

The background features a night-time industrial facility, likely a refinery or chemical plant, with several tall distillation columns and towers illuminated by warm lights. Overlaid on this scene is a complex network of white lines and glowing nodes, representing a digital or data network. The overall color palette is dominated by deep blues and teals, with the industrial lights providing a warm contrast.

INTEGRATED CENTRAL OPERATIONS

SRIKANTH V & BAISHAKHI BHATTACHARYYA

09-MAY-2024

Honeywell

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AGENDA

- 01 INTELLIGENT AUTONOMOUS – AN OVERVIEW**
- 02 HONEYWELL INDUSTRIAL AI SOLUTIONS**
- 03 ENTERPRISE AI**
- 04 EXPERION OPERATOR ASSISTANT**
- 05 OPERATOR ROLE COMPLEXITY ANALYSIS (ORCA)**
- 06 VISION & CLOSING DISCUSSION**

AUTONOMOUS OPERATIONS - A TOP PRIORITY INITIATIVE FOR FUTURE OPERATING MODEL

OPERATIONAL CONTEXT

- Redefining of business processes
- Transformation of core processes
- Workforce optimization and productivity
- Leverage technology to enable transformation
- Integrated smart end to end transformation journey

AUTONOMOUS OPERATION OBJECTIVES

- Create a shared ambition and vision across the enterprise
- Identify key levers and value-driven initiatives
- Create incremental value from collaborations between operational plants
- Put in place the foundation to enable transformation

INTELLIGENT AUTONOMOUS: DRIVE BUSINESS STRATEGIES THROUGH OUTCOME BASED TECHNOLOGIES

CORPORATE GOALS

OPTIMIZE PRODUCTION

LOWEST COST OF PRODUCTION

CLEANEST PRODUCTION

OUTCOMES

END-TO-END OPTIMIZATION

SAFETY & OPERATIONS EXCELLENCE

ASSET MANAGEMENT

COMPETENCY & PRODUCTIVITY

SUSTAINABILITY

BUSINESS TRANSFORMATION

PROCESS OPTIMIZATION

ADVANCED AUTOMATION

SUB-SURFACE INTEGRATION

IMPROVED RELIABILITY

WORKFORCE COMPETENCY

LOWER ENERGY & EMISSIONS

- Improved production/yields
- Leverage Process Digital twins.
- Widen scope of optimization
- Run at peak performance with intelligent insights

- Automated start-up/Shut-down of operating units
- AI enabled predictive insights
- Driving operational productivity and business intelligence

- Partnership with sub-surface domain specialists
- Integrate sub-surface and surface models
- Drive the wider scope of optimization

- Health & performance monitoring assets
- Predictive analytics from instrument sensors to assets
- Corrosion monitoring

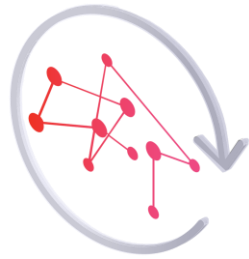
- Simulated environment for control room and field operators
- Leverage AR/VR for functional competency
- Mobility solutions for productivity

- Monitor and assess energy and emission KPIs
- Monitor & quantify fugitive emissions
- Reporting on Scope-1 and Scope-2 emissions

- Partner as needed for business process transformation
- Focus on adoption and change management
- Evaluate value of transformation

ALIGNMENT AND FOCUS ON 7 WORKSTREAMS

INTELLIGENT AUTONOMY REQUIRES INDUSTRIAL AI



INDUSTRIAL AI

Industrial Grade Artificial Intelligence to enable moving away from rule-based systems to closed-loop autonomous systems

66%

Industrial Manufacturers reporting increases in revenue attributable to AI

55%

Industrial Manufacturers reporting decreases in operating costs attributable to AI

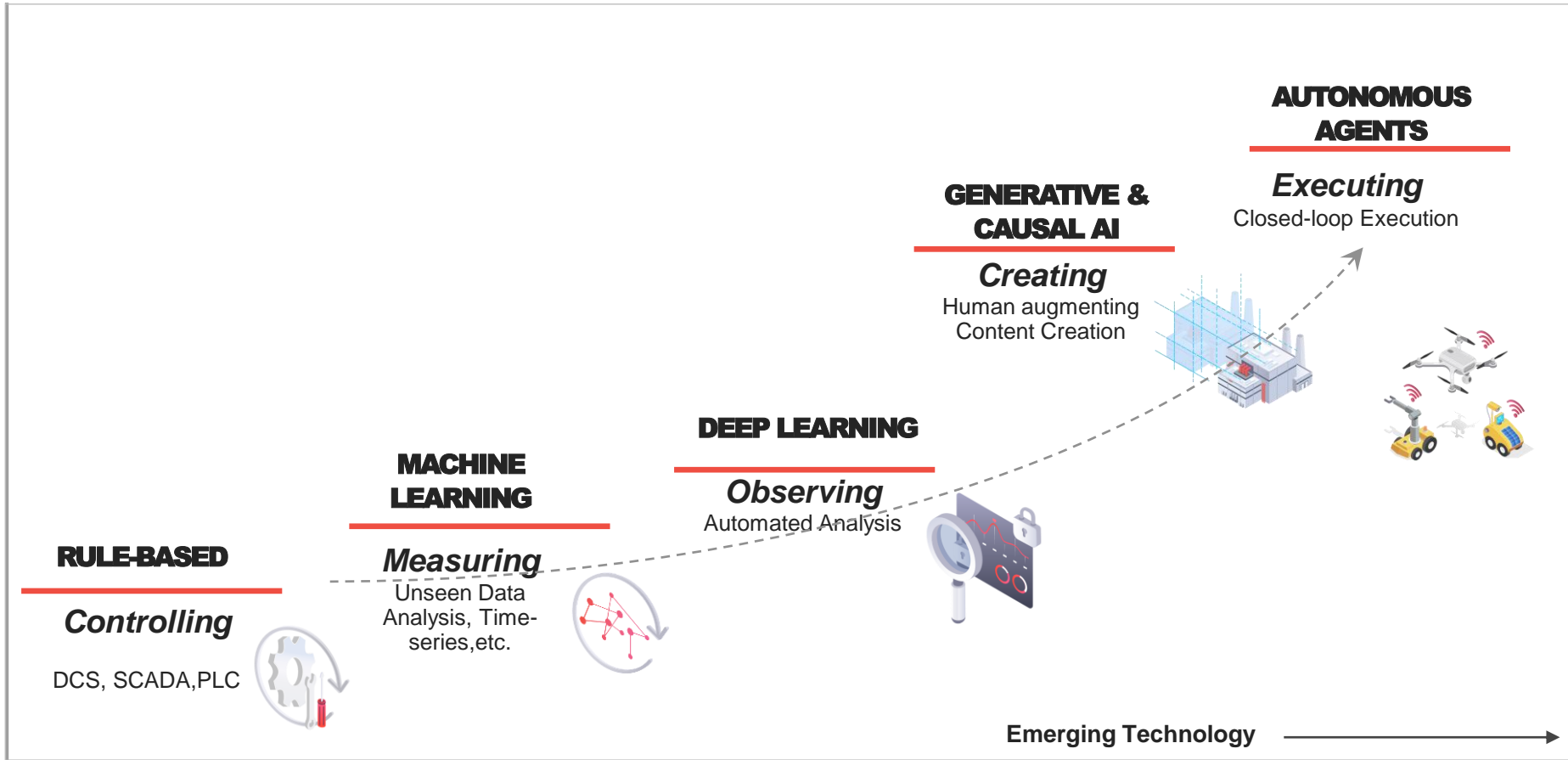


NEXT GENERATION INTELLIGENT OPERATIONS

=

Process Knowledge + Digital Technologies + Artificial Intelligence

MATURITY OF AI IS UNLOCKING NEW POSSIBILITIES



13%

AI transformation to be faster than Digital Transformation

75%

Share of Companies Including AI in Core of Business Strategies

Accenture Research: The Art of AI Maturity (2021)

CURRENT AI PARADIGMS EASE ADOPTION AND INCREASE SCOPE OF INTELLIGENT AUTONOMY

HUMAN AUTONOMY TEAMING

Effective Human-Autonomy Teaming facilitates better performance than humans alone or machines alone.

