PT KILANG PERTAMINA INTERNASIONAL

Advancing Indonesia's Oldest Refinery Data Management: Implementing Multi-layered Digitalization as Strategic Platforms for Real-time Business Monitoring & Decision-making

Dimas Priyambodo
Process Engineer — Pertamina Refinery Unit III Plaju
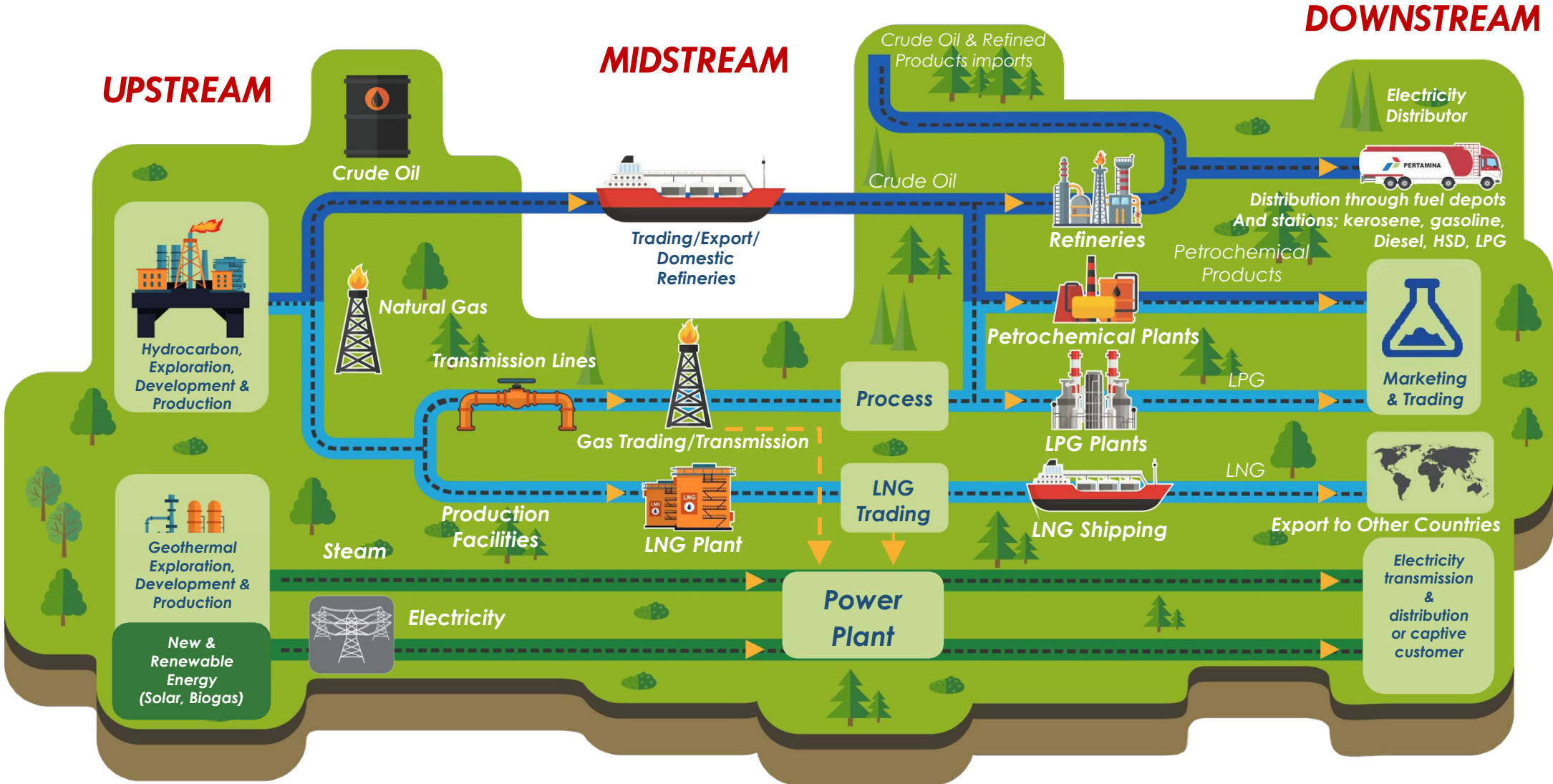
AOG Energy 2024
Perth, 15 March 2024

1. Pertamina Business Overview

2. Plaju Refinery: Preserving Legacy, Adapting Technology

3. Case Study: Enhancing Product Disharge Operation through Digitalization

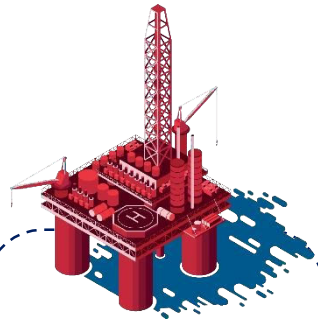# Pertamina: Indonesia's Fully Integrated Energy Company

Pertamina Business Group

PERTAMINA — *100%* — Government of Indonesia

| Upstream	Refining & Petrochemical	Commercial & Trading	Power & NRE	Gas	Integrated Marine Logistic	Services
PERTAMINA HULU ENERGI	**PERTAMINA KILANG PERTAMINA INTERNASIONAL**	**PERTAMINA PATRA NIAGA**	**PERTAMINA NEW & RENEWABLE ENERGY**	**PERTAMINA GAS NEGARA**	**PERTAMINA INTERNATIONAL SHIPPING**	

