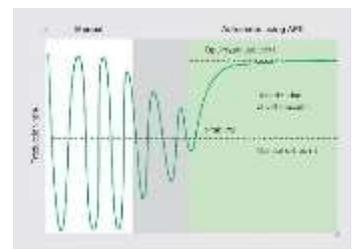




# Digital Transformation at BPCL Mumbai Refinery

Digital Solutions Team  
BPCL-MR

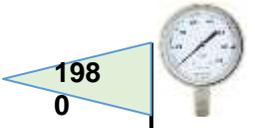
# BPCL Refineries - In the forefront of Change



**Advanced Process Control**

Real time Analyze Data  
Processes

1995



**Analog Systems**

1980

**Distributed Control System**

Autonomous Connecting and Collecting Data

1985

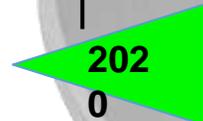


**IIoT/ Machine Learning Based Predictions**



2018

**Augmented Intelligence**



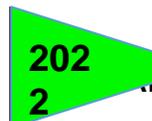
2020

**Digital Solutions Team Formed**



**SAP Integration/Manufacturing Exe Systems/Foundation Field Bus**

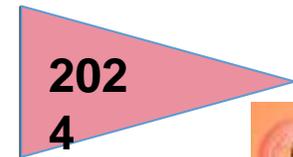
Single Source Of True Data, True Foundation For



2022

**Seamless Merger of Bina Refinery Establishment Digital Center of Excellence**

Enterprise Approach



2024

**“ Digital” "One View**





# Digital Initiatives at BPCL Mumbai Refinery

## Digital Turnaround

Digital Turnaround Activities, Activity Monitoring, Drone Surveillance, AI Visual Analytics

## AR-VR Technologies

AR based Remote Assistance, VR based Safety Training Modules

## Digital Twins & RPA

Real time self optimising SMART Refinery and Robotic Process Automation Scenarios

## Digital Strategy & Roadmap

Digital Strategy and Roadmap was formulated for BPCL Group Refineries

## MS Teams

Implementation of MS Teams platform in Refinery

## Remote Access

Availability of Refinery Portal & Applications to all users through VPN

## COVID19 Response Custom Applications

COVID19 Vaccination Slot Booking, Online Rota Application etc.

