

WHO WE ARE & OUR STRENGTHS

WHO WE ARE



Virtual & Intelligent Plant Provider:

by integrating 3D Digital Twin, AI and GenAI Technologies and using data & documents to enhance reliability, sustainability and operational excellence



Experienced Team:

Domain, Technology and Entrepreneurial experts



Global Footprints:

From North America to The Middle East and India

OUR STRENGTHS

Delivering **Single Source of Truth** by Contextualizing Data and Documents from IT, OT and ET Sources

Integrated AI + GenAI End-to-End Solutions

– Real-time monitoring to diagnostic, predictive and prescriptive

Immersive & Transformative Experience

with 3D, VR & GenAI Combined – Plant virtual replica and Human-like conversational GenAI experience for workflow & operational efficiency enhancement

RECOGNIZED BY ANALYSTS. TRUSTED BY INDUSTRY.

Analyst Recognition & Brand Differentiation

- ✓ *Visionaize is recognized among leading Digital Twin innovators — providing contextualized, industry-grade solutions where competitors focus on consumer visualization. – Gartner*
- ✓ **Listed in APM Competitive Landscape (2025)** and earlier named a “Cool Vendor in Oil & Gas” (2015) - **Gartner**
- ✓ **Featured by Verdantix Green Quadrant for APM (2024)** as a notable provider alongside ABB, AspenTech, AVEVA

Strategic Partnership Validation

Embedded in GE Vernova APM Integrity for RBI and inspection data.
“Our partnership with Visionaize brings an enhanced, scalable capability to APM that accelerates implementation and reduces costs for customers.”
- **GE Digital** Power Generation & O&G

Chiyoda Corporation

“By integrating Visionaize’s 3D Digital Twin into plantOS, we reduced maintenance costs by ~40% and lowered worker hazard exposure by ~30%.”
- **Chiyoda** Manager O&G

Industry & Customer Validation

“The versatile software has streamlined our inspection work process tremendously.”
- **Saudi Aramco** Inspection Supervisor

“One hour in V-Suite equals eight hours in the field.”
- **Shell** Engineering Manager

Recognized by...

Gartner

VERDANTIX



GE VERNOVA



أرامكو السعودية
saudi aramco



... and more!

Visionaize

KEY CLIENTS & VALUE ADDITION

EXPERT TEAM

IOCs, NOCs, Independents & Partners



In Most Cases: ROI > 10x, Payback < 6 Months

<p>\$15.6M</p> <p>Optimized Inspection & Maintenance</p> <ul style="list-style-type: none"> \$15.6 MM in benefits over 5 years* 287% annual ROI* <p>كيان السعودية saudi kayan</p> <p>SAUDI KAYAN, SAUDI ARABIA World's largest facility of its kind</p>	<p>\$16.3M</p> <p>Transformed Operating Practices</p> <ul style="list-style-type: none"> \$16.3 MM in benefits over 5 years* Payback in < 1 year <p>أرامكو السعودية saudi aramco</p> <p>SAUDI ARAMCO, SAUDI ARABIA Ras Tanura (Flagship) Refinery</p>	<p>\$15M</p> <p>Mechanical Failure</p> <ul style="list-style-type: none"> Recovered 13 days ahead of schedule \$15 MM in benefits - in year 1 (\$700 project cost) <p>ExxonMobil</p> <p>EXXONMOBIL - TORRANCE, CALIFORNIA 166,000 barrels per day - #1 Crude Unit</p>
<p>\$8M</p> <p>Benefits impact per year</p> <p>Real Time Optimization</p> <ul style="list-style-type: none"> 2% increase in profit - due to max propylene production 7-10% reduction in energy <p>Middle East Refiner 105 kbpd Refinery FCC Unit</p>	<p>\$7.5M</p> <p>Benefits impact per incident / equipment</p> <p>Predictive Maintenance</p> <ul style="list-style-type: none"> Avoid unplanned shutdown Maintenance costs - material, labor <p>US Midstream Operator Gas Compressor in Midstream</p>	<p>\$9M</p> <p>Benefits impact per year</p> <p>Remote Performance Monitoring</p> <ul style="list-style-type: none"> Increase production and yield Reduce energy consumption Optimal use of offsite specialist pools, quick decision making <p>US Petrochemical Group Ethylene Plant - Ethane based</p>

V-SUITE



V-Suite: Contextualized Platform

Upload Data & Documents
Admin Interface



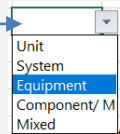
- P&IDs
- Datasheets
- Process Description
- Operating Procedure
- C&E Diagrams
- O&M Manuals
- Operations Logs
- Maintenance Logs
- Sensors Tags
- LIMS Data

Process Data & Documents for Hierarchy and Contextualization



Setup Hierarchy of each data/document (using drop down):

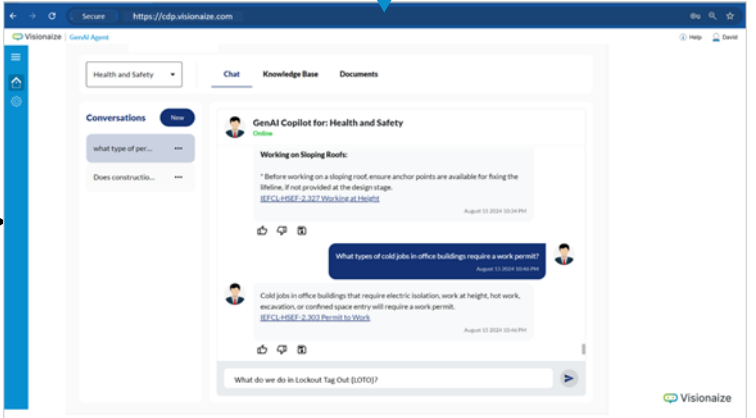
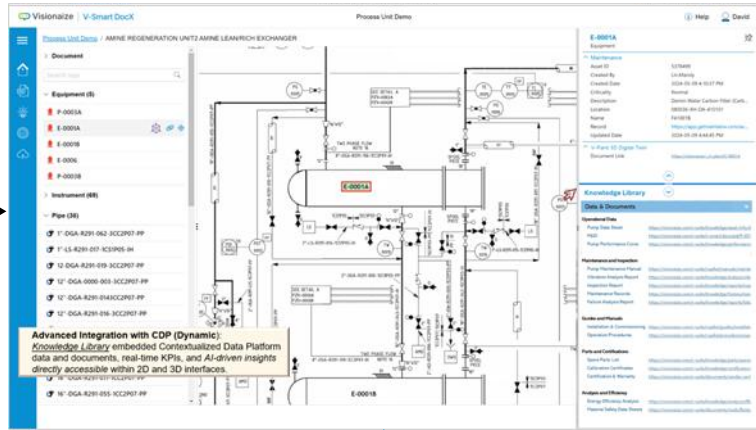
- P&IDs
- Datasheets
- Process Description
- Maintenance Logs
- Sensors Tags



Contextualize data/document (using NLP/LLM):

Connect data/documents after extracting info/detail to the associated:

- Component/ Material
- Equipment
- System
- Unit



AI Solutions

3D Digital Twin/
2D Smart DocX

GenAI Agents

Our Portfolio: Operational Digital Twin

AI/GenAI Solutions

Monitor Remote Performance	Predict Ops Upset & Maintenance	Optimize Process Performance	Prescribe GenAI Agents	Sustain Emissions & Decarbonization
Digital Twin (2D & 3D)	Anomaly Detection Model	Plant Predictive Model	LLMs and Feedback Loop	Quantification
KPIs & Analysis	Forecasting Model	AI Optimizer	Cause Analysis & Recommendations	Monitoring
Diagnosis & Recommend	Root Cause & Recommend	Object Function Flexibility	GenAI Assistants	Reduction
What If	What if	Integrated RTO + APC	What if	Reporting

3D Digital Twin Solutions

Operate Immersive Contextualization	Inspect Asset Integrity Assessment	Maintain Preventative & Strategic	Turnaround & Upgrade Extension & Modernization	Comply Regulatory & Safety Assurance
Real Time & Performance	3D Loops & Circuits	Scheduling & Planning	Scheduling & Planning	Safety Zones
Alerts and IOW	CML / TML Data	Operator Rounds	Equipment & Resources	Temporary Assets
Engineering Data	Corrosion Tracking	Best Practices	Inventory & Supply	Egress & Shelter
Review and Troubleshoot	Damage Review	Procedures	Critical Path & Mitigation	PMI: Positive Material ID

V-Suite Platform

Contextualized Data Platform, 3D Digital Twin, P&ID Explorer, AI/ ML, Generative AI

IT Data ERP, MES, Pricing Data, External Data	OT Data PLC, SCADA, DCS, Historian, LIMS, Plant Logs, ELogs, Visual Feeds	ET Data O&M Manuals, P&IDs, Datasheets, Data Dictionary	As-Built	Drone

DEPLOYED USE CASES

Energy, Chemicals & Industrial Sectors

Multiple use-cases in Energy, Chemicals and Other Industrial Sectors

Oil & Gas Upstream/ Midstream

- Enhanced Oil Recover (EOR) Optimization and Polymer Injection Reduction
- Predictive Maintenance of a Gas Compressor for Midstream
- Predictive Maintenance of Pumping Systems for Oil & Gas Operator
- Production Fields Real Time Monitoring Center
- Subsea Gas Lift Riser and MPP Boosted Real Time Production Optimization OTC Paper and PoC
- Well Logging, Field Interpretation and Volumetric Analysis AI-based PoC
- Workers PPE Compliance using Computer Vision

Oil & Gas Downstream/ Chemicals

- Real Time Optimization of Refinery FCC Unit
- Energy Minimization and Cell Health Prediction of Chlor Alkali plant electrolyzer
- Predictive Maintenance of FCC Main Air Compressor
- Pre-Heat Heat Exchangers Fouling Prediction and Schedule Optimization in Refinery CDU/VDU
- CO2 Excursion Prediction from Amine Absorber in Ammonia plant
- PP Plant Reactor Lump Formation Prediction
- Real-Time Performance Monitoring & Analysis with GenAI Troubleshooting Agent + Contextualized Data Platform
- Remote Performance Monitoring with Digital Twin for Ethylene Plant
- Demand Forecast and Inventory Optimization for a Petrochemical Complex
- Decarbonization Monitoring & Reduction
- GenAI CoPilot for HSE Procedures/ SOPs
- Corrosion/damage detection using CV

Other Industrial Sectors

- Cobble Occurrence Prediction in Steel Plant Rolling Mill – [Metal Processing \(MP\)](#)
- Blast Furnace Optimization – [MP](#)
- Predicting Power Requirement for Steel (EAF) – [MP](#)
- Automated Product Quality Check in Zink Plant – [MP](#)
- Prediction & Condition Monitoring of Fans – [Power](#)
- Steam Generator / Boiler Online Thermal Stress Monitoring – [Power](#)
- Optimization of Main Steam Temperature of Steam Generator - [Power](#)
- Dynamic Modelling, Scheduling and Improving Operation of Mills / Pulverizers - [Power](#)
- Balancing Power Demand & Supply – [Utility](#)
- Power Transmission & Distribution Network Inspection – [Utility](#)
- Discrete Manufacturing Planning & Scheduling Optimization – [Manufacturing \(Discrete\)](#)
- Coal Trucks Planning, Scheduling & Tracking for Aluminum Plant – [Logistics](#)

UPSTREAM/ MIDSTREAM USE CASES

A decorative graphic consisting of two horizontal bars. The top bar is solid blue and has a diagonal cut on its left side. Below it is a longer bar with a green-to-blue gradient, also featuring a diagonal cut on its left side.

Use Case: EOR Optimization & Polymer Injection Reduction

Upstream Oil & Gas

Challenge:

Client uses polymer injection for EOR. Currently, the polymer solution is get prepared at the centralized processing facility and is injected at various wellheads. In actual field operation, it has been observed that maintaining the right viscosity at wellhead level to get maximum production is a challenge as:

- Operators are not sure what is the target viscosity of polymer solution to be injected at various wellheads to get maximum oil recovery
- Viscosity loss happens depending on pipeline length and not injecting the polymer with right viscosity
- Lack of visibility in maintaining the right dilution ratio
- Due to the remote location of multiple wells, it become difficult to do lab testing of wellhead viscosity on a shift basis.

Solution:

Visionaize's team addressed this problem with two integrated solutions. The first one is using our Real-Time Optimizer (RTO), we identified the optimum (or target) viscosity required at anytime to get maximum oil production. Basically, optimizer considered oil production as the objective function and used viscosity and other well operating parameters as manipulated variables to be determined. Then our predictive solution predicted the viscosity that is being injected into the wells and if there is deviation between predicted viscosity and RTO's optimum viscosity, polymer dilution ratio is to be adjusted to get the maximum oil production.

Steps/ Method Used:

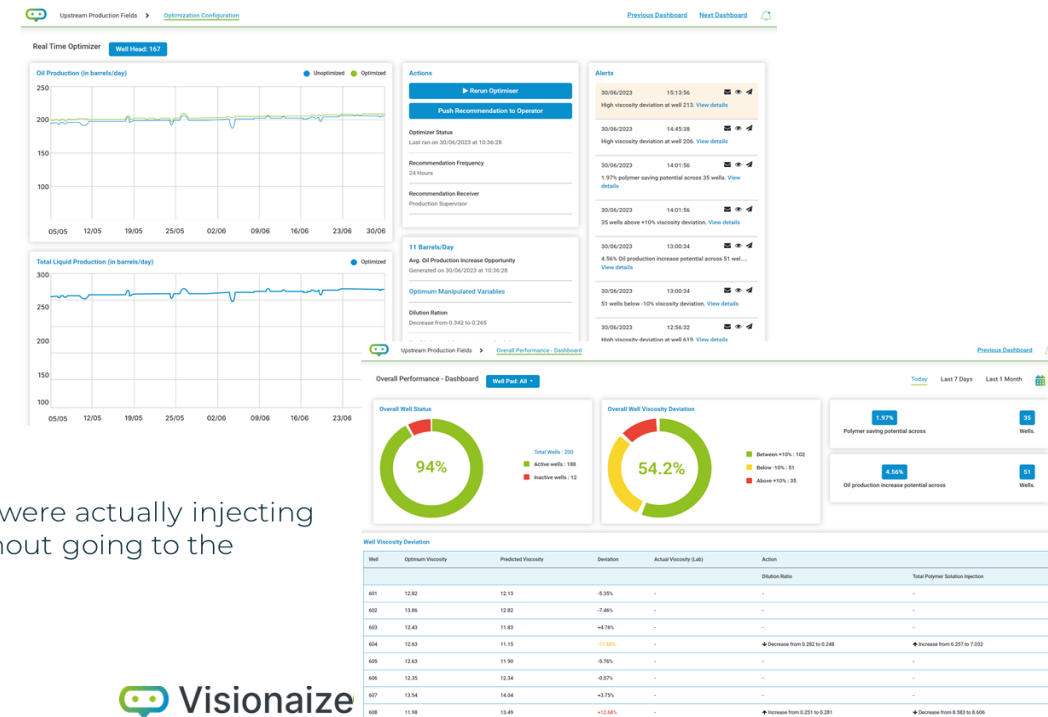
Our team worked on geophysical, operational and lab data from:

- Reservoir system including geo
- Central Processing facilit
- Wellpad
- Wellhead

The entire data set was compiled and correlated with each operating parameters, use AI+Physics based models to estimate the optimized viscosity at wellhead using AI Optimizer and predict the actual viscosity at CPF level and Wellhead level using the historical operating and lab data to inject the polymer with optimum viscosity to achieve optimum EOR.

Value Proposition (day-to-day) & Benefits (long-term):

- Assist run the EOR process in most optimum way and upto the last oil recovery possible.
- Solving not only the issue of what should be the injected viscosity but also what viscosity operators were actually injecting
- Taking corrective action if there is a deviation between optimum vs predictive (actual) viscosity without going to the remote location
- Avoid going to remote locations on regular basis for viscosity sampling and lab data
- **Increased 2% oil production** with significant **decreased in polymer consumption.**



Use Case: Predictive Maintenance of Centrifugal Compressor for Permian Basin Midstream Operator, USA

Challenge/ Problem Statement:

A large Midstream operator in Shale Basin was experiencing shutdowns of the compressor in their gas compression system, leading to substantial losses in production. Out of 5 shutdowns, 4 were unplanned, costing up to \$210,000 per hour and 1.5 days per shutdown.

Solution:

Our Predictive Maintenance application leverages both process and machine data to detect issues early as many equipment's problems happen due to process/ operational issues somewhere in the upstream side of the equipment. It uses equipment and process historical data to train/ fine-tune our pre-built anomaly and predictive models, connects the trained models to IoT network to process real-time OT data, and continuously tunes/ auto-trains its anomaly detection and predictive model for more accuracy as equipment continues to operate.

- Detects anomalous behavior using supervised and unsupervised machine learning algorithms
- Generative AI enabled FMEA provides the failure mode responsible for the main cause of the problem
- Predicts the remaining time to fail of equipment ahead of time so that enough time is there to take action
- Generative AI enabled what-if provides recommendations of managing the failure and increasing the operating window of equipment.



Value Proposition (day-to-day) & Benefits (long-term):

- Alert and help technician and operator early on any performance or maintenance issue of equipment
- Avoid or mitigate unplanned shutdown
- Help to lower the energy consumption and carbon reduction
- Work as an assistant for any questions technician and operator have
- Helped our large customer **save \$7.5M per shutdown** by ensuring 100% asset availability



Use Case: Predictive Maintenance of Pumping Systems for Oil & Gas Operator, Colombia

Challenge/ Problem Statement:

A Latin American Midstream operator relied on a set of high-throughput centrifugal pumps to move refined products between refineries, depots and jetties. These pumps are critical for the reliability of company's logistics system. However, frequent trips of these pumps were causing unplanned downtime, requiring emergency maintenance and disrupting the logistics system. The root cause was often unclear, delaying repair and increasing risk.