- **Upstream**
  - PT Pertamina Hulu Rokan
  - PT Pertamina EP
  - PT Pertamina Hulu Indonesia
  - PT Pertamina EP Cepu
  - PT Pertamina EP Cepu ADK
  - PT Pertamina Internasional Eksplorasi & Produksi
  - PT Elnusa Tbk
  - PT Pertamina Dirlling Services Indoenesia
  - PT Badak NGL
  - PT Pertamina E&P Libya
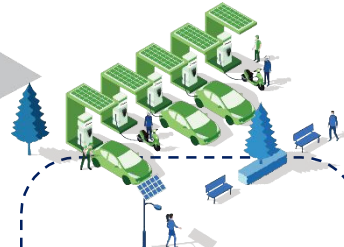 - Pertamina East Natuna
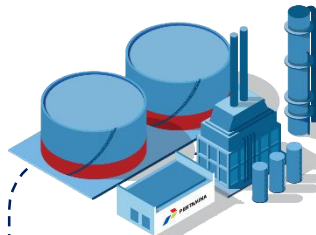
- **Refining & Petrochemical**
  - Kilang Pertamina Balikpapan
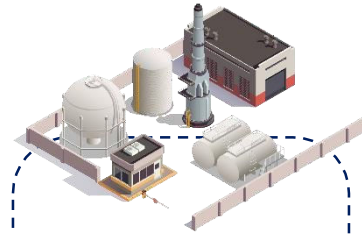 - Pertamina Rosneft Pengolahan & Petrokimia
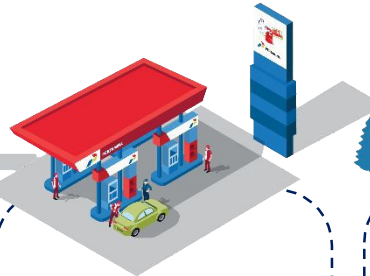
- **Commercial & Trading**
  - PT Pertamina Retail
  - PT Pertamina Lubricants
  - Pertamina International Marketing and Distribution Pte Ltd
  - PBAS
  - Patra SK
  - Patra Trading
  - Patra Logistik
  - Pertamina Petrochemical Trading
  - PITSA

- **Power & NRE**
  - PT Pertamina Geothermal Energy

- **Gas**
  - PT Pertamina Gas
  - PT Saka Energi Indonesia
  - PT Gagas Energi Indonesia
  - PT PGN LNG Indonesia
  - PT PGAS Telekomunikasi Nusantara
  - PT PGAS Solution
  - PT Permata Graha Nusantara

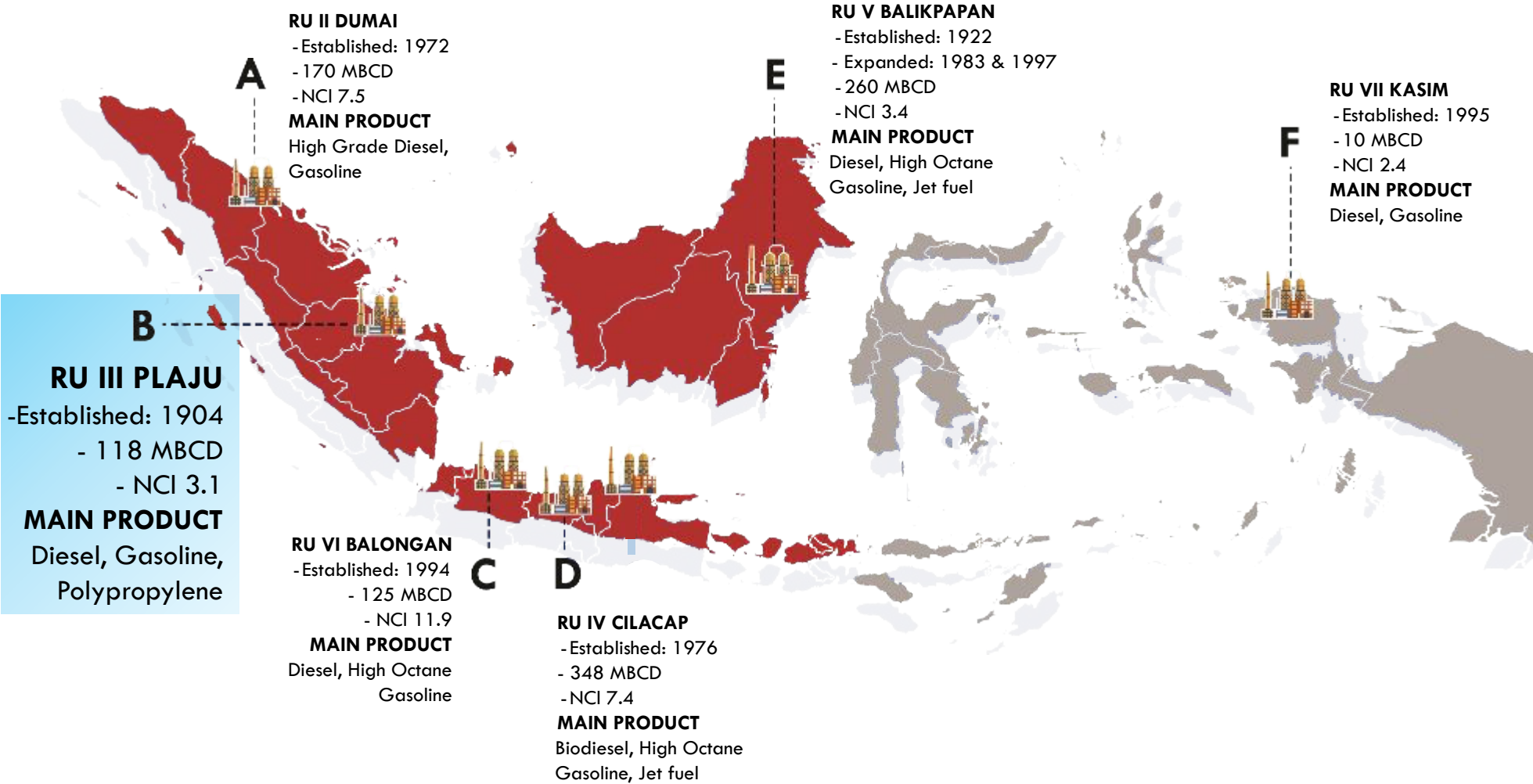- **Integrated Marine Logistic**
  - PT Pertamina Trans Kontinental
  - PT. Peteka Karya Tirta
  - PIS Sinagpore

