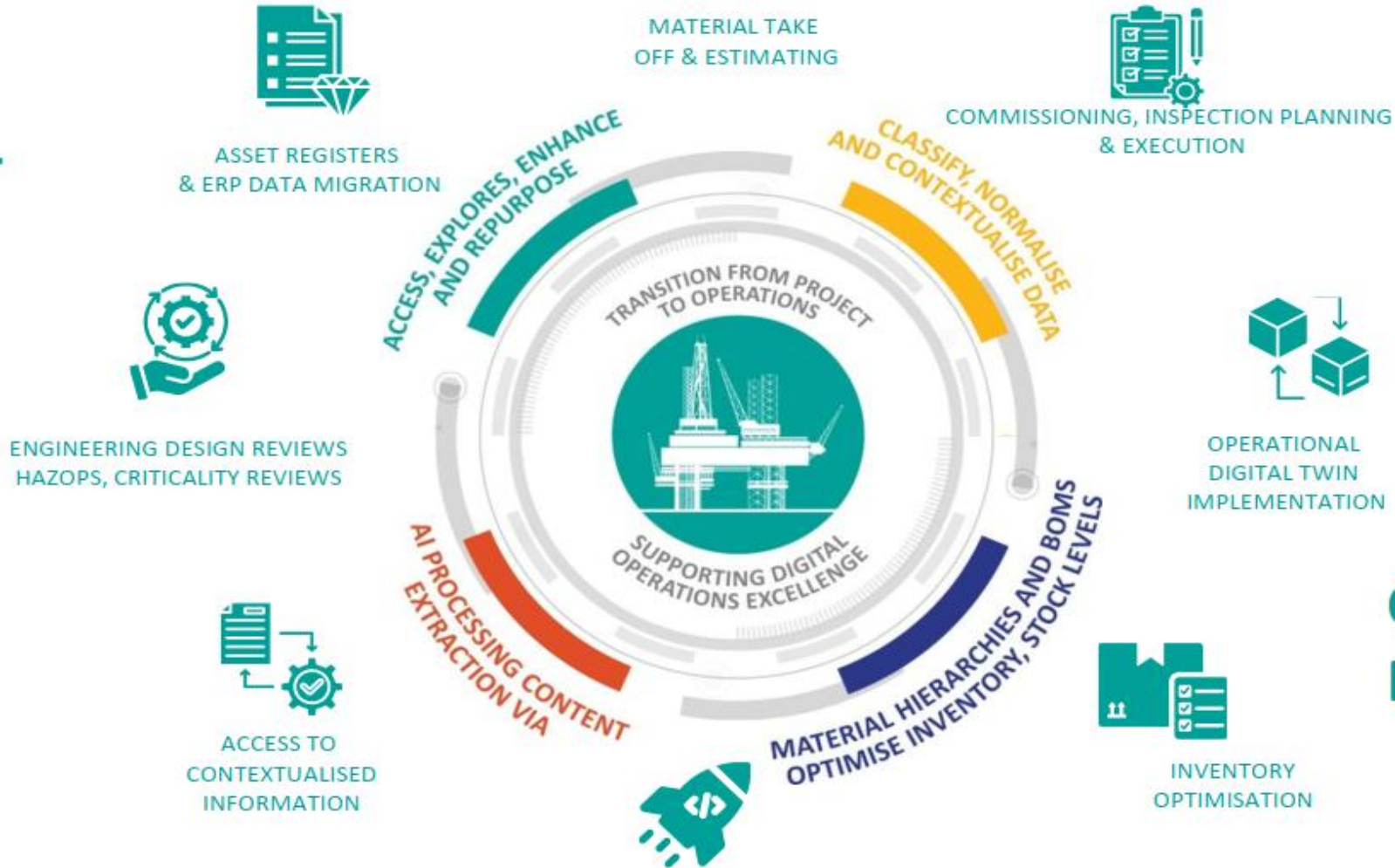
Connected Consistent Information



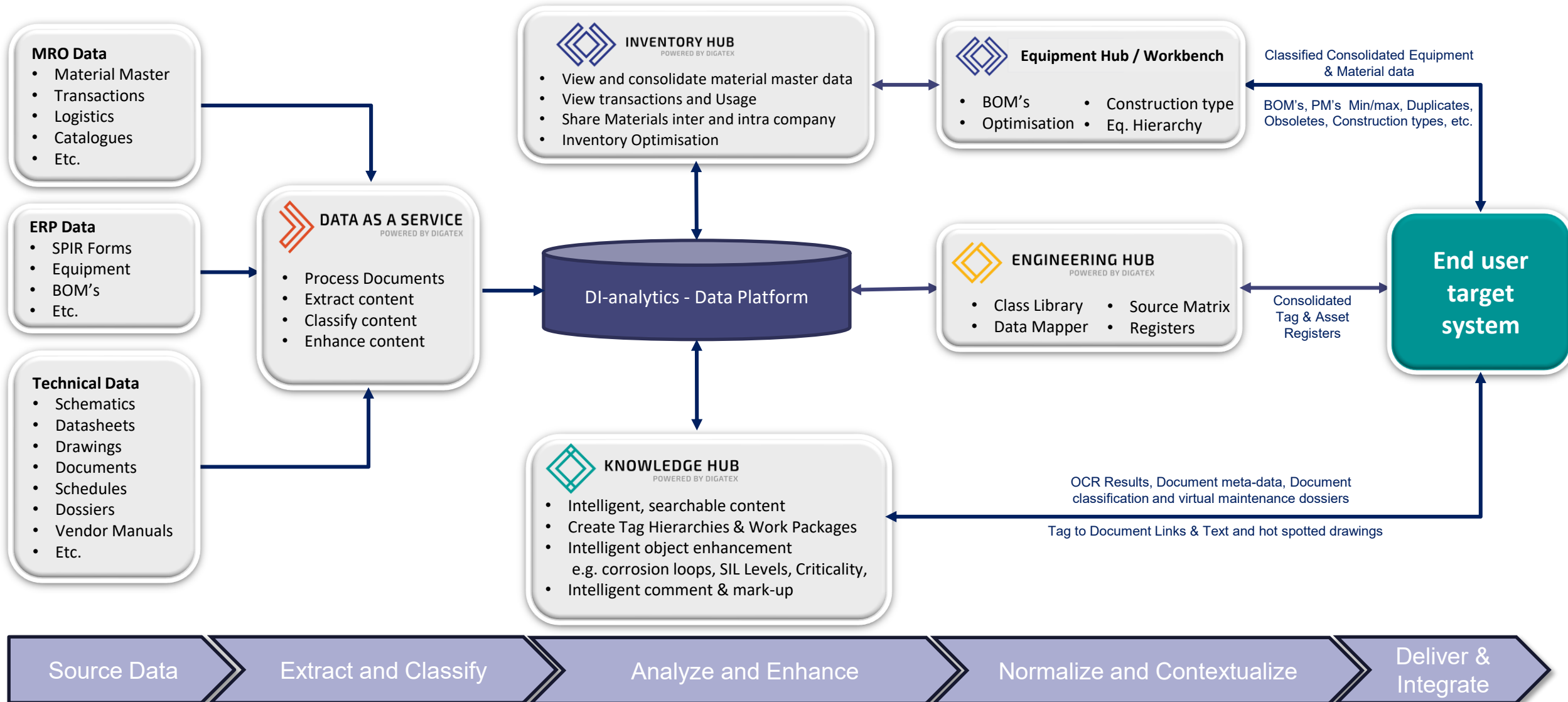
Digitally Intelligent Documents  
Fast Data access to Stakeholders  
System to System Collaboration



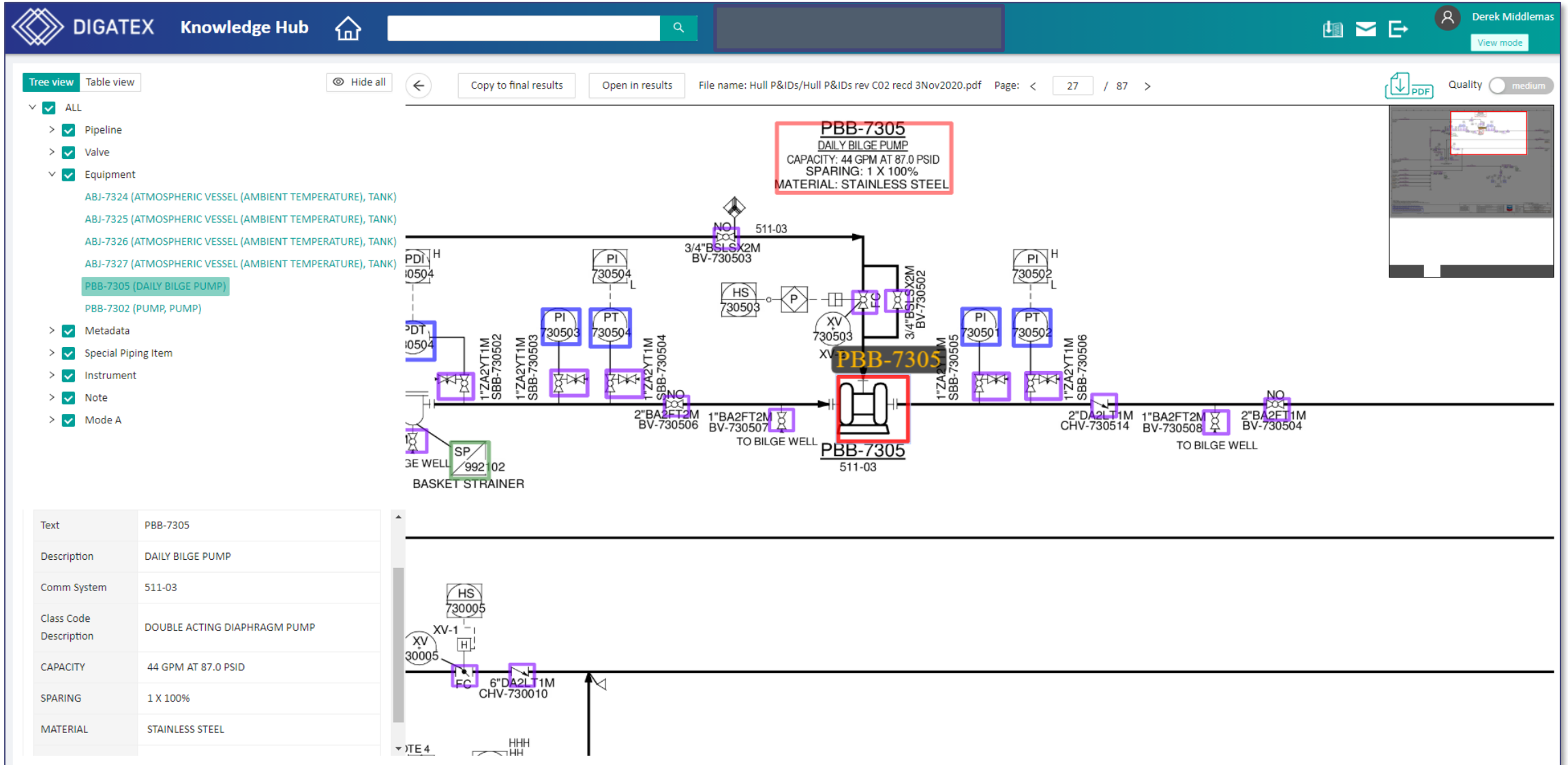
## PROJECT



## OPERATIONS & MAINTENANCE



# Intelligent P&ID Data Extraction



The screenshot displays the DIGATEX Knowledge Hub interface. At the top, there is a navigation bar with the DIGATEX logo, 'Knowledge Hub', a search bar, and user information for 'Derek Middlemas'. Below the navigation bar, there are tabs for 'Tree view' and 'Table view', and a 'Hide all' button. The main content area shows a P&ID diagram of a bilge pump system. A callout box highlights the pump 'PBB-7305' with the following details: 'DAILY BILGE PUMP', 'CAPACITY: 44 GPM AT 87.0 PSID', 'SPARING: 1 X 100%', and 'MATERIAL: STAINLESS STEEL'. The diagram includes various components like tanks (ABJ-7324 to ABJ-7327), pumps (PBB-7302, PBB-7305), valves (XV-730503, XV-730504), and instruments (PI-730503, PT-730504, PI-730502, PT-730502). A metadata table is visible in the bottom left corner.