## Dashboards

COVID 19 Vaccination Self Update and Dashboard, COVID19 Information Portal

# Focus Areas for Improving Operational Excellence



**Health Security Safety  
& Environment  
(HSSE)**



**Maintenance &  
Reliability**



**Energy  
Management**



**Production Planning &  
Scheduling**



**Production  
Execution**



**International Trade  
& Supply Chain Optimization**

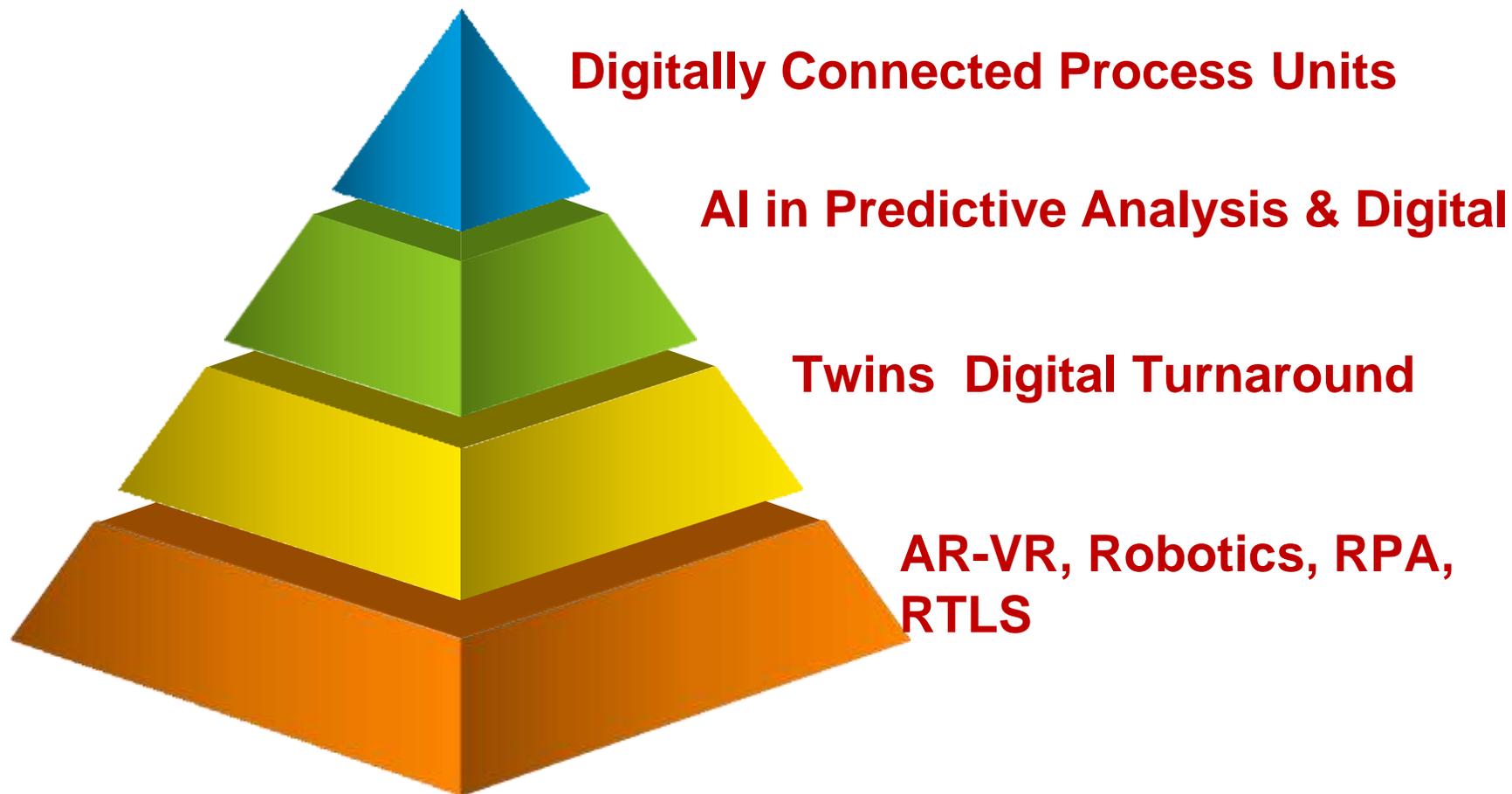


**Non-Hydrocarbon  
Supply Chain**



**Engineering &  
Capital Projects**

# BPCL Refineries - In the forefront of Change



# Digitally Connected Process Units



State-of-the-art mobile solutions



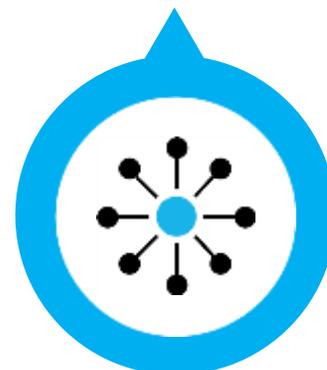
Ensuring Cybersecurity



Data Analysis for operational Intelligence



Digital Workflow



Seamless Connectivity to Modules



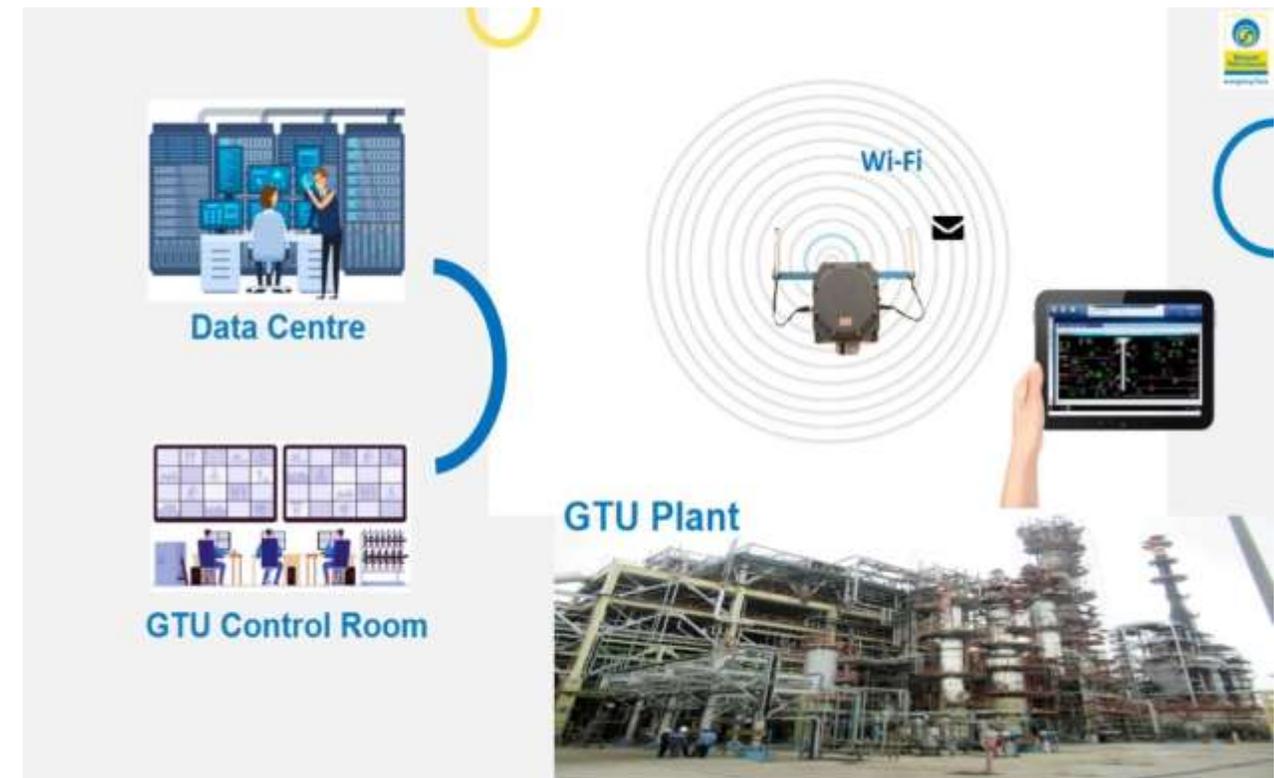
Unified Communication

Increased Productivity & Enhanced

# Digitally Connected Process Units

In-house solution for a responsive and connected manufacturing unit at : GTU, HCU & LOBS.

- 1. State of the art - Mobility solutions
- 2. Seamless Connectivity to refinery network
- 3. Data Analytics and Intelligent



Productivity in field activities increased by 30%.

# Digitally Connected Process Units

Live DCS Graphics in Field through secure data connection on hand-held Intrinsic Tablets

Online availability of drawings, P & IDs and PFDs

SAP, Work Permit System, BPAI, LIMS Access in real time from field

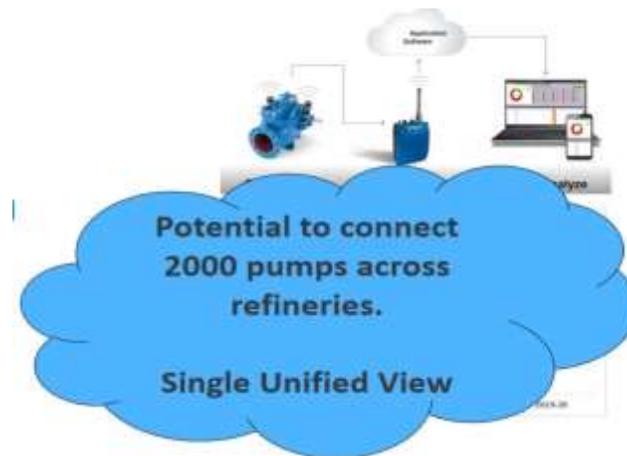
Online Field Log-sheets for quick data capture and analysis

Critical Pumps health monitoring using Web based tools and wireless sensors



# IIOT Initiatives - BPCL One Rotary

- Leveraging IIOT for Continuous monitoring of critical pumps
- Reduced Mean time between failures
- Increased Productivity
- Reduced energy losses
- Improved Reliability