- **Services**
  - PT Asuransi Tugu Pratama Tbk
  - PT Pertamina Pedeve Indonesia
  - PT Patra Jasa
  - PT Pelita Air Service
  - PT Pertamina Bina Medika IHC
  - PT Pertamina Training & Consulting

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Pertamina Oil Refineries: Six operating refineries across Indonesia's archipelago

RU II DUMAI
- Established: 1972
- 170 MBCD
- NCI 7.5
MAIN PRODUCT
High Grade Diesel, Gasoline

RU V BALIKPAPAN
- Established: 1922
- Expanded: 1983 & 1997
- 260 MBCD
- NCI 3.4
MAIN PRODUCT
Diesel, High Octane Gasoline, Jet fuel

RU VII KASIM
- Established: 1995
- 10 MBCD
- NCI 2.4
MAIN PRODUCT
Diesel, Gasoline

RU III PLAJU
- Established: 1904
- 118 MBCD
- NCI 3.1
MAIN PRODUCT
Diesel, Gasoline, Polypropylene

RU VI BALONGAN
- Established: 1994
- 125 MBCD
- NCI 11.9
MAIN PRODUCT
Diesel, High Octane Gasoline

RU IV CILACAP
- Established: 1976
- 348 MBCD
- NCI 7.4
MAIN PRODUCT
Biodiesel, High Octane Gasoline, Jet fuel

Summary

Crude Refining Capacity
1.4 Million
From 1 million barrel / day

Crude Quality
~2%S
From 0.2%S (Sweet)

Valuable Product
~95% vol.
From ~ 75% vol

Fuel Production
1.200 kbpd
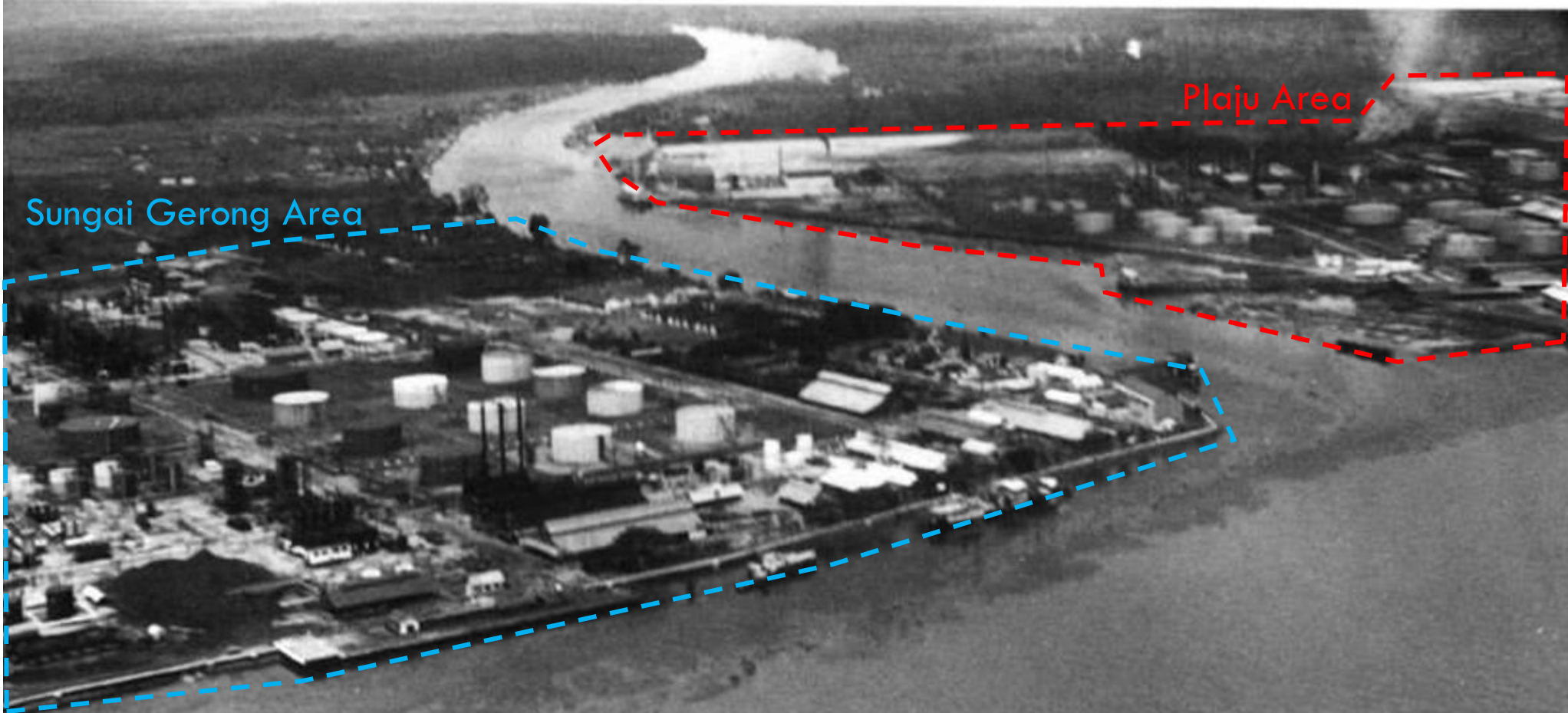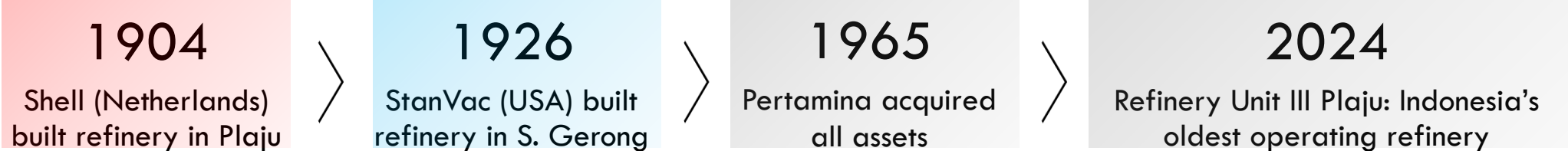From 600 kbpd