Human Strengths



- Intuitive, Judge Changing Situations
- Emotional, Feel
- Culturally Sensitive
- Imaginative

Best suited to:

Can work on Tasks which have limited data

Shifts from short term to long term concerns

Machine Strengths



- Ingesting Data - Fast
- Repetitive Tasks
- Accurate
- Consistently Rational

Best suited to:

Lower-level routine tasks which are Repetitive and happen in closed management system

Effective teaming facilitates better performance than humans alone or machines alone

HONEYWELL INDUSTRIAL AI SOLUTIONS

Towards Intelligent Autonomous Operations

ENTERPRISE AI

PRODUCTION INTELLIGENCE

Enterprise level AI-powered decision support system offering integrated perspectives, guided diagnoses and prescriptive recommendations to help make rapid decision and enhance business performance.

CONTROL ROOM AI

OPERATIONS COPILOT

Worlds first AI-infused Automation system based on the foundational best in industry Experion control system technology infused with explainable, validated artificial intelligence you can trust

FIELD AI

INTEGRATED FIELD WORKER APP

Integrated Field Worker system infused with 'artificial intelligence' to make Field Operations and Maintenance actions easier, safer and first time right

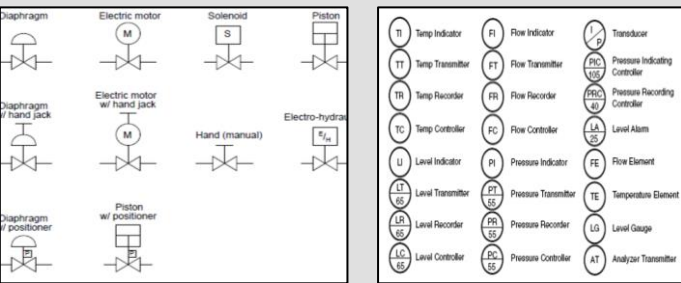
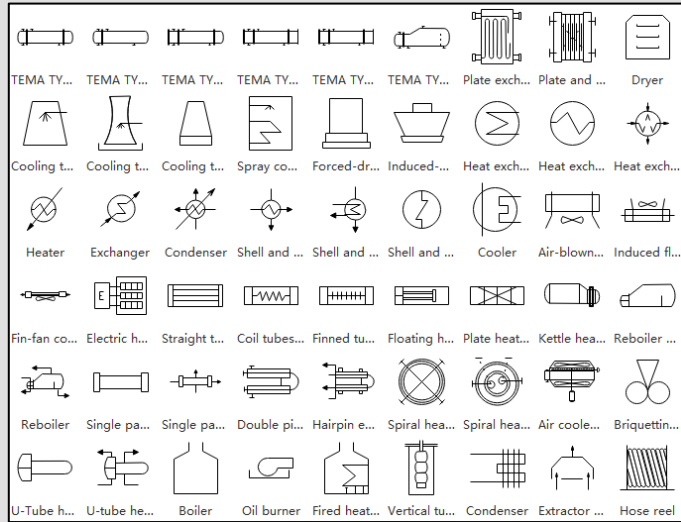
The background features a complex industrial facility, likely a refinery or chemical plant, illuminated at night. The scene is overlaid with a glowing, interconnected network of white lines and nodes, resembling a data or communication network. The overall color palette is dominated by teal and blue tones, with warm yellow and orange lights from the industrial structures. The text 'ENTERPRISE AI ASSISTANT' is prominently displayed in the center in a bold, red, sans-serif font.

ENTERPRISE AI ASSISTANT

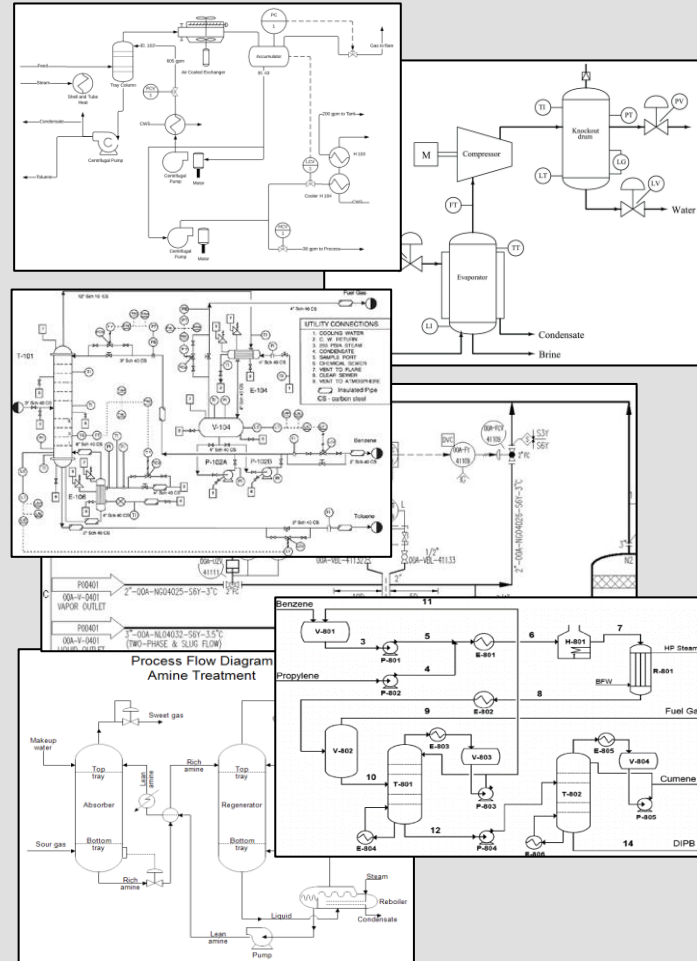
Honeywell

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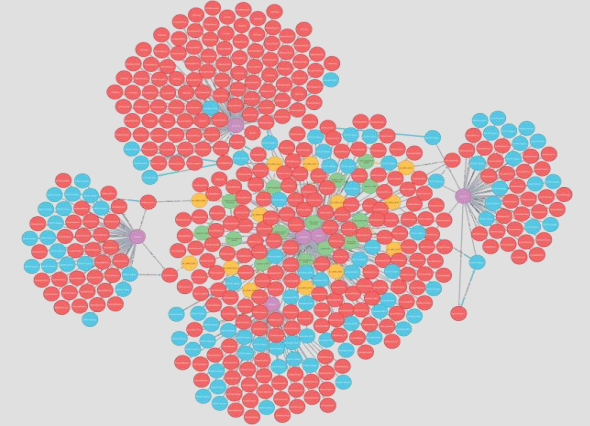
ENTERPRISE AI – THE LEARNING



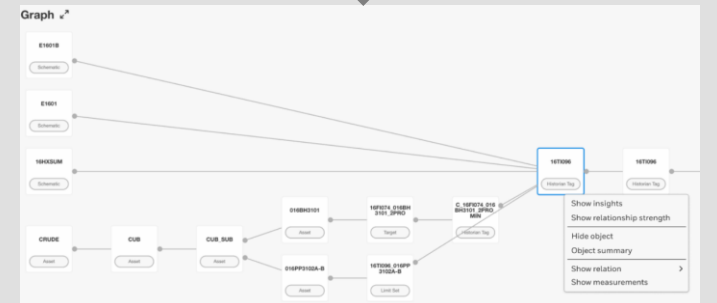
Trained ML model based on exhaustive Symbol Library