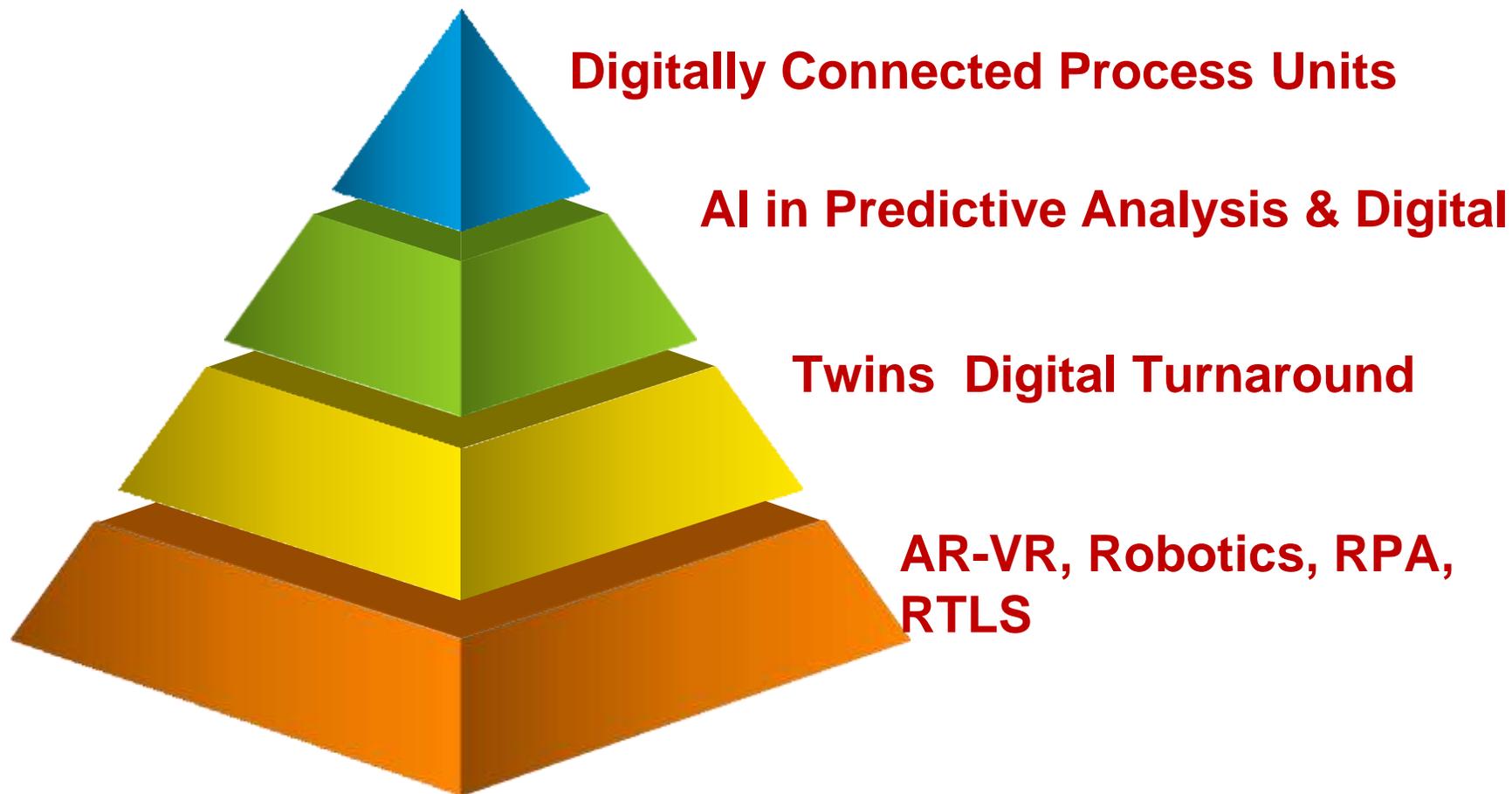
Wireless Transmitters for Pump

Analytics of Plant web Insight

| Fault Condition  | Vibration | Peak Impacting | Pressure (Discharge, Differential and Seal Fluid) | Seal Fluid Level | Temperature | Leak Detection |
|------------------|-----------|----------------|---|------------------|-------------|----------------|
| High Vibration   | ☑         |                |   |                  |             |                |
| Cavitation       |           | ☑              | ☑   |                  |             |                |
| Bearing fault    |           | ☑              |   |                  |             |                |
| Pre-cavitation   |           |                | ☑   |                  |             |                |
| Low head         |           |                | ☑   | ☑                |             |                |
| Low Discharge    |           |                | ☑   |                  |             |                |
| Seal Pressure    |           |                |   | ☑                |             |                |
| Low Suction      |           |                |   | ☑                |             |                |
| Low Flow         |           |                |   | ☑                |             |                |
| Strainer Fault   |           |                |   | ☑                |             |                |
| Seal Failure     |           |                |   |                  |             | ☑              |
| Seal Fluid Level |           |                |   | ☑                |             |                |
| Bearing temp     |           |                |   |                  | ☑           |                |
| Liquid HC Leak   |           |                |   |                  |             | ☑              |



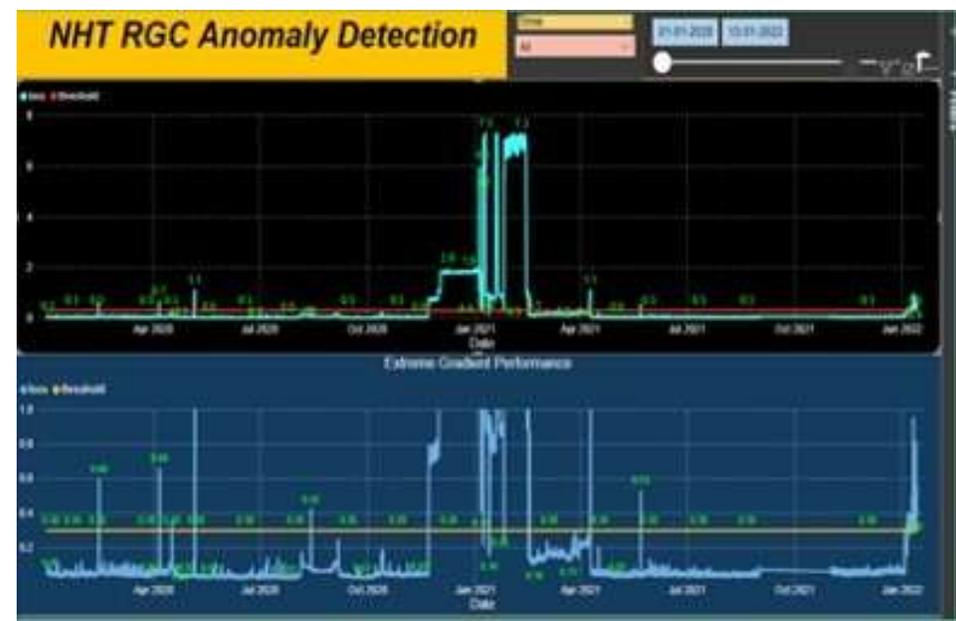
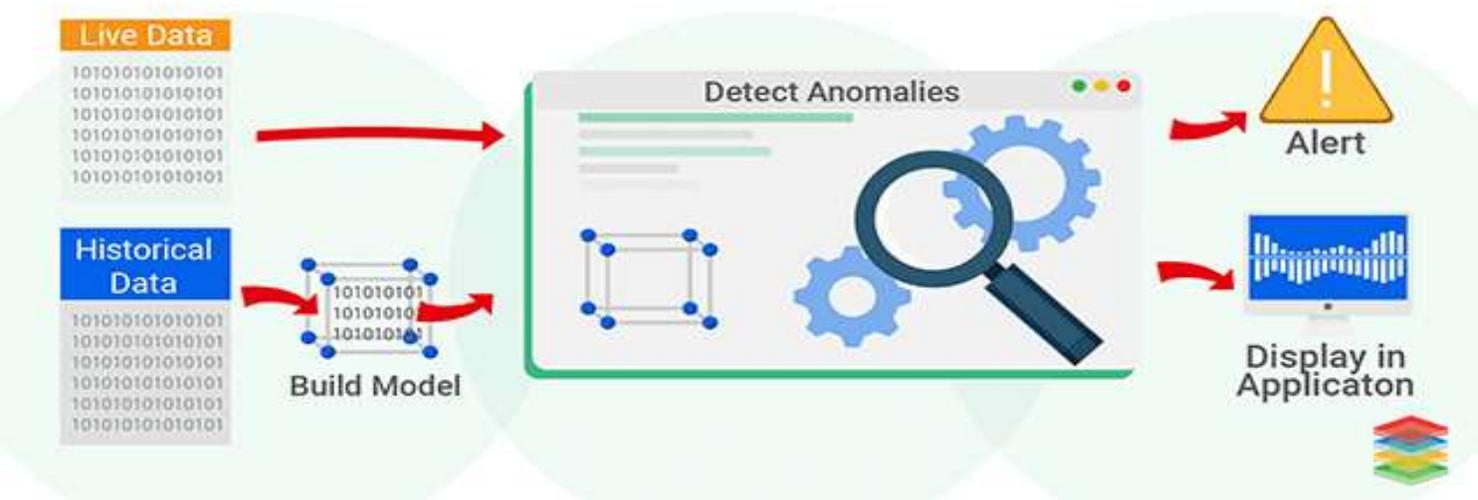
# BPCL Refineries - In the forefront of Change



