LUMMUS DIGITAL

Reinventing Hydrocracker Performance Through Real-Time Digital Intelligence

A 400,000 bpd full conversion refinery in Saudi Arabia set out to strengthen hydrocracker reliability preserve catalyst health and improve energy efficiency. By deploying Lummus Digital's integrated performance monitoring and advisory platform the operator achieved measurable gains across unit stability energy recovery and catalyst lifecycle while establishing a scalable digital foundation to support continuous and sustained performance improvement.

~$4M+
Annual Value Identified

2-3 Months
Catalyst Cycle Extension

2-3%
Energy Efficiency Improvement

The Client

Introduction

A 400,000 barrel-per-day full conversion refinery operating in Saudi Arabia runs at high severity and under tight operating windows, is critical to throughput, energy efficiency, and overall refinery profitability. Stable reactor behaviour and healthy catalyst performance are essential to meeting production targets safely.

However, day-to-day operations were challenged by limited real-time visibility into unit health. Critical indicators related to reactor temperature profiles, catalyst condition, hydrogen balance, and energy performance were spread across multiple systems. Without a single timely and integrated view emerging issues were often identified late increasing the risk of instability off specification production and margin loss and forcing teams to react rather than intervene early.

Key Challenges

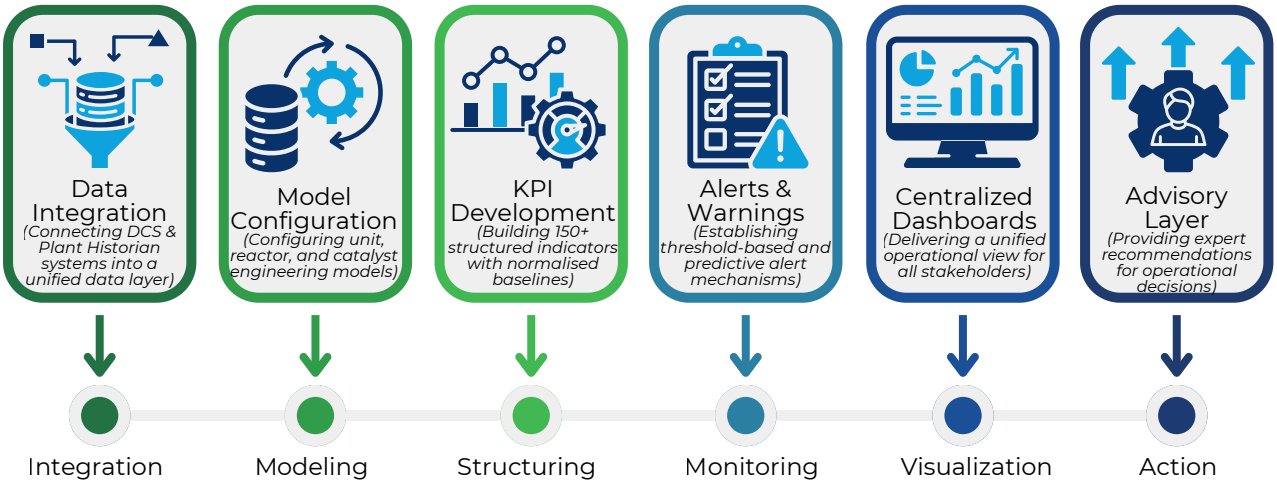
- Limited real time visibility into hydrocracker and reactor health across the unit.
- Delayed detection of catalyst degradation and reactor thermal issues.
- Suboptimal operating capacity driven by hidden constraints resulting in 2-5% throughput gap versus design.
- Excess energy consumption from inefficient equipment representing $3M-$5M per year in recoverable value.
- Elevated risk of off specification production and unplanned downtime with each day of hydrocracker downtime costing $1M-$2M in lost margin.

The Solution

Lummus Digital's Approach

Lummus Digital implemented an integrated digital performance monitoring and advisory solution tailored for hydrocracker operations. Real-time data from control, historian, and engineering systems was consolidated into a single operational view, supported by advanced engineering models and normalised KPIs. This enabled early detection of reactor, catalyst, and energy-related issues, improved situational awareness, and faster decision-making through centralised dashboards and alerts.