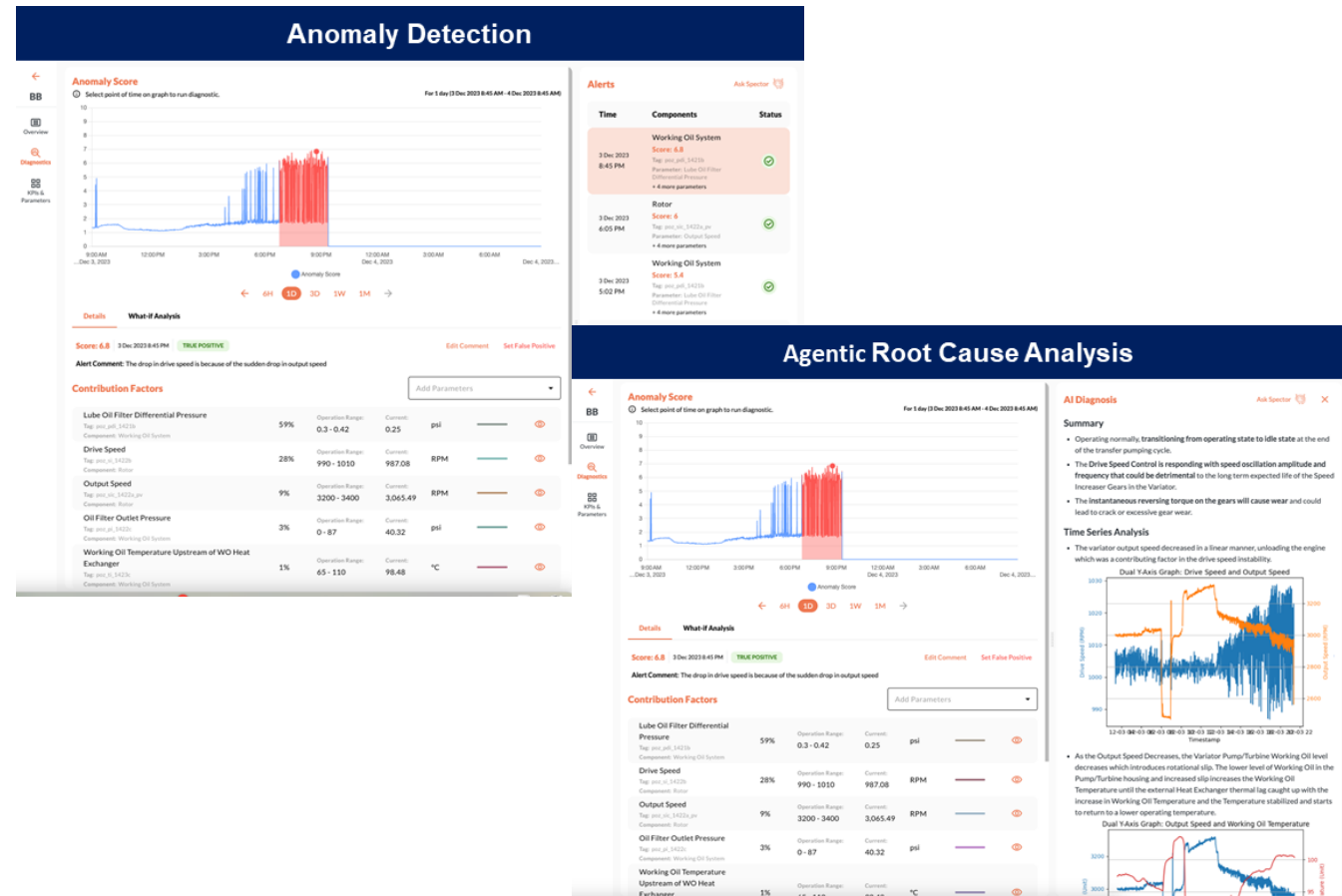
Solution:

Visionaize deployed our ML Anomaly Detection and Predictive Models + GenAI Reliability Agent for 100+ Pumping Systems for CENIT, the midstream subsidiary of EcoPetrol that flagged an early-stage anomaly and alert.

- Anomaly detection model and avoid false positives and false negatives
- Predicts issues upto 2 weeks before – remaining time to fail
- GenAI agent enabled FMEA performed root cause diagnosis
- Recommended preemptive maintenance before performance degraded.

Value Proposition & Benefits:

- \$320K+ in downtime reduction per predicted failure event of a pump
- Failure detected upto 2 weeks in advance, enabling planned shutdown
- MTTR reduced by 42% with contextualized troubleshooting.



Use Case: Real Time Monitoring Center (RTMC)

Upstream Oil & Gas, East Africa Country Petroleum Authority

Challenge/ Problem Statement:

As Petroleum Authority's mandate is to monitor and regulate the exploration, development, and production, together with the refining, gas conversion, transmission, and storage of petroleum in the country, it wishes to implement a Real-Time Monitoring Center (RTMC) to transmit, receive, process, display, and store data submitted in real-time by the Licensees to the Authority to enable efficient analysis, aid decision-making, surveillance, and monitoring as well as reservoir management and determination of revenues and taxes.

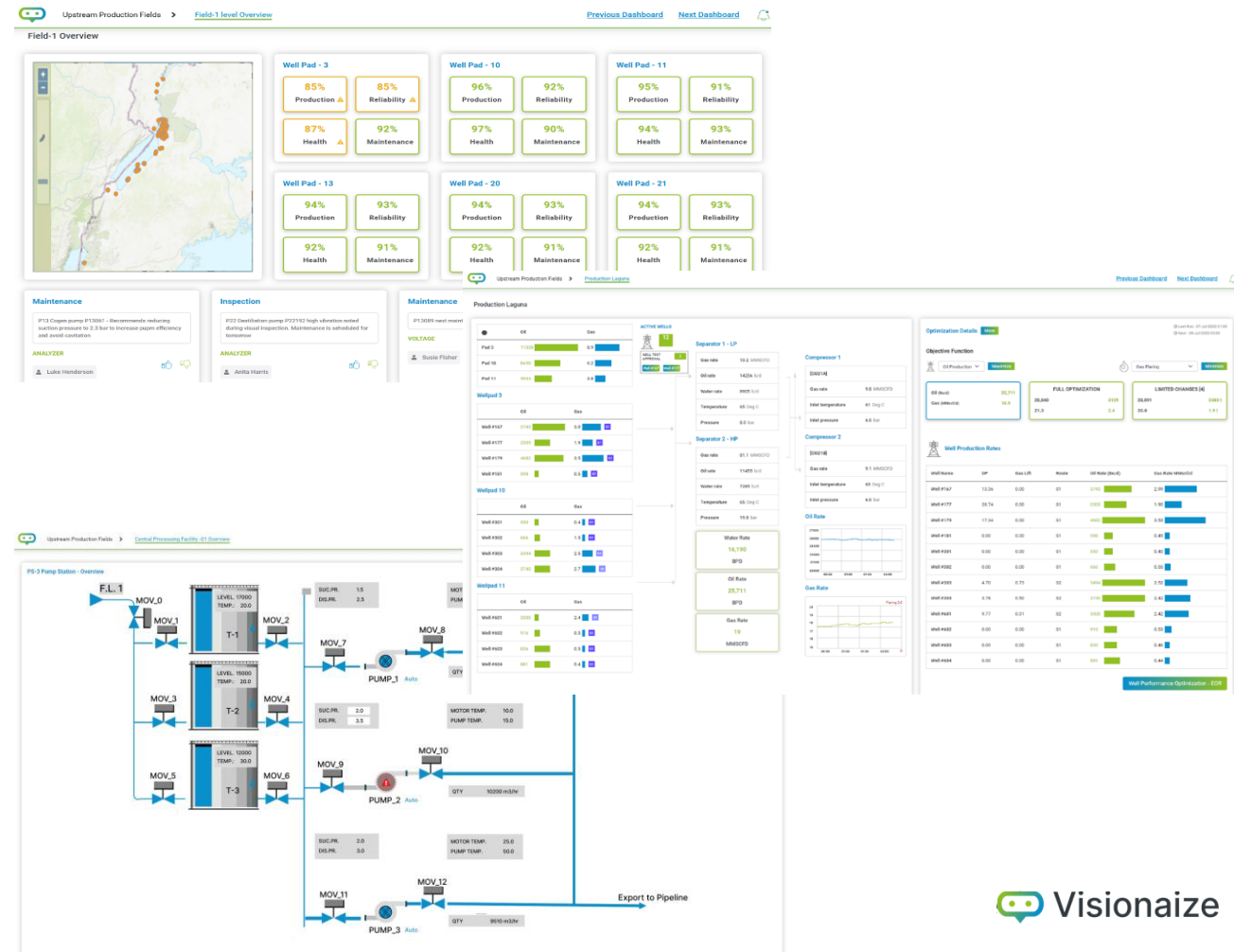
Solution:

The RTMC is an integrated solution comprising the following layers of data connectors, data storage, AI and physics based models and various dashboards:

- **Data Storage:** The solution4 database is integrated with a Real Time Data Repository (RTDR). Database architecture considers independent and interrelated databases per domain orchestrated by a Master Data Manager (MDM) and Governance Model Data Quality (GMDQ).
- **Modelling and KPIs:** The solution has AI & Physics-based models and calculation of KPIs required for various domains. The Physics-based models are directly available from the operators or developed by us.
- **Forms and Workflows:** The required Forms and Workflows are developed for the Communication and Reporting workflows
- **Dashboards:** The solution has the following domain and reporting dashboards as part of the applications with visual alerts and analysis capability:
 - Production and Economics workflows
 - Drilling & Completions and Geology & Geomechanics workflows
 - Geoscience workflows
 - HSE Workflows
 - Communication Process workflows
 - KPIs and Reporting workflows

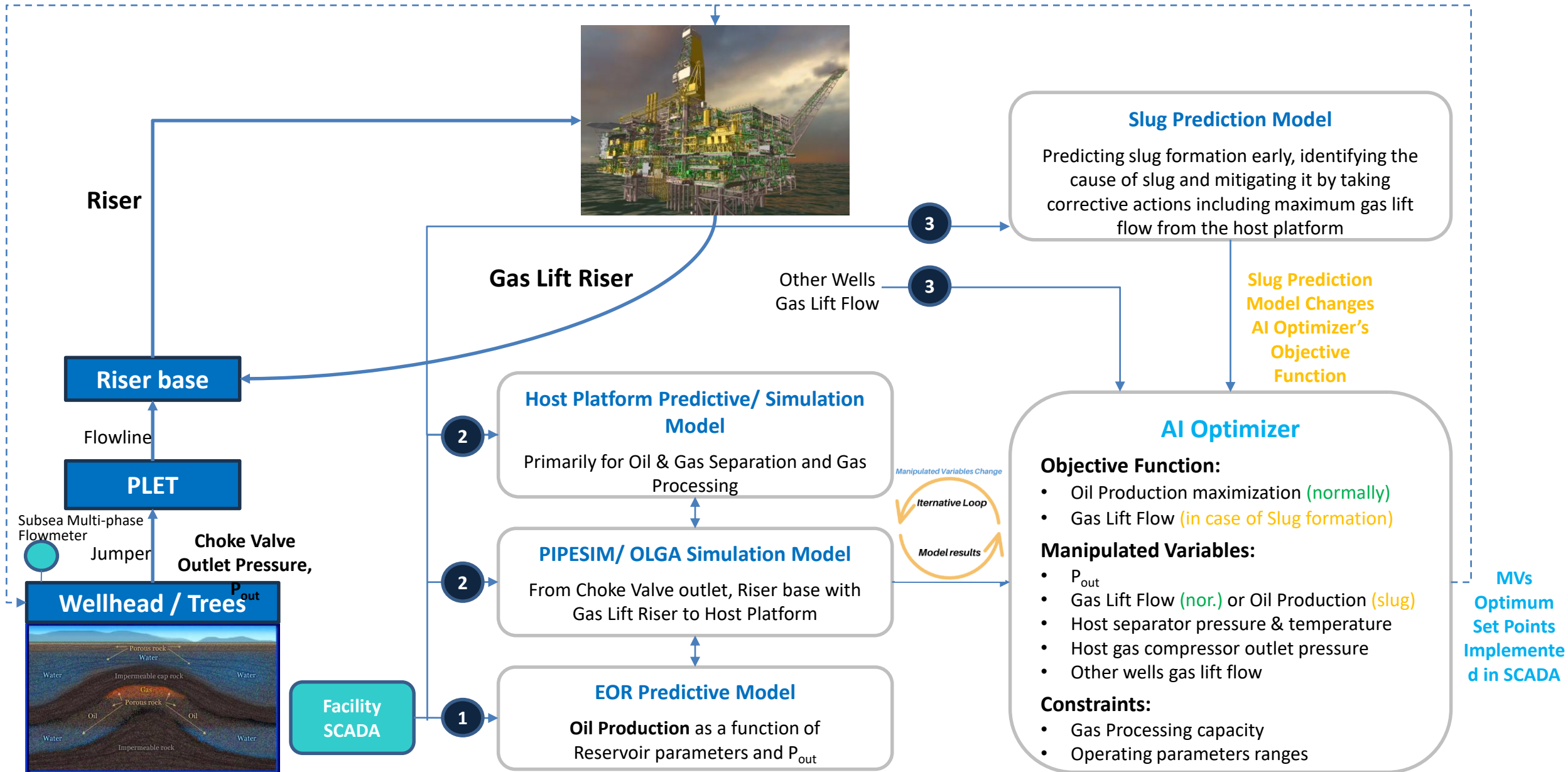
Value Proposition & Benefits:

- Increase in margins and operational excellence
- Gain in production and efficiency
- Improve in reliability and uptime
- Enhance safety and reduce carbon emissions
- Improved collaboration



Use Case: Subsea Gas Lift Injection @ Riser Base – 1 of 2

Real Time Optimization Proof of Concept



Subsea Gas Lift Injection @ Riser Base – 2 of 2

Real Time Optimization Proof of Concept, OTC USA Paper

Offshore Technology Conference (OTC) 2024

OTC-35038-MS

Harnessing Artificial Intelligence to Improve Production and Operational Efficiencies in Deepwater Subsea Tiebacks

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Abstract

Subsea tiebacks are a principal building block of deepwater developments. Operators seek to continuously enhance operational efficiencies and tieback distances while reducing capital, operating expenditures, and emissions. Rapid advances have been made in remote operations, subsea equipment capabilities and standardization. However, significant additional improvements in subsea tieback operational efficiencies are achievable by leveraging the steep decline in data storage and processing costs, the massive increase in processing power and high-speed internet along with the availability of proven Artificial Intelligence (AI) and Machine Learning (ML) tools.

Subsea tieback operational efficiency improvements are bottlenecked by human operator ability to process and respond in a timely manner to the overwhelming quantity of data collected by modern subsea monitoring and sensor technologies. This paper will address specific areas where the proven ability of AI and ML tools to assimilate large quantities of data, together with bespoke algorithms, can provide real-time, targeted recommendations to unlock the following improvements in subsea tieback operational efficiencies:

Enhanced Oil Recovery: With real-time detection and analyses of changes and anomalies in production flow, AI can use Model Predictive Control (MPC) or Hybrid AI-Physics Models to optimize production rates, riser base gas lift, and gas or water injection systems.

Predictive Maintenance: By ingesting and analyzing real-time sensor and Autonomous Underwater Vehicle (AUV)/ Remote Operated Vehicle (ROV) data, AI algorithms can:

- Improve performance and reliability of subsea boosting systems (multiphase pumps, power generation and conditioning).
- Increase operational uptime and service life by anticipating potential failures in subsea infrastructure.

Operational Efficiencies: AI can process vast amounts of data from disparate sources to support decision-making related to:

- Monitoring and predicting flow assurance challenges while suggesting targeted mitigations.
- Maintaining optimum production rates and flow conditions from wellhead to production manifold.
- Providing a holistic view of complex multi-tieback systems to facilitate decision-making targeting total asset performance.

By combining data gathered from multiple sources (SCADA, PLC, Camera DVR, etc.) with bespoke algorithms, AI can provide diagnostic, prescriptive, intelligent insights; accelerate positive interventions; increase ultimate recovery while reducing downtime, power requirements, and emissions.

The offshore oil and gas industry is embracing AI to make operations safer and more efficient. This paper will show how an integrated, holistic and targeted approach of incorporating AI into subsea tiebacks will enable the industry to immediately and inexpensively attain new levels of operational excellence, cost-effectiveness, and environmental sustainability.

Use Case: AI-based Well Logging, Field Interpretation & Volumetric Analysis– 1 of 2

Business Case

- Field Volumetrics: To accurately predict the volume of Hydrocarbon (OOIP/ OGIP) for the field
- To cut the time of field analysis from months/years to days
- To predict the optimum new drill locations
- To accurately enhance the data quality for better decision making

Challenge:

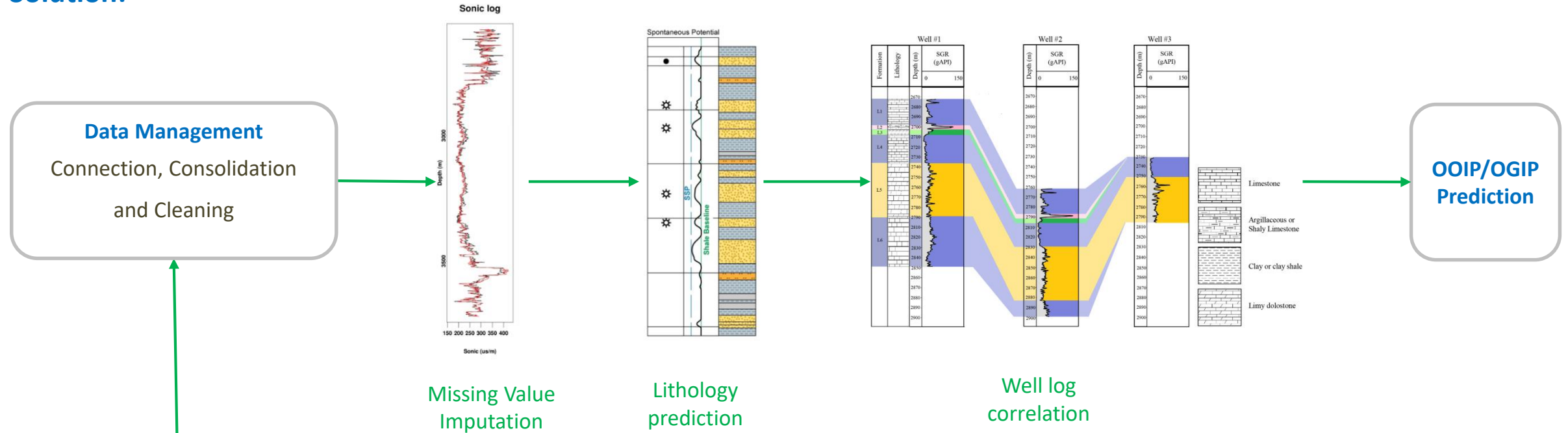
- Log data is noisy/missing and incomplete
- Building the complete sub-surface map of the field using log correlation is complicated and requires deep domain expertise
- Complicated to combine various data types (core, seismic/ well, engineering, etc.) to create a holistic view of the field

Benefits

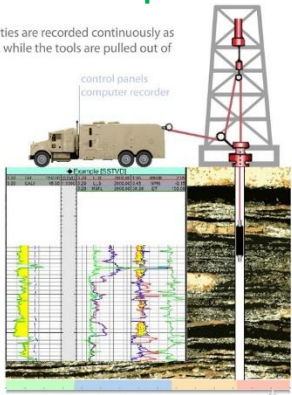
- Reduced analysis time leads to better ROI
- AI and data-driven methodology helps in reducing error and increasing safety as compared to traditional analysis
- Quick evaluation of new areas to study the economic feasibility

AI-based Well Logging, Field Interpretation & Volumetric Analysis– 2 of 2

Solution:



The physical properties are recorded continuously as a function of depth, while the tools are pulled out of the well.