# Predictive Analytics using AI ML Techniques



## Real Time Anomaly Detection



# In-House Digital Twins

## Real Time Self Optimizing SMART Refinery

Crude Mix  
Characterization



Real Time Crude Assay Based On The Crude Mix Unlocking Exact Product Potential

ARTIFICIAL  
INTELLIGENCE  
ENABLED  
SYSTEM



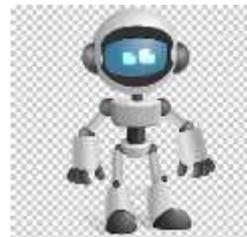
AI Enabled Decision Making For Reactors Operation And Catalyst Remaining Life Predictions

DIGITAL TWINS  
OF THE  
PROCESS UNITS



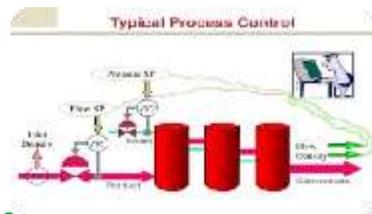
Complex Modelling Of Integrated Digital Twin Models With Live Operating Conditions

ROBOTIC  
PROCESS  
AUTOMATION



Automated Process Features Using Software Robots To Remove Human Intervention

ADVANCED  
PROCESS  
CONTROL

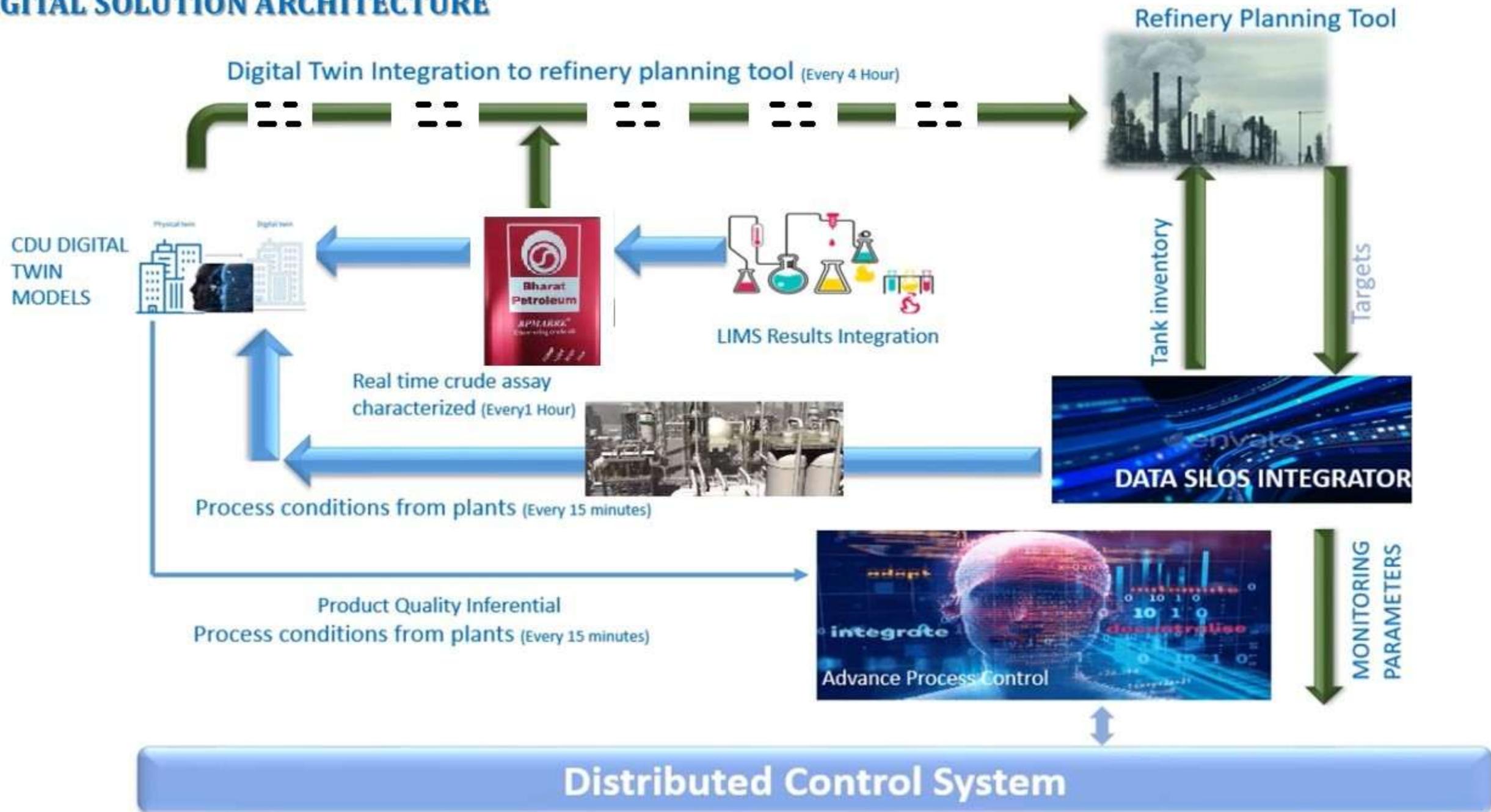


Digital Twin Outputs To Advance Process Control Integrations For Real Time Process Unit Wise & Refinery Wide Optimization