Fuel Production Quality
EURO V
From EURO II

Petchem Production
~12.000 ktpa
From 1.660 ktpa

The History of Refinery Unit III Plaju

1904	1926	1965	2024
Shell (Netherlands) built refinery in Plaju	StanVac (USA) built refinery in S. Gerong	Pertamina acquired all assets	Refinery Unit III Plaju: Indonesia's oldest operating refinery

Preserving Legacy: Most of the refinery assets are still in operating
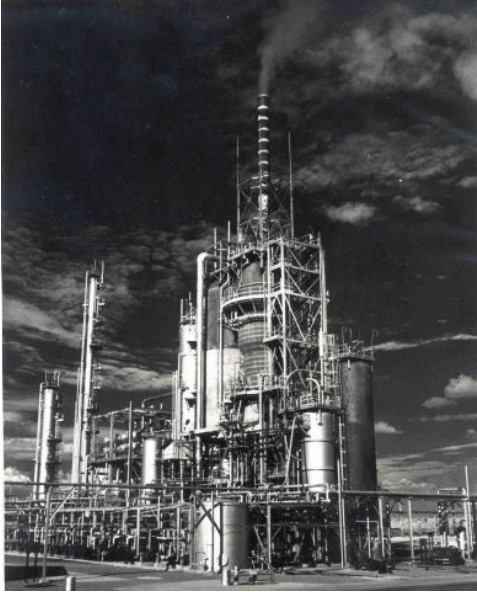
FCC unit, built around '50s

FCC unit, now

Dock #3, around '50s

Dock #3, now

Aerial view of Refinery, around '40s

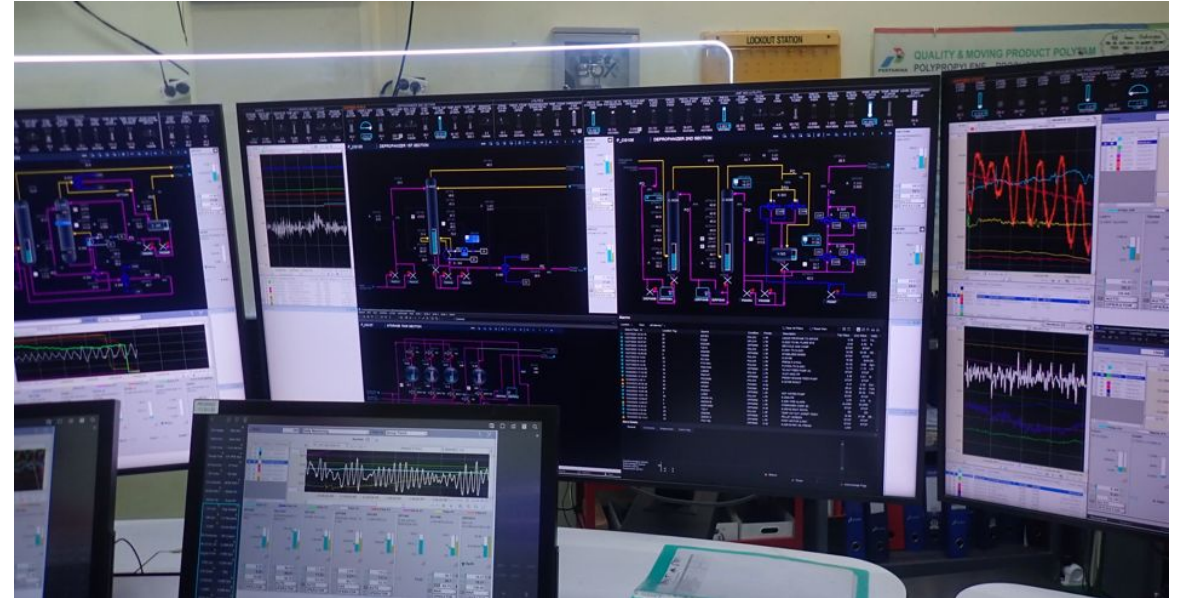Aerial view of Refinery, now

Adapting Technology: An example, upgrading control system to the latest technology