Import PFD/P&ID

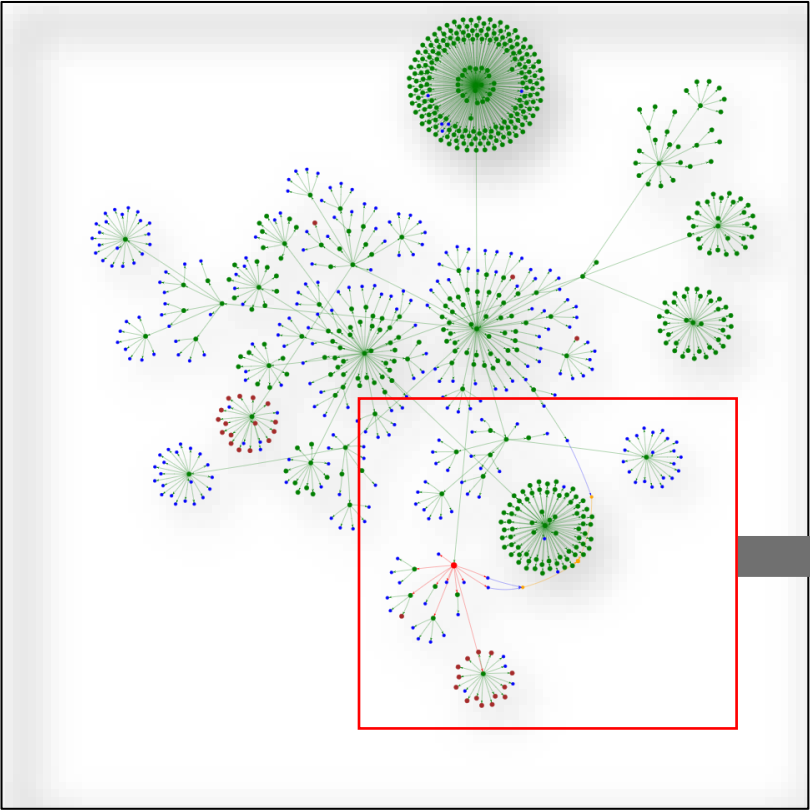


Augment Knowledge Graph

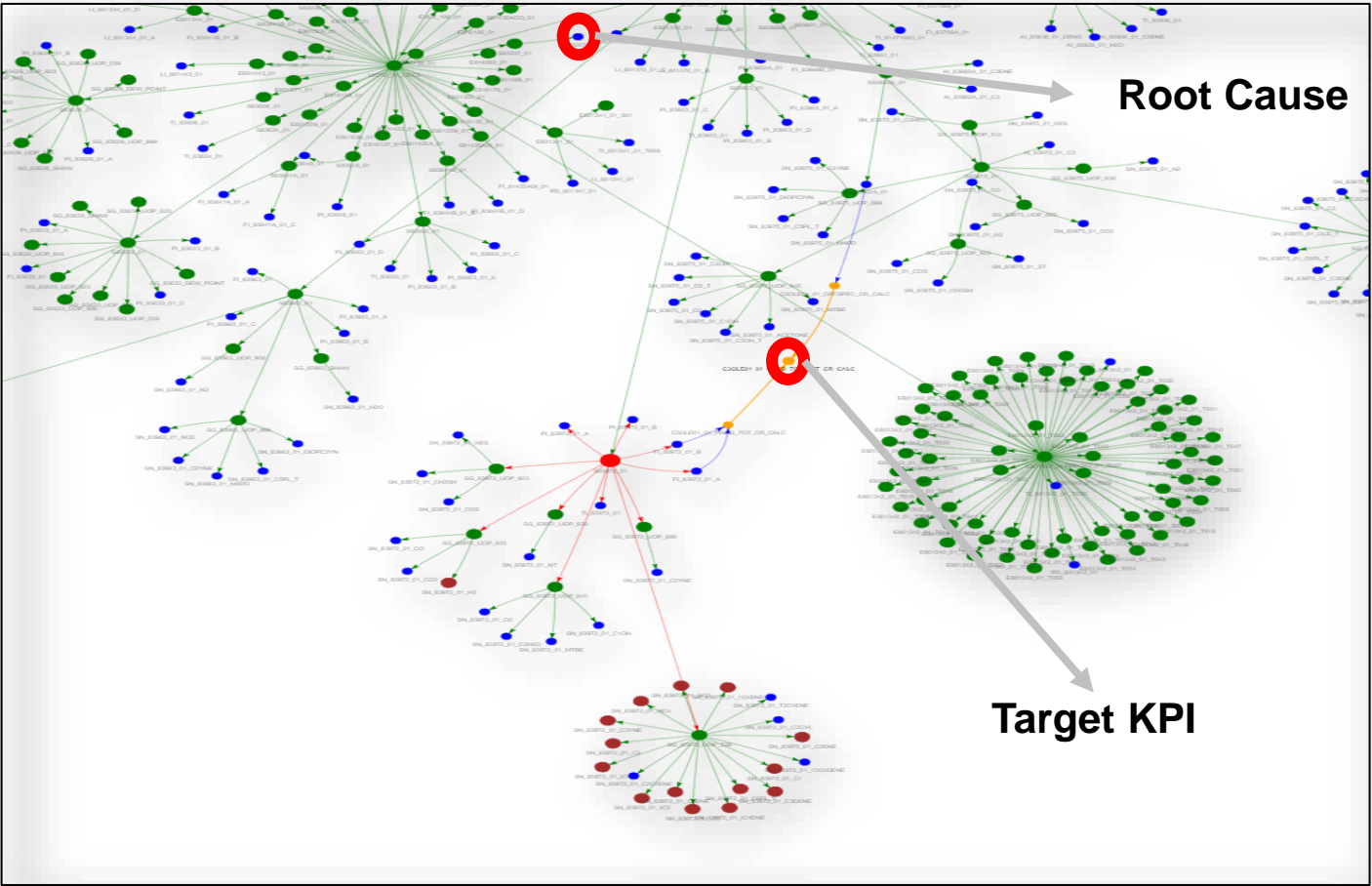


Integrate OT Systems Data

ENTERPRISE AI - THE OUTCOME



OLEFLEX KNOWLEDGE GRAPH
(simplified)



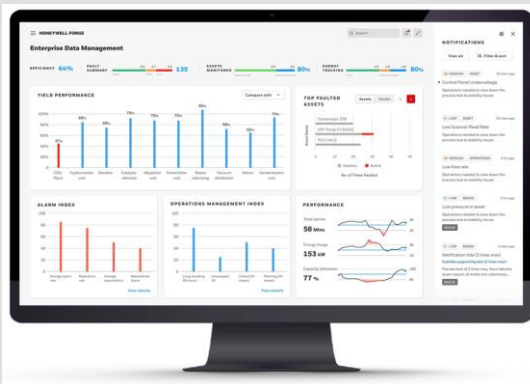
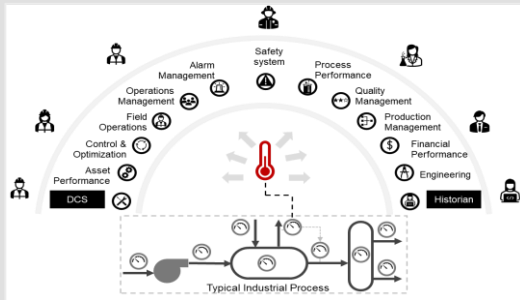
Focus On Propylene Yield KPI

ENTERPRISE AI - PUTTING IT ALL TOGETHER

Monitor

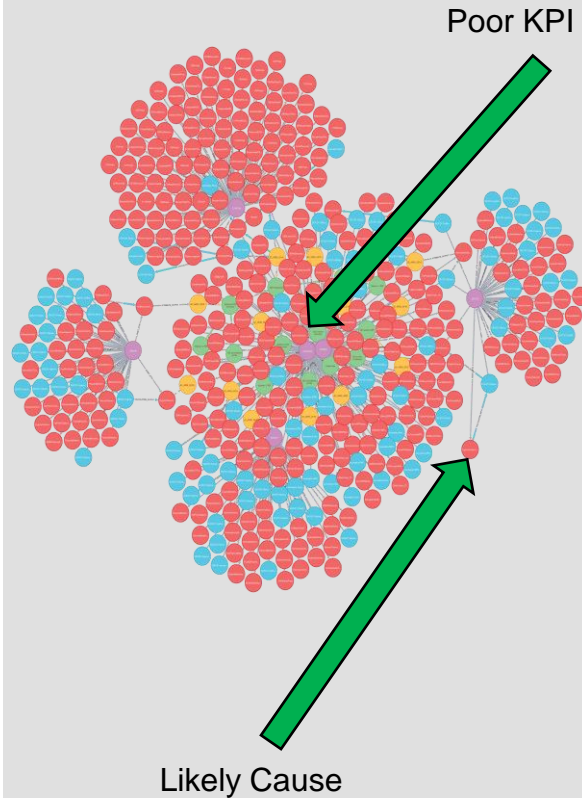
1. Persona-based KPIs & Dashboards

Align business & Operations goals



Diagnose

2. Actionable Insights to accelerate RCA



3. Intelligent Search

“How do I best run process unit A, to make product B, using feedstock C?”



Question

“Your best production run with unit A, and feedstock C to make product B was on 18 Dec 2020 with the following settings.....”