Virtual Online Analyzers For Critical Properties Like Asphaltenes, MCRT, Sulfur etc

# DIGITAL SOLUTION ARCHITECTURE



# APC & Real Time Optimization Amine Absorber & Regeneration Units –

## Digital Twin approach

### DIGITAL TWIN- APC INTEGRATION

- 1. Reducing Lean Amine circulation**  
Optimize lean amine circulation controlling rich amine loading in real-time  
APC in 6 Amine absorbers
- 2. Optimize Steam in Amine Regen units.**  
Optimize steam usage by monitoring lean amine loading  
APC in 3 Amine regeneration units
- 3. Digital Twin for Real Time Optimization:**  
Predicts Real-time Lean Amine loading  
Real time simulation updates APC inferential every 1 hr.
- Annual savings:**  
\$ 1 M (USD)/Year  
Real time Optimization  
APC integrated with Digital Twin (Simulation Model).

CHT best Innovation award by for the year 2020-21

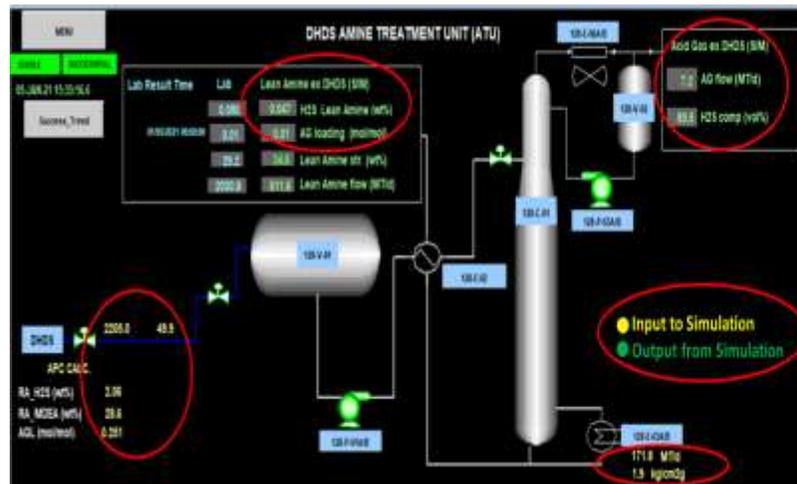


सत्यमेव जयते



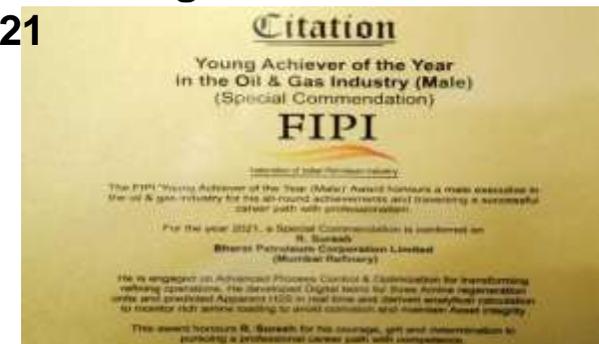
Centre For High Technology  
Ministry of Petroleum & Natural Gas  
Government of India