Pneumatic controllers

Discrete (single loop) controllers

Modern Distributed Control System (DCS)

Small parts of Plaju Refinery's unit uses these control types

Majority of our unit area uses the latest DCS version

Background: Current challenges and view for the future

Pertamina's side

Indonesia's main energy driver

Plaju Refinery
- *Indonesia's oldest refinery*
- *One of main energy producers*
- *Crucial for maintaining energy security*

Grand Challenges

Global Competition

Rapid industrial development, which undoubtedly impacts global competition at an extraordinary pace (Chin et al., 2019)

Industry 4.0

To face the Industry 4.0, the company must embrace to be digitally aware (Sari, T., 2020)

View for The Future

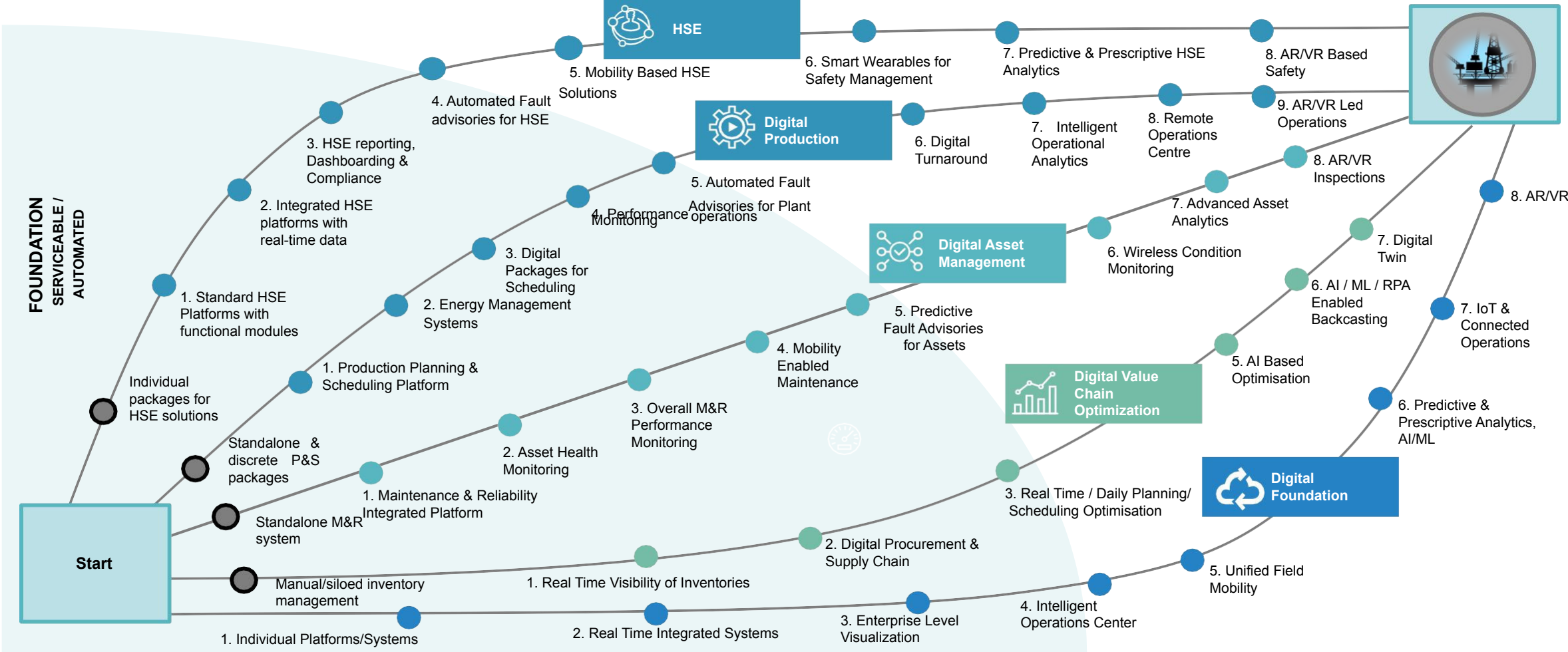**Strategic Information System (SIS)**

Transformation of integrative information systems to support company's strategy (Arias-Pérez et al., 2020)

"Smart Refinery"

The future of refineries is significantly shaped by digitalization development, delivering unprecedented efficiency, sustainability, and adaptability (Olaizola, 2022)

Becoming "Smart Refinery": Five Key Areas to be Digitally Enhanced

FOUNDATION SERVICEABLE / AUTOMATED

HSE
- 1. Standard HSE Platforms with functional modules
- 2. Integrated HSE platforms with real-time data
- 3. HSE reporting, Dashboarding & Compliance
- 4. Automated Fault advisories for HSE
- 5. Mobility Based HSE Solutions
- 6. Smart Wearables for Safety Management
- 7. Predictive & Prescriptive HSE Analytics
- 8. AR/VR Based Safety

Digital Production
- 1. Production Planning & Scheduling Platform
- 2. Energy Management Systems
- 3. Digital Packages for Scheduling
- 4. Performance operations
- 5. Automated Fault Advisories for Plant Monitoring
- 6. Digital Turnaround
- 7. Intelligent Operational Analytics
- 8. Remote Operations Centre
- 9. AR/VR Led Operations