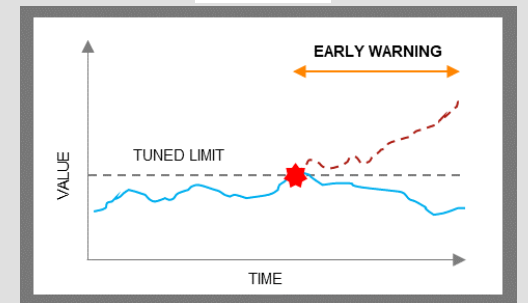
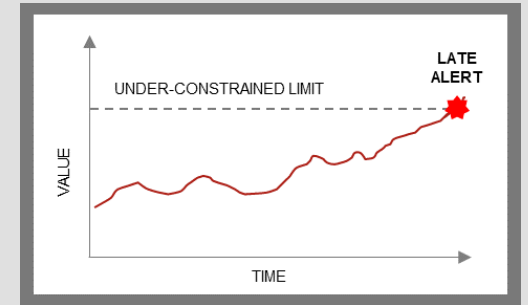
Answer



Predict

4. Bad Actor or KPI Deviation Predictions

Increased Risk



Early Warning

The background features a complex industrial plant, possibly a refinery or chemical processing facility, illuminated at night. The scene is overlaid with a glowing, interconnected network of white lines and nodes, resembling a data or communication network. The overall color palette is dominated by teal and blue tones, with warm yellow and orange lights from the industrial structures. The text 'EXPERION OPERATOR ASSISTANT' is prominently displayed in the center in a bold, red, sans-serif font.

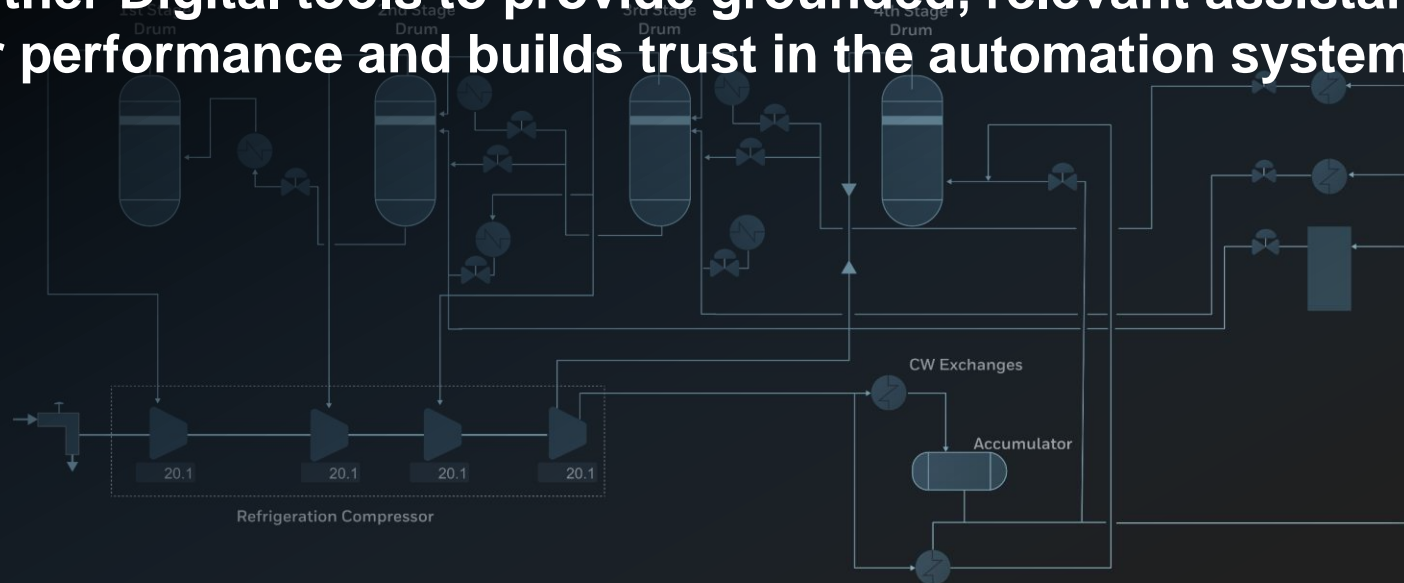
EXPERION OPERATOR ASSISTANT

Honeywell

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EXPERION OPERATOR ASSISTANT

Enable process plant operators to work at an elite level of performance by using analytics, AI and other Digital tools to provide grounded, relevant assistance that improves operator performance and builds trust in the automation system



Advisories

- Cracker B1, Zone 2, CPD above expected range**
Check coil temperatures and flow distribution.
24 May 2022 10:17AM
- Cracker B1 sub-optimal control of flue stack oxygen**
Should be below 2%. Check health of the cracker air fuel ratio controls.
24 May 2022 10:15 AM

Ask Experion

- Tues 7:10am
Increase B4 hydrocarbon feed to 385 nm3/hr over 30 mins.
- Experion** Tues 7:10am
OK, increasing B4 hydrocarbon feed to 385 nm3/hr over 30 mins.
- Tues 7:12am
Tell me if B4 TMT changes by more than 10 degrees.
- Experion** Tues 7:12am
OK, I'll tell you if B4 TMT changes by more than 10 degrees.
- Tues 7:12am
Remind me to check B4 differential pressures in 4 hours.
- Experion** Tues 7:12am
Reminder created.
- Experion** Tues 7:40am
B4 hydrocarbon feed has reached 375 nm3/hr

Last shift

Ask a question or press a button below

Message...

Find Answers Set Reminders Automate

Predicted Trip

Potential trip on propylene refrigeration system.

Recommended Action:
Ramp C2 fractionator reboiler flow to 50m³/h to prevent a refrigeration system trip.

Arrives in:
20 mins

Show rationale



Clean reboiler steam trap
Demethanizer
Wind interaction
2022

3 of 6 complete

Available Activities

- Start Cracking Start
- Stop Cracking Start
- De-coke Furnace Start

Watch List

- Cracker B1 Decoke CO2: 12.8% (Last 3 Hours)
- Cracker B1 COT: 810.0 DegC (Last 3 Hours)
- Cracker B1 TMT: 945.7 DegC (Last 3 Hours)
- R-1B Power: ON (Last 3 Hours)

Activities in Progress (4)

- B1 Decoking scheduled**
Perform Decoking Procedure on Cracker B1
Due: NOW
Current Coke Level: 85.6%
Start
- Start-up Reboiler Cracker B2**
Work Instruction: 5 Tasks
1 of 5 complete
- Clean reboiler steam trap Demethanizer**
Work Instruction: 8 Tasks
3 of 6 complete

Available Activities (3) +

- Start Cracking** Start
- Stop Cracking** Start
- De-coke Furnace** Start

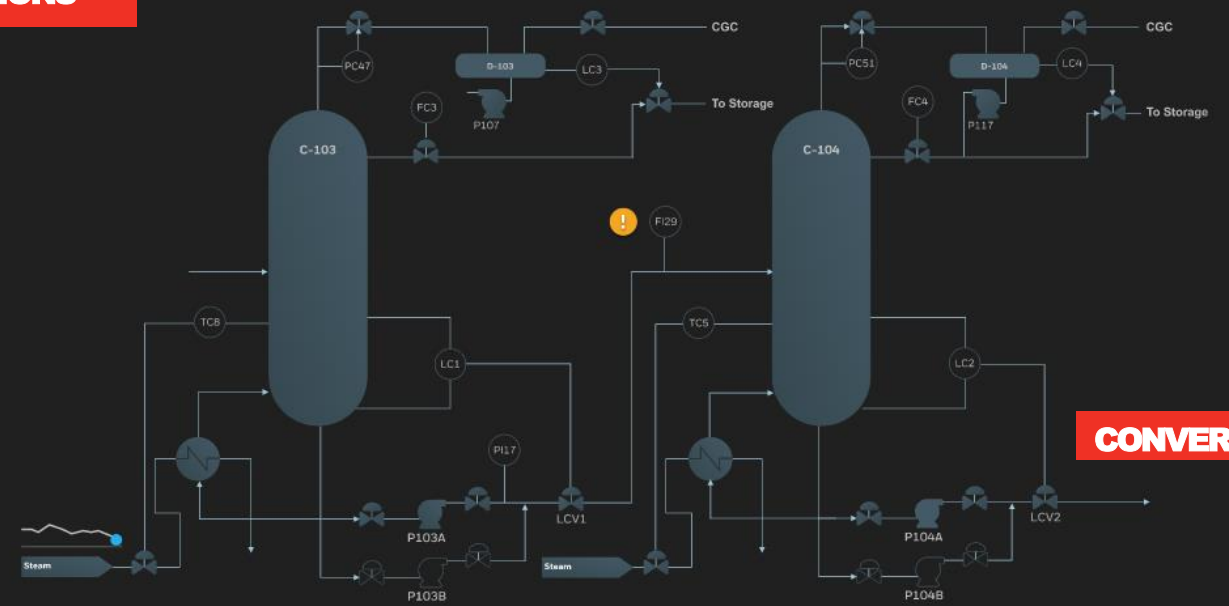
Watch List (4)