Digital Twin company of the year 2021 –

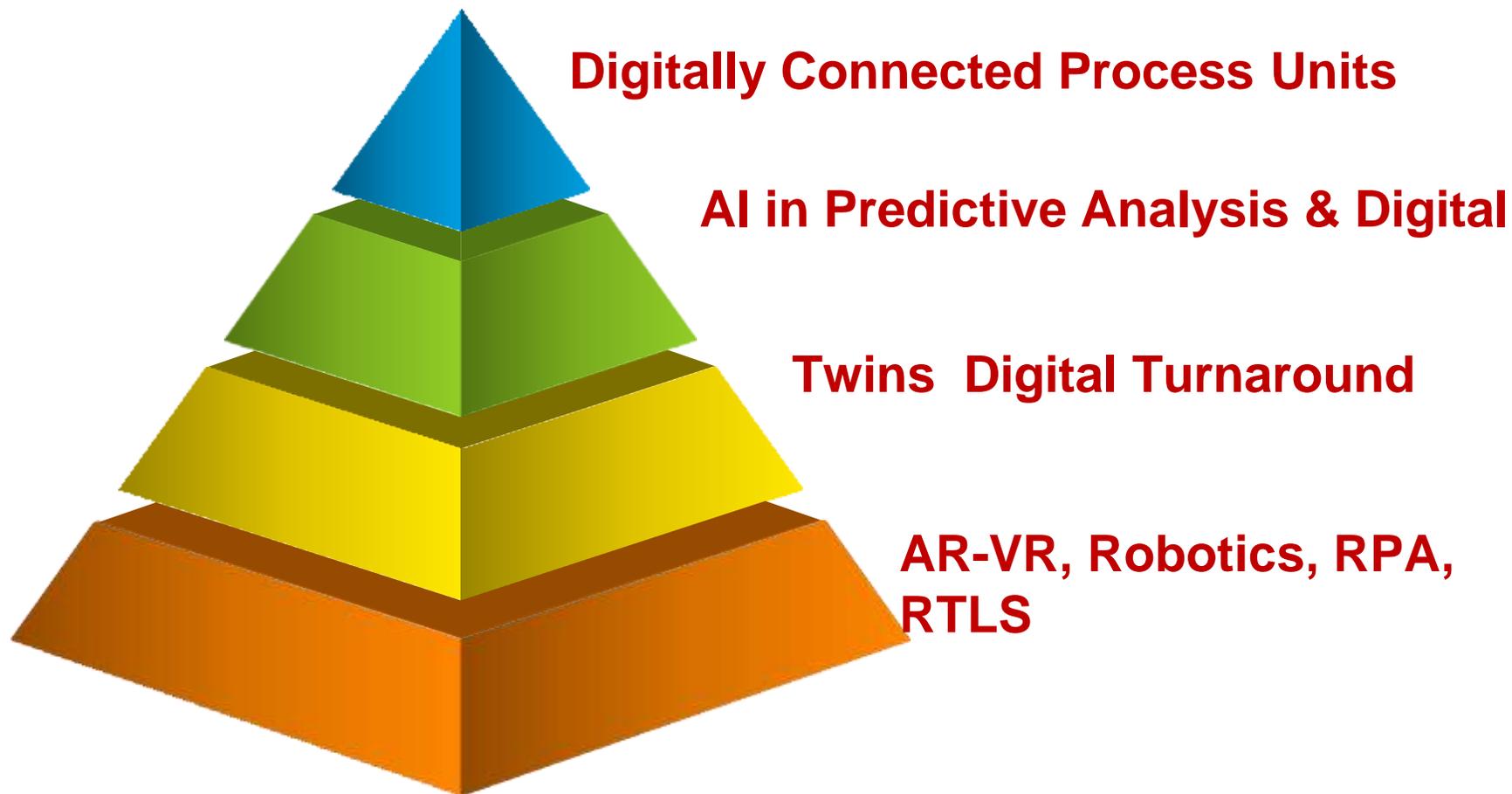


| Description                 | Control | Service | Loss | Measurement | Capacity | Units | Capacity | Units | Control |
|-----------------------------|---------|---------|------|-------------|----------|-------|----------|-------|---------|
| 1211002 @ MF Steams CO C-01 | On      | On      | On   | 34177       | 34177    | 34177 | 34177    | 34177 | On      |
| 1211002 @ MF Steams CO C-01 | On      | On      | On   | 34177       | 34177    | 34177 | 34177    | 34177 | On      |
| 1211002 @ MF Steams CO C-01 | On      | On      | On   | 34177       | 34177    | 34177 | 34177    | 34177 | On      |
| 1211002 @ MF Steams CO C-01 | On      | On      | On   | 34177       | 34177    | 34177 | 34177    | 34177 | On      |

FIPI – Young Achiever of the Year Award 2021



# BPCL Refineries - In the forefront of Change



# Key Features of Digital Interventions in Turnaround



Real time Monitoring of Plan Vs Actual Using handheld devices



Intelligent cameras are for Activity Monitoring



Complete monitoring of progress using Live streaming of all critical activities



Drone Flights including Night Vision Drones for safety surveillance



Automated Covid parameters screening



Augmented Reality with GOPRO Cameras for column internal Inspections



Artificial Intelligence-Visual Analytics based Man Power Counting



Live streaming of catalyst loading for remote locations



# Digital Interventions during Turnaround



# Digital Interventions during Turnaround

## Safety Surveillance Observations

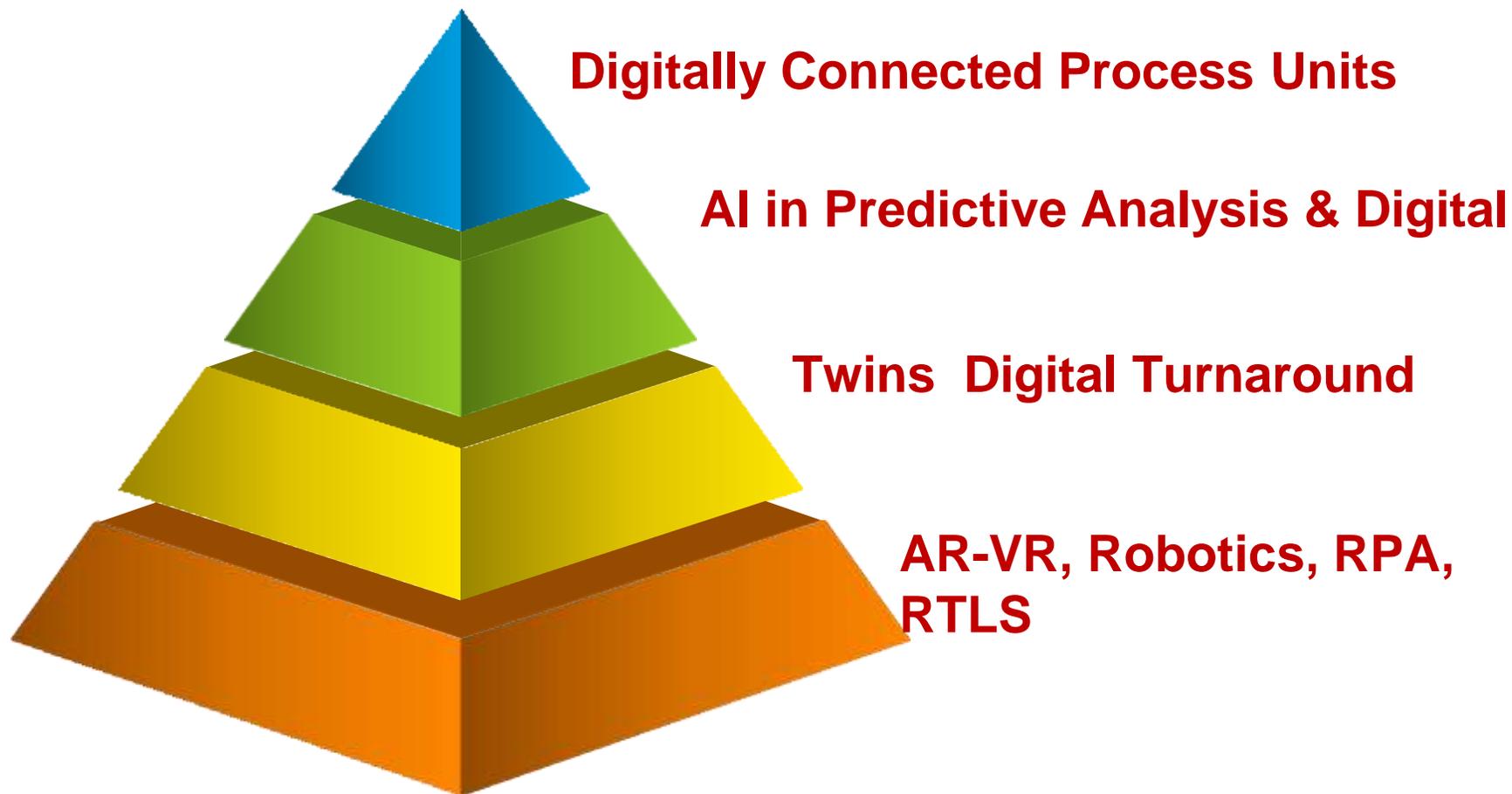


## Frequent High-Risk Observations



**Drone-based - Stack Inspection**

# BPCL Refineries - In the forefront of Change



# Augmented Reality / Virtual Reality Experience Centre-MR



- **Oculus Quest**

(VR Device)

Used for Virtual Scenario Safety Trainings.



- **Microsoft HoloLens 2**

(Head Mounted device)

Used for AR/ VR and Mixed Reality Scenarios.