Digital Asset Management
- 1. Maintenance & Reliability Integrated Platform
- 2. Asset Health Monitoring
- 3. Overall M&R Performance Monitoring
- 4. Mobility Enabled Maintenance
- 5. Predictive Fault Advisories for Assets
- 6. Wireless Condition Monitoring
- 7. Advanced Asset Analytics
- 8. AR/VR Inspections

Digital Value Chain Optimization
- 1. Real Time Visibility of Inventories
- 2. Digital Procurement & Supply Chain
- 3. Real Time / Daily Planning/ Scheduling Optimisation
- 4. Intelligent Operations Center
- 5. AI Based Optimisation
- 6. AI / ML / RPA Enabled Backcasting
- 7. Digital Twin
- 8. AR/VR

Digital Foundation
- 1. Individual Platforms/Systems
- 2. Real Time Integrated Systems
- 3. Enterprise Level Visualization
- 4. Intelligent Operations Center
- 5. Unified Field Mobility
- 6. Predictive & Prescriptive Analytics, AI/ML
- 7. IoT & Connected Operations
- 8. AR/VR

Start

- Individual packages for HSE solutions
- Standalone & discrete P&S packages
- Standalone M&R system
- Manual/siloed inventory management

Potential Digitalization Across the Plaju Refinery's Value Chain

|	Planning	Supply chain	Operations	Maintenance	Reliability	Engineering	HSSE	Procurement
Value Boosters	Business intelligence for dynamic planning e.g. smart LP with demand and price forecasting, predictive crude quality etc.	Real time supply network optimization e.g. inventory monitoring, port call optimization etc.	Automated plant mgmt. with yield, throughput, energy intensity improvement using advanced analytics	Digitally assisted predictive maintenance and preplanned shutdown/turn arounds	Using machine learning and advanced algorithms to reduce failures/cost of poor quality	Digitalization and automation of engineering processes to generate data based insights	Geo-tracking and permitting applications with use of robots for remote inspections to improve safety	Digital procurement tools including e-auction, Cleansheet, etc.
Enablers	End to end visibility through sensorisation and IoT		New digital capabilities e.g. data scientist, analytics engineer etc.		New governance and business operating procedure		Enhanced cybersecurity to protect connected ecosystem	

Multi-layered Digital Applications: overview of plant information management framework

Plant Information Management Framework

SCADA
DCS
PLC → OPC
Controllers
Databases → Text files
Instruments → Manual data
IIoT Gateways
Cloud systems

Collect → Store and Enrich → Visualize and Deliver

Visualize | Report
Analyze | Notify
Share | Integrate

Data sources

Data processing & delivering

Users

Multi-layered Digital Applications: building apps by utilizing plant information management system
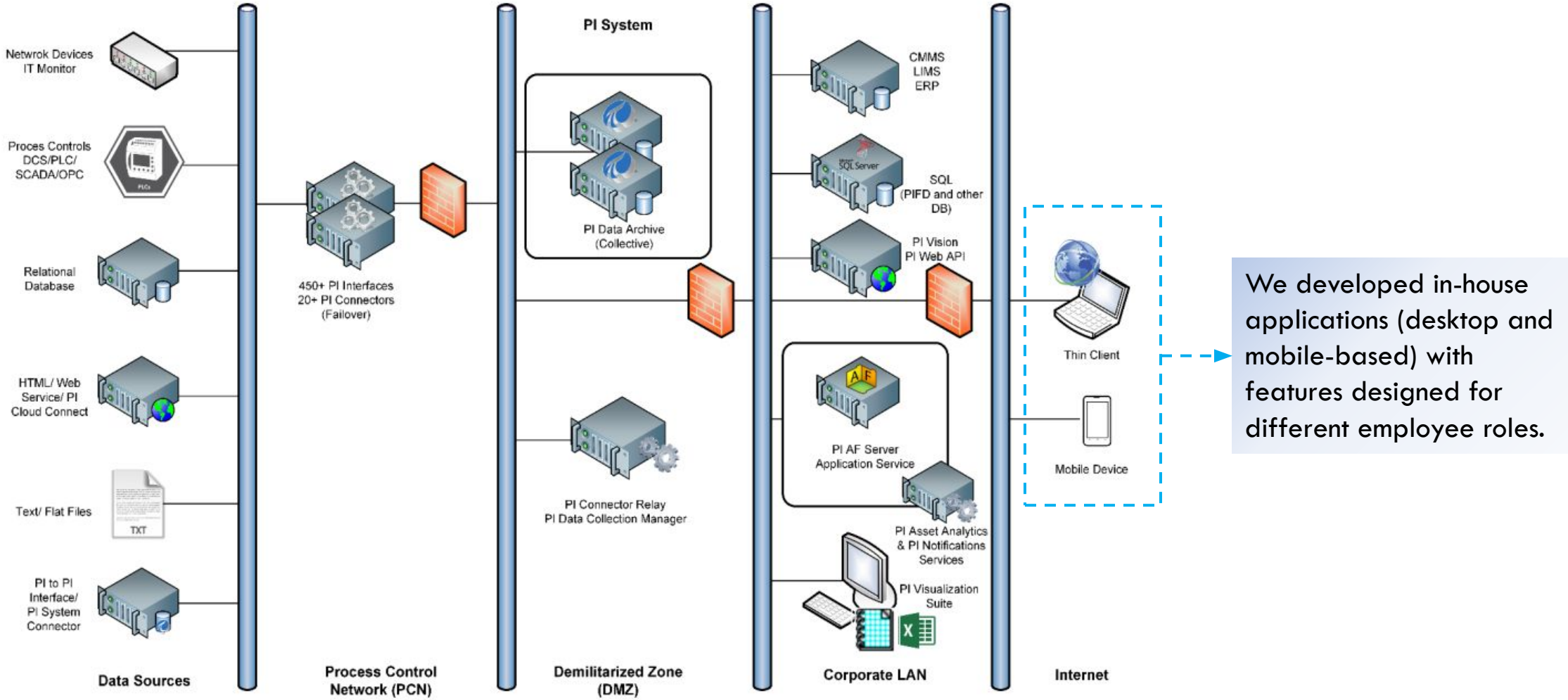
We developed in-house applications (desktop and mobile-based) with features designed for different employee roles.