Text	PBB-7305
Description	DAILY BILGE PUMP
Comm System	511-03
Class Code	DOUBLE ACTING DIAPHRAGM PUMP
DESCRIPTION	
CAPACITY	44 GPM AT 87.0 PSID
SPARING	1 X 100%
MATERIAL	STAINLESS STEEL

# Inventory Optimization – Forecasting

Material: 32925 - COMPOUND,TYPE ELECTRICAL,INSULATING,FORM PASTE [↗](#)
History [↻](#)

Material Data
Where-Used factors
Lead Time Variation (0)

Type	Medium	Price per unit (AUD)	43.49
MRP Type	P	Planned Delivery Time	14
Material Group		Contract Delivery Time	NA
MIN	30	MAX	38

Recommendations Overview
Stock Allocation
Forecasting
Settings

Statistical Forecasting (naive) [▼](#)

**Material Data**

Price per Unit	43.49	Current Inventory	38
Lead Time (days)	14	Lead Time (months)	0.47
Old Max	38	Old MIN	30
Old Average	34	New Average	23.5
Old Average (real)	43	New Average (real)	19
Real Saving PA	190	Average Saving PA	82
Service factor	94 %	End Date	2033-09



Selected Recommendation:  
[Demand] Max demand during the Lead time

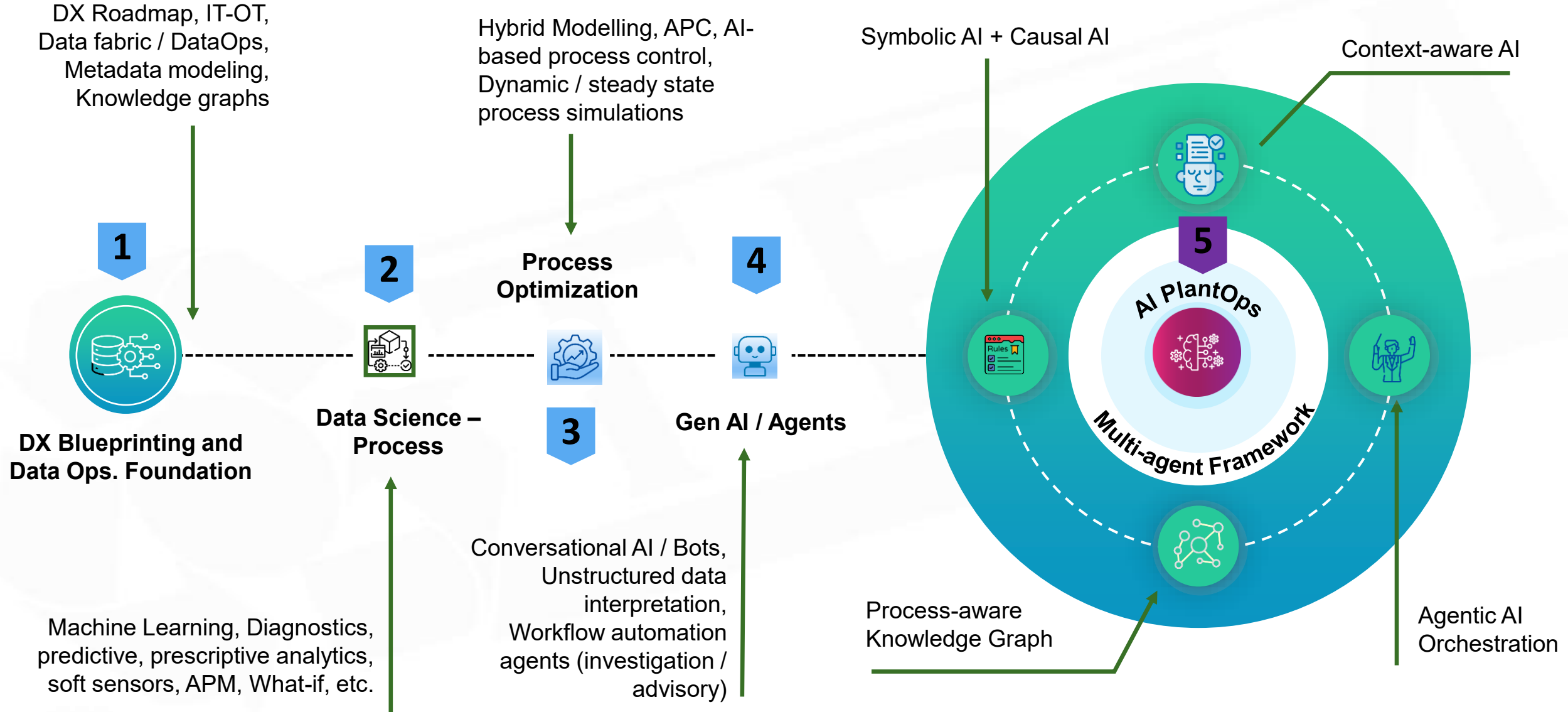
■ Future Stock   
 ■ History Stock   
 ■ Reorder Point   
 ■ MAX   
 ■ Zero point

**Model Parameters** Save as a recommendation

New Max	24 <a href="#">↗</a>
New MIN	23 <a href="#">↗</a>
Holding	18 <a href="#">↗</a>
Used Pm transactions	<input type="checkbox"/> <a href="#">↗</a>



# Tridiagonal.ai – Empowering Industrial AI Evolution



# Tridiagonal.ai – Core Functionalities

## 6 AI PlantOps

- Recommendations & prescriptions
  - Network Intelligence, Value Chain
  - Knowledge management,
  - Standardization of processes

## 4 Inference (Predictive)

- ML or AI based non-linear / multi-variate estimators
- Quality predictions, production prediction, emissions prediction

## 5 Workflow Management

- Persona based – Reasoning Agents
- Advisory for enabling decision making
- PlantGPT – For Industrial Data

## 3 Physics

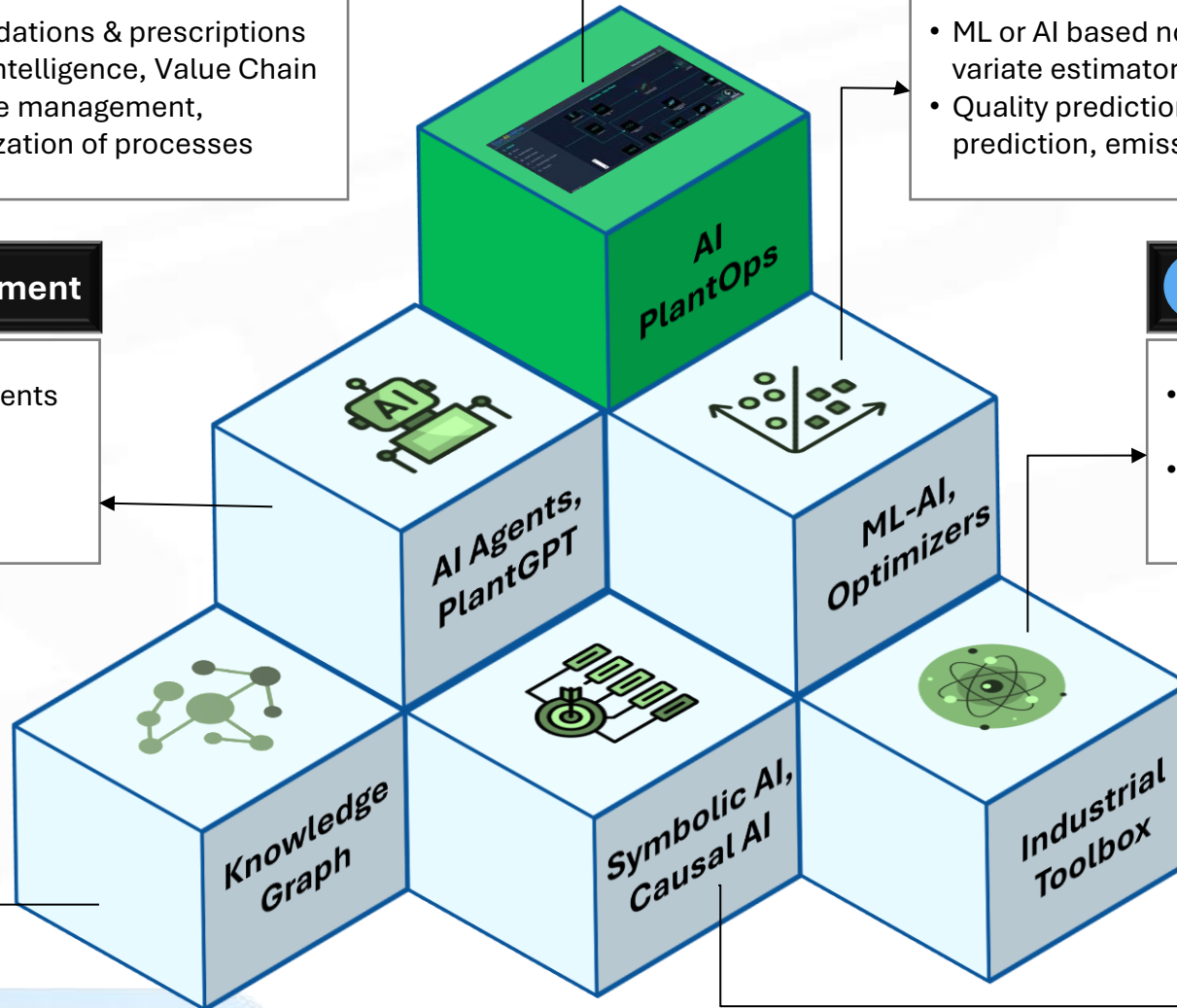
- Industrial Toolbox to capture physics – heat & mass balance
- Capture first-principles to validate recommendations