- **Oculus Go**

(VR Device)

Used for Virtual Scenario Safety Trainings



- **Real Wear Device**

(Head Mounted Tablet)

# AR – VR Use cases in BPCL MR



## Remote Assist for Equipment Maintenance

Support the field operators for critical maintenance activities by Remote Experts from anywhere in the world.



## Custom made AR/VR based Learning Experience

Immersive training session for refinery specific use-cases for Safety and Operation training.



# Robotic cleaning of Manholes (Improved Health / Safety)

## Collaborated Efforts with Startup Company- GenRobotics

**Application :-** Cleaning of 50 Nos. Manholes in Mumbai Refinery & 10 nos in public areas (Collaboration with MCGM)

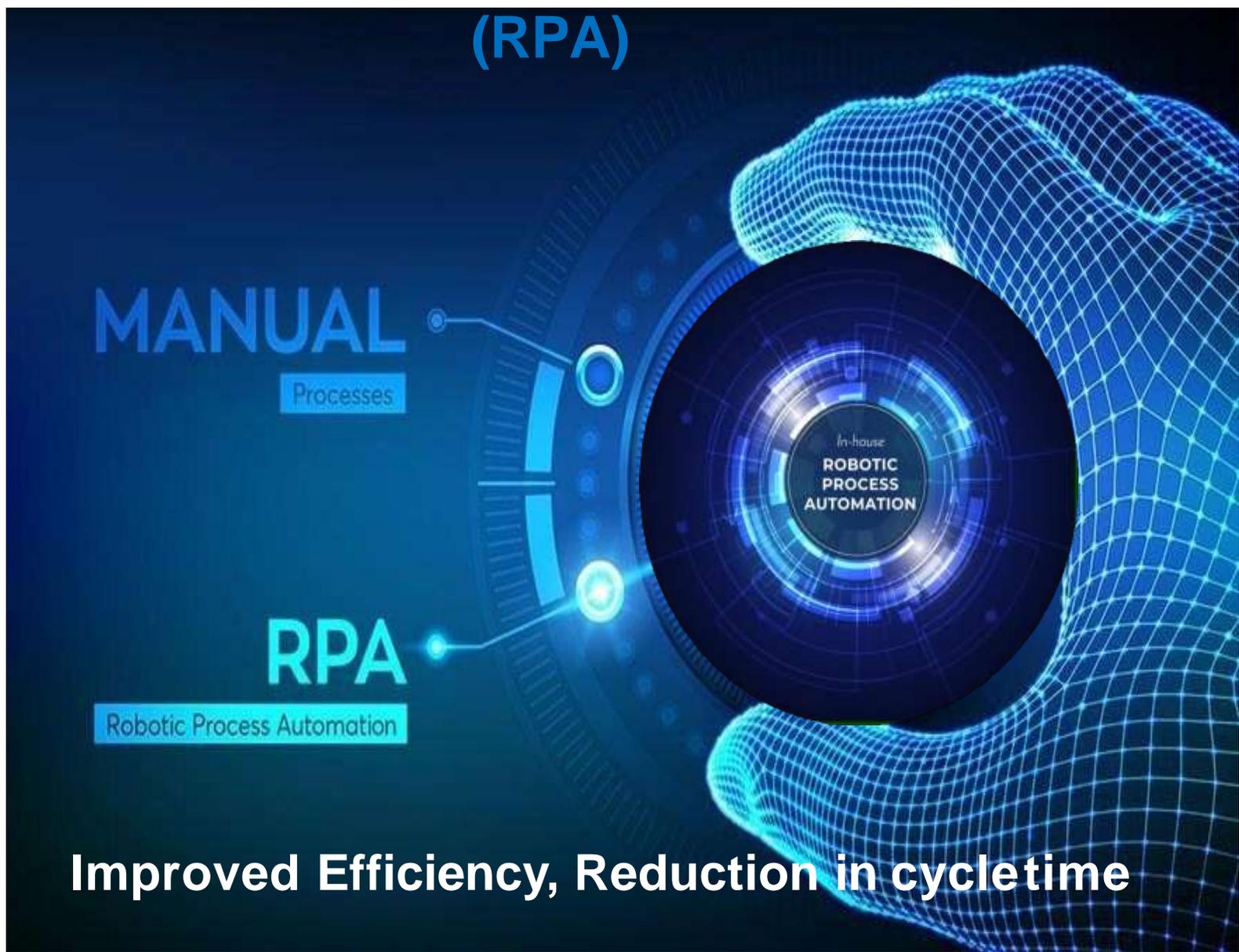
**Technique Adopted :-** Intrinsically safe cameras suitable for hydrocarbon environment with display screen, control panel, robotic arm and bucket, total weight – 60 Kg

**Technology :-** Bandicoot (World's first robotic scavenger)

**Benefits :-** Eliminates risk, safety & health hazards to workers involved in manual cleaning of sewers/ manholes



# Robotic Process Automation (RPA)



**Improved Efficiency, Reduction in cycletime**

## RPA Applications deployed so far..

- Procurement
- HR Employee Relations
- HR Benefits & Administration
- TDU Dispatches



**Manhours Saving**

# Benefits of Robotic Process Automation (RPA)

**Productivity**  
High volume in less time

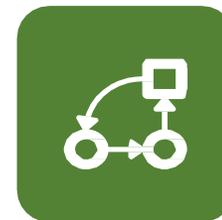


**Availability**

Bots don't sleep!