- Cracker B1 Decoke CO2**
Last 3 Hours: 12.8% View Details
- Cracker B1 COT**
Last 3 Hours: 810.0 DegC View Details
- Cracker B1 TMT**
Last 3 Hours: 945.7 DegC View Details
- R-1B Power**
ON View Details

EXPERION® OPERATOR ASSISTANT

ADVICE

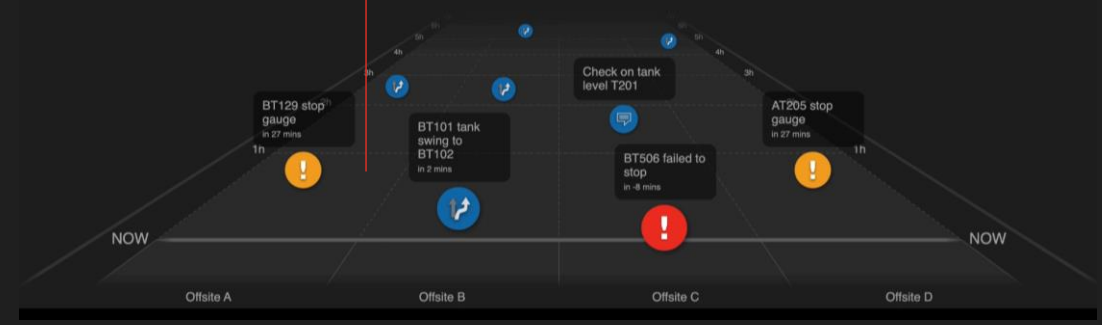
ELECTRONIC WORK INSTRUCTIONS



CONVERSATIONAL UI

WATCHLIST

SCHEDULED & PREDICTED EVENTS



Advisories (4)

- Cracker B1, Zone 2, CPD above expected range**
Check coil temperatures and flow distribution.
24 May 2022 10:17 AM
- Cracker B1 sub-optimal control of flue stack oxygen**
Should be below 2%. Check health of the cracker air fuel ratio controls.
24 May 2022 10:15 AM

Ask Experion

- Tues 7:10am: Increase B4 hydrocarbon feed to 385 nm3/hr over 30 mins.
- Experion Tues 7:10am: OK, increasing B4 hydrocarbon feed to 385 nm3/hr over 30 mins.
- Tues 7:12am: Tell me if B4 TMT changes by more than 10 degrees.
- Experion Tues 7:12am: OK, I'll tell you if B4 TMT changes by more than 10 degrees.
- Tues 7:12am: Remind me to check B4 differential pressures in 4 hours.
- Experion Tues 7:12am: Reminder created.
- Experion Tues 7:40am: B4 hydrocarbon feed has reached 375 nm3/hr.

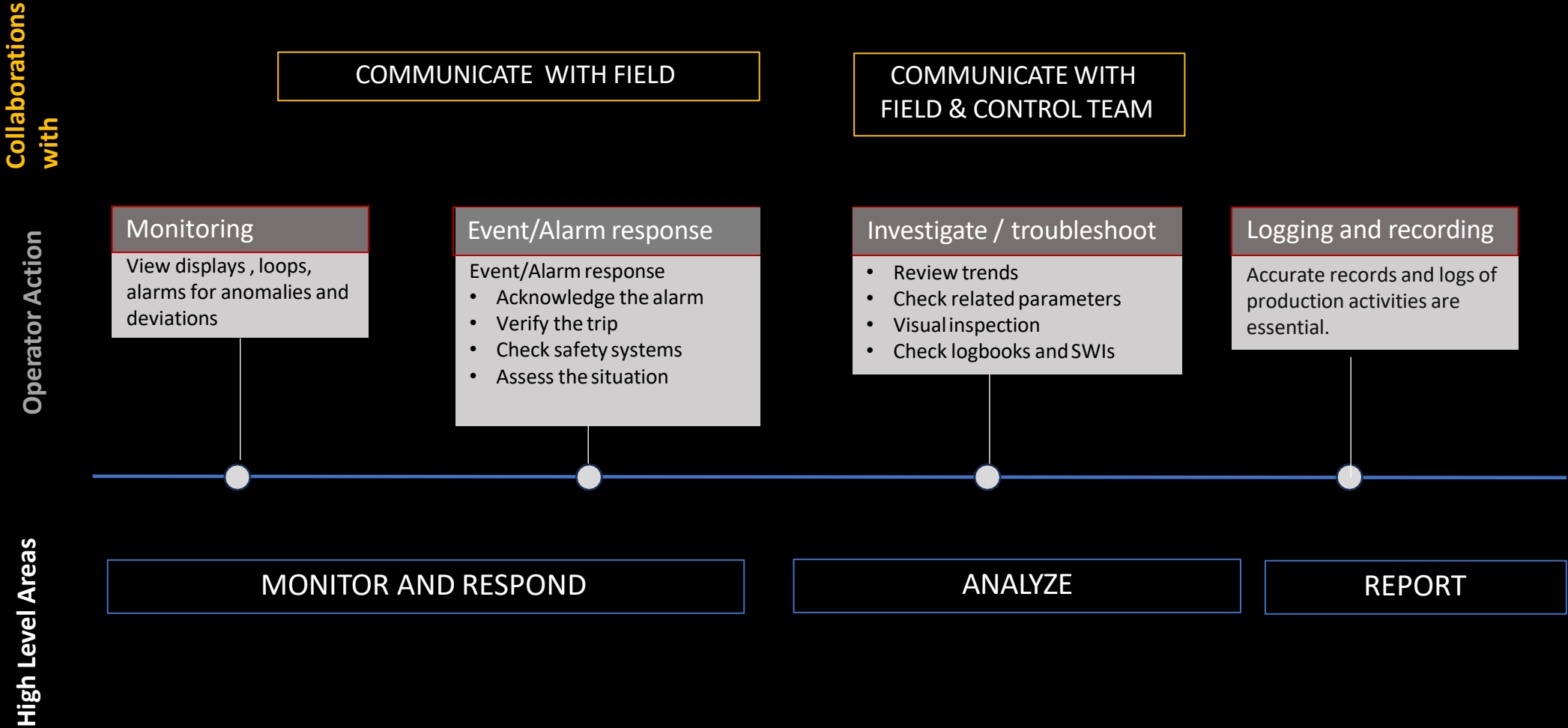
Last shift

Ask a question or press a button below

Message...

Find Answers Set Reminders Automate

TYPICAL OPERATOR TASKS



EXPERION OPERATOR ASSISTANT VISION

Collaborations
with

COMMUNICATE WITH FIELD

COMMUNICATE WITH
FIELD & CONTROL TEAM

Operator Assistant
Supported Action

Monitoring

- ✓ **Get early prediction**
- ✓ Create watch lists to monitor loops /tags
- ✓ Monitor APC ON/OFF
- ✓ Monitor production KPIs
- ✓ Get alerts

Faster situation awareness

Event/Alarm response

- ✓ **Get step by step Alarm assistant**
- ✓ Delegate repetitive tasks to assistant through Electronic Work Instructions / ProcOps

- Alarm assistance for early career operator
- Faster actions

Investigate / troubleshoot

- ✓ **Get real time analysis**
- ✓ **Get real time & explainable insights and recommendations**