## 1 Process Interconnections

- P&ID based contextualization
  - Interconnected assets, processes
- Value chain based - Identifies the direction of material & fuel flow

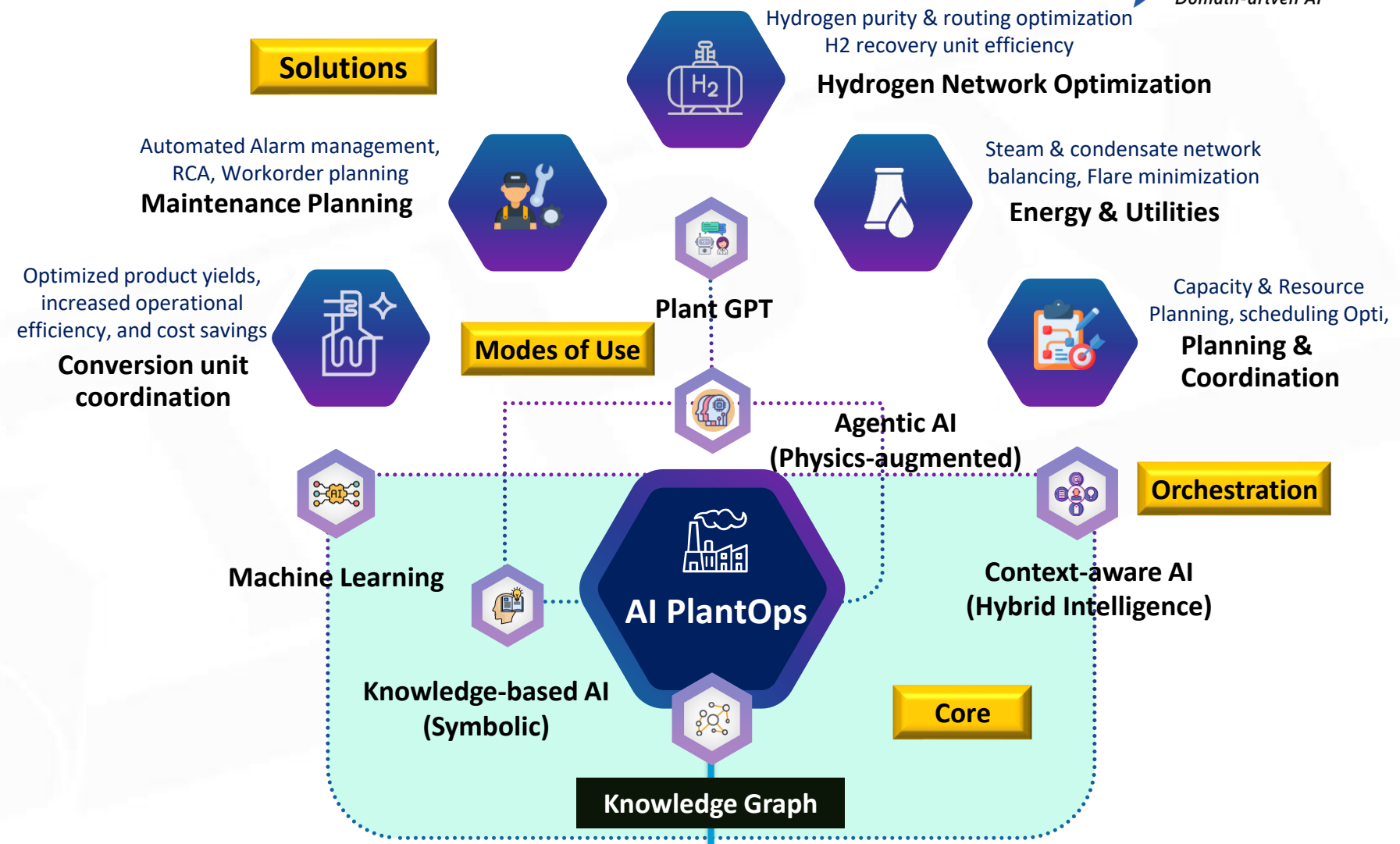
## 2 Domain Experience

- Symbolic AI to Model – production planner's experience
  - Enable knowledge mgmt.
- Develop plant-level Fault tree analysis



# Tridiagonal.ai – AI PlantOps

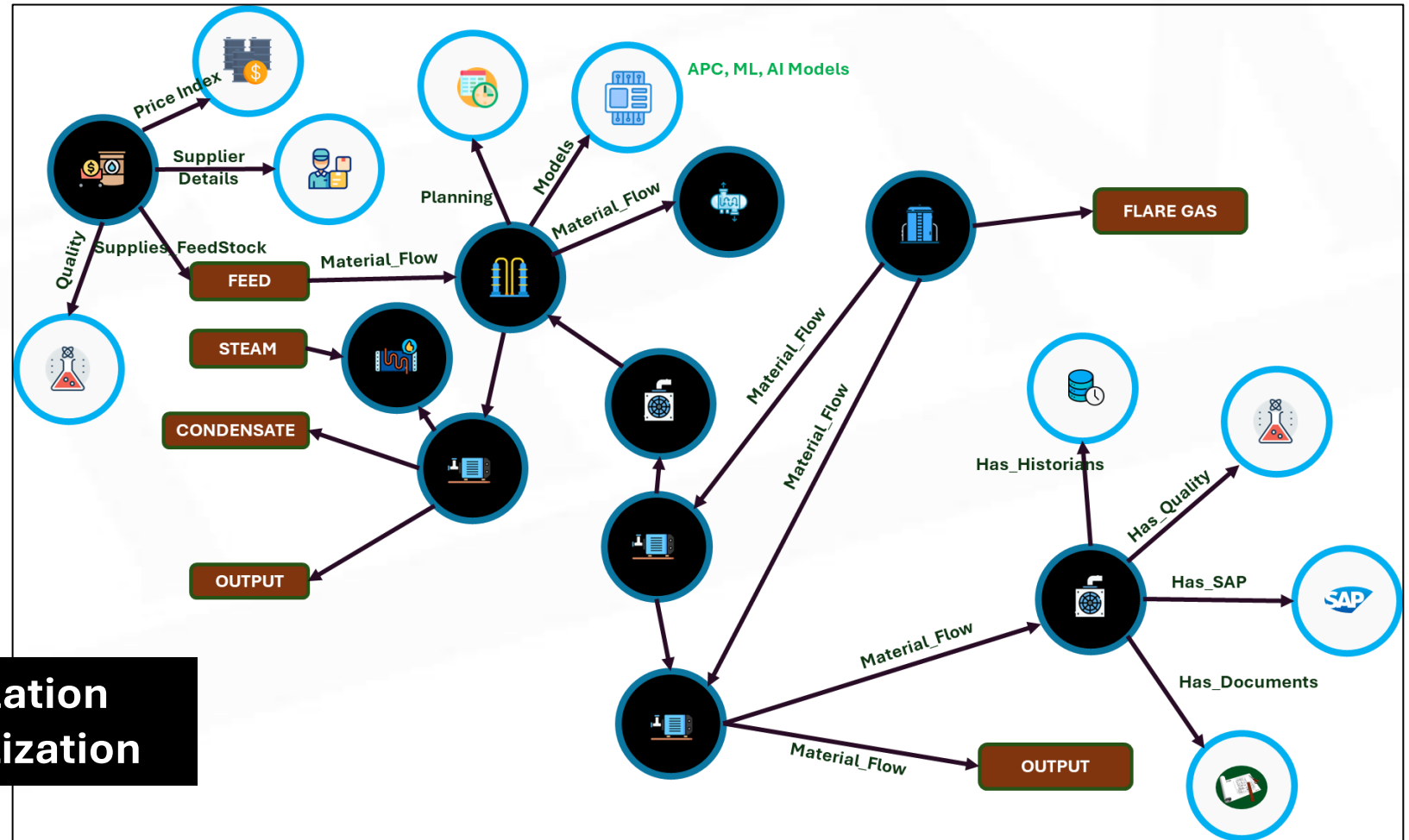
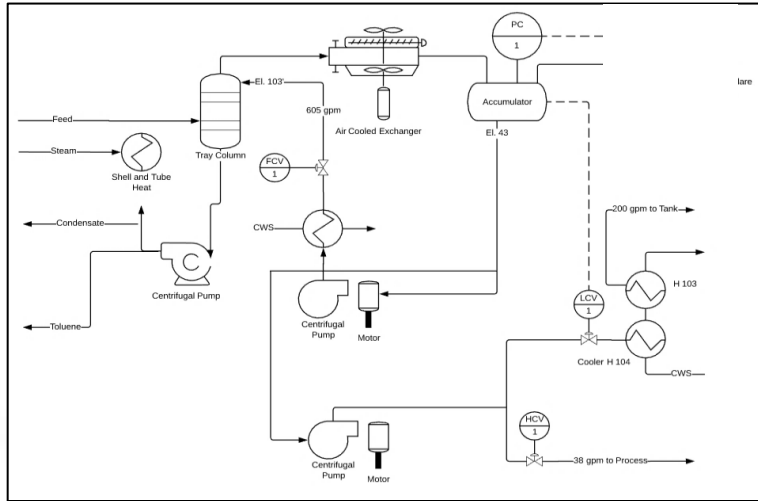
- Modes of Use:**  
Shadow / Advisory / Autonomous
- Agentic AI –**  
Simulates, validates, and executes actions using physics-economic coupling
- Context-aware AI –**  
Connects plant insights with cost, demand, logistics, and price drivers
- Machine Learning –**  
Learns and predicts yield, energy, and fouling behaviors across feedstocks and operating conditions
- Symbolic AI –**  
Encodes process rules, heuristics, and operational logic (e.g., COT, TMT limits, furnace coking dynamics, yield relationships)
- Value Chain Knowledge Graph –**  
Creates a unified digital backbone linking feedstock, furnaces, downstream units, logistics, and markets into one digital ecosystem



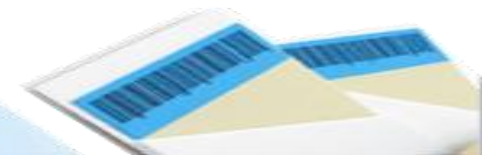
Input data sources for the AI PlantOps system:

- SAP Module
- Operating Manuals Documents
- Maintenance Manual Documents
- Time Series Data sources
- Simulation output excel file
- RCA reports documents
- P&ID Files

