LUMMUS DIGITAL

Developed by Lummus DIgital | Powered by mcube™ | Build on CLG's Propietary Process Knowledge

Turning Residue into Margin: Impact from AI-Driven Intelligence at Residue Upgradation Facility for a leading Indian refinery

A leading Indian refinery commissioned one of the world's first 3.55 MMTPA LC-MAX® residue upgrading units, delivering up to 93% conversion of vacuum residue to high-value distillates and operating at one of the industry's highest complexity levels (NCI 11.6).

To manage the risks of a first-of-its-kind startup, the refinery deployed India's first LC-MAX® Digital Suite, enabling end-to-end operational intelligence from day one. By integrating real-time data with licensor process models, the platform established a trusted digital foundation for safe commissioning, faster stabilization, and sustained operational performance.

$2.5/bbl
LC-MAX® GRM uplift

+$1-2M/yr
Digital-driven GRM upside

+10%
Distillate yield gain

The Client

Introduction

A leading Indian refining organization commissioned one of the world's first large-scale LC-MAX® residue upgrading units. The unit is central to the refinery's value-uplift strategy, operating within exceptionally tight severity windows. From the outset, leadership recognized that the success of this unit would materially influence overall refinery performance, margin capture, and long-term operability.

Unlike conventional units, this LC-MAX® facility was first-of-its-kind at this scale, with no historical operating benchmarks or proven startup playbooks to rely on. During commissioning and early operations, manual monitoring and siloed systems required additional structure to deliver the confidence needed for safe feed cut-in, rapid stabilization, and sustained operation. The organization needed accurate, real-time insight into data integrity, catalyst and inventory behavior, yields, and unit stability, while aligning teams around a single, trusted operational view. This was a first-of-its-kind startup with exceptionally low tolerance for error.

Key Challenges

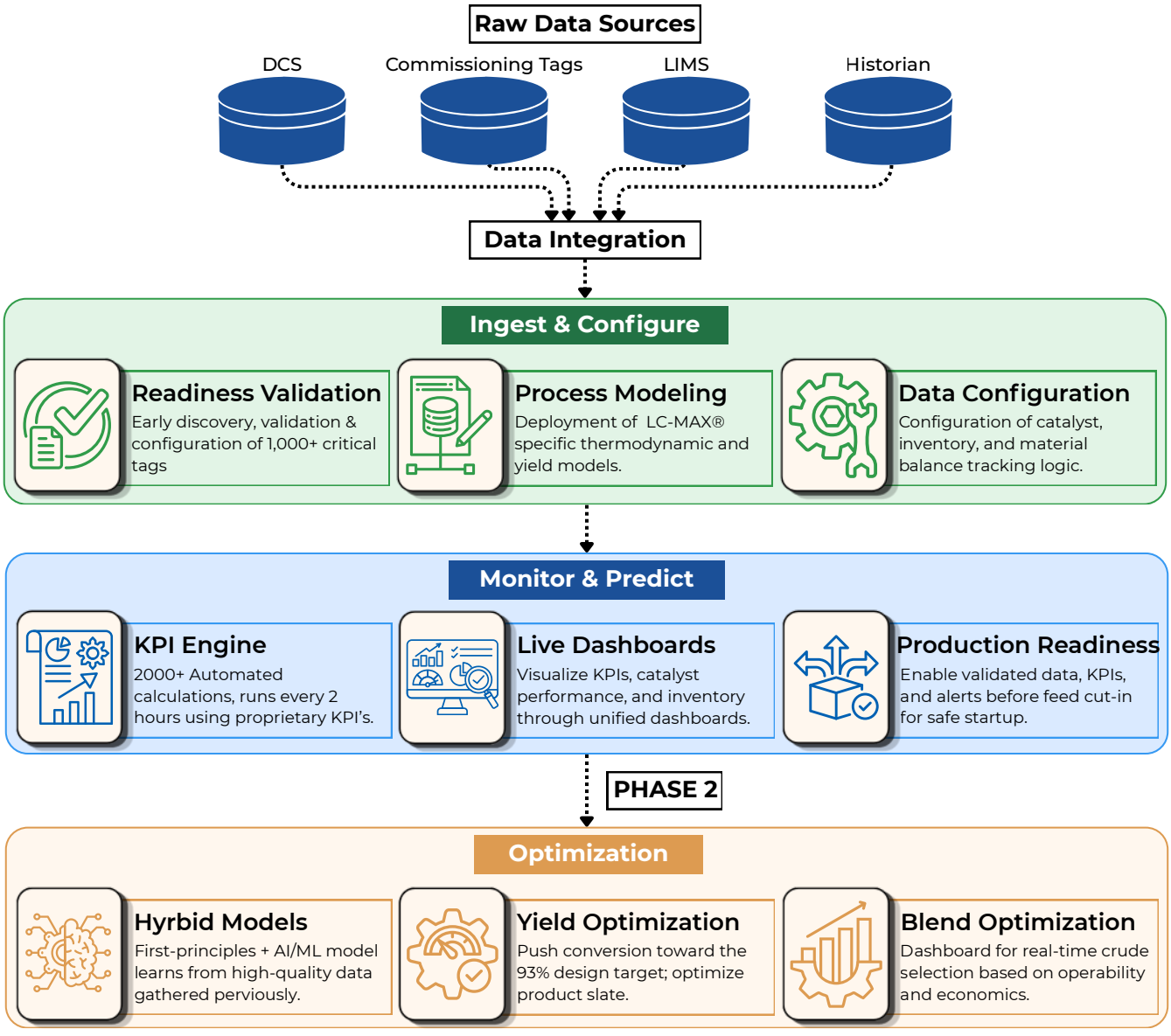
- High startup and safety risk during pre-startup and feed cut-in
- Fragmented visibility across critical LC-MAX® process systems
- Inconsistent catalyst, inventory, and mass balance tracking
- Limited visibility into early feed characterization and yield estimates
- Manual, time-intensive readiness and performance calculations
- Cross-functional misalignment during a critical startup phase