Decision support

Logging and recording

- ✓ **Auto logging**
- ✓ **Automatic report generation.**

Manual work reduction

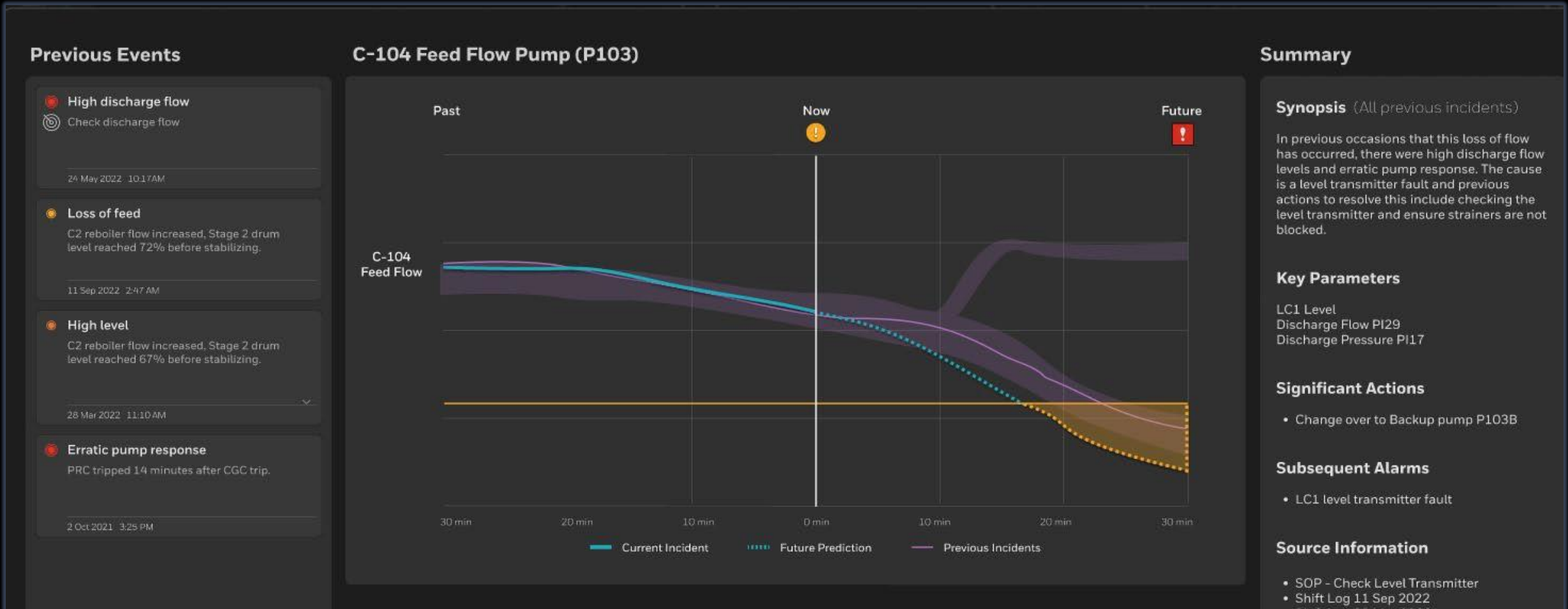
High Level Areas

MONITOR AND RESPOND

ANALYZE

REPORT

ASSISTED TROUBLESHOOTING INVESTIGATION



- Automatically compile and present information for past incidents, and emerging situations
- Speeds up troubleshooting

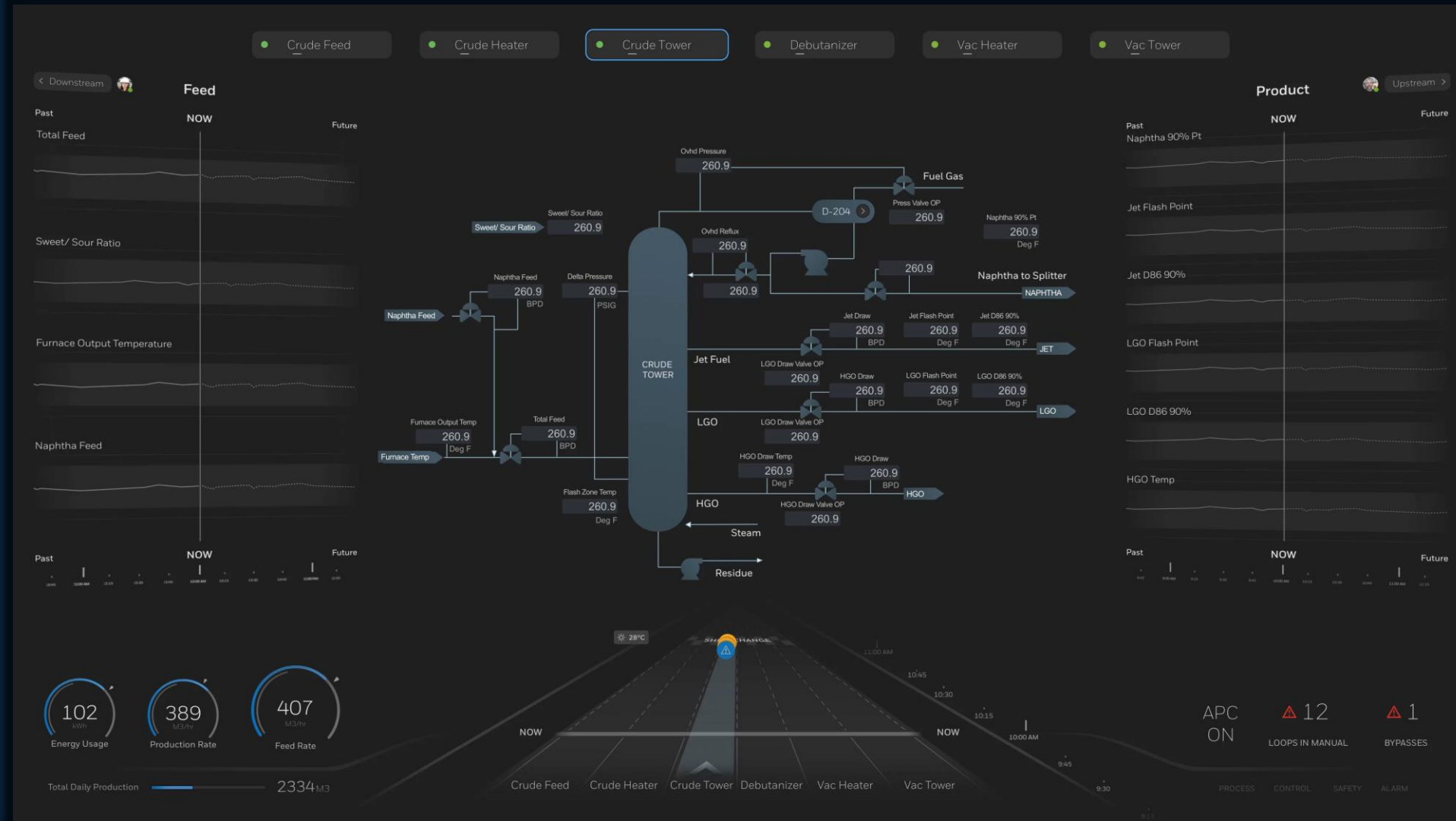
LOOK AHEAD RUNWAY & FUTURE TRENDS

Look ahead Runway

Unique approach for operators to visualize what's coming up, enable better situation awareness & proactive action. On a runway representing multiple units and on individual trends, the look-ahead display shows future predictions for items such as:

- Blending and Movement Events
- Alarms
- APC Guidance Events
- APC Process Value predictions on Trends