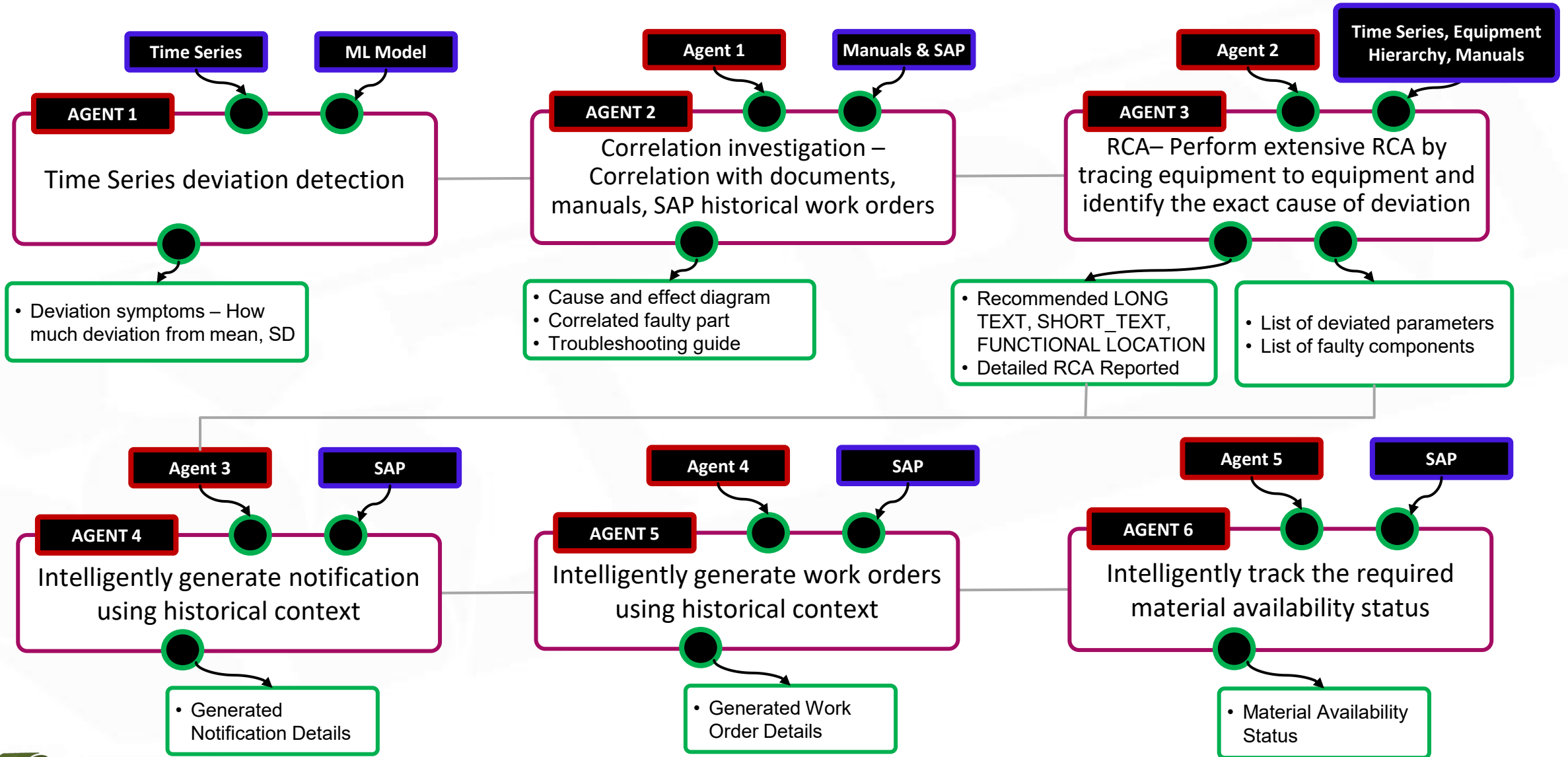
# Tridiagonal.ai – Process Aware Knowledge Graph



- P&ID-based Data Contextualization
- Value Chain Based Contextualization



# Automated Multi-Agent Maintenance Workflow



# Tridiagonal.ai – Agentic AI Applications



- Knowledge accelerators driving domain contextualization for SAP PM, Documents, and EAM
- Workflow level management for maintenance & planning for multisite operations
- Conversational agent for diagnostics



- Equipment, section and site level emissions management
- Emission management powered by predictive emission capabilities
- Knowledge assisted conversational agent for noncompliant emissions RCA



- Preheat section optimization strategy
- Predictive & prescriptive maintenance strategy capabilities
- Equipment management strategy optimization



- Lifecycle management of the existing deployed models
- Domain driven recommendations for improving and fine-tuning the ML model performance
- Daily, weekly report generation capabilities



- Informed turnaround, shutdown and planning at section level
- Management of the workflow augmented with domain intelligence
- Generate recommendations for optimized workflows



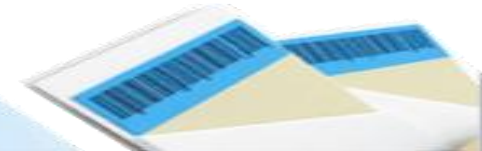
- Knowledge accelerators to derive scenarios for planning & optimization workflows
- Forecasting the de-coke requirements for emissions & fuel management
- What-if simulator for decoking procedure (shutdown) planning



- Knowledge accelerators driving domain contextualization for all type of data sources including – SAP PM, Documents (Maintenance, Operating Manuals), standards and compliances
- Knowledge augmented workflow planning
- Foundation of Industrial tools



- Human-like root cause investigation capabilities to interpret the mechanical and process related deviations
- Generate cause & effect diagram for informed diagnostics
- Generate recommendations for management of critical assets



# TPM Connected Worker Solutions

- RealWear Navigator Head-Mounted Tablets
  - Ruggedized, Hands-free, Voice-controlled, Intrinsically-safe
  - New lighter-weight Arc 3
- RuggedEdge Mobile 5G Gateway & IoT Hub
  - Intrinsically-safe EdgeWatch
  - Field Connectivity with Edge AI
- Intoware WorkfloPlus
  - AI-enhanced Workflow & Business Process Digitalization
- XR Tech's XR Sense
  - Machine Vision AI with Automatic Anomaly Detection & Situational Awareness
- WolterKluwer's Enablon
  - Integrating process safety management to the Connected Worker



# Connected Worker

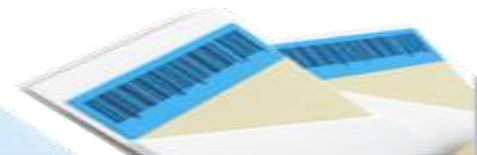
## Key Benefits of Hands-Free Solutions:

- *Eliminate downtime by up to 75%*
  - First-time fixes on heavy equipment can be reduced by up to 75% through collaboration
- *Reduce travel footprint*
  - Let a single remote expert assist multiple machines and facilities at once, without costly travel
- *Improve safety and productivity*
  - Access to information in context without distraction workers maintain situational awareness



- Modular & rugged with full-shift use
- Seamless hands-free use with robust voice controls
- Intrinsically-safe and Thermal Camera (FLIR) options
- Services and Support

<b>What you can do out of the box</b> No extra software or connectivity required	Image & Video Capture	<ul style="list-style-type: none"> <li>• Share knowledge</li> <li>• Capture processes</li> <li>• Perform inspections</li> <li>• Document issues</li> <li>• Reduce paper</li> <li>• Faster training</li> </ul>	<b>What you can do with 3<sup>rd</sup> party software</b> Select from one of our many software partners	<b>Remote Mentor</b> (XR Sense, Brochesia, etc.) Requires connectivity	Provide expert knowledge remotely
	Video Playback			<b>Industrial IoT Data Visualization</b> (XR Sense) Requires connectivity	Performance, diagnostics, predictive data & historic trends
	Document Navigation			<b>Digital Workflow</b> (XR Sense, Intoware, Brochesia, TeamViewer)	Increased productivity & error reduction



# RealWear Navigator 520



**Communicate and Connect**  
Four Microphones with Active Noise Cancellation

**100% Hands-Free Use**  
Fully Voice-Controlled up to 100 dBA



**See the Invisible**  
Access to FLIR Thermal Studio Suite



**Revolutionary Modular Design**  
48MP Camera Sensor with Enhanced Zoom

"Flashlight On"



**Ease of Use and Secure**  
Fingerprint Reader to Unlock Device



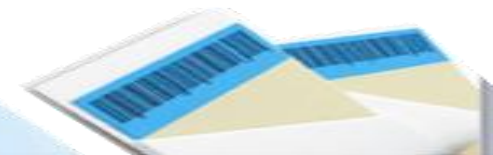
The Next Generation of  
Rugged Wearables



*\* RealWear Navigator Z1 is the intrinsically-safe model*



# RealWear Navigator Z1 – 360° View



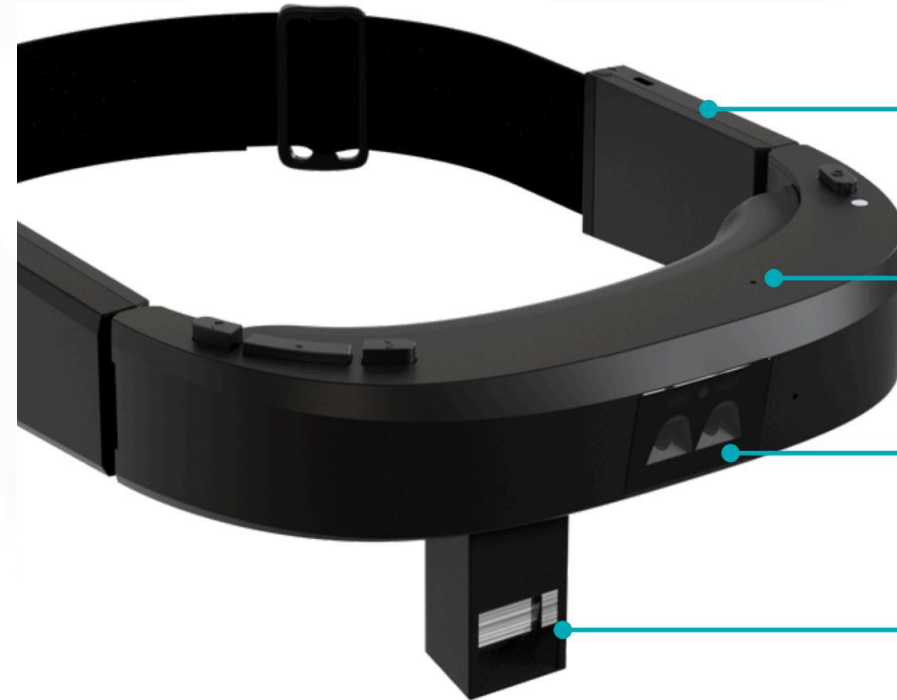
# RealWear Arc 3



## Why the Arc 3?

*Not every job requires heavy ruggedization, such as in lighter-duty use in logistics, warehousing, retail, healthcare, and field service*

- **Precision display:** Featuring a double retina display, designed for sharp visuals
- **Sleek, as it should:** Weighing 175 grams, and can be worn with any PPE equipment
- **High-performance camera system:** Two lenses, capturing any environment

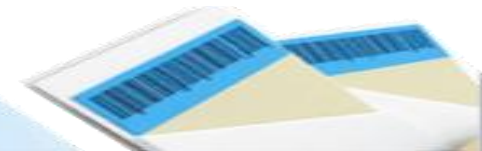


Weighing just 175 grams, the RealWear Arc 3 is lightweight, easy to wear and adjust.