Well Log across a zone

- Imputing the missing info in the well data
- To predictively determine lithology layers
- To estimate the areal extent of each layer between the wells
- To predict the petrophysical Properties of the desired zone/ intervals
- Combing different data types using domain first principles and data science

Use Case: Workers PPE Compliance

Challenge/ Problem Statement:

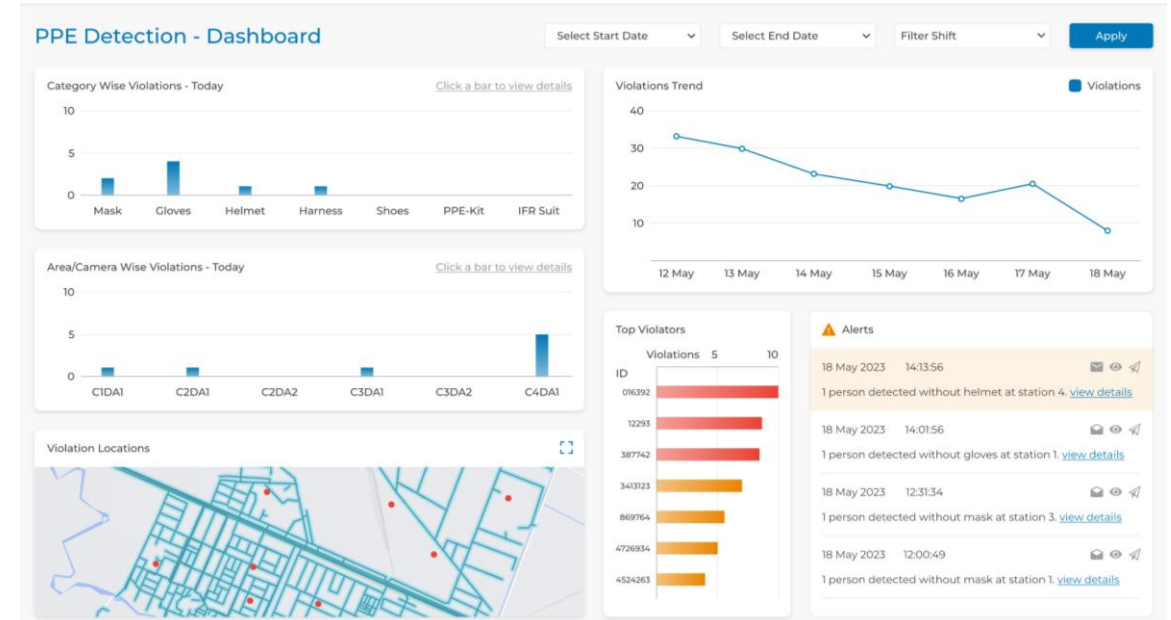
Client wanted to ensure worker safety and regulatory compliance in their oil & gas facility by using video analytics and AI computer vision for real-time detection of PPE wearable by workers. This solution aims to minimize risks and improve workplace safety standards.

Solution:

- Real-time video analytics for continuous PPE monitoring.
- AI-based detection of missing or improperly worn PPE - helmets, gloves, glasses, harnesses, etc.
- GIS location of any breach with x, y, z coordinates and its status.
- Automatic non-compliance alerts and notifications to supervisors/ safety manager.
- Data logging and reporting for compliance audits, trend analysis, and workers behavior training.

Benefits:

- **Enhanced Operational Efficiency by 25%+**: Reduces manual supervision needs and auditing.
- Minimizes injury risks by ensuring proper PPE use at all times.
- Helps the plant meet safety regulations and avoid penalties related to PPE violations.



Safety Breach

Recording | Camera 01

Image | Camera 01

Incident Location: Station 3

Violation ID - 75846293 (Unresolved)

Date & Time : 21/11/2022 12:31:34
Shift : A
Area/Camera : Camera 01
Violation Duration : 00:15:12
Start Time : 12:31:34
End Time : 12:46:46
Category : Mask
Company : -

Worker :
Violation Reason :
Comments :

Take Actions

Violation Addressed by :

Resolution

- Supervisor Informed
- Worker Warned
- Penalty Charged

Communicate to

DOWNSTREAM USE CASES



Use Case: Real-Time Optimization

Refinery FCC in Middle East

Challenge/ Problem Statement :

Many plants operate on the fundamental of design conditions when it comes to operating and set points of the parameters. However over time, plant behaviour and requirement of products and availability of feedstock get changed, and there is more room available to operate the plant beyond designed base set points. Hence, most of the plants do not run optimally.

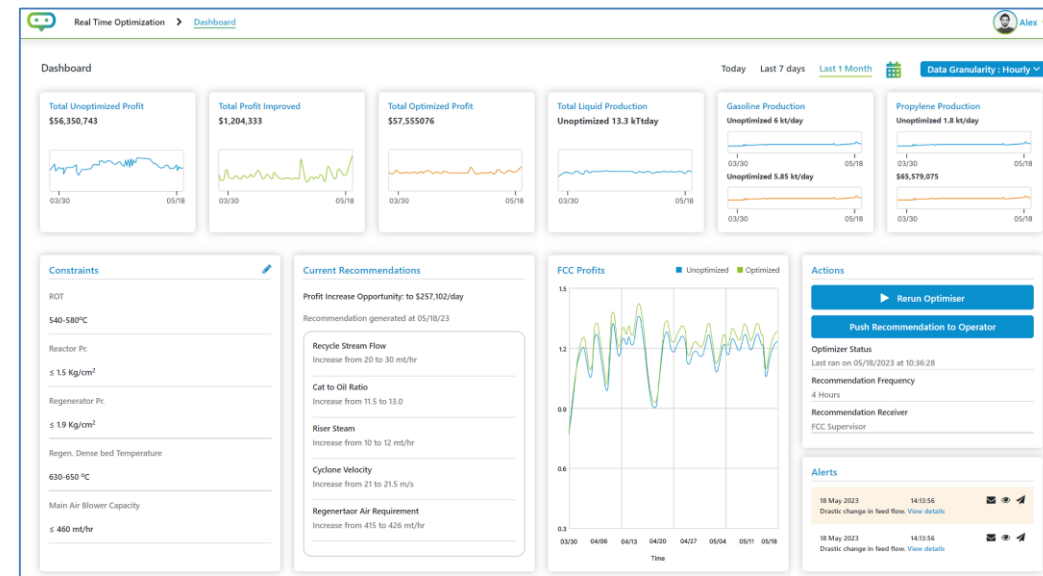
Solution:

Our RTO consists of a plant predictive model and an AI optimizer. Plant predictive model is a hybrid model replicating plant behavior using first principle and data science. AI optimizer optimizes its objective function (production, yield, profit or energy consumption) within the plant constraints while pushing/ manipulating the independent variables in the plant predictive model towards the boundaries. After every run on regular frequency (say, 4 hrs) or on any drastic changes in the feed/ operating conditions, our RTO runs and provides the optimal target set points of the manipulated variables to the DCS Engineer (open loop) for implementation in DCS.

- Built Plant Process Simulation Model using AI. This model is an AI+ 1st principle based. The 1st principal establishes plant fundamental while AI replicates plant behaviour with auto-train capability
- Built AI Optimizer with flexible objective function – propylene production, gasoline production or profit maximization and with parameters' constraints of safe and stable operating ranges
- Once models trained, tested and deployed, the real-time un-optimized plant data is processed through Plant Predictive Model and AI Optimizer. After few iterations with Prediction Model-AI Optimizer, the AI optimizer gives optimum set points of manipulated variables
- These new optimum set points are implemented in DCS to achieve the maximum desired product production or maximum profit.

Value Proposition & Benefits:

- Assist run the plant in most optimum way and upto the last dollar every day, every hour and every moment
- Work as an advisor to run the plant optimally if there is a change in product(s) demand and different feedstock needs to be processed
- The Plant Predictive Model works as a great tool for what-if analysis if operator wants to try any change in parameters, feedstock or other inputs and see the outputs before implementing in real plant.
- Help reduced the energy consumption and emissions
- Added **\$8-9M** benefits/ year for a 105kbpd FCC.



Use Case: Energy Minimization & Cell Health Prediction

Chlor Alkali (Caustic Soda/ Cl2) Plant

Challenge/ Problem Statement:

- In Chlor-alkali plant of 40,000 MTPY x 3 chlorine production, electrolyzer unit is a significant energy consuming process - approx. 50% of total variable production costs in plant
- Cell replacement, reliability, and their life was a concern of downtime – which results in production loss

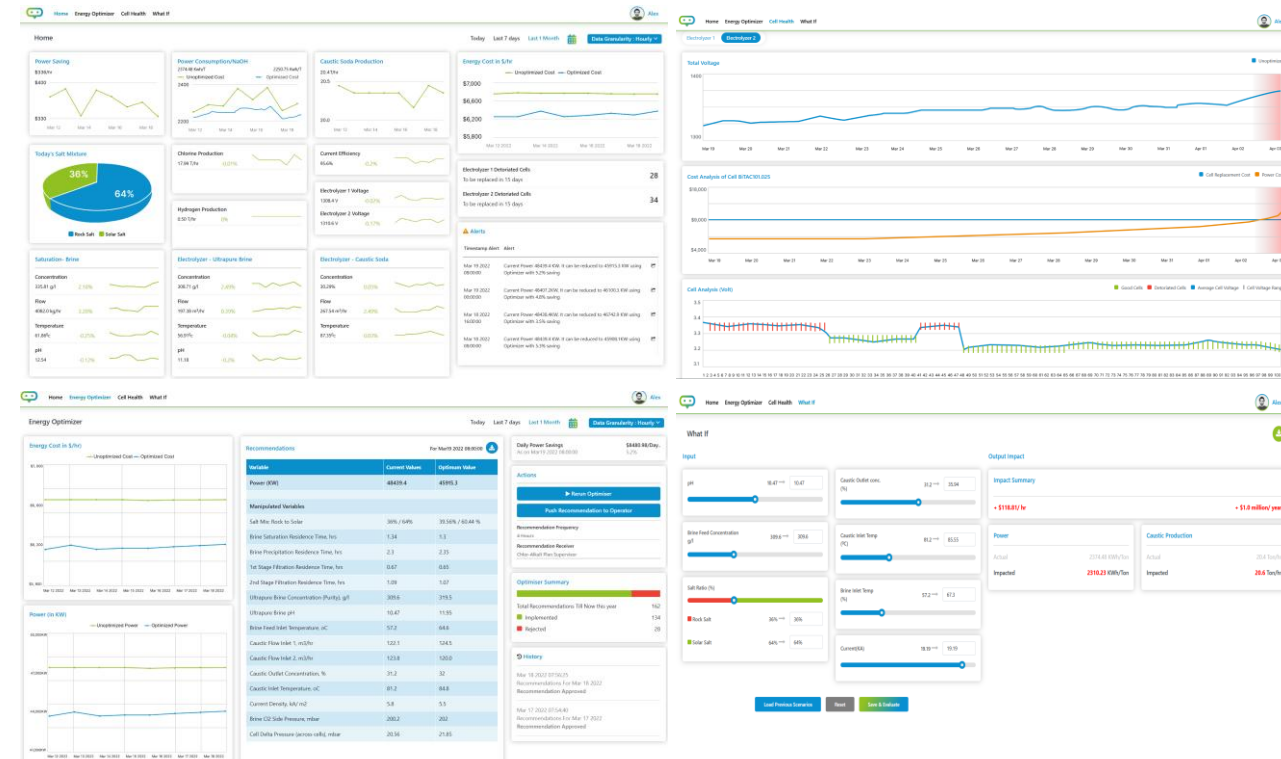
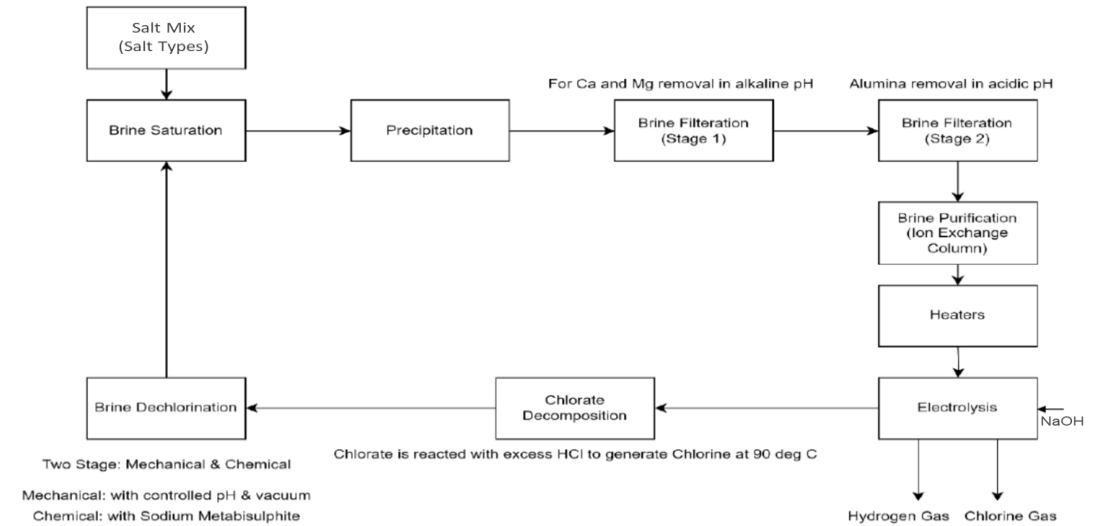
Solution:

Solution is a combination of **Energy Real Time Optimization (RTO)**, **Cells Health Prediction and Optimization of cells replacement time & eventually production.**

- RTO consists of a plant predictive model and an AI optimizer
- Predictive model replicates dynamic behavior of electrolyzer + brine system
- AI optimizer minimizes energy consumption within parameter range constraints while pushing manipulated variables in predictive model towards boundaries
- After few iterations, RTO provides optimal set points of the manipulated variables for implementation in DCS and achieves minimum energy consumption
- Cells Health Predictive Models determine optimum time for replacement of individual or group of cells considering capex of replacement and costs of energy
- Cell Health Predictive models also enhance cells health by identifying cause of cells health degradation and mitigation actions which reduces production loss

Benefits:

- Reduced 5% energy per ton of caustic soda production and gain 2% production
- Adding net benefit of \$3 M/yr with ROI 20x and payback less than three months**



Use Case: Multi Stage Centrifugal Compressor Performance for Petchem Group's Charge Gas Compressor, Gulf Coast USA

Challenge/ Problem Statement:

Client's three stage charge gas compressor has performance issue of low efficiency and high power consumption.

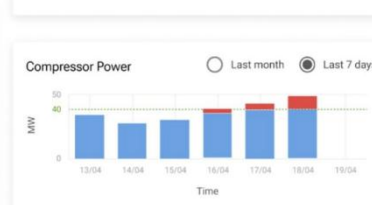
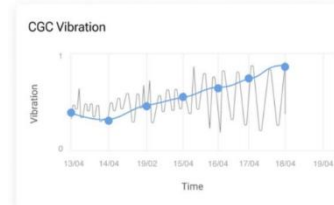
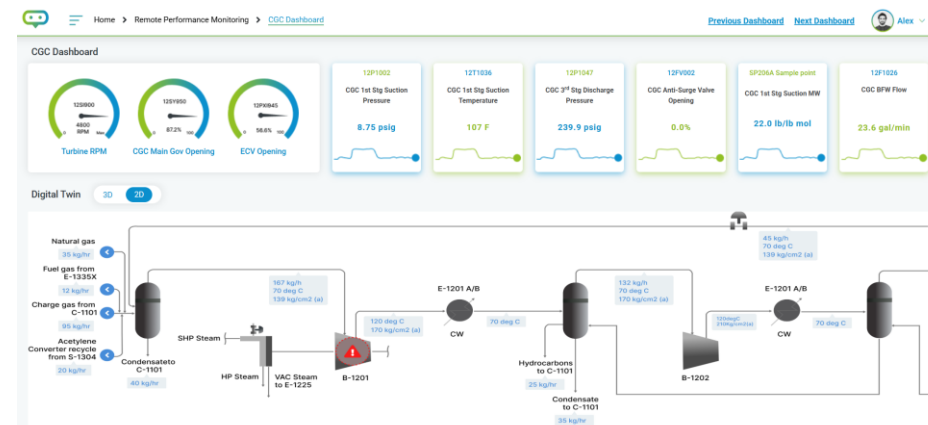
Solution:

Our 2D Digital Application based on data science AI created a simulation model which provides real-time KPIs such as efficiency, power and provides its current operating points with respect to vendor performance curve. It uses equipment and process historical data to train/ fine-tune our pre-built AI-based simulation model, connects the trained models to IoT network to process real-time OT data, and continuously tunes/ auto-trains its simulation and predictive model for more accuracy as equipment continues to operate.

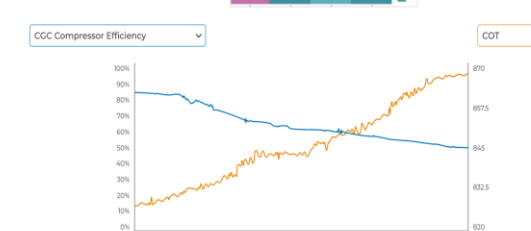
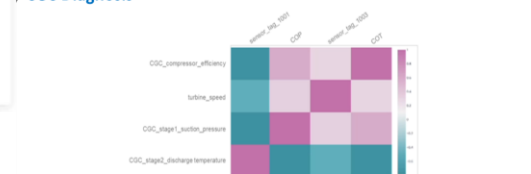
- Real-time performance monitoring using KPIs
- Detects how compressor is running with respect to vendors performance curve and best operating point
- 2D Digital Twin provides real-time parameters and KPIs right on the 2D Digital Twin of machine and at components level and instrument level
- User can perform what-if analysis to enhance and optimize the performance of compressor by playing with manipulated variables including the feed, temperature, pressure etc.
- If there is any KPI is not upto target or offtrack, the user can then diagnose the problem, accessing data science/ technical analysis tools such as correlation mapping. Finally, the user can conduct root cause identification, for example determining that heater coil outlet temperature in ethylene cracker is the main cause of poor performance/ reduced efficiency of charge gas compressor (CGC).