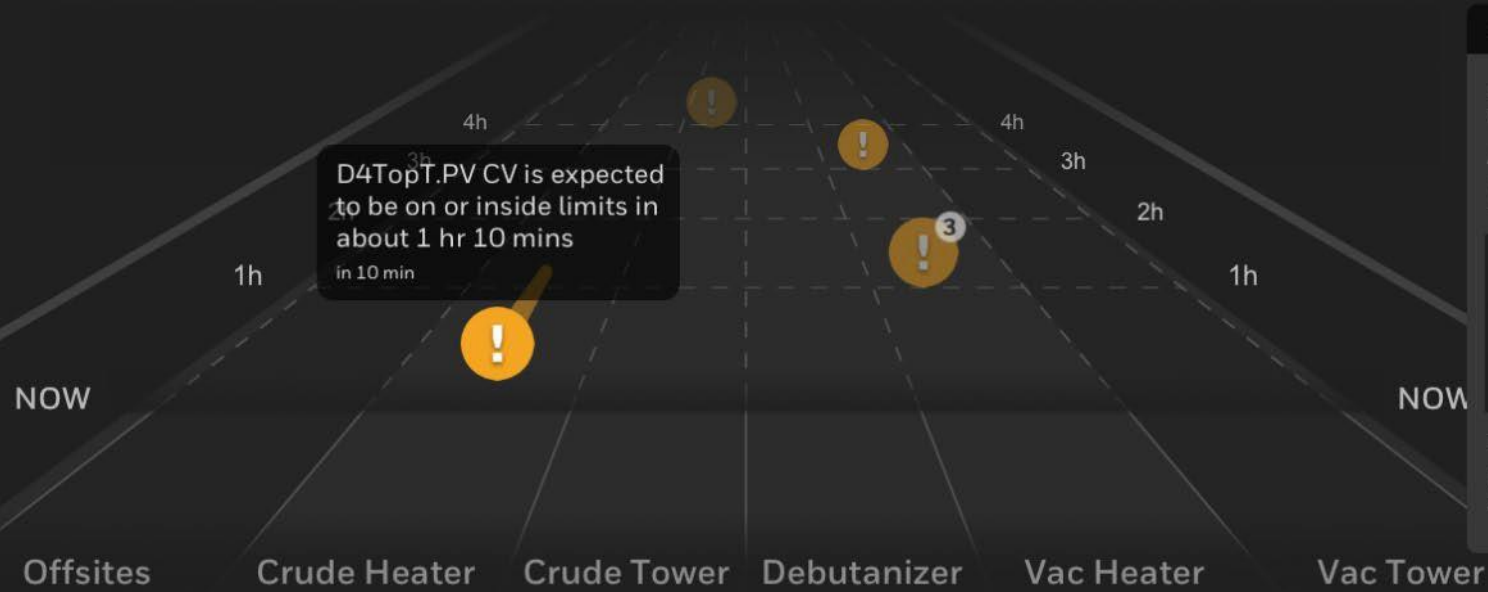
+ add events from your own applications



CONTROL PERFORMANCE

LOOK AHEAD RUNWAY FOR OPERATOR TREND

Advanced Process Control (APC)



Limit Excursion [X]

D4TopT.PV CV is expected to be on or inside limits in about 1 hr 10 mins

Arrives in:
10 mins

Past NOW Future

Recommendation:
If recovery time is not acceptable, consult an engineer

BLENDING AND MOVEMENT

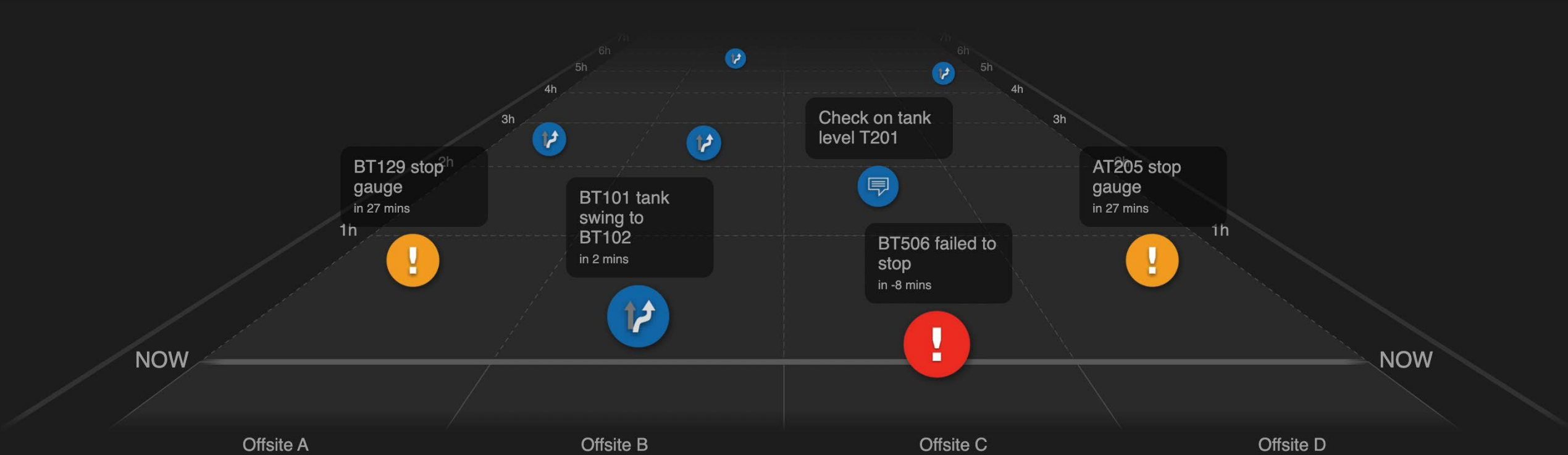
LOOK AHEAD RUNWAY FOR OPERATOR

Blending and Movement (PBM)



PREDICTIONS FOR OPERATOR

Scenario 1: Anticipate future actions that may require manual intervention
(x100 speed)



OPERATOR ALARM ASSISTANCE

Typical Action Alarm Assistance

Guidance and Specific Actions to Take with Alarms Based on Past Historical Actions. We use some analytic methods to mine historical data to find a similar pattern of alarms and the associated operator actions that led to the return to normal.

Like an auto-complete for operations, operators can choose from likely actions and then page callup and point selection can happen with a single click.

Helps inexperienced operators with likely correct response and helps experienced operators with speed of response

The screenshot displays an 'Alarm Summary' interface. At the top, there are controls for 'Location', 'View: (all alarms)', '(Filter applied)', 'Clear All Filters', and 'Reset View'. Below these are several icons for window management and user profile. The main area is a table with columns: Date & Time, Location Tag, Source, Condition, Priority, Description, and Trip Value. The first row is highlighted in blue and shows an alarm for 'LC1330B' with condition 'PVLO' and priority 'U 00', described as 'Flow rate too low'. A 'Typical actions' popup menu is open over the first row, listing three suggested actions: 'Go to Reboiler and change WFC1104.SP', 'Go to Reboiler and change FC3289.SP', and 'Go to Reboiler and change mode FC3289'. The popup also shows the alarm details: 'LC1330B PVLO', 'Reboiler PVLO 44.0 u (Limit: 50.0 u)'. The table below the popup shows three other alarms, all with the description 'Console Station is not available' and 'Insufficie...' in the Trip Value column.

Date & Time	Location Tag	Source	Condition	Priority	Description	Trip Value
5/31/2017 13:08:23	LC1330B	CONSOLE STATION 1	PVLO	U 00	Flow rate too low	
5/31/2017 13:08:23	LC1330B PVLO	CONSOLE STATION 1	COMMS	U 00	Console Station is not available	Insufficie...
5/31/2017 13:08:23	11/12/2020 13:50:30	CONSOLE STATION 1	COMMS	U 00	Console Station is not available	Insufficie...
5/31/2017 13:08:23	CStn01	CONSOLE STATION 1			Console Station is not available	Insufficie...

EXPERION AI VISION OPERATIONS ASSISTANT

Activities in Progress

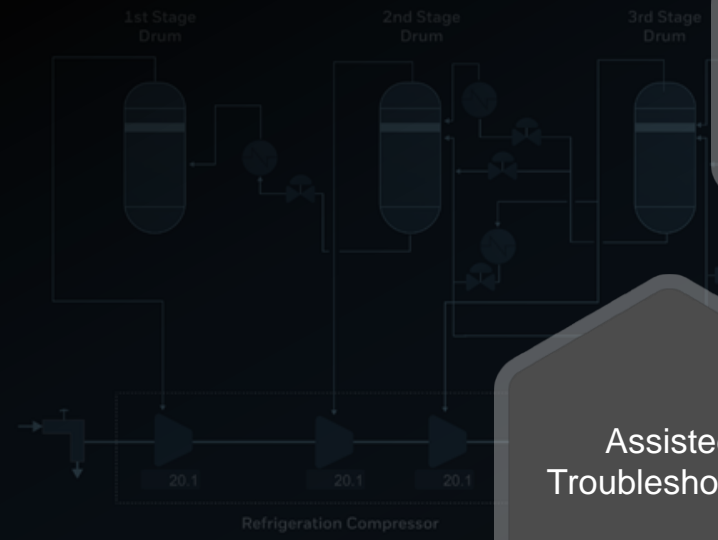
- B1 Decoking
Perform Deco
Cracker B1
Due 10:24
Current CO2 85.6%
- Start-up Reboiler
Cracker B2
Work instruction 3 tasks
1 of 5 complete
- Clean reboiler steam trap
Demethanizer
Work instruction 8 tasks
3 of 6 complete