Featuring four built-in microphones and advanced noise reduction technology.

Dual camera system to capture a broader field of view and allowing to zoom for details.

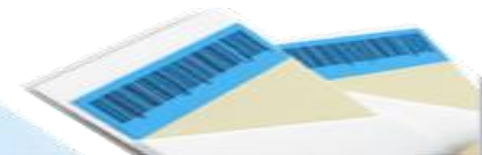
See-through display, allowing sharp details and a full-color HD micro-OLED display.



# RealWear Navigator – Use Cases



Use Case	Remote Collaboration & Training	Field Service Management	Inspections with Thermal Camera	Digital Workflows
<b>Problem</b>	You are in Maintenance in a plant, where it's noisy, Wi-Fi can be spotty and you need help getting the machine to work properly	You are in Field Service working on repairing broken equipment where 50% of accidents happen during downtime	You are an Inspector climbing a ladder when you spot an issue that requires you to file a report including a picture	You are a Mechanic in a complex process environment needing to use a clunky binder for SOPs
<b>Pain Points</b>	<ul style="list-style-type: none"> <li>Operational Delays</li> <li>Retirement/departure</li> <li>Financial Impact of downtime</li> </ul>	<ul style="list-style-type: none"> <li>Operational Delays</li> <li>Safety incidents</li> <li>Financial Impact of downtime</li> <li>Digital transformation</li> </ul>	<ul style="list-style-type: none"> <li>Operational Delays</li> <li>Safety incidents</li> <li>Financial Impact of downtime</li> </ul>	<ul style="list-style-type: none"> <li>Safety incidents</li> <li>Retirement/departure</li> <li>Digital transformation</li> </ul>
<b>Solution</b>	RealWear works in even noisy environments, leaving your hands free to get the job done. Turn on the flashlight, call a colleague in 5G, and get up and running faster	RealWear enables access to information relevant to the machine at hand, speeding up the maintenance while keeping you safer with compliance information	RealWear makes it easy to take a picture and send a report hands-free	With RealWear you can identify the steps needed quickly and easily, helping you fix the equipment instead of fumbling for an answer
<b>Features</b>	<ul style="list-style-type: none"> <li>Enhanced camera makes it easier to collaborate</li> <li>Works with advanced solutions built for operational environment</li> <li>Faster knowledge sharing and training</li> </ul>	<ul style="list-style-type: none"> <li>Enhanced connectivity with 5G</li> <li>Lighter weight for all-day use</li> </ul>	<ul style="list-style-type: none"> <li>Thermal camera helps spot issues before they become critical</li> <li>Power of AI increases inspection effectiveness</li> <li>Certified to work in hazardous environments</li> </ul>	<ul style="list-style-type: none"> <li>Enhanced display makes it easier to view workflows and documents</li> <li>More storage so you have information at hand</li> </ul>
<b>Benefits</b>	Improve effectiveness and reduce downtime	Enhance safety while reducing time to fix	Reduce downtime and improve safety	Improve productivity and reduce frustration



# Connected Worker – Mobile 5G Gateway & IoT Hub



**RUGGEDEDGE**



Purpose-built, industrial grade, intrinsically safe (ATEX Zone 1 & Zone 2) edge computing hub with 5G, enterprise grade Wi-Fi 6/6E, BLE, NFC and Starlink connectivity ready out-of-the-box



## Fixed Mounted 5G

5G & Wi-Fi /Bluetooth anywhere in the field with intrinsically safe power. Audio & video surveillance viewed globally (EdgeView™)



## Global Push-To-Talk (PTT)

Fully functional PTT digital communications anywhere in the world



**RUGGEDEDGE**



# RuggedEdge Intrinsically Safe EdgeWatch

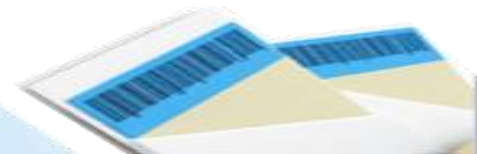


RUGGEDEDGE

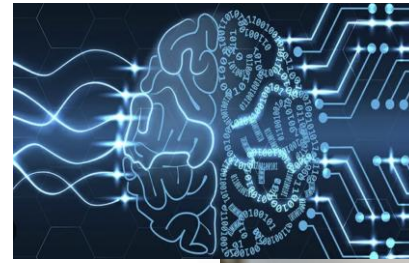
World's only AI-enabled health monitoring smart watch designed for combustible environments



- Class 1 Div 1 / Zone 1 Certified
- IP68 dust/waterproof
- Ruggedized MIL-STD-810H
- Android Operating System
- WIFI Enabled
- Bluetooth, GPS, NFC
- **SOS** button
- **Man-down** feature
- GPS Location
- Vibration Alarms
- Health Monitoring
  - Activity Levels / Exertion
  - Heart Rate / Pulse Tracking
  - Blood Oxygen Level



# AI on the Edge



- **RuggedEdge AI Push-to-talk**

- Uses natural speech to communicate with AI and answers are returned audibly and on screen
- Supports 80 languages and auto-detects the language spoken
- Large language model (LLM) is trained with domain specific information, OEM and customer data, providing detailed and accurate answers to technical questions
- Platform can tap into real-time data like maintenance, safety and operational records
- Highly secure platform where the speech engine, LLM, domain & customer data stay local to the device



# Workflow & Business Process Digitalization



Streamline & standardise paper processes into digitalised tasks accessed by mobile, tablet or wearable device

**w<sup>+</sup>** **WorkfloPlus**  
Making the complex simple

Instantly distribute job reports and generate previously unavailable data into human based procedures



## Work Instructions



- 200% Productivity Boost\*
- Accurate Machine Set Up
- Distribute SOPs Instantly

## Compliance



- 100% Accurate ISO Audit Trail
- Improve Health & Safety
- Guarantee Industry Regulations

## Inspections



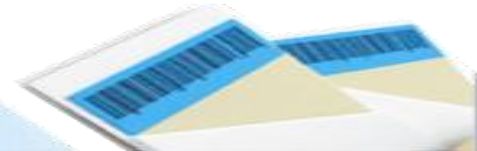
- 300% Extra Inspections\*
- Optimise Maintenance
- Increase Product Quality

*\* Petrofac Proof of Concept Use Case*

## Training



- Retain Expertise of Workers
- Onboard Workers Quickly
- Remote Expert Assistance



# WorkfloPlus AI Features

## Smart Workflow Creation

Create a prompt and AI-generates digital instructions based on your needs

**New Draft Workflow**

Workflow Name \*  
HAZOP workflow

---

Description

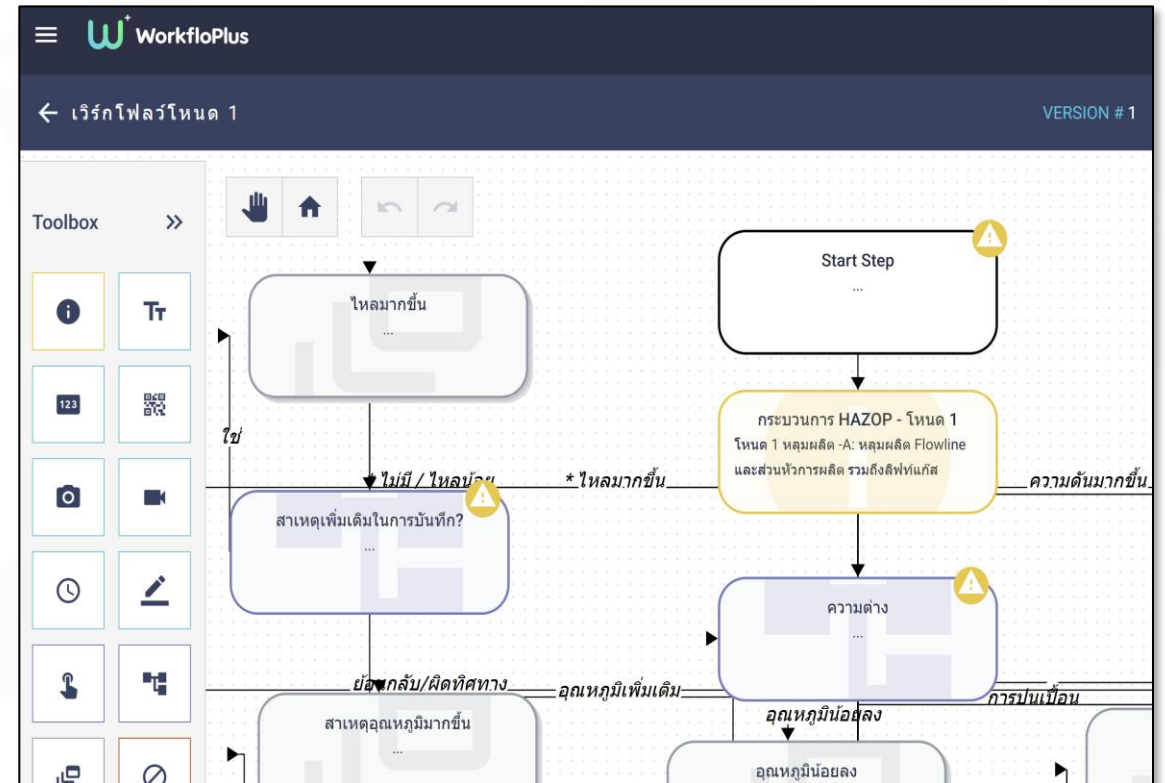
Generate a workflow for executing a HAZOP study, importing the relevant data from Asset Database, selecting a HAZOP node from a drop down list, then a parameter, then a deviation, then causes, then consequences, then safeguards, then risk matrix value, then recommendations, and then responsible party. Workflow should iterate over all deviations, then parameters and then nodes.

Please note that you are responsible for reviewing and verifying the Workflow generated by the AI Workflow Generator. The AI Workflow Generator may not generate a Workflow that is compliant with applicable laws and regulations and you must therefore fully verify the process to ensure it meets your business needs and any legal and/or regulatory requirements.