Value Proposition & Benefits:

- Enhance efficiency and reduce power consumption
- Reduce carbon emission
- Improve reliability by operating within surge range
- Helped customer **save \$1.7M per year** by enhancing performance and by ensuring 100% asset availability



CGC Diagnosis



Use Case: Heat Exchanger Efficiency Prediction

Fouling Prediction & Cleaning Schedule Optimization for Aramco JV, Saudi Arabia

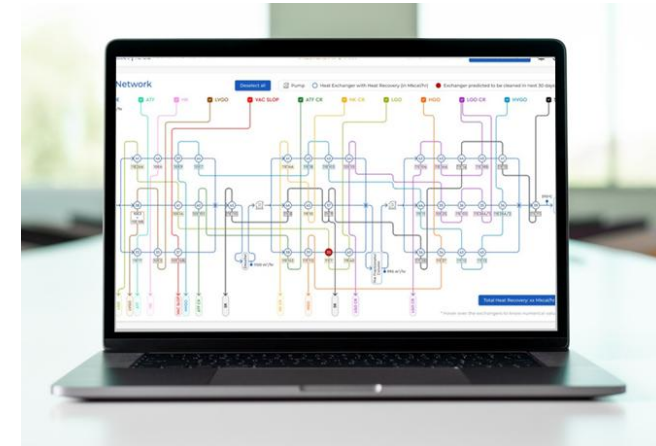
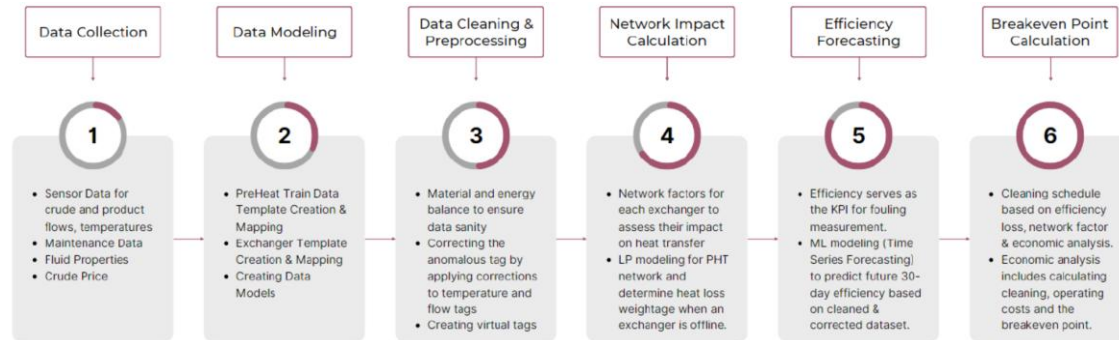
Challenge/ Problem Statement:

Heat exchanger fouling is a significant issue faced by the oil & gas industry, and especially with refining's CDU/VDU pre-heat train of our Middle Eastern client. The heat exchangers fouling was leading to increased maintenance costs, decreased plant profitability, and increased CO2 emissions as pre-train heat exchangers fouling caused furnace firing. Periodic cleaning is necessary to improve heat transfer efficiency, but it can be costly. On the other hand, infrequent cleaning leads to increased energy consumption due to limited heat transfer capabilities..

Solution:

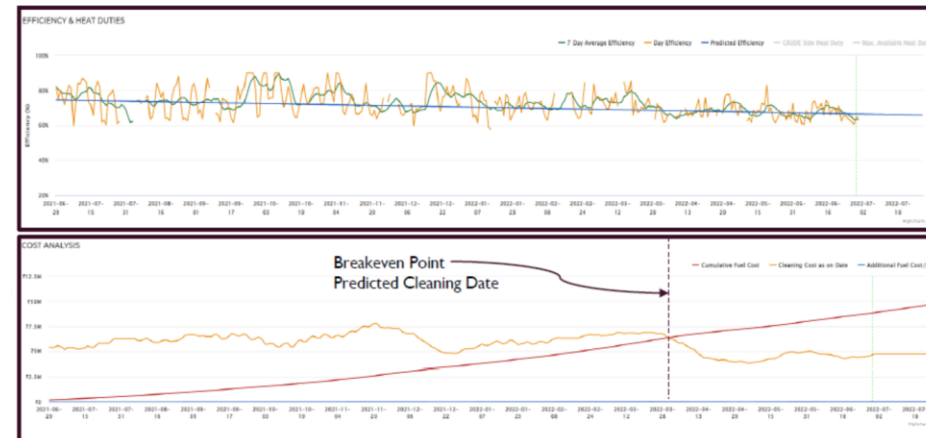
Our solution uses first principle and AI-based approaches to monitor heat exchangers in real-time, predict end-of cycle due to fouling based on the loss in heat coefficient and its tradeoff with maintenance cost to suggest optimal cleaning schedules. Its key features are.

Methodology:



Value Proposition & Benefits:

- Alert and help operator early the degradation of particular exchanger performance
- Improved asset availability with on-time warnings, improved shutdown turn-around time
- 0.5% additional heat recovery in crude oil pre-heat networks
- Reduction of upto 2300 MT/yr CO2 emissions due to fouling
- Saved **\$12.2M million per refinery** between consecutive planned shutdowns.



Operational Cost/ Additional Fuel Cost is the cost of the fuel that supplies the energy in the furnace to make up for the heat loss in the network because of the fouled exchanger.

Cleaning Cost includes the mechanical/ chemical cleaning cost and the cost of fuel that supplies the energy in the furnace to make up for the heat loss in the network when the exchanger is taken offline for cleaning.

Use Case: CO2 Excursion Prediction from Amine Absorber Ammonia Plant Indonesia

Challenge/ Problem Statement:

An Asia ammonia operator used to have disturbances such as foaming in amine absorber. Once there is such disturbance, the absorber can not extract all the CO2 upto the ppm level and high CO2 ppm goes to downstream section and raise the temperature of the methanator. This CO2 excursion triggers a shutdown in the plant resulting in loss of production/ revenue.

Solution:

Our solution detected and predicted early CO2 excursion from amine absorber as a result of foaming in the absorber to avoid any upset in downstream operations and eventually plant shutdown. The solution identifies the cause of problem and provides recommendations to avoid unplanned shutdown. It has following modules:

- Anomaly Detection Engine - Detects anomalous behavior of process system.
- Root Cause Analysis – GenAI-based root cause of the problem.
- Predictive Model – Predicts the remaining time of threshold level ahead of time so that enough time is there to take action.
- Recommendations – GenAI-enabled recommendations of managing the upset and avoiding unplanned shutdown or offspec products.
- What-if Analysis – Performs scenarios and take corrective action.

Value Proposition:

- **Saved \$2.2M** per incident of CO2 excursion.
- Avoid unplanned shutdown and production loss.
- Work as an assistant for any questions operator has.



Use Case: PP Reactor Lump Formation Prediction

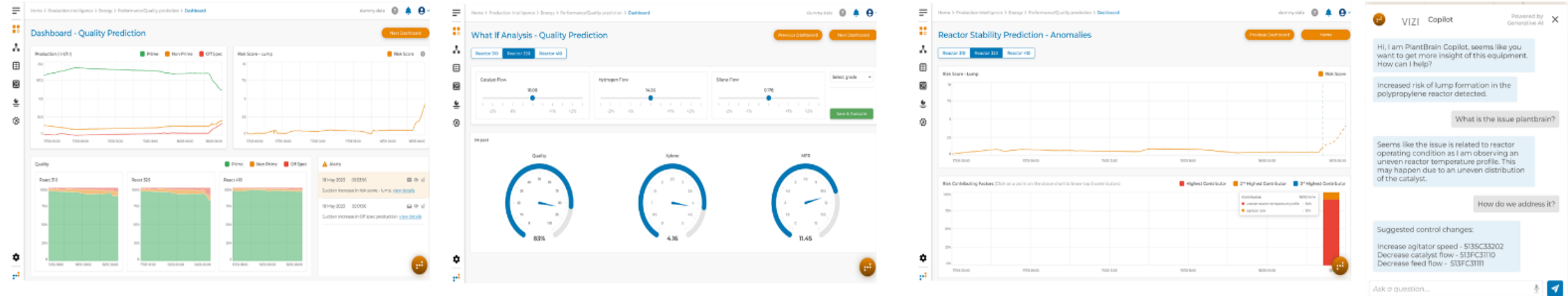
Petrochemical Group India

Challenge

A leading petrochemical company, in their attempt to increase production of Polypropylene got caught up in lump formation, increasing downtime and operational expenses. For a Complex polymeric reaction, the operator is dependent on delayed lab based quality estimation and hence immediate action can not be taken. Hence, potential reactor stability issue occurs. Reactor instability issue creates safety issues in the plant.

Solution

- Visionaize data scientists and domain experts started with identifying "tags" (MFI & xylene) causing the lump formation and having direct co-relation with the production process. Data of approximately 3 years was studied and a correlation amongst various tags was created.
- Developed ML model to notify a possibility of a lump formation at- least 15 mins prior to the event and take mitigating/ avoiding actions.
- Developed an intelligent forecasting tool creating situations and stimulating "what-if" scenarios for helping achieve expected and desired quality targets.



Benefits

- Saved approximately **\$ 11 Million every year** by preventing lumps during a reaction in PP Reactor and reducing off-spec production.

Use Case: CDP, KPIs Monitoring and GenAI Troubleshooting Agent Refinery, Midwest Operators in US

Challenge/ Problem Statement:

Client was looking a tool which can analyze real-time data and KPIs of Hydrocracker unit and in-parallel leverage documents/ data such as process description, operating manuals, SOPs, catalyst detail, vendors documents, datasheets, cause & effect diagram, P&IDs, operations logs, maintenance logs etc. and build a comprehensive Contextualized Data Platform (CDP) and Troubleshooting tool which can map various data and documents and answer any questions viz. of information extraction, cause analysis or actionable recommendations related to plant real-time operations including of unit operations, equipment and/ or overall plant performance.

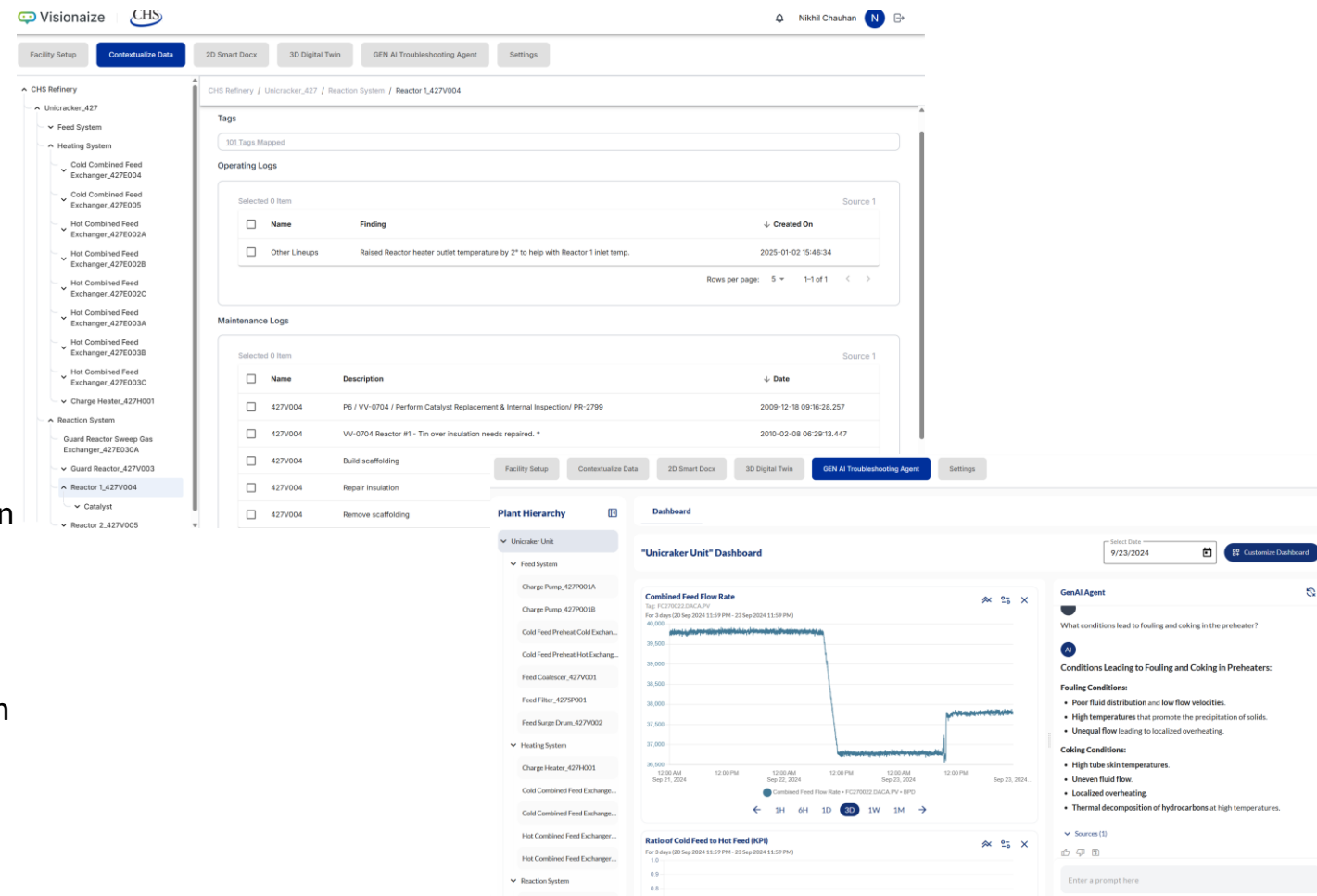
Solution:

Built CDP and Developed, trained, and certified GenAI agent:

- Built CDP for more than 1000's of documents, logs, tags
- Create plant, system, equipment, component/ material level KPIs
- Build alert system if any KPIs or parameters off-track from normal norm
- Build GenAI Troubleshooting Agent leveraging our multi-modal know-how and foundation models
- GenAI Agent provides conversational answers/ information in a format suitable for the question: text, tabular, correlation heat map, charts, causal analysis, etc.

Benefits:

- Quick and accurate decision making for plant level or drill down to any level in plant hierarchy
- Enhanced operational excellence - avoiding upset/ repairs required, unplanned shutdown, and providing recommendations of getting more from plant



Use Case: Remote Performance Monitoring with Digital Twin Ethylene Plant for Petrochemical Group, US Gulf Coast

Challenge/ Problem Statement:

At present, plant performance monitoring is done predominantly at the plant level with DCS. Similarly, though a lot of data is captured at DCS by historians and LIMS, companies lack the tools to get insight from this massive data and realize its value. This presents a challenge in improving plant health and asset performance. Some companies use Excel spreadsheets or in-house tool by downloading the data in batches. But these tools are static and have limited analytics capability.

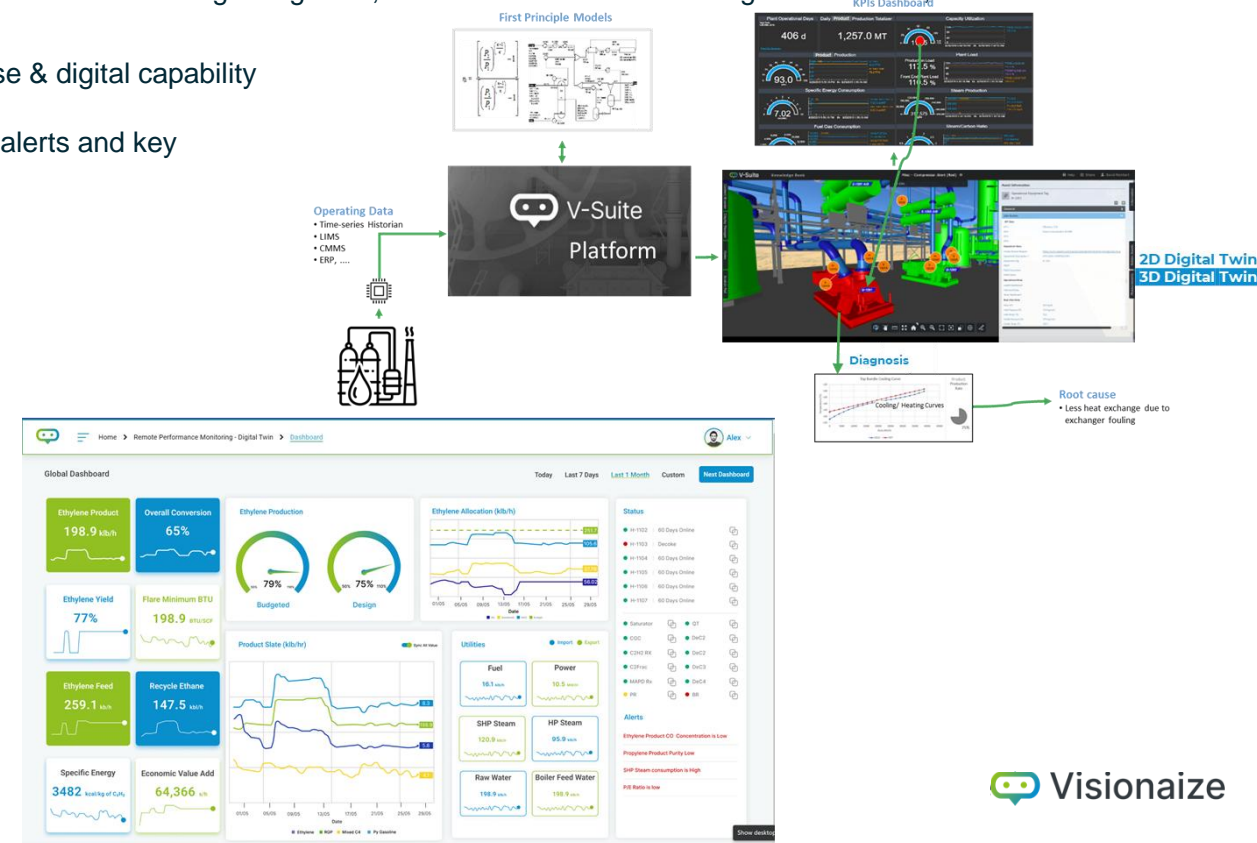
Solution:

Moving the DCS or traditional performance monitoring to Visionaize's Remote Performance Monitoring brings 24/7 real-time performance monitoring and improvement of overall plant, individual system and equipment using KPIs, 2D/ 3D digital view of plant and analytics. The application also raises real-time alerts, and provides instant reporting of plant or asset health issues or operating parameters that are off-limits, allowing for performance improvements through diagnosis, root cause assessment using data science, and actionable recommendations using Generative AI.