The Solution

Lummus Digital's Approach

To support safe commissioning and early operations, Lummus Digital deployed the LC-MAX® Digital Suite through a phased approach to support safe commissioning and early operations. Phase 1 delivered a production-ready foundation before feed cut-in, integrating real-time plant data with proprietary models to create a unified view and automate key calculations, establishing a single source of truth. This front-loaded deployment reduced startup risk by replacing manual workflows and enabling real-time visibility into catalyst tracking, mass balance, yields, and unit stability. Phase 2 builds on this by introducing hybrid models to optimize yields, energy performance, and overall efficiency.

Implementation Diagram



The Impact

With the LC-MAX® Digital Suite live before feed cut-in, the refinery established a unified, data-driven operating foundation during one of the most critical phases of unit lifecycle. Real-time visibility, automated intelligence, and cross-functional alignment enabled safer commissioning, faster stabilization, and a scalable platform for future AI-driven optimization.

MARGIN EXPANSION AT SCALE

- **$2.5/bbl GRM** uplift driven by LC-MAX® conversion
- Equivalent to **~$275M annual value at 110 KBPD capacity**

ON TOP OF THIS

- **+$1–2M/year incremental margin** leverage through digital optimization (expected in Phase 2)

RADICAL PRODUCTIVITY GAINS

- **2,000+ automated calculations** every 2 hours
- Tasks that previously took **days of manual effort** now happen continuously

YIELD OPTIMIZATION WITHOUT TRIAL-AND-ERROR

- **~10% improvement** in distillate yield vs. baseline

MORE IMPORTANTLY

- Optimization decisions are now **simulated before execution**
- Trade-offs (yield vs. energy) are **quantified in advance**

STARTUP INTELLIGENCE FROM DAY ONE

UNLIKE TRADITIONAL DEPLOYMENTS

- System was **production-ready** before feed cut-in
- Enabled **real-time monitoring** of catalyst health, reactors, and hydrogen systems

By integrating licensor knowledge, real-time data, and advanced calculations into a single platform, the refinery reduced startup risk while laying the groundwork for sustained, AI-enabled operational excellence.

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

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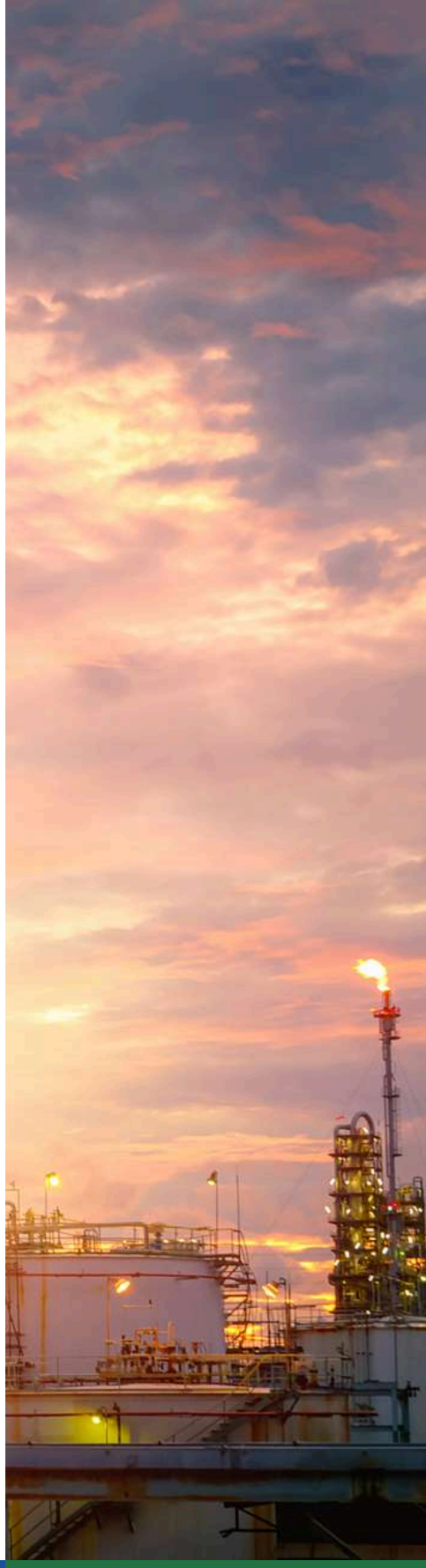
Lummus Digital

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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