Implementation



Results

- **2-3%** improvement in energy efficiency across critical equipment.
- **40-60%** reduction in time from issue emergence to operator awareness & response
- **2-3 months** extension in catalyst cycle through earlier detection of thermal excursions.
- **$4M-$6M/year** in estimated value from energy recovery, stability & downtime.
- **150+ structured KPIs** consolidated from disparate systems into a unified real-time monitoring platform.

The Impact

With a unified digital platform in place, the refinery gained a more connected and reliable view of its hydrocracker operations. Real-time visibility, structured insights, and secure collaboration have enabled faster decisions, improved operational stability, and a stronger foundation for long-term performance and scalability.

OPERATIONAL IMPACT

- **40-60%** faster issue detection
- Real-time visibility into reactor and unit behaviour across all operating modes
- Emerging operational issues identified in hours rather than days

COST & EFFICIENCY

- **$4M-$6M/year** estimated value
- **2–3%** energy efficiency improvement across critical heat exchange and fired heater equipment
- Better asset utilisation through constraint visibility

REALIABILITY & PERFORMANCE

- **2-3 months** catalyst cycle extension
- Enhanced catalyst protection deferring **$15M-$25M** in reload costs
- Improved reactor stability through early WABT detection

STRATEGIC VALUE

- **150+ KPIs** unified
- **60-70%** reduction in manual reporting effort
- Single shared real time operational view
- Scalable foundation for AI APC and predictive maintenance

By integrating data, insights, and deep process expertise into a single platform, the refinery established a scalable foundation for more reliable, efficient, and intelligent hydrocracker operations

Discover how Lummus Digital can help your refinery realise similar results.

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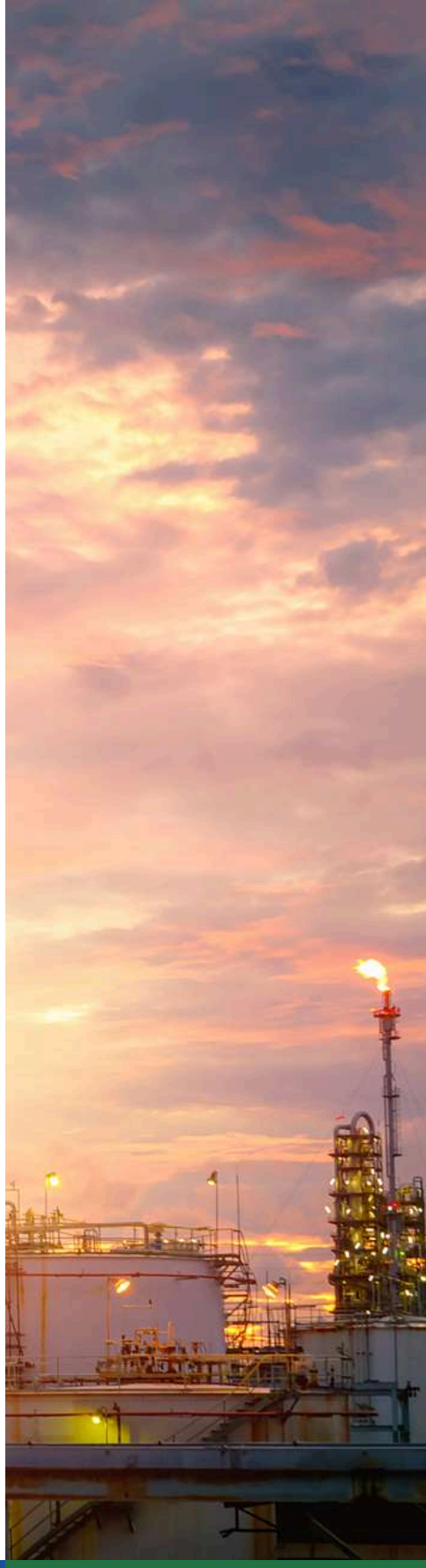
Lummus Digital

Where Process Intelligence Drives Profit

Lummus Digital brings physics-first intelligence to downstream energy combining deep process engineering expertise with advanced AI/ML to optimize refining and petrochemical operations from the inside out.

Born from decades of process technology leadership, we unite strategic advisory, process intelligence, and domain expertise to deliver what matters most: maximizing yields, protecting margins, and improving reliability across assets.

We don't overlay dashboards on your operations. We understand the thermodynamics, kinetics, and mass-energy balances behind them, and that's what makes the difference.



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