- Built KPIs dashboards of overall plant, systems, and equipment using domain expertise & digital capability and included analytical tools
- Developed intelligent 2D/ 3D Visual View of Plant with process replica of plant, visual alerts and key parameters
- Added drilldown capability for root cause & diagnosis and alerting capabilities
- Built a what-if analysis tool for various scenarios of operations
- Added Generative AI based CoPilot for actionable recommendations

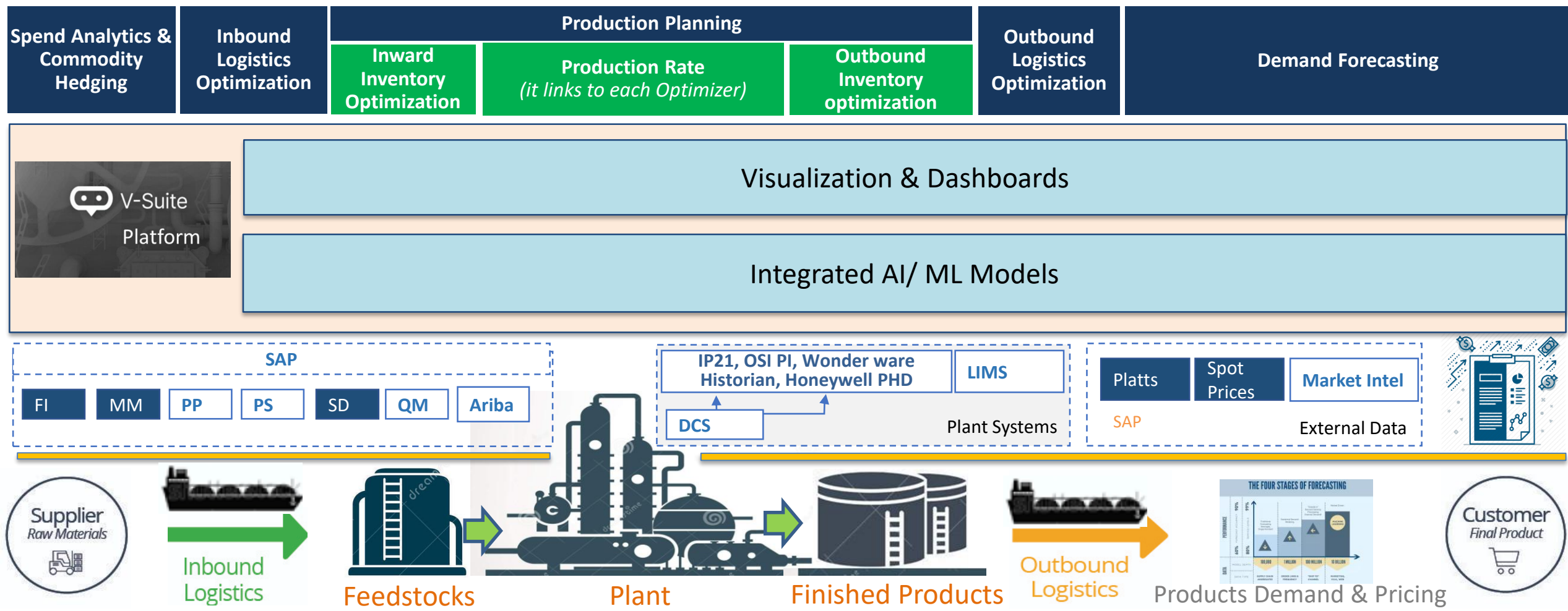
Value Proposition:

- Monitor real-time performance of plant and assets from anywhere
- Easily come to know any process or equipment issues proactively and identify root cause of problem to solve
- Improve plant performance while processing different feedstock, meeting products demand and changing operating parameters
- Effective collaborative system for different departments/ stakeholders and for regular (daily/weekly) operations review
- Added **\$8-10M benefits/ year** which includes \$6.5M for increased in production/ yield and \$1.5M for decreased in energy consumption.



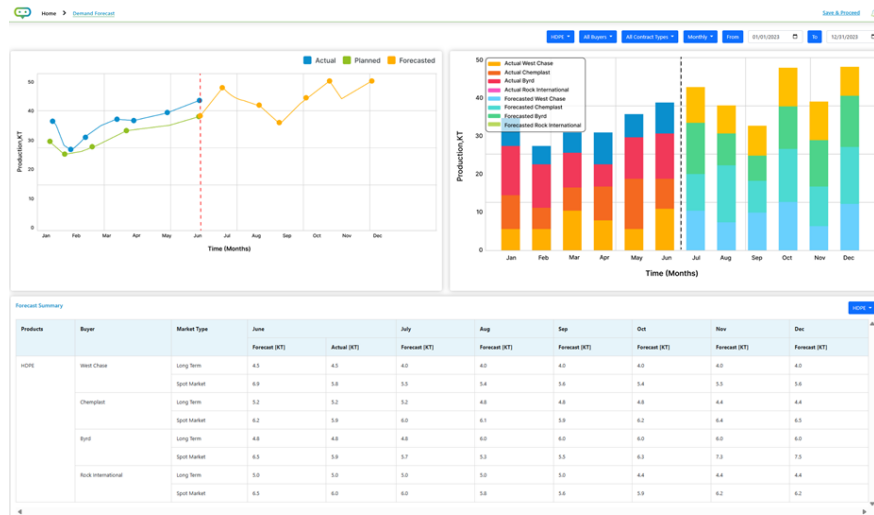
Use Case: Supply Chain Optimization: Demand Forecasting, Inventory Optimization & Production Planning

Real Time Products Demand Forecasting, Inventory (products and feedstock) Optimization and Optimum Production Planning for maximizing the overall profit

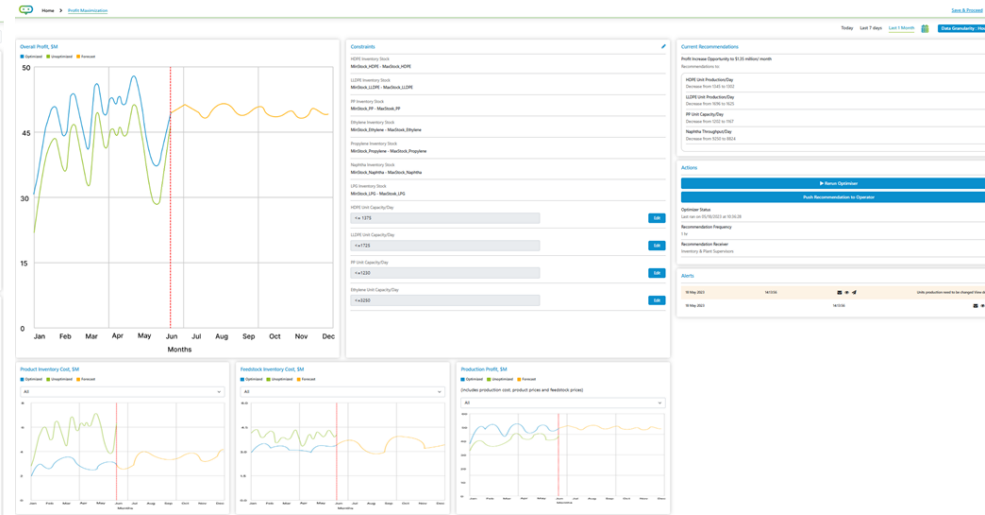


Demand Forecasting, Inventory Optimization & Production Planning

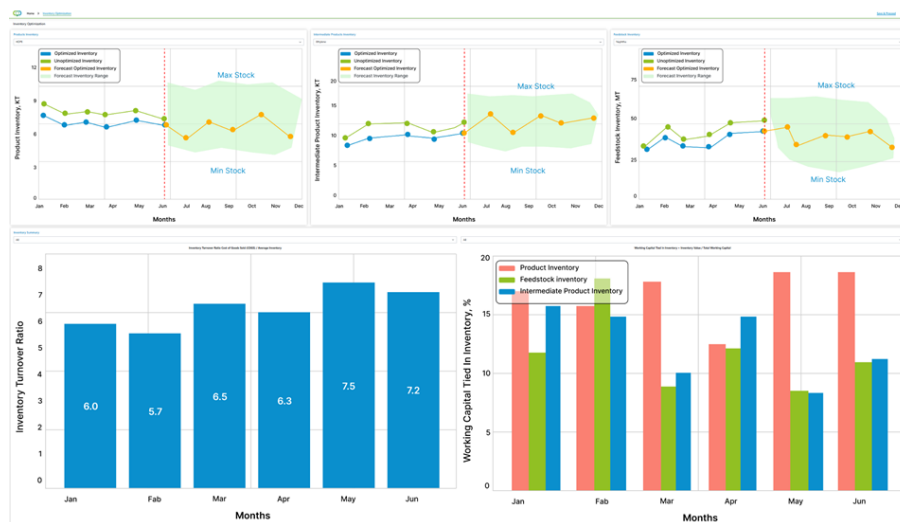
Demand Forecasting (of Products)



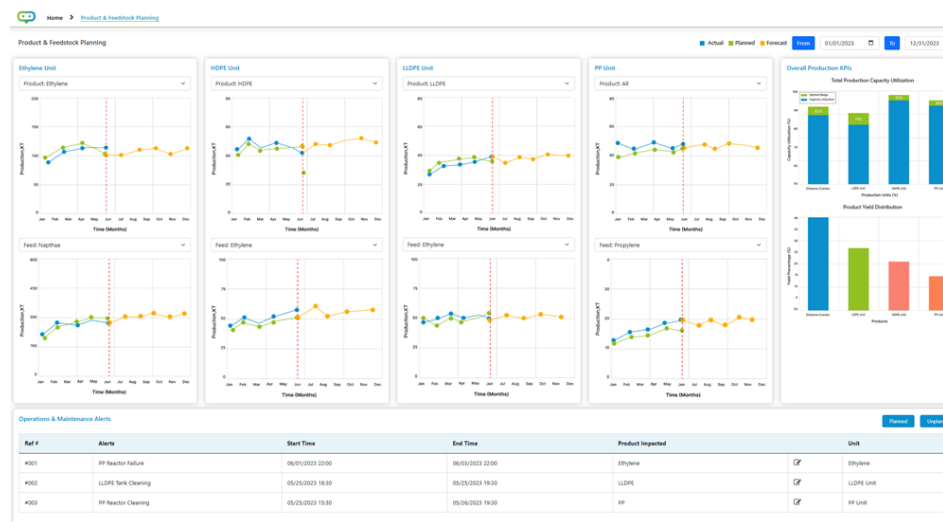
Overall Profit Optimization (based on Inventory and Production)



Inventory Optimization (of Products and Feedstock)



Production Planning



Use Case: Decarbonization Monitoring & Reduction

Challenge/ Problem Statement:

- Real-time monitoring of GHG emissions for Scope 1, Scope 2 etc., is very complex problem when one needs to identify the sources of emissions and quantify the emissions.
- The more challenges come for the reduction of carbon emissions without changing the hardware but using AI technique as emissions relate to the energy management and consumption by various consumers in the plant.

Solution and Steps/ Method Used:



Quantification

- Assess Complex or Unit wide Scope 1 & Scope 2 (if Scope 3 also there) GHG emissions
- Sources of emissions
- Approved/certified methodologies & factors for calculations



Monitoring

- Real time, online analysis and trending
- Carbon Digital Twin up to source level
- Advisory alerts and Generative AI based recommendations



Reduction

- Energy Efficiency improvements through optimal operating conditions
- Reduction via feed/utility/fuel substitution
- Configuration / Technology changes
- AI-driven what-if & optimization



Reporting

- Internal reporting to key stakeholders
- External reporting in approved format & methodologies
- Auto-generated to eliminate time consuming analysis
- Connectivity to databases of regulating bodies.

Value Proposition (day-to-day) & Benefits (long-term):

- Identification of high emission sources - units / equipment.
- Energy Efficiency improvement using what-if and optimization techniques.
- Technologies assessment for quantification of emissions reduced.
- Real Time Emissions Monitoring enables effective and timely actions to reduce Net Emissions.
- Emission Report Generation in standard format for high level glance at complex or plant level.

Up to 8%

**Reduction in
carbon emissions**

Use Case: HSE Procedures – GenAI ChatBot

Challenge/ Problem Statement:

As part of client’s digitalization roadmap, client has explored the use of Generative AI-assisted ChatBot for various procedures – Health, Environment & Safety, Quality, Inspection, Maintenance and Operations. They approached Visionaize to execute the Generative AI ChatBot for HSE Procedures as a pilot activity.

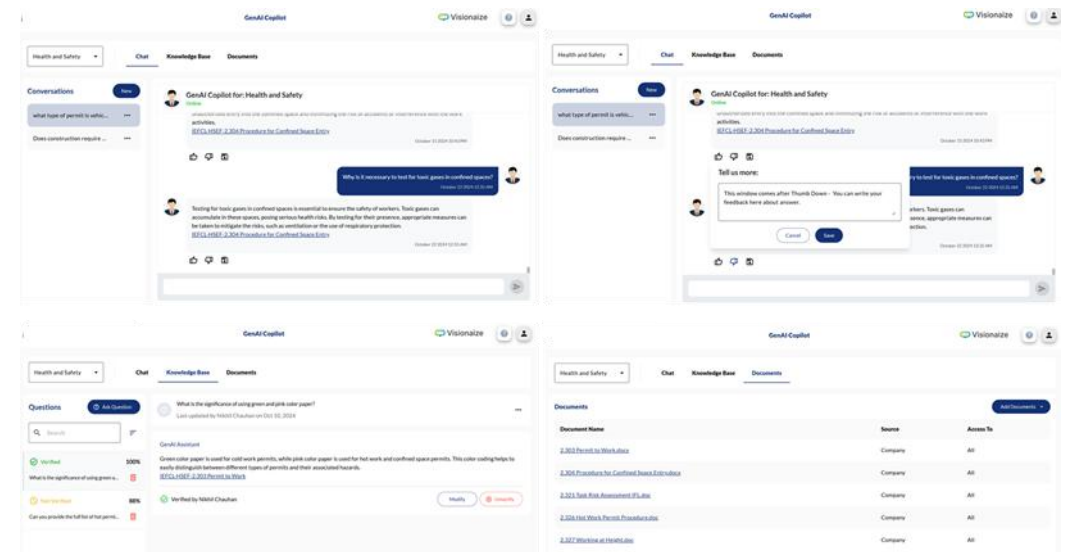
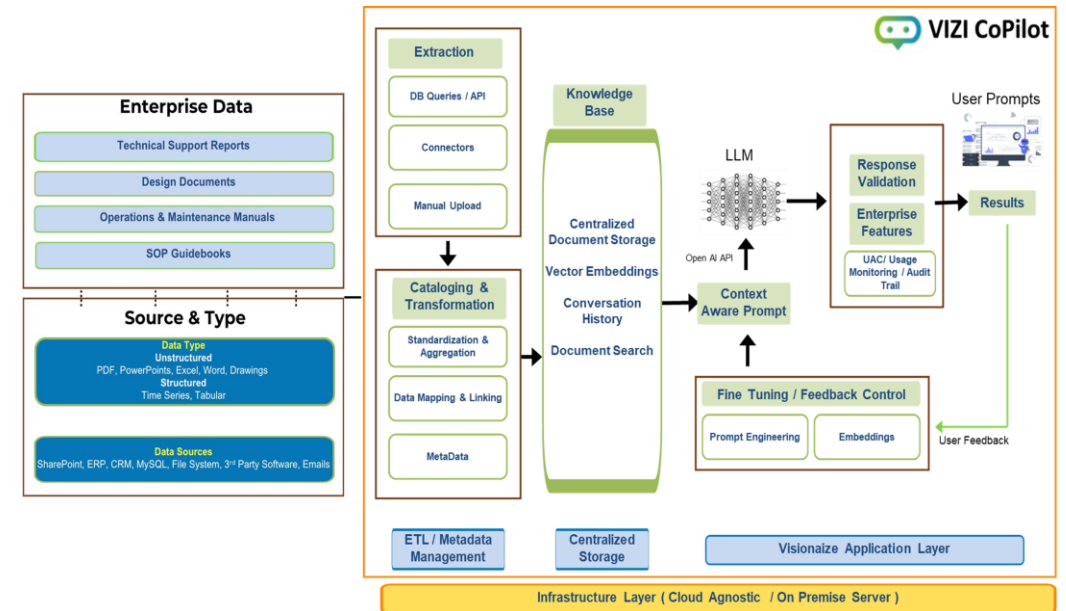
Solution:

Development, training, testing, tuning and implementation of an GenAI system that serves as an advisor on HSE procedures / policies of client:

- Create a Chatbot to answer common queries of frontline workers
- ChatBot is based on Azure Open AI LLM trained based on client’s own documents – hence it is contextual
- ChatBot provides responses supported by information available in PDF / word documents, provided by client
- ChatBot gives answer in textual, tabular and/or chart format depending on the question

Benefits:

- Increased people efficiency
- Improved operational excellence due to safe work and reduced downtime
- A proved use case for scale-up for operations, maintenance and troubleshooting use cases



Use Case – Corrosion and Damage Detection

Challenge/ Problem Statement:

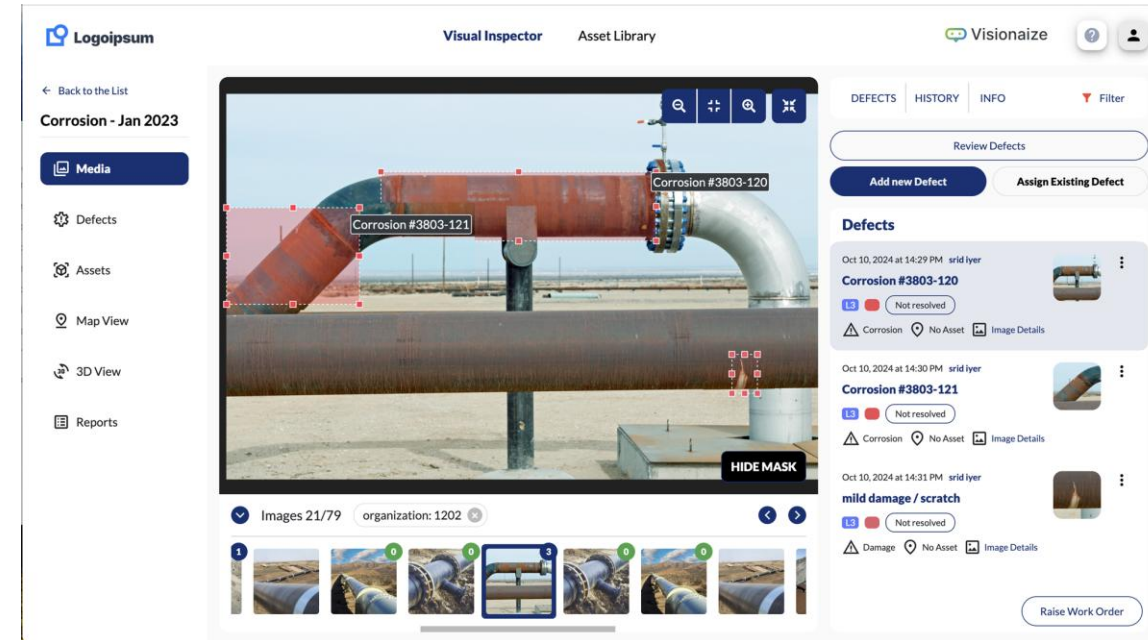
A large Petrochemical client wanted to replace the traditional manual visual inspection with an automated system which is efficient, accurate and cost effective. They selected Visionaize to detect corrosion, damages, and material fatigues in their petrochemical plant using image analytics which not only improved the detection efficiency by 80%+ but also enhanced the accuracy and costs of inspection.