Source: AVEVA PI System Architecture

Multi-layered Digital Applications: three main apps supporting business & operational activity
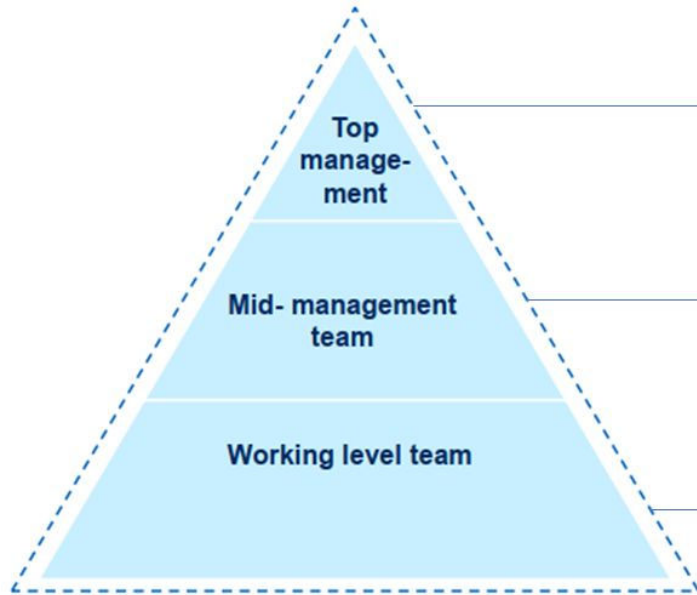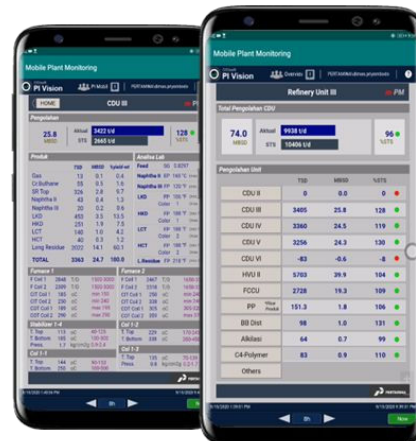
Target	Application	Features
General Manager, Managers	**PROFIT** — Mobile & desktop	• Strategic decisions. • Tracking KPI. • Tracking financial & operational metrics.
Senior Engineers, Engineers	**Mobile Plant Monitoring** (m-PM) — Mobile	• Real-time monitoring of plant operating conditions and product quality. • Helps engineers to make predictive trends based on historical data, enhancing decision-making
Field Operators	**Dashboard Operating Window** (DOW) — Desktop	• Comprehensive process condition. • Helping operators do quick action if there is an abnormal condition within process.

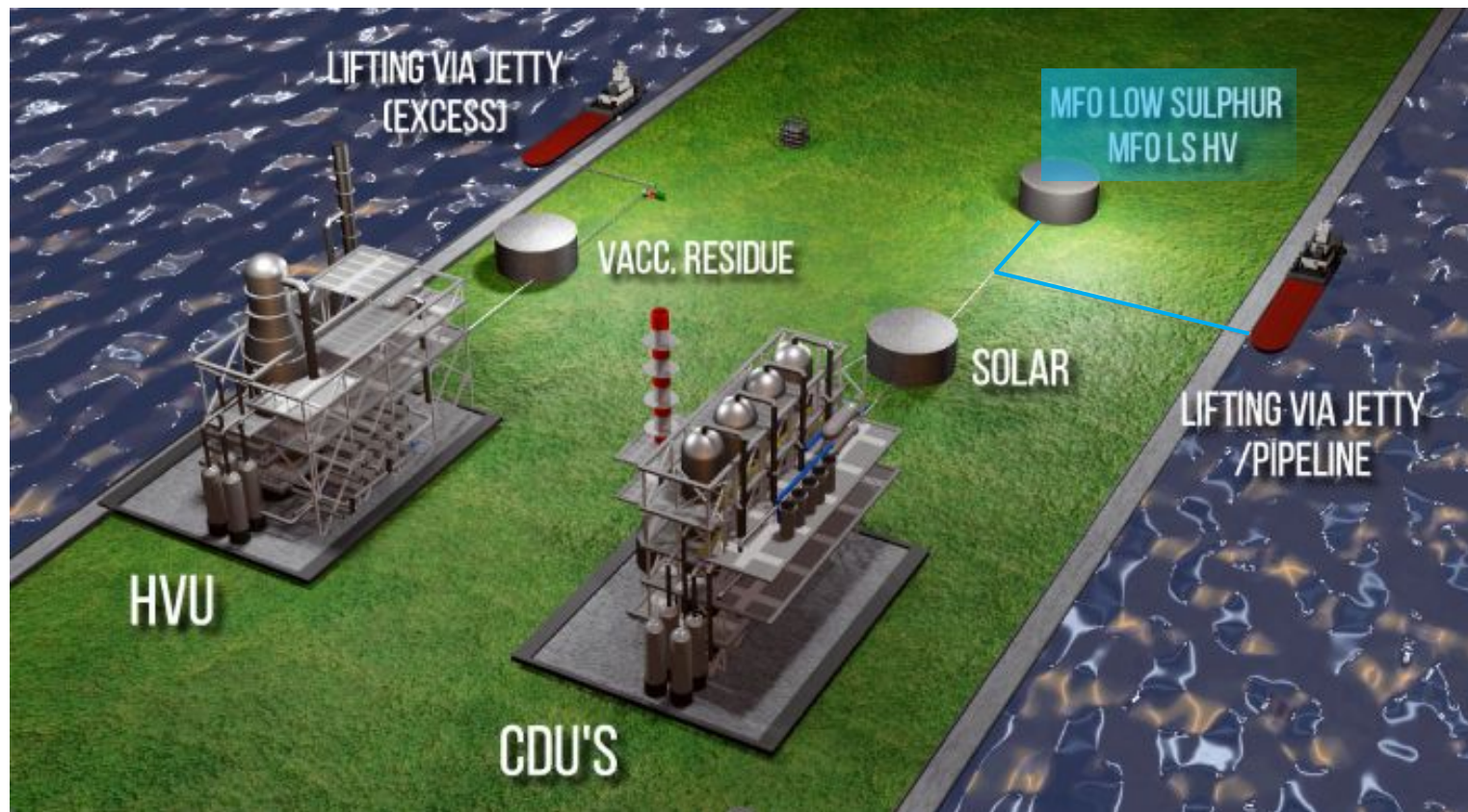# Case Study: Enhancing Product Lifting Operation through Digitalization