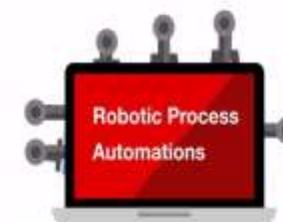


**Accuracy**  
0% error rate



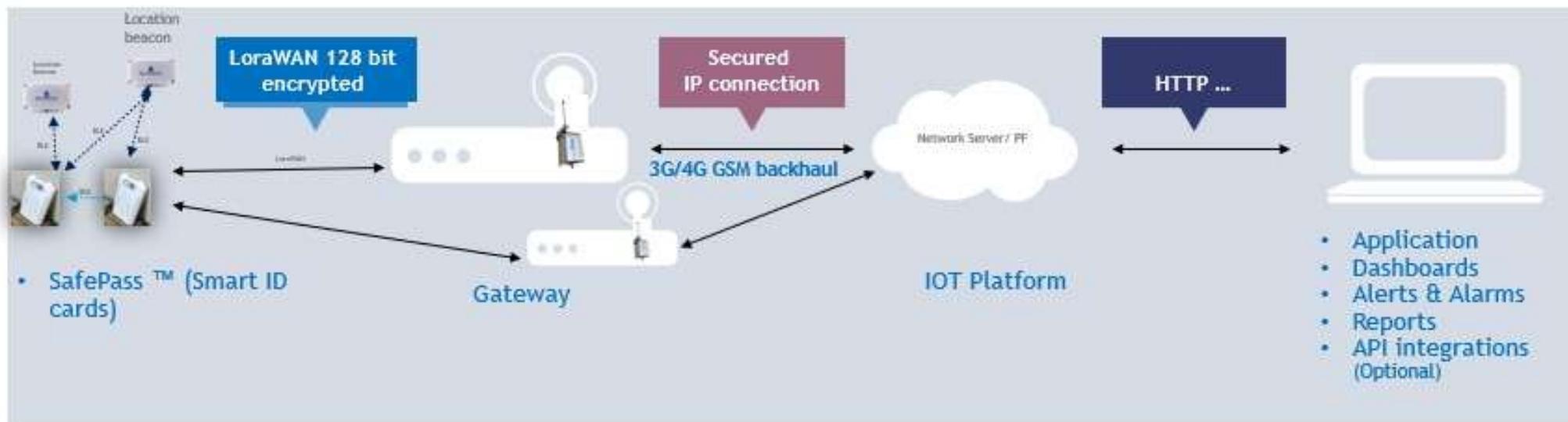
**Audit Trail**  
All activity logged

**Scalability**  
Quick ramp up/down



# Real Time Location Sensing (RTLS)

Solution architecture : Wireless, Easy to deploy & scale



ID card :  
battery powered  
( 1 year life)

ATEX compliant



Location Beacons :  
battery powered ( ~ 1-year  
battery life)

ATEX compliant



LoRaWAN receiver ( Gateway): powered  
device with dual redundancy . GW uses  
backhaul of 3G/4G from 2 operators  
1 active + 1 redundant connection

# Salient Features of RTLS Solution



## Location Information

Captures location(Zone) information. Enables IN/Out time automatically, performance/behaviour analytics etc.



## Audio alarm & Alerts

ID card generates audio alarm if an employee enters a hazardous or restricted zone



## Geo fencing

Demarcate work area into zones, allowing alerts to be generated if employees enter restricted or hazardous zones



## SoS signaling

Employees can send an SoS signal to alert appropriate executives in case of an emergency



## Headcount

Detecting number of employees in each work area



## Proximity detection (Optional)

Ability to detect and alert on sensing proximity



## Fall and immobility

Ability to detect and alert on sensing proximity

## ZONE BEACONS



## SafePass™



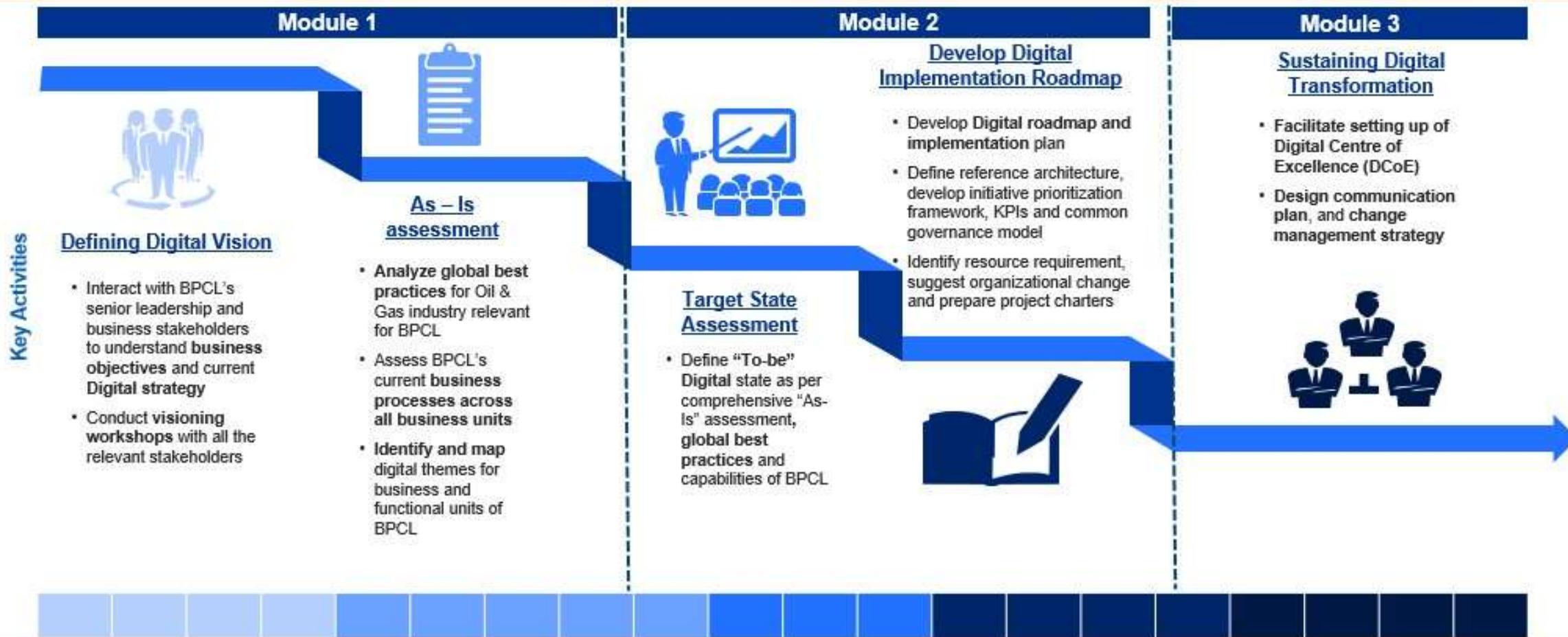


# Formulation of Digital Strategy & Roadmap for Refineries

## BPCL DIGITAL STRATEGY DEVELOPMENT FOR REFINERIES

Project  
**UTKARSH**

*Digitally connected. Futuristic refineries.*



# Refinery of new Era

## Real-time Operational Excellence through Digital Transformation

Reduced risk to personnel safety and health

- Real Time Monitoring of Personnel
- VR Based Safety Training using immersive technologies

An intelligent, predictive and near-real-time business

- Digital Twin Approach (Process and Asset Digital Twin)

Operational Excellence

- Advanced Process Control application integration to online process simulations.

Concurrent real-time supply chain management and optimization

- Crude import to product supply, integrated value chain

Continuous improvement in asset availability, reliability and integrity

- Asset Integrity integrated to Predictive Analytics for Reliability Improvement

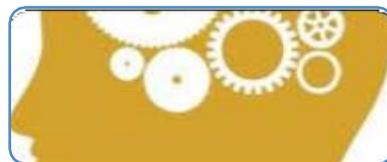
# Strategies for Adopting Digital at BPCL Mumbai Refinery



**Leadership & Strategy**



**Embracing Digital as**



**Culture Capability**



**Building**



**Digital Enablement Plan**

Thank You