Create
 Generate
Cancel

## Instant AI Translation

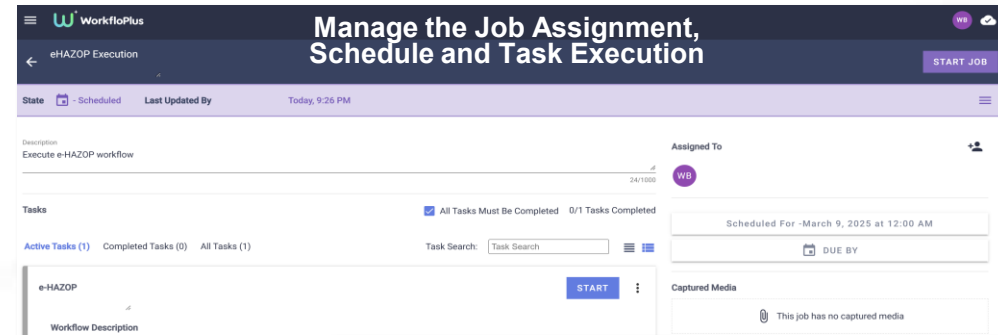
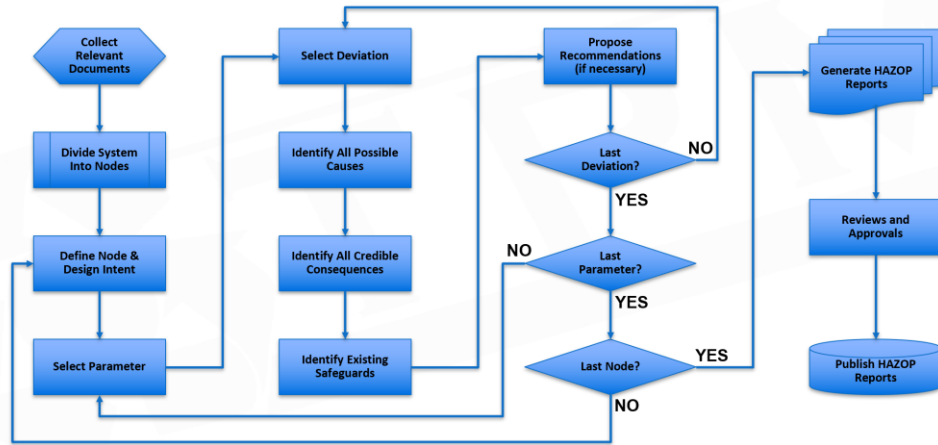
AI translates workflows instantly into multiple languages for global rollout, with workflow consistency across languages



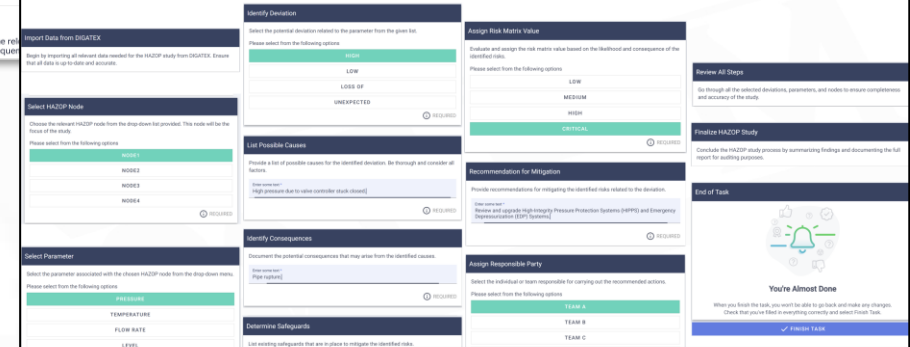
**One Process. One Standard. Everywhere.**  
**Satu Proses. Satu Piawaian. Di Mana-mana.**  
 หนึ่งกระบวนการ มาตรฐานเดียว ทุกที่  
 एक प्रक्रिया। एक मानक। हर जगह।

# Example: e-HAZOP Workflow Creation

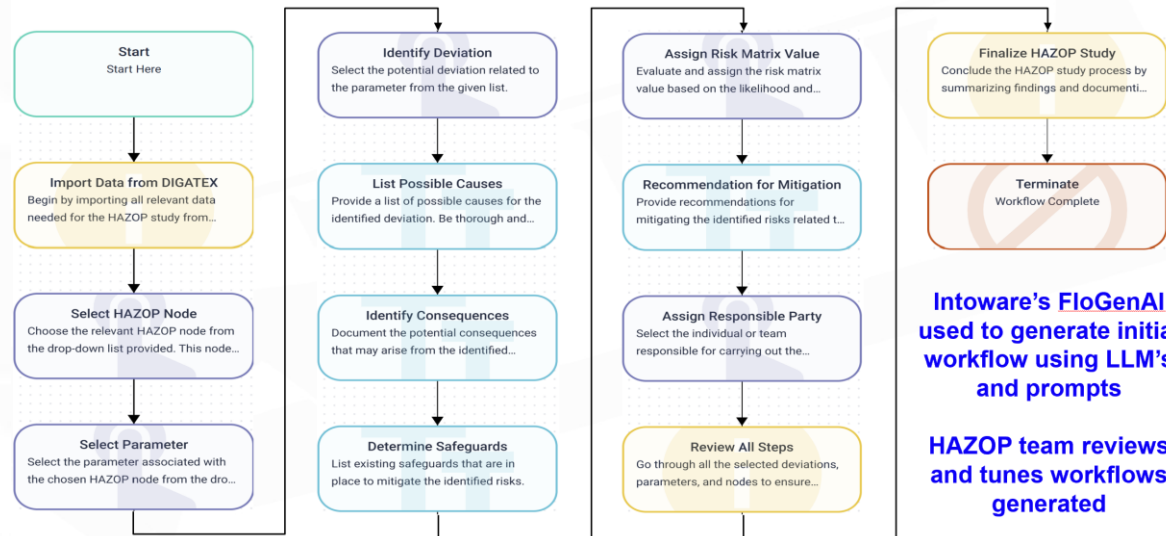
## Typical HAZOP Process



## Executing the e-HAZOP Job



## AI-generated Workflow in WorkfloPlus



Intoware's FloGenAI used to generate initial workflow using LLM's and prompts

HAZOP team reviews and tunes workflows generated

**Node 2 Workflow**  
 Completed By - tpm-solutions.com  
 Started - 10 Apr 2025 at 15:50:37 (UTC +8)  
 Duration - 7 minutes

**Automatic Report Generation on Job Completion**  
 Completed - 10 Apr 2025 at 15:58:26 (UTC +8)  
 Actual Duration - 1 minute

---

**Completed Steps**

**HAZOP PROCESS - NODE 2**  
 Completed By - tpm-solutions.com  
 Total Duration - 2sec Active Duration - 2sec  
 Node 2. Wellhead-A: Sump, Vent & Drain System

*This step has no value.*

---

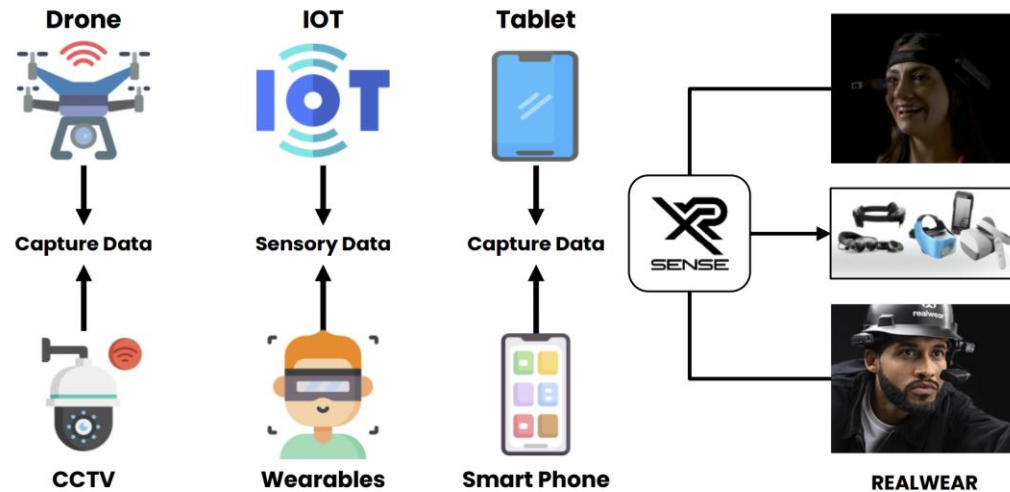
**Deviation**  
 Completed By - tpm-solutions.com  
 Total Duration - 1sec Active Duration - 0sec

No/Less Flow

# AI-enhanced Vision – XR Sense



- XR Sense uses Machine Vision to automate tasks and seamlessly incorporate MV findings into a single operational view
- Powerful web-based platform combines camera-enabled end-user devices, with highly accurate geographic information systems and a smart decision-making engine
- High-performance, scalable, secure solution



**WORKFLOW**

The step-by-step workflow for quality assurance  
Glass to glass remote support to optimize productivity

**Remote Support**

Ability to see operators' location, connect with experts and support via call, annotation, and key data as required.

**Computer Vision**

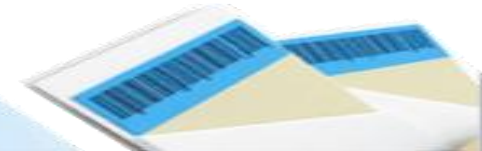
Automatically detect anomalies from various capture devices and centralise results to increase business intelligence.

**Automation**

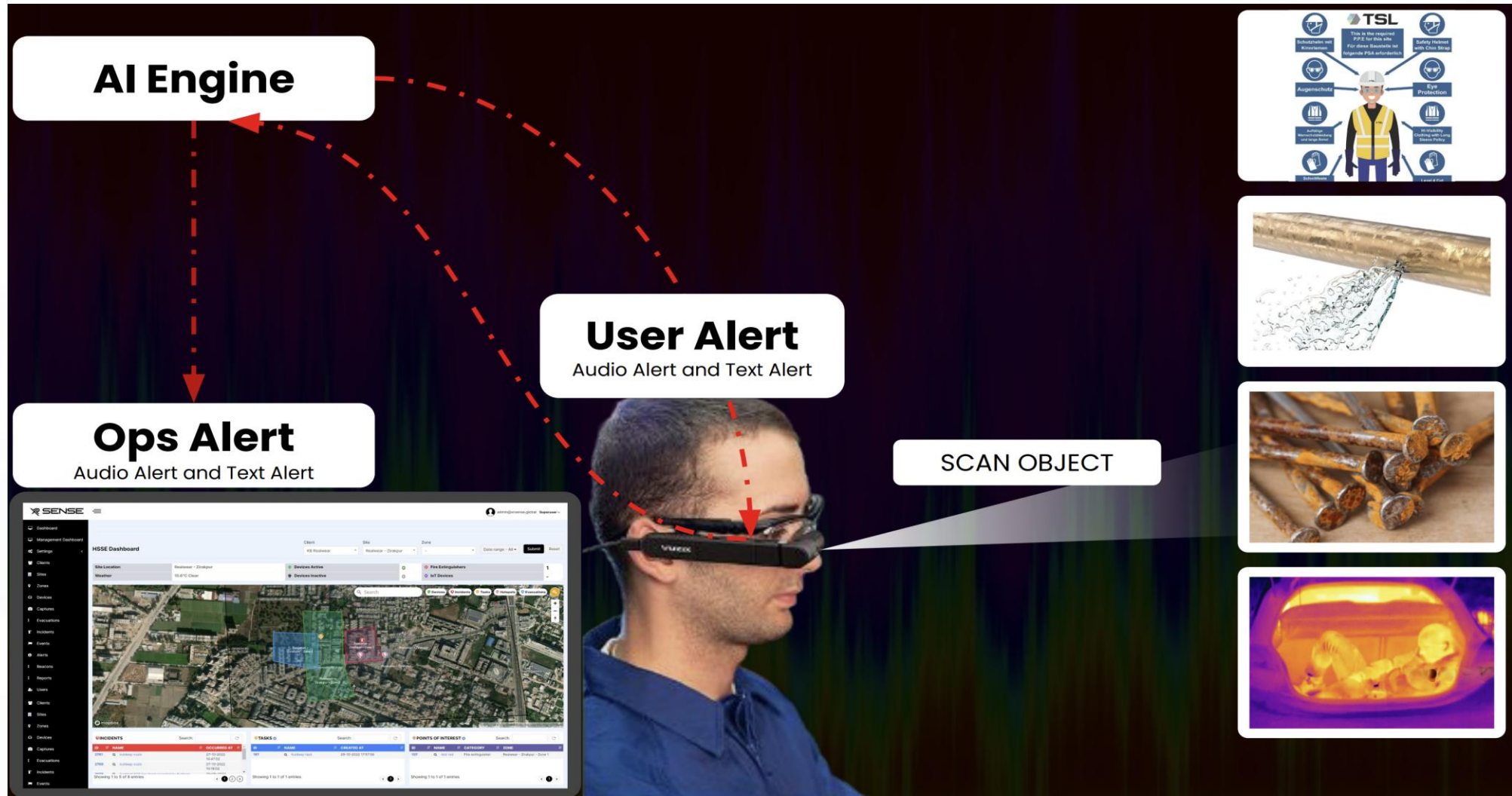
Immediate actions and alerts to reduce waste, increase productivity and ensure worker safety.