Objective

Lifting product Marine Fuel Oil (MFO) Low Sulphur (LS) from Tank D-2 to Jetty #10

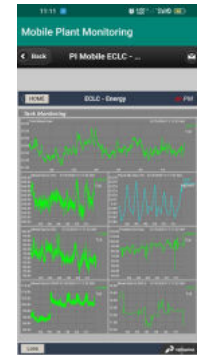# Case Study: Enhancing Product Lifting Operation through Digitalization

Activity

1 **Supply Chain team** order product lifting:
- Product: MFO LS   • From: Tank D-2
- Quantity: 70 MB   • To: Jetty #10
- Measuring method: Oil Metering

Engineers check the equipment readiness, such as tank instrument devices.

Output

Document of product lifting order
Document of equipment readiness

Application

m-PM **Mobile Plant Monitoring**

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2 **Oil Movement operators** do preparations:
- Check the Tank D-2 quantity using ATG (Automatic Tank Gauging)
- Check product specification in Tank D-2
- Coordinate with Ship's Crew about ship properties, such as Vessel Experience Factor (VEF)

Readiness (both tank & ship) before lifting begin

DOW **Dashboard Operating Window**
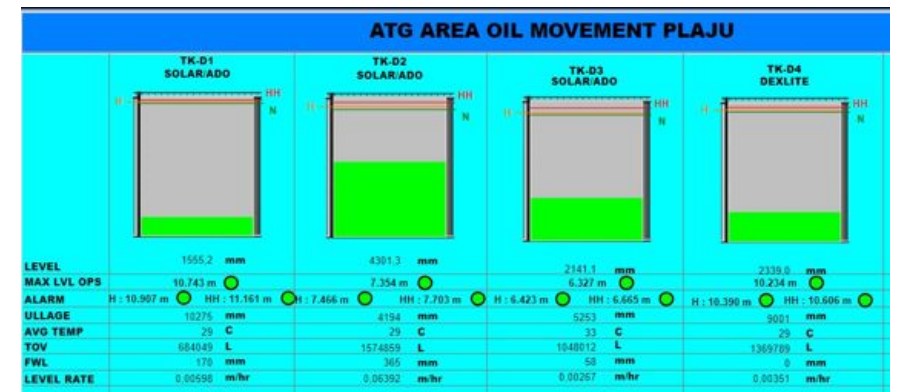
Case Study: Enhancing Product Lifting Operation through Digitalization

Activity	Output	Application

3 **Oil Movement operators** perform loading products to ship:
- Begin transferring product from Tank D-2 by operating MOV (Motor Operated Valves).
- Measure the volume of product transferred using Oil Metering devices.
- Coordinate with Tank Operators & Ship's crew to finish the product lifting operation

Smooth execution of product lifting

MOV Control Display
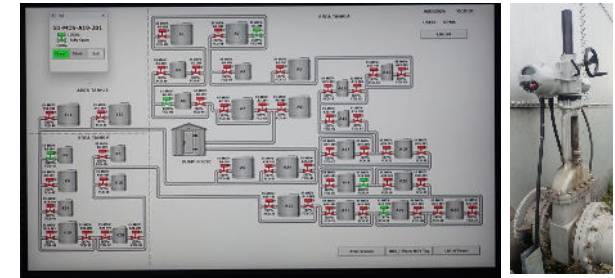
4 **Oil Accounting team** verify the product volume and create several documents, such as Bill of Quantity (BOQ)

Final documents of custody transfer

ROAS
Refinery Oil Accounting System

5 **Management team** monitor the impacts of the product lifting operation on several Key Performance Indicators (KPI), and to develop future business strategies.

Monitoring KPI and develop business strategies

PROFIT