Available Activities

- Start Cracking [Start]
- Stop Cracking [Start]
- De-coke Furnace [Start]

Watch List

- Cracker B1 Decoke CO2: 12.8% [View Details]
- Cracker B1 COT: 810.0 DegC [View Details]
- Cracker B1 TMT: 945.7 DegC [View Details]
- R-1B Power: ON [View Details]



Assisted
Procedural
Operations

Proactive Advice
for optimal control &
asset performance

Assisted
Troubleshooting

EXPERION OPERATIONS

AI Enabled
Assistance

Delegate routine
tasks to the
system to reduce
workload

Display predicted
events to improve
situation
awareness

Alarm Assistance
& Tuning from
history

Advisories

- Cracker B1, Zone 2, CPD above expected range
Check coil temperatures and flow distribution.
24 May 2022 10:17AM
- Cracker B1 sub-optimal control of flue stack oxygen
Should be below 2%. Check health of the cracker air fuel ratio controls.
24 May 2022 10:15 AM

Experion

- Tues 7:10am
Increase B4 hydrocarbon feed to 375 nm3/hr over 30 mins.
- Tues 7:10am
Increase B4 hydrocarbon feed to 375 nm3/hr over 30 mins.
- Tues 7:12am
Alert me if B4 TMT changes by more than 10 degrees.
- Experion Tues 7:12am
OK, I'll tell you if B4 TMT changes by more than 10 degrees.
- Tues 7:12am
Remind me to check B4 differential pressures in 4 hours.
- Experion Tues 7:12am
Reminder created.
- Experion Tues 7:40am
B4 hydrocarbon feed has reached 375 nm3/hr

Last shift

Ask a question or press a button below

Message [Microphone icon]

Find Answers | Set Reminders | Automate

The image features a complex industrial facility, likely a refinery or chemical plant, illuminated at night. The scene is dominated by tall distillation columns and intricate piping, all glowing with warm yellow and orange lights. Overlaid on this industrial landscape is a vast, glowing network of white lines and nodes, resembling a data or communication network. The nodes are small, bright spheres, and the lines connect them in a complex, web-like pattern across the entire scene. The background is a deep blue, suggesting a twilight or night sky. The overall aesthetic is high-tech and futuristic, emphasizing the integration of industrial operations with advanced digital technology.

HOW IT WILL WORK?

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HONEYWELL CONSULTING OFFERINGS

Pre-Feed Phase

- Remote Operator Readiness Report (RORR)
- Autonomous Operations Philosophy (AOP)

Feed Phase

- Remote Operations Center Design (ROCD)
- HMI Design: Interactions Requirements Analysis (IRA)
- Operator Role Complexity Analysis (ORCA)
- Remote Operations Competency Matrix
- Remote Operations Video Wall Design (VWD)

Operational Phase

- RAO (Remote Autonomous Operations) Baseline study and Mentoring

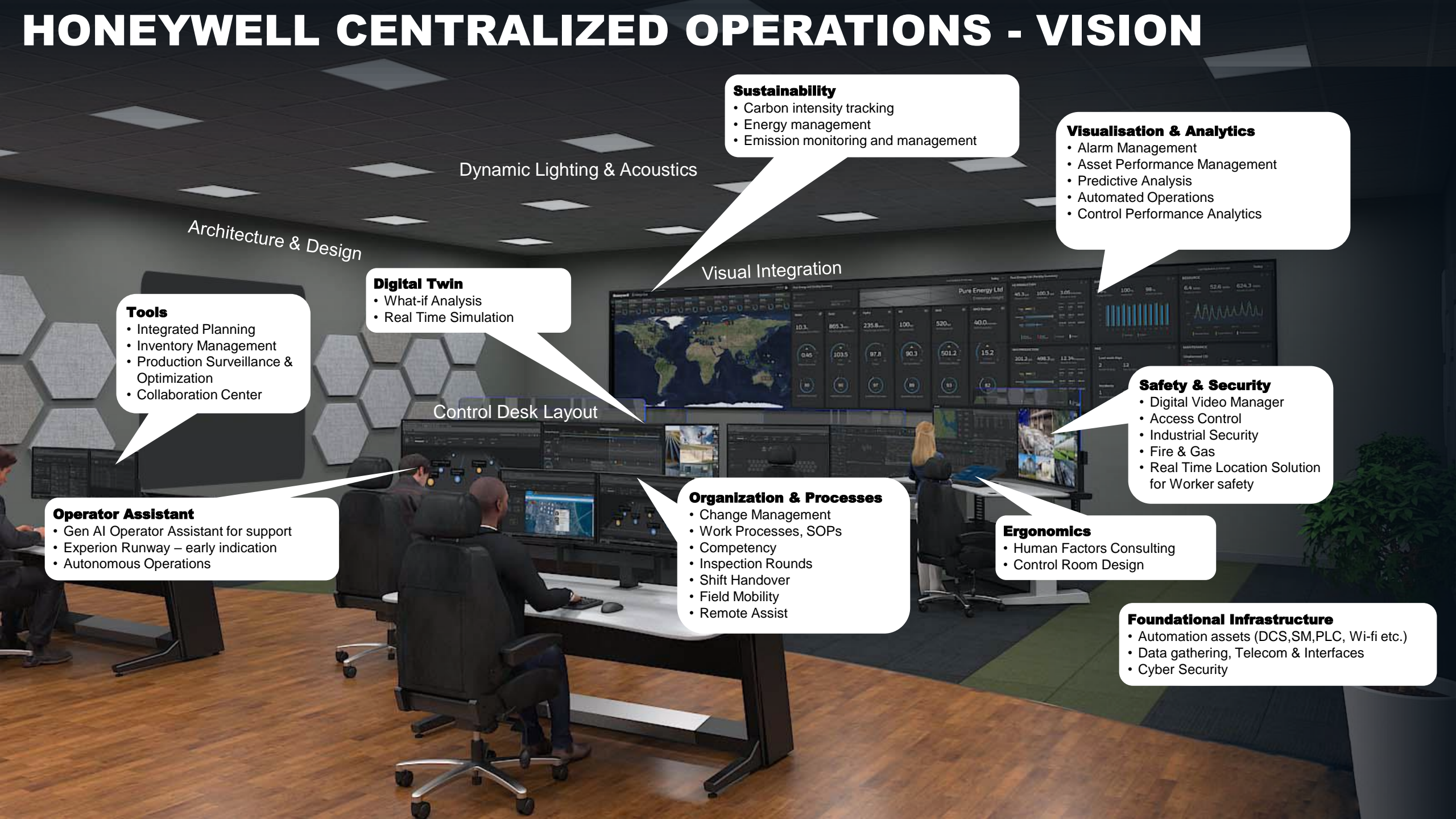
OUR CONSULTING IS ASM CERTIFIED

What is the Abnormal Situation Management Consortium?

The Abnormal Situation Management (ASM) Consortium is a group of companies that collaborate to improve industrial safety and prevent abnormal situations in complex manufacturing and process industries through research, guidelines, training, and consulting services.



HONEYWELL CENTRALIZED OPERATIONS - VISION



Dynamic Lighting & Acoustics

Architecture & Design

Visual Integration

Digital Twin
• What-if Analysis
• Real Time Simulation

Tools
• Integrated Planning
• Inventory Management
• Production Surveillance & Optimization
• Collaboration Center

Control Desk Layout

Operator Assistant
• Gen AI Operator Assistant for support
• Experion Runway – early indication
• Autonomous Operations

Organization & Processes
• Change Management
• Work Processes, SOPs
• Competency
• Inspection Rounds
• Shift Handover
• Field Mobility
• Remote Assist

Sustainability
• Carbon intensity tracking
• Energy management
• Emission monitoring and management

Visualisation & Analytics
• Alarm Management
• Asset Performance Management
• Predictive Analysis
• Automated Operations
• Control Performance Analytics

Safety & Security
• Digital Video Manager
• Access Control
• Industrial Security
• Fire & Gas
• Real Time Location Solution for Worker safety

Ergonomics
• Human Factors Consulting
• Control Room Design

Foundational Infrastructure
• Automation assets (DCS,SM,PLC, Wi-fi etc.)
• Data gathering, Telecom & Interfaces
• Cyber Security



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