**Situational Awareness**

Know where your workers are and the tasks they are performing; to improve performance and create a safer environment.



# XR Sense's AI Workflow



XR Sense's dashboard monitors the health, safety and security of your workers, including the surrounding environment, facilitating remote and autonomous operations

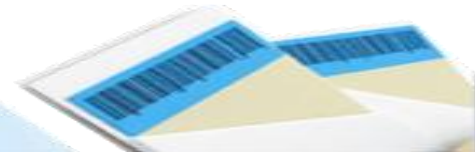
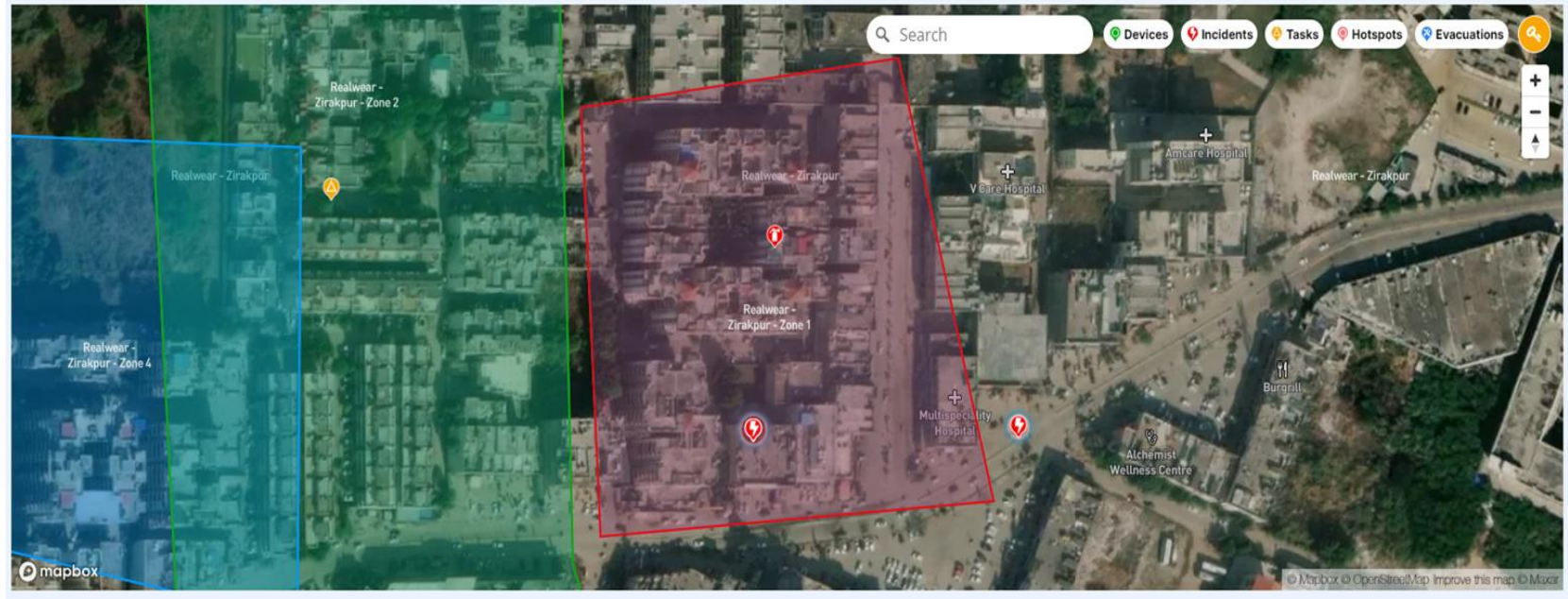
### Increase

- Safety & evacuation
- First responder access
- Speed of communication
- Productivity
- Site and cross-team awareness

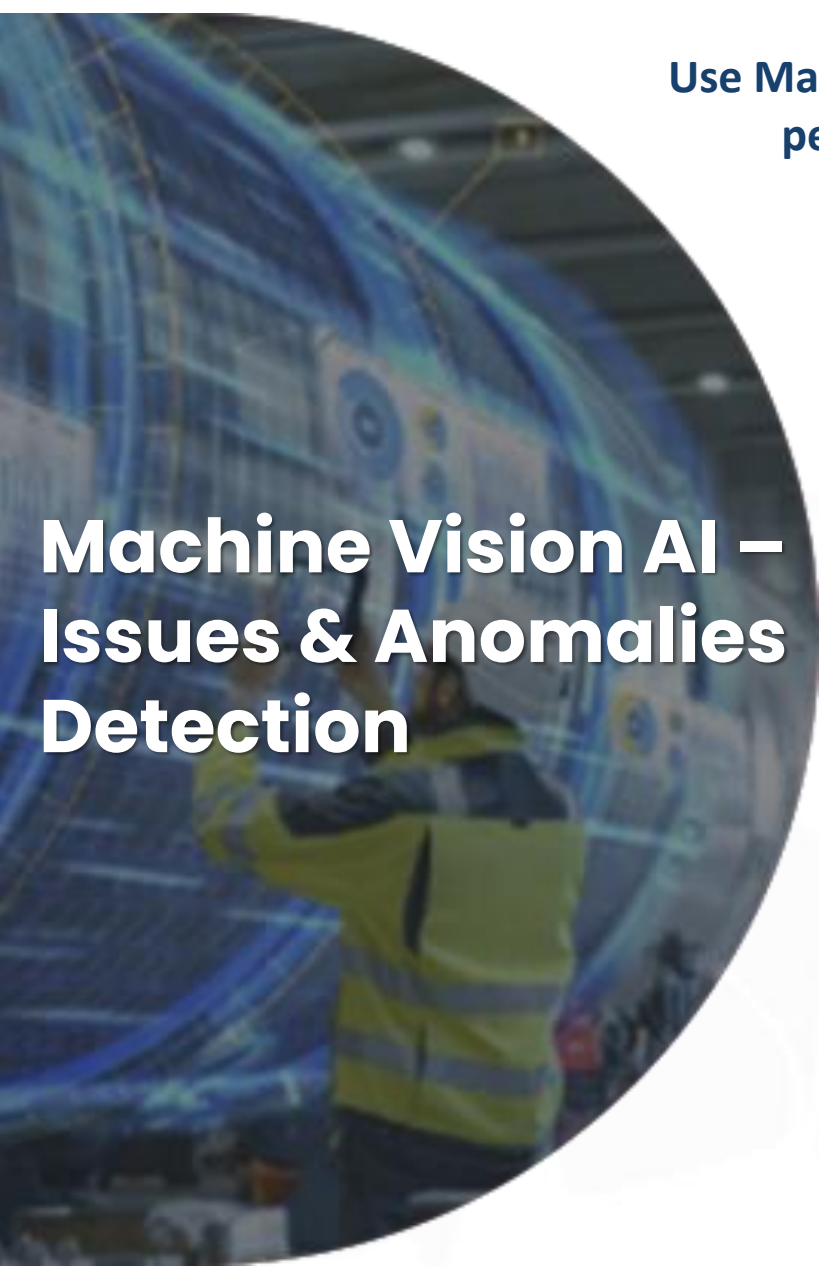
### Decrease

- Serious injury
- Risk
- Downtime
- Operator rounds
- Non-productive time

# Situational Awareness



Use Machine Vision AI to automatically detect issues & anomalies with equipment, personnel and sites, generating appropriate responses and notifications



# Machine Vision AI – Issues & Anomalies Detection

## Increase

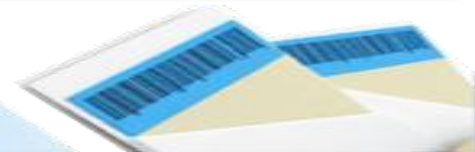
- Rapid issue/anomaly awareness
- Ability to intervene before escalations
- Autonomous operations
- Focus on value-adding activities
- Worker capabilities

## Decrease

- Serious injury & travel risk
- Operator rounds
- Low-level tasks
- Manual reporting



771245	
Device Name	Noa Device HMT
Date & Time	12-10-2022 11:54:42
Device UID	A6cde2487c5f8842
Device ID	120
Resolution	1920X1080
Detections	
<input checked="" type="radio"/> Fire	
Client	YIT UK
User	Noa
Site	UK
Zone	CHD Zone
Quality	Low
Latitude	30.6381796
Longitude	76.8161319



# Machine Vision AI automatically detects the presence of fire, initiates first responder response, and notifies workers and/or supervisors



## Machine Vision AI – Fire Detection

### Increase

- Rapid issue/anomaly awareness
- Ability to intervene before escalations
- Autonomous operations
- Focus on value-adding activities
- Worker capabilities

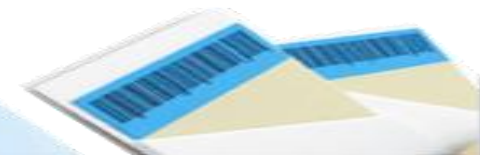
### Decrease

- Serious injury & travel risk
- Operator rounds
- Low-Level tasks
- Manual reporting