Key Features:

- Integration with Visionaize Mobile App for image capture and real-time or in batch pushing to Computer Vision platform for processing.
- Automated identification of objects – pipelines/ pipes/ fittings, tanks, and equipment.
- AI-powered image analysis for detecting defects - corrosion, cracks, and fatigue. Also, detecting the severity of defect type.
- Manual annotation for human intervention and for continuous learning by AI.
- Forecast the severity of defects based on detected degradation patterns.
- Recommendations based on defects and its severity using GenAI and auto generation of reports for field actions for inspection, repair or replacement.

Benefits:

- **80% + Improvement in Operational Efficiency and Large Cost Reduction:** AI based corrosion, damage and fatigue detection are superfast. Also, it reduces unnecessary inspections while focusing on critical areas.
- Early detection of corrosion, damage and fatigue helps prevent costly equipment and structure failures and plant downtime.



	Good Condition	Opportunity task		Preventive Maintenance / Basic Care Task		Repair / Replace task /	High Risk - Immediate
Damage classification	Class 0 As new condition	Class 1 Superficial degradation	Class 2 Minor degradation	Class 3 Moderate degradation	Class 4 Significant degradation	Class 5 Severe degradation	Class 6 Functionally failed
Actual measured corrosion loss	No corrosion	Minor surface rust, paint loss	minimal rusting/corrosion <1mm (<.040")	>1mm to 2mm (>.040"-.080")	>2mm to 3mm (>.080" to .120")	>3mm (>.120")	Functionally failed (Below FFS thickness)
Example pictures - external degradation							
Example pictures - Corrosion Under Insulation							
Example pictures - Contact Point Corrosion							

METAL PROCESSING USE CASES



Cobbles Occurrence Prediction in Rolling Mill Steel Manufacturer

Challenge:

A Middle East Steel Manufacturing company has a large Rolling Mill process which is the final operation for steel bars and billets production after the Smelting process. Cobbles occurrence was a large problem in the Rolling Mills as it affected not only the production but also was a big safety and reliability issue. There was no mechanism to prevent it as operator and technician came to know the issue when event already happened.

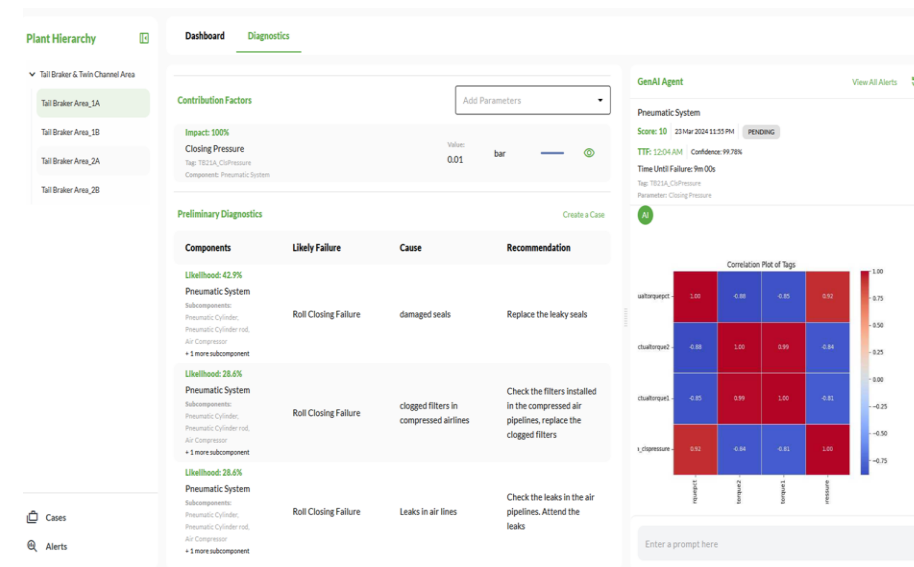
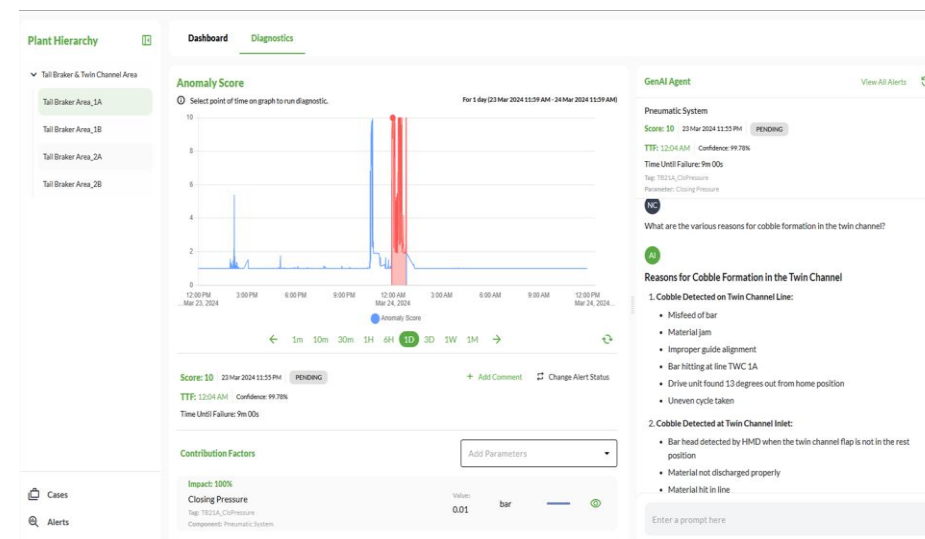
Solution:

The Cobble Occurrence Prediction solution leverages AI and GenAI integrated approach to detect issues early. It uses Tail Braker & Twin Channel area tags and upstream process tags historical data to train anomaly and predictive models and connects the trained models to IoT network to process real-time OT data. Moreover, it identifies root cause of issue using GenAI-based cause analysis and provides actionable recommendations.

- Anomaly Detection Engine - Detects anomalous behavior using supervised and unsupervised machine learning algorithms.
- Predictive Model – Predicts the remaining time of threshold level (cobble occurrence) ahead of time so that enough time is there to take action.
- Root Cause Analysis – Generative AI & rule based enabled provide the root cause responsible for the main cause of the problem.
- Recommendations – GenAI enabled recommendations of managing the cobble occurrence and avoiding unplanned shutdown.

Value Proposition:

- **3% increased in uptime and production**
- Reduce production loss/ delays and improve uptime
- Enhance safety.



Use Case: Blast Furnace Intelligent Monitoring & Optimization

Steel Manufacturer

Challenge/ Problem Statement:

Challenges in improving blast furnace performance arise due to the limited utilization of valuable data captured at the plant level through L1 & L2 automation systems, often relying on static Excel sheets or in-house tools with limited analytics capabilities.

Solution:

- Solution replaces traditional L1 & L2 monitoring with real-time performance tracking.
 - Utilizes KPIs, intelligent digital twin, and optimization techniques for overall improvement.
 - Real-time alerts and instant reporting on furnace health and operating parameters.
 - Performance enhancement through data-driven diagnosis and root cause assessment while offering actionable recommendations using Generative AI .
1. Working with domain experts, Visionaize built KPIs and analysis tools of overall blast furnace
 2. Developed 2D Digital Twin with process replica of furnace, visual alerts and key parameters
 3. Using historical data, built AI models for fuel optimization, coke rate prediction, silicon prediction, anomaly detection and cause analysis
 4. Built recommends tool using GenAI trained with contextual data/ knowledge management



Value Proposition (day-to-day) & Benefits (long-term):

- Monitor real-time performance of Blast Furnace from anywhere
- Easily come to know any issues proactively and identify root cause of problem to solve
- Improve and optimize furnace performance while changing operating parameters
- Improved collaboration and Optimal use of off-site/local specialist pools
- **Added \$5M benefits/ year** which includes \$3.5M for increased in production and \$1.5M for decreased in fuel consumption – i.e. 7-10% gain in the production of hot metal and 8-10% reduction in energy consumption/ ton



Use Case: Predicting Power Requirement Steel Manufacturing (EAF)

Challenge/ Problem Statement:

- Aligning the power production with the fluctuating power demand of EAF and LRF
- Environmental and process factors such as mix of raw material (composition of DRI, scrap), atmospheric conditions and availability of material and assets can alter the run time of EAF and create imbalance in power produced with power consumed

Solution:

Balancing power supply from captive power plants (CPP) with fluctuating manufacturing demand in Electric Arc Furnace (EAF) and Ladle Refining Furnace (LRF) processes poses a challenge, resulting in surplus power generation known as "infirm power" in the steel plant.

Steps/ Method Used:

- Use historical data and developed power consumption forecast model for all operating scenarios
- Dynamic delay root cause tree to predict delays. Digital checklist and validation checks for SOP compliance. Predict heat start/end time with a lead time of up to 10 minutes
- End Time Prediction for EAF: Using AI Based Scheduling and process modelling



Value Proposition (day-to-day) & Benefits (long-term):

- Improved Forecasting: Predict heat start and end times with a lead time of up to 10 minutes. Operators can take action in CPP
- With improved forecasting, production aligns with power demand
- Increased Operational Efficiency due to predictive insights
- **Reduced Surplus Power from 15 MW to 5 MW**, leading to zero
- **Cost Savings of approx. \$2 Million per year**

Use Case – Automated Quality Check of Zink Product

Objective/ Problem Statement:

A Zink Plant operator wanted to have an automated system to capture defects in the zink product bars to improve quality, get insights, and a live link with finished goods issue. Their current system was manual and inefficient and not very effective:

- 600 Ingots/hr of production rate makes manual QC impractical
- Hazardous operating conditions for workers

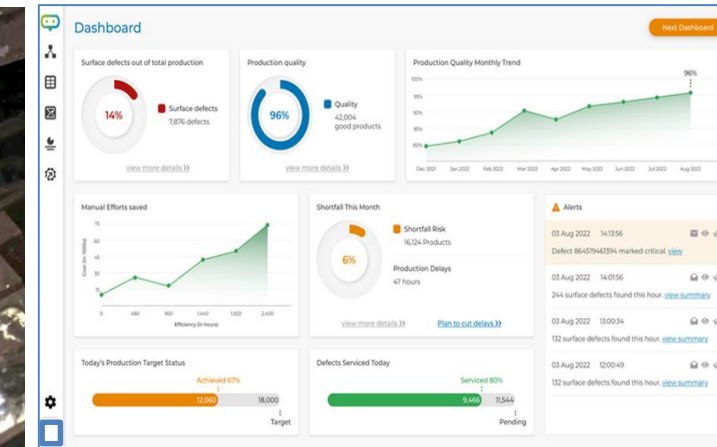
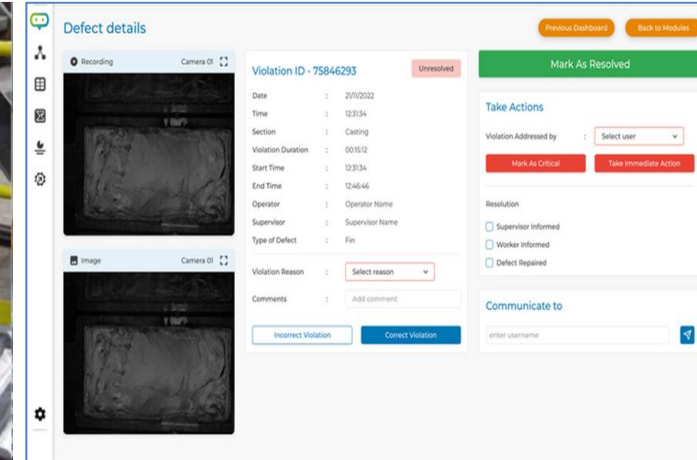
Solution:

AI-based system was developed using computer vision to capture defects at high speed, enabling real-time tracking, detect defects, get insights, and take corrective actions.

- Developed computer vision model using historical data and images of good quality and abnormal quality.
- Automated system captures any defects in products as it moves on the belt at high speed.
- It identifies the contributing factors and the probable cause of problem to take corrective actions.

Benefits:

- **Reduced bad quality products by 90%.**
- Help operator for real time defect tracking & alert mechanism – worker efficiency increased/ costs reduced by 60%.
- Enhanced safety of workers in hazardous work area.



POWER & UTILITY USE CASES



Multiple use-cases in Energy, Chemicals and Other Industrial Sectors

Oil & Gas Upstream/ Midstream

- Enhanced Oil Recover (EOR) Optimization and Polymer Injection Reduction
- Predictive Maintenance of a Gas Compressor for Midstream
- Predictive Maintenance of Pumping Systems for Oil & Gas Operator
- Production Fields Real Time Monitoring Center
- Subsea Gas Lift Riser and MPP Boosted Real Time Production Optimization OTC Paper and PoC
- Well Logging, Field Interpretation and Volumetric Analysis AI-based PoC
- Workers PPE Compliance using Computer Vision

Oil & Gas Downstream/ Chemicals

- Real Time Optimization of Refinery FCC Unit
- Energy Minimization and Cell Health Prediction of Chlor Alkali plant electrolyzer
- Predictive Maintenance of FCC Main Air Compressor
- Pre-Heat Heat Exchangers Fouling Prediction and Schedule Optimization in Refinery CDU/VDU
- CO2 Excursion Prediction from Amine Absorber in Ammonia plant
- PP Plant Reactor Lump Formation Prediction
- Real-Time Performance Monitoring & Analysis with GenAI Troubleshooting Agent + Contextualized Data Platform
- Remote Performance Monitoring with Digital Twin for Ethylene Plant
- Demand Forecast and Inventory Optimization for a Petrochemical Complex
- Decarbonization Monitoring & Reduction
- GenAI CoPilot for HSE Procedures/ SOPs
- Corrosion/damage detection using CV

Other Industrial Sectors

- Cobble Occurrence Prediction in Steel Plant Rolling Mill – [Metal Processing \(MP\)](#)
- Blast Furnace Optimization – [MP](#)
- Predicting Power Requirement for Steel (EAF) – [MP](#)
- Automated Product Quality Check in Zink Plant – [MP](#)
- Coal Trucks Planning, Scheduling & Tracking for Aluminum Plant – [MP](#)
- Discrete Manufacturing Planning & Scheduling Optimization – [Plastic Industry](#)
- Prediction & Condition Monitoring of Fans – [Power](#)
- Steam Generator / Boiler Online Thermal Stress Monitoring – [Power](#)
- Optimization of Main Steam Temperature of Steam Generator - [Power](#)
- Dynamic Modelling, Scheduling and Improving Operation of Mills / Pulverizers - [Power](#)
- Balancing Power Demand & Supply – [Utility](#)
- Power Transmission & Distribution Network Inspection - [Utility](#)

Use Case: Predictive Modelling and Real Time Condition Monitoring of Fan

Challenge/ Problem Statement:

Maintaining and enhancing operational excellence. Maintenance planning on critical assets in the least disruptive way and synchronized with the overall maintenance cycle of the plant, Online monitoring and condition analysis, Insight into maintenance planning and scoping, Real time prognosis and solutions, Continuous operation of critical asset which is an essential KPI for the overall plant performance. This will enable you to equipment operation strategies powered by the Moreover, client was looking a real-time monitoring of energy consumption of whole plant and all parameters which affect the energy consumption and a tool for scenarios analysis to reduce energy consumption.

Solution :

Our solution was a combination of Optimization (RTO) and Real-Time Monitoring. The RTO consists of a plant predictive model and an AI optimizer. Plant predictive model is a hybrid (Data Driven + Model Driven Analytics) model replicated the dynamic behavior of equipment using physics data on how equipment operates and responds to the environment, the digital model is used to analyze and simulate real operating conditions, including how it responds to changes, and how you can improve your operations and KPI

- Using historical data and design data the predictive model is an AI+ Data Driven + Model Driven Analytics
- Model-driven predictive analytics apply physics and simulation-based models to analyze asset data and exhibit predictive capabilities by recognizing and qualifying asset behavior in relation to failure modes and operating characteristics.
- Model-based analytics effectively provides with self-learning capabilities and enables rapid scalability across entire asset populations. It also bridges the gap between as-built or factory data as the model-driven analytics becomes responsive to real-time data.
- Data-driven analytics can support early identification of deviating asset performance patterns using unsupervised machine learning.
- Leveraging data-driven analytics enables pattern recognition building on the augmented data output provided by the model-driven analytics, and thus, further enhances the predictive capabilities of the resulting hybrid condition monitoring as a whole
- White-if Analysis tool to perform various operating scenarios

Value Proposition (day-to-day) & Benefits (long-term):

- Assist to run with maximum uptime every day, every hour and every moment
- Eliminating unnecessary preventive maintenance and avoid unplanned events leading to reduced maintenance costs
- Synchronized with the overall maintenance cycle of the plant
- Online monitoring and condition analysis
- Extend fan life, improve performance and improved site safety
- Predictive Model with what-if ,simulating any change in parameters and see the outputs before implementing in real plant
- Anomaly detection and Reducing operational costs and risks
- Help reduced energy consumption and emissions
- Augmented reality experiences displayed on mobile devices and smart eyewear
- Maximizing future usability of predictive model driven solutions with openness and scalability from data capturing, communication, storage, processing and analytics, to user interfacing.