771245

Device Name	Noa Device HMT
Date & Time	12-10-2022 11:54:42
Device UID	A6cde2487c5f8842
Device ID	120
Resolution	1920X1080
<b>Detections</b>	
Fire	
Client	YIT UK
User	Noa
Site	UK
Zone	CHD Zone
Quality	Low
Latitude	30.6381796
Longitude	76.8161319



Assess the location and condition of equipment with Machine Vision AI, to see if they are missing, and generate associated reporting & warnings



# Machine Vision AI – Equipment

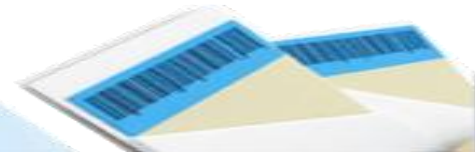
## Increase

- Anomaly awareness
- Missing high-value equipment awareness
- Productivity
- Ease of reporting
- Management reporting

## Decrease

- Redundancy requirement
- Operator rounds
- Manual reporting

49669	49497	27109	27206
Device UID: 25b5fba66c2e61d1(#20) Device name: Shell Haven On-site Device at 2022-01-26 13:45:18	Device UID: 25b5fba66c2e61d1(#20) Device name: Shell Haven On-site Device at 2022-01-26 13:45:12	Device UID: 25b5fba66c2e61d1(#20) Device name: Shell Haven On-site Device at 2021-12-08 13:25:46	Device UID: 25b5fba66c2e61d1(#20) Device name: Shell Haven On-site Device at 2021-12-08 13:25:43
Has_Face: No	Has_Face: No	Has_Face: No	Has_Face: No
Has_Hard_Hat: No	Has_Hard_Hat: No	Has_Hard_Hat: No	Has_Hard_Hat: No
Has_Fire_Extinguisher: Yes	Has_Fire_Extinguisher: Yes	Has_Fire_Extinguisher: Yes	Has_Fire_Extinguisher: Yes



Machine Vision AI automatically detects whether workers are wearing safety hats, glasses, gloves, boots, vests or overalls, and notifies users and/or supervisors



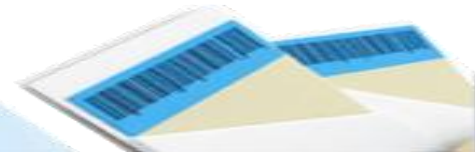
# Machine Vision AI – PPE Detection

### Increase

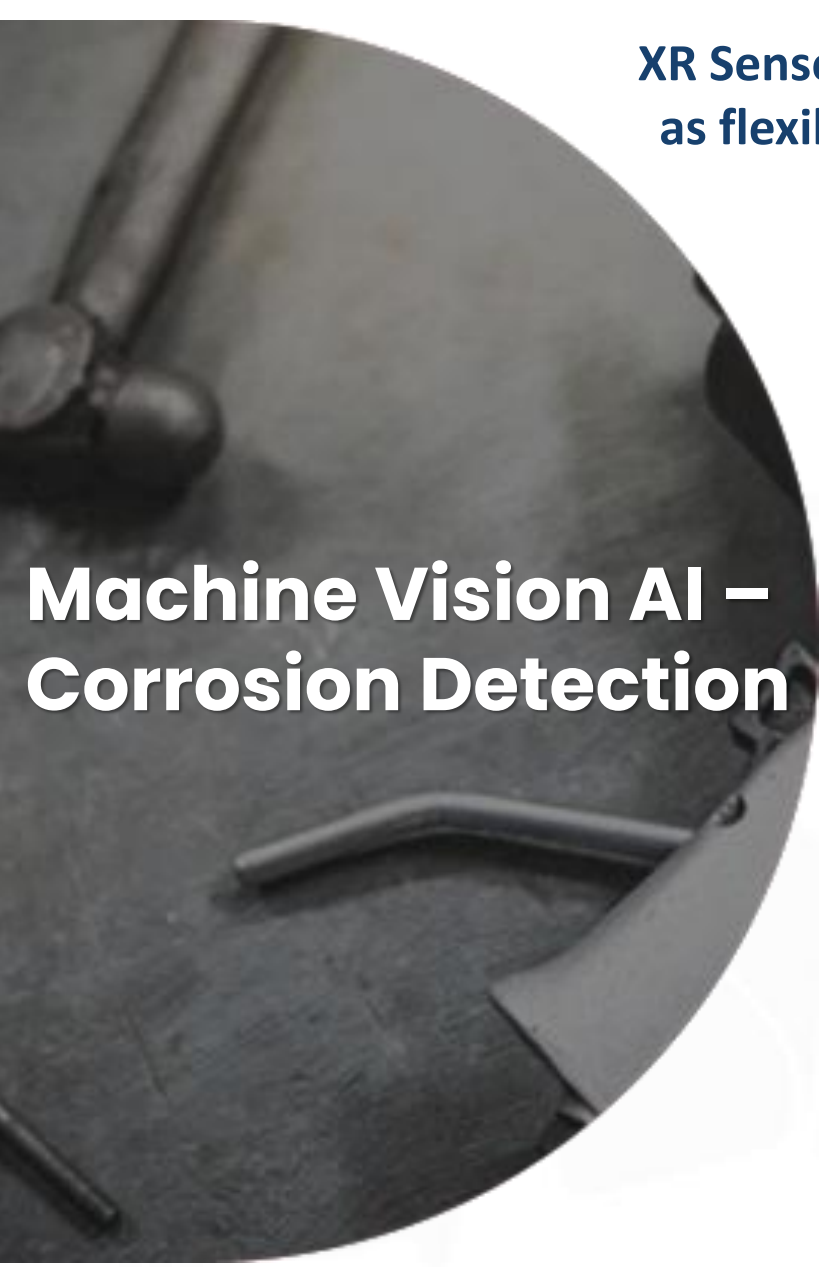
- Worker identification (Face recognition)
- PPE compliance
- Worker health & safety
- Safety awareness

### Decrease

- PPE omissions
- Risk
- Injury
- Lost & wasted time



XR Sense has developed Machine Vision AI models to detect corrosion as well as flexible actionable results for instant task and maintenance management



# Machine Vision AI – Corrosion Detection

## Increase

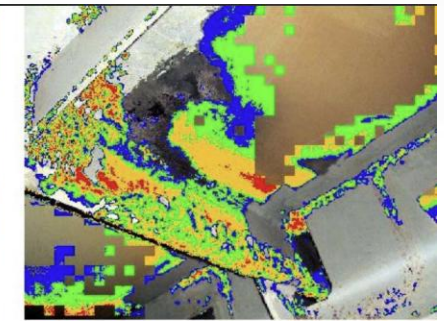
- Data-driven maintenance decisions
- Success of preventative maintenance
- Asset lifespan
- Worker efficiency with automation & streamlined inspection processes
- Regulatory standards compliance

## Decrease

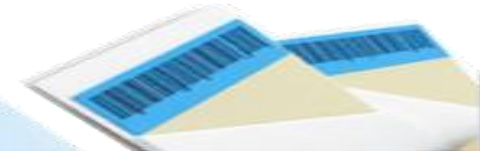
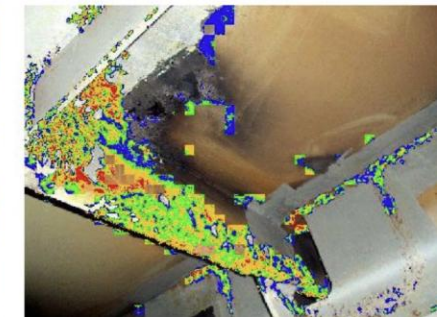
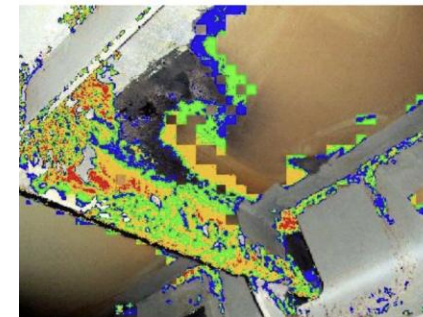
- Risk of catastrophic failure and associated lost production
- Repair costs with early detection
- Inspector workloads & risks with drone inspections & automated analysis



Original image








$\tau_E = 0.2$

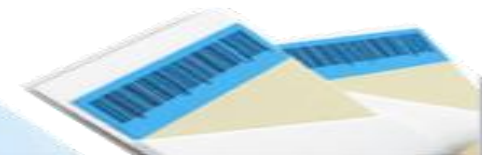


# Connected Process Safety Management



 <b>ESG Excellence</b>	 <b>Environmental Management</b>	 <b>Health &amp; Safety Management</b>	 <b>Process Safety Management</b>	 <b>Control of Work</b>
Asset level emissions Water discharge	Air Quality Water Management Waste Management	Occupational Health Industrial Hygiene Ergonomics Analysis	Barrier Management Dynamic BowTie	Shift Management
Stakeholders Mgmt <i>Materiality Assessment</i> Project Portfolio Mgmt ROI Analysis Scenario Analysis	Environmental Analysis <i>Spills and Air emissions event tracking<sup>1</sup></i>	JSA/JHA Training/Competency BBS Observations <i>Full Investigation Mgmt</i>	BowTieXP <i>Process Safety Event<sup>1</sup></i> <i>Emergency planning &amp; response</i>	SIMOPs ORA LO/LC & TD Checklists <i>On-time Prevention<sup>1</sup></i>
Risk Management	Compliance Management	Inspection Management	BowTieXP Enterprise	iDiagrams (P&IDs)
GHG Emissions Utility Data Management <i>API to 3<sup>rd</sup> party systems</i>	Calendar	<i>Injury/Illness tracking</i> Safety Meetings	Process Hazard Analysis Mechanical integrity Inspection	Permit to Work Isolations Mgmt./LOTO TRA/JHA
Objectives Management Metrics	Document Control Audit Management	Root Cause Analysis Incident Management	Management of Change	Site Monitoring & Graphics
ESG Disclosure Reporting (Powered by CCH Tagetik) ESG Open Insights	Compliance+	H&S Open Insights Risk & Control Register		MOC & PSSR (ORM) GIS Visualization Tag Assistant

**TPM Connected Worker solutions can integrate into Enablion for real-time process safety management**



# TPM Solutions Summary

- Highly experienced Consultants/Subject Matter Experts driving value through Business Process as a Service (BPaaS)
- Energy & Process industry focus including Energy Transition / Clean Fuels
- Cutting Edge Solutions for Plant Performance
- Digital Operational Excellence full capability including proven AI applications
- Connected Field Worker/Technician empowerment for Energy, Manufacturing and Service industries
- Value Add to Capital Projects
- Our advanced digitalization and Artificial Intelligence solutions provide leading-edge technology to our clients, supported by our deep domain expertise, capturing benefits, improving efficiencies, and enhancing safety in a sustainable manner

***Design, Operate, Manage, and Improve your Business  
(from any location, on any device)***



[www.tpm-solutions.com](http://www.tpm-solutions.com)  
[info@tpm-solutions.com](mailto:info@tpm-solutions.com)