Use Case: Steam Generator / Boiler Online Thermal Stress Monitoring

Challenge/ Problem Statement:

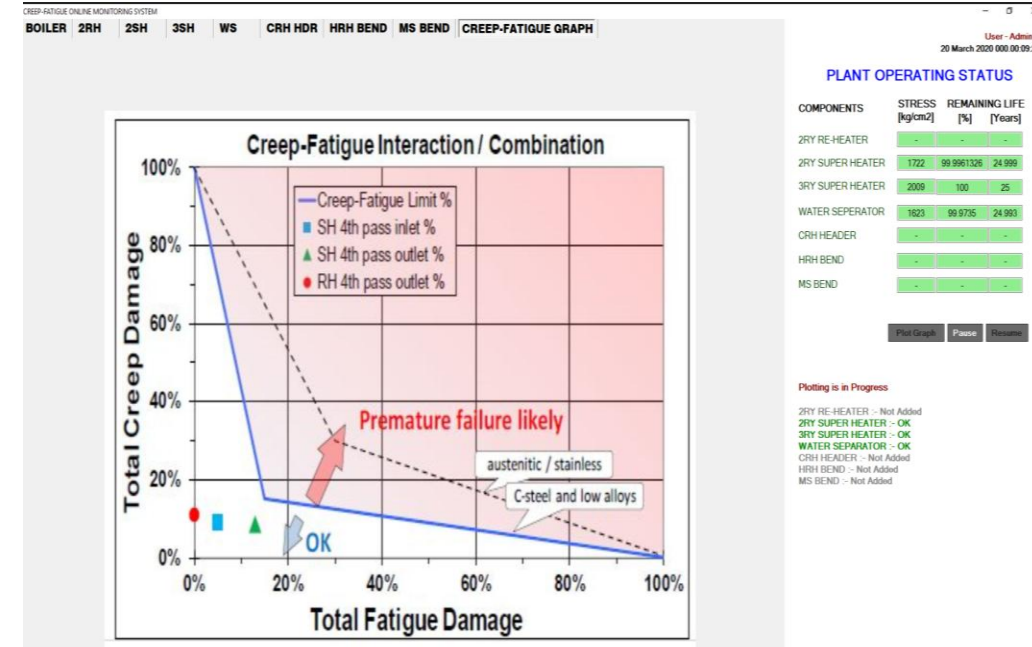
- Introduction of renewables power resources (such as solar, wind etc.) on grid has called for flexible operation with wide variation in MW load of coal fired thermal power plant
- Due to fluctuation of MW loads on power grid, steam generator pressure parts material experiences fatigue stress which reduces the life of material significantly

Solution :

- Online Software uses real time DCS data as operating process parameters and calculates fatigue stress & creep stress in operating condition of boiler.
- It uses DCS inputs and calculates fatigue stress & creep stress in operating condition of boiler. It estimates the damage caused by fluctuating loads and damage caused over a period of time of operation. The program then converts the damage into remaining life of material.
- It estimates the damage caused by fluctuating loads and damage caused over a period of time of operation.
- Software then converts the damage into remaining life of material used in pipes and tubes, header, bends etc., raise alarm to the operating personnel and DCS
- Creates Automatic alarm / warning signal when boiler runs on abnormal condition
- Email notification to boiler operator at abnormal operating event

Value Proposition (day-to-day) & Benefits (long-term):

- Real time calculation of fatigue stress, creep stress, total stress & continuous monitoring of remaining life of components
- Safe operation of the steam generators under Cyclic loading operation with high temperature & high pressure fluctuations.
- When load fluctuation is beyond design data, alert/warning signal to operating person & DCS
- Data displayed in real-time trends
- Dynamic operating point on Creep-fatigue interaction curve on HMI for each component from ASME Section III-Div. 5
- Eliminating probability of unplanned shutdown occurrence
- Minimizing O&M Cost



Use Case: Optimization of Main Steam Temperature of Steam Generator

Challenge/ Problem Statement:

- Integration of large-scale renewable power generation into the power grid necessitates flexible operation of fossil-fired power plants
- Limitation of maximum ramp rate and number of load cycles due to thermal stress experienced by the boiler pressure parts, turbine metallurgy
- Impact on boiler pressure parts material and turbine material due to creep and fatigue effect by main steam temperature deviation beyond acceptable
- Extreme difficulties in optimization of main steam temperature which plays a vital role in achieving higher load ramp rate and flexible operation of the steam generators.
- Plant shutdown either due to damage of components or due to large variation of steam temperature

Solutions :

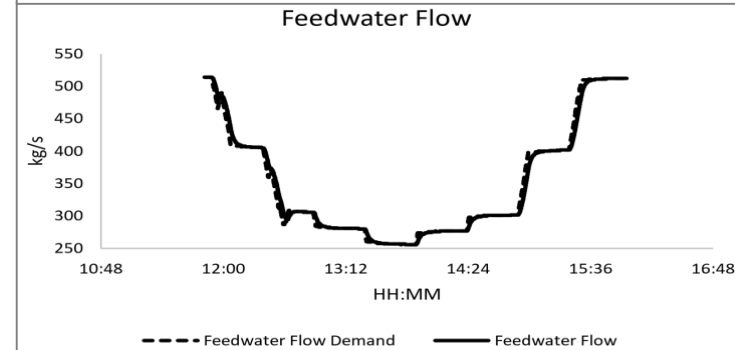
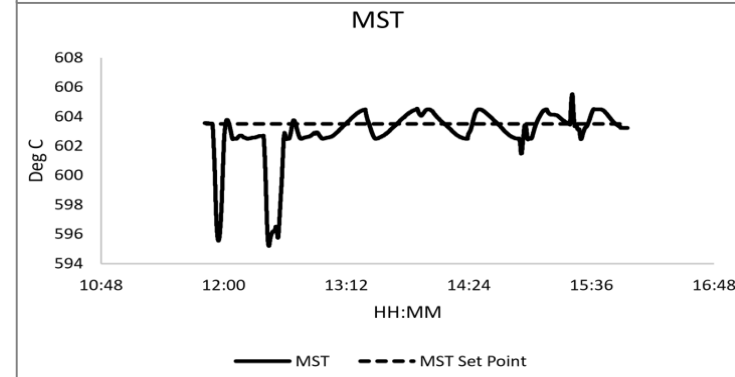
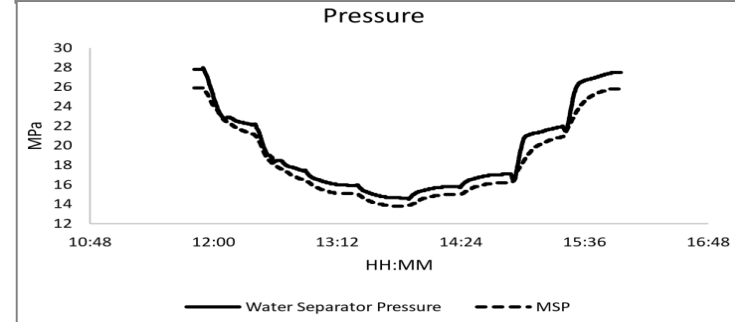
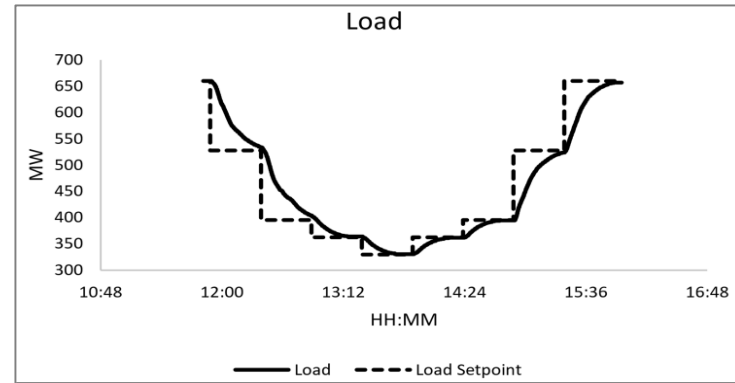
- Robust, reliable, precise optimization technique integrated with control strategy under load swing conditions.
- Multi input Multi output non-linear model-based dynamic prediction and optimization based on first principle and data driven

Value Proposition (day-to-day) & Benefits (long-term):

- Maintaining main steam temperature within acceptable limits under wide load range while operating in flexible mode
- Maximizing ramp rate and number of load cycles and minimizing thermal stress experienced by the boiler pressure parts, turbine metallurgy
- Minimizing probability of failure and plant shutdown either due to damage of components or due to large variation of steam temperature

- 1°C lower MS temperature increases annual fuel expenditure >26 lakhs INR
- 1°C lower HRH temperature increases annual fuel expenditure >25 lakhs INR
- 1 TPH higher attemperator spray flow increases annual fuel expenditure >2 lakhs INR
- 1 kg/cm² lower MS pressure increases annual fuel expenditure >52 lakhs INR
- 1°C higher flue gas temperature increases annual fuel expenditure >50 lakhs INR
- 1°C lower feed water temperature increases annual fuel expenditure >136 lakhs INR

(Financial impact calculated with coal cost of INR 3998 per MT & GCV of 3841 Kcal/Kg & PLF of 85%)

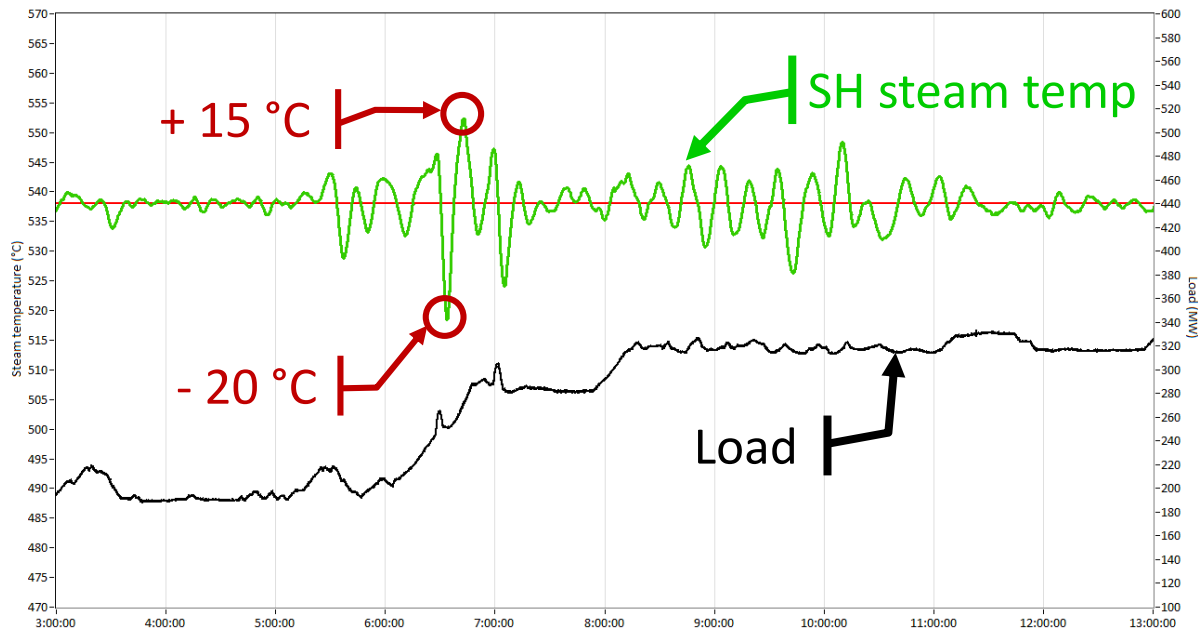


Optimization of Main Steam Temperature of Steam Generator

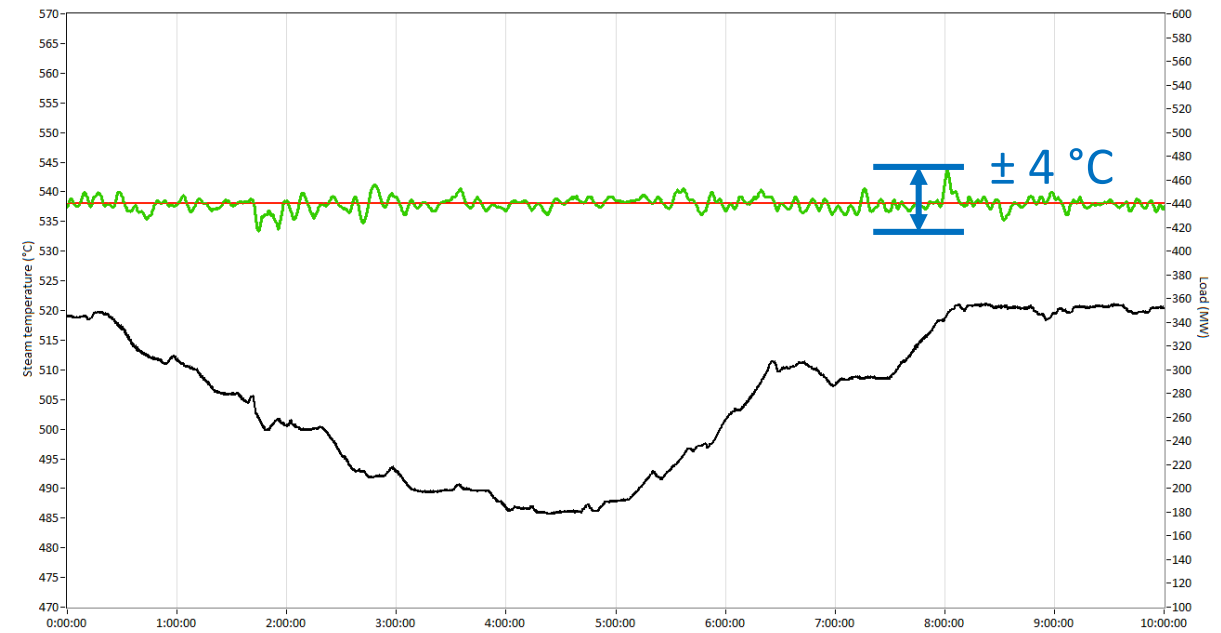
Load changes in Coal Power Plant

No thermal fatigue during load changes

← Conventional control →



← AI control →



Use Case: Dynamic Modelling, Scheduling and Improving Coordinated Operation of Mills / Pulverizers

Challenge/ Problem Statement:

- More and more penetration of renewable energy in the power grid calls for rapid and automatic flexible operation of coal fired steam generator.
- Fast response of the boiler in a thermal power generating plant becomes necessary to generate the megawatt load as per the demand placed on the grid to maintain the power system frequency with support of boiler steam flow, pressure and temperature to the steam turbine generator.
- Unpredictable dynamic response of the coal pulverizer under varying coal characteristics and feed rate in the combustion control system.
- Real time condition monitoring of pulverizer
- Automatic scheduling of pulverizers depending on the combustion condition and flame stabilization inside furnace.
- Coal firing rate for actual combustion in the affects to achieve higher ramp rate required for flexible operation. In conventional combustion control, the total coal firing demand is equally distributed to all the operating pulverizers without observing the healthiness of it whether one or more pulverizer are really capable of handling the coal demand and giving full throughput to the furnace or not and flame stabilization.

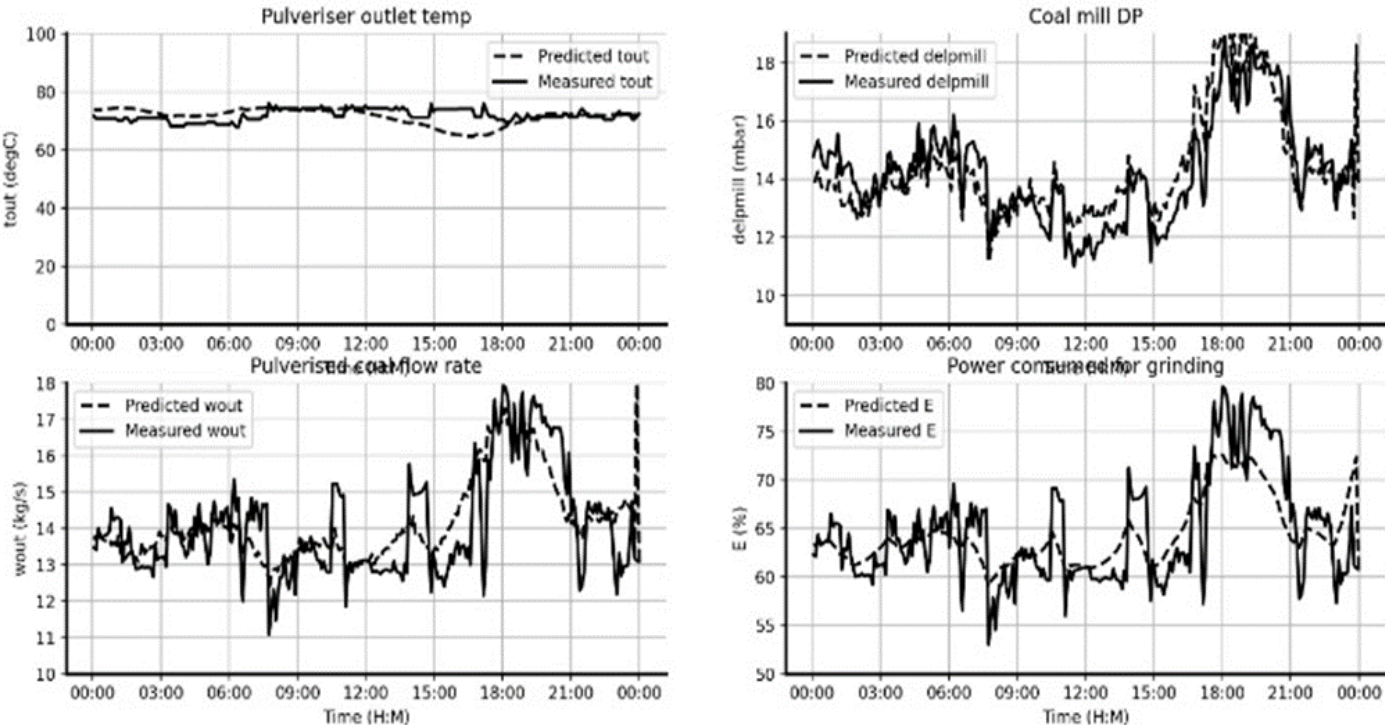
Solutions :

- Realistic multivariable nonlinear predictive model of pulverizer dynamic behavior under varying coal characteristics and coal feed rate that optimizes and enhances performance of combustion control in the existing control system so that the boiler response can be improved under transient condition of megawatt load demand variation.

Value Proposition (day-to-day) & Benefits (long-term):

- Coordinated control of all operating pulverizer can be achieved by optimum loading of each pulverizer based on their real operating performance.
- Improve significantly the load ramp rate, heat rate, NOx reduction, primary air flow, average oxygen demand, unburnt carbon under varying coal flow demand and under the constraint of maximum pulverizer loading capacity to finally achieve the operational flexibility and stability towards higher megawatt load ramp rate of coal fired power generating plant.
- 0.1% higher unburnt carbon in bottom ash increases annual fuel expenditure > 21 lakhs INR
- 0.1% higher unburnt carbon in fly ash increases annual fuel expenditure > 80 lakhs INR

Model predicted outputs - 14 Oct 2020 (with moisture variation effect)



Use Case: Balancing Demand and Supply in Power System

Challenge/ Problem Statement:

- Interconnected power system through Transmission & Distribution (T&D) lines suffers imbalance in nominal frequency and voltage level due to unplanned & random variation of load demand
- Limited ability of the generation side to follow the fast changing load initiate deviations in the power grid frequency and tie-line power interchange
- Absence of synchronous methodology to measure the frequency and voltage without measurement delays and make decisions synchronously
- Governor control as a primary level control as a first line of defence against sudden frequency rise/fall alone unable to eliminate deviation of system frequency from nominal value and generation units deviate from their respective schedules, in response to changes in load
- Emergency condition arises during transient disturbances due to a tripping of a generator or a loss of load block and leads to the frequency changes due to the mismatch in load and generation.
- The drop in operating level of the frequency depends on the instance of starting point of disturbance as well as the system inertia, which provides the initial ability of the power system to oppose change in the frequency
- Managing generation, distribution services and regulators synchronously and efficiently

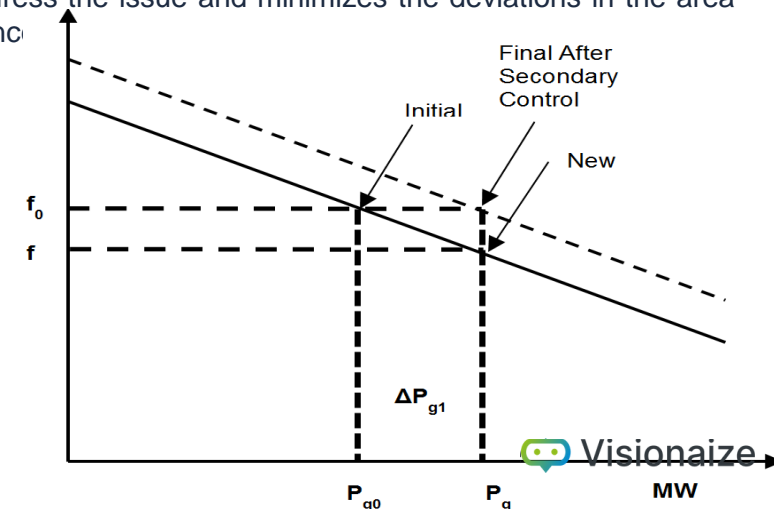
Solution :

- In case there is any load change in one of the areas, active power from the other system is supplied to the system with load change to help restore the system frequency
- The only way to regulate frequency is to maintain the balance between demand and supply in real time by Load Frequency Control (LFC) through Internal predictive modelling (IPMC)
- For practical purpose it is prudent to consider asynchronous methodology which incorporates frequency measurement delay including boiler-turbine-generator response and asynchronous decentralized decision making.
- It regulates the frequency of each area and to simultaneously regulate the tie line power as per inter-area load dispatch schedule & area control response
- Load Frequency Control with active power as secondary level with free governor or restricted governor mode operation address the issue and minimizes the deviations in the area frequency and tie-line power interchange ensuring the steady state errors to zero by regulating frequency to maintain the balance

Value Proposition (day-to-day) & Benefits (long-term):

LFC through IPMC results

- Lesser frequency deviation
- Reduced Settling time
- Reduce steady state error
- Simple to realize and easily tuned
- Improved damping for two or more areas



Use Case: Power Transmission & Distribution Network Maintenance & Inspection Using Digital Twin & AI/ML

Challenge/ Problem Statement:

- Non availability of smarter asset planning to keep up with the changing pace with respect to type of consumers, connection and grid upgrade programs
- Absence of fast inspection and maintenance of entire T&D networks for prompt identification of status, faults, electrical or geometrical defects in network elements resulting from external factors (storms, mechanical damage, fire, floods, climatic effect etc.).
- Lack of comprehensive and efficient management of forestry in the T&D network surroundings including local houses, roads, waterways ,vegetation and trees.
- Feasibility of automated T&D lines inspection instead of using fleet of human inspectors that provides far more detail at far more regular intervals, facilitating better planning, inspection, faster response ,maintenance and vegetation management.
- Alerting situational awareness, risk analysis and quick emergency handling to prevent mass outage of T&D network and critical damage to the surroundings and infrastructures
- Design deficiency in network management with improved technical strategy in heterogeneous power sourcing environment

Solution :

- 3D parametric modelling of the entire or critical network with highly accurate automated measurement of geometrical parameters using photogrammetry, LiDAR system components, point density, flight parameters, drones, GIS data processing methods, integration with SCADA , data mining, processing, and analysis from heterogeneous data sources to provide interactive immersive visualization and analytics capabilities with the help of customized AIML algorithm

Value Proposition (day-to-day) & Benefits (long-term):

- Centralized smarter asset planning and network management that improve both economic and social value by optimizing practices through integration of the information and systems belonging to all stakeholders.
- 3D modelling and digital twin along with GIS Mapping creation can help infrastructure operators identify the precise location of power system infrastructure elements in the field.
- Facilitates planning, prediction, information acquisition, prioritization, operation management, and behavioural pattern modelling increasing management efficiency.
- Data driven model and analytics facilitate faster network inspection and anomaly detection capabilities and improvements in overall system safety and maintenance productivity.
- Improved and smarter inspection and maintenance
- Improved emergency handling and accurate prompt response
- Reduce downtime of T&D network and Substations
- Seamless accommodation of new external stake holders



MANUFACTURING & LOGISTICS USE CASES

A decorative graphic consisting of two horizontal bars. The top bar is solid blue and has a diagonal cut on its right side. Below it is a longer bar with a green-to-blue gradient, also with a diagonal cut on its right side.

Plastic Supply Chain– Planning & Scheduling Optimization

Challenge/ Problem Statement: Our client, a plastic production company had a manual production scheduling process, thus had challenges to manage the changes in demand, machine breakdown, and material availability with complex & multi-layer constraints leading to inefficiency & suboptimal productivity. Therefore, client was looking a tool to provide them with end-to-end visibility over fulfilment of each sales order, autonomous planning and on-the-fly scheduling based on changes in order demand, availability of material, and machine breakdown, identify causes of delays & take action, and predict estimated time of delivery.

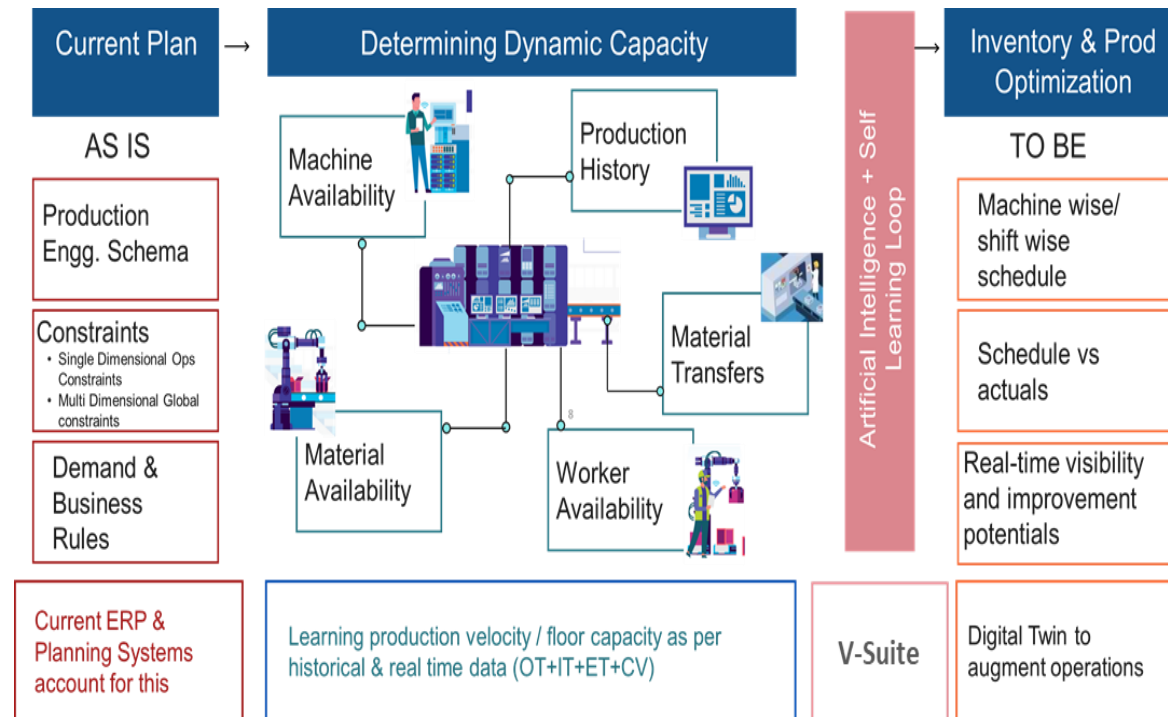
Approach & Solution: Visionaize’s V-Suite platform uses advanced algorithms and machine learning techniques to analyze real-time data from various sources, such as production equipment & sensors, CRM and inventory system to provide intelligent and autonomous production planning & scheduling. This helps to optimize production efficiency and minimize the impact of unexpected events on the production process. Key features of solution are:

- SOP/UI for extracting Data from a single source of truth for daily operations
- Demand forecast based on order booked and AI using historical and projected market data
- Dashboard with analysis of plan vs actuals at overall, department and operator levels
- Insights related to deviations in plan vs actuals and recommended actions to be taken
- Interactive Dashboard for Number of Units Clear to Build based on current and promised inventory levels
- Application to recommend inventory allocation for multi-SKU case
- Production Planning analytics at department level
- Shortfall / wastage estimation

Benefits:



Approach Schematic:



Use Case – Traffic Scheduling, Safety & Security

Challenge/ Problem Statement:

Client was using number of trucks for the transportation of coal from various suppliers' mines to their aluminum plant. Client wanted to have complete visibility of trucks movement – scheduling, safety and security. Client would also like to create an alert if there is any deviation between scheduled vs actual arrival, reasons of delay, real-time tracking of them and any safety or security concerns using AI/ Computer Vision and GenAI.

Key Features:

- Real time monitoring of trucks and their activities/ movement from supplier inputs, client fence to within campus and bays area.
- GIS location of each truck within the client fence and their status/ conditions.
- Any traffic congestion identification and prediction and optimization of schedule on the fly.
- Speed check and security of trucks when on way and within the fence area.

Benefits:

- **Net Benefit \$3.6M per year** in consistent plant utilization and coal trucks efficiency.
- Any anomalies in scheduled vs actual is spotted in real-time with GenAI-based corrective action. Similarly, high speed alerts and traffic congestion alerts are well taken for safety and economics.
- Proactive decision making and Good collaborative platform for all stakeholders.

DL4-D3 8589 B102B

Transporter	: Sitani
Source	: Belpahar
Weight	: 26.230 T
Quality	: Bituminous
Work Order	: LGKL7492
Shipment ID	: 174935
Entry Time	: 29/06/2023 08:14:26
Unloading Status	: Complete
Schedule Status	: Delayed
Violation Status	: None

Filter Trucks

Search a truck by number, order/shipment ID

Unloading Zone: All

Weight (Tonnes): All

Coal Quality (Kcal): All

Transporter: All

Source: All

Potential Risk

Traffic Congestion

Time: In next 62 minutes

VIZI Copilot

Powered by GPT4o

What is the reason for this potential risk?

Seems like the area is facing a heavy traffic which will take another 25-30 minutes to normalise. Furthermore 35 trucks will be arriving in the next 1 hours. This might cause a traffic congestion in this area within 62 minutes.

How do we address it?

Suggested traffic control changes

Reroute the trucks coming at bay areas B101A, B101B from main road 1 to passage 17 for the next 30 minutes.

Do you want me to communicate the effect of this potential risk that might occur on related orders to respective customers?

Ask a question...

Safety Violation

Recording Camera 01

Violation ID - 75846293

Violation Date & Time : 29/06/2023 09:31:34

Violation Duration : 00:03:12

Start Time : 09:31:34

End Time : 09:34:46

Violation : Speeding

Area Incharge : Trisha Col

Truck Details

Truck No.	: DL1 HZ 2064
Transporter	: Sitani
Source	: Belpahar
Weight	: 32.450 T
Quality	: Bituminous
Work Order	: 3FKG0582
Shipment ID	: 368755
Entry Time	: 29/06/2023 08:14:26
Unloading Status	: Complete
Schedule Status	: On time
Driver's Name	: Ram Kumar Paswan Full details >>

Violation Management

Mark As Critical Take Immediate Action

Incorrect Violation Correct Violation

Violation Reason :

Comments :

Violation Addressed by :

Resolution

Area Incharge Informed

Driver Warned

Penalty Charged

Communicate to

enter username

- Real time 2D Digital Twin of premises using computer visions and IoT showing live movements & conditions including truck violation (safety & schedule) and traffic.
- Real time truck status with schedule & safety reports & functionality to take actions for violation (if any).
- Functionality to view upcoming potential risks & resolve them.

- Potential risk feature will show the predicted potential risks in the premises in the upcoming hours.
- GenAI assists user in finding the reason and suggest resolutions to prevent such potential risk.

- Violation management interface to address any safety and schedule violation with rule based resolutions, actionable and functionality to communicate the violation.

3D DIGITAL TWIN USE CASES



V-PLANT- Digital Twin

Crawl, Walk, Run Approach – What it does:

V-Plant® addresses these Challenges with a Crawl, Walk, Run Approach



V-Plant Explorer

- Rapid Time to Value
- 3D Scans & Images
- Light Data Integration
- Organizational Readiness

V-Plant Pro: Hybrid 3D Digital Twin

- Medium Functionality
- Hybrid 3D Model (Mesh + Critical Assets)
- Deeper Data Integration

V-Plant 360: Enterprise Platform

- Full Functionality
- Robust 3D Model of Facility & Assets
- Broad System & Data Integration

Single Data Integration and Data Management Layer

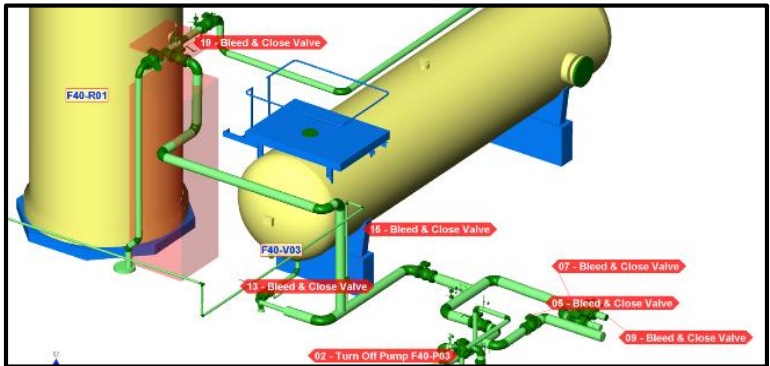
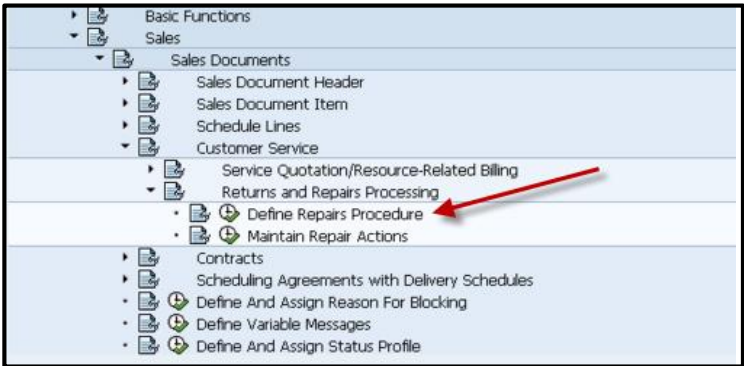
Easy to Get Started

Operational Efficiencies

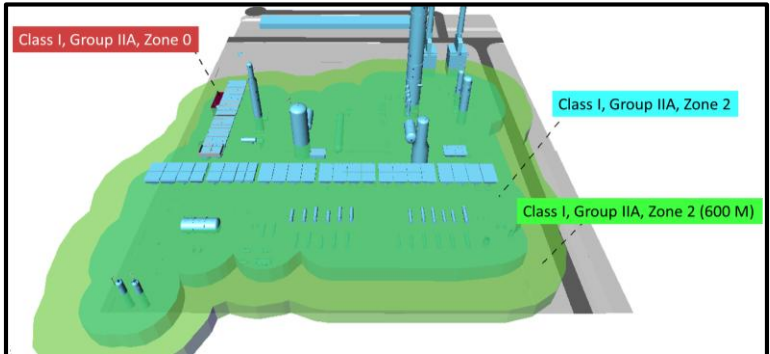
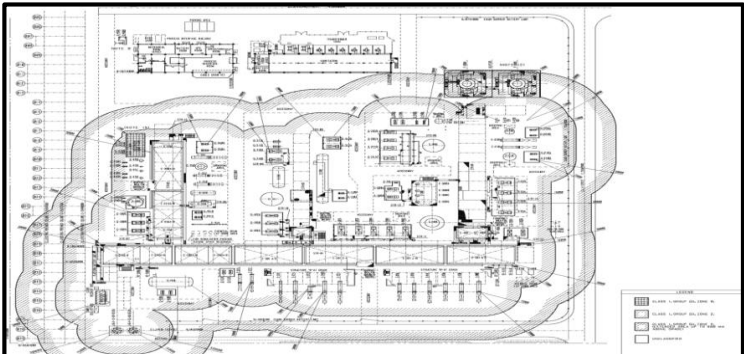
Operational Transformation

Example Uses Cases | Maintenance & Turnaround

Maintenance Systems,
Work Orders
& Procedures



Drawings
Data Sheets,
& Diagrams



Operator & Contractor
Orientation Training and
Safety



THANK YOU

Learn from a Digital Transformation expert on how this innovative technology can decrease downtime and improve business outcomes in your unique operations environment.

[visionaize.com](https://www.visionaize.com)