IMUBIT

WHITEPAPER

An Optimizing Brain™ for Your Plant

Closed Loop AI for Accelerating Operational Excellence.

At the heart of the energy industry's most significant challenges lies complexity, testing plants' ability to digitally transform and achieve sustainability goals.

Traditional or linear plant optimization methods no longer deliver the outcomes needed to stay ahead. AI process optimization solutions promise incredible opportunity. However, amid the sea of options, it is imperative to cut through the noise and focus on tangible strategies that will propel your operations to achieve a higher state of excellence.

AI leaders cut through the complexity to outpace peers and attract new talent

50%
of energy executives say complexity is an obstacle to sustainability
Forbes

70%+
of millennials and Gen-Z think the industry is dangerous
EY

62%
of Gen Z say a career in oil and gas is unappealing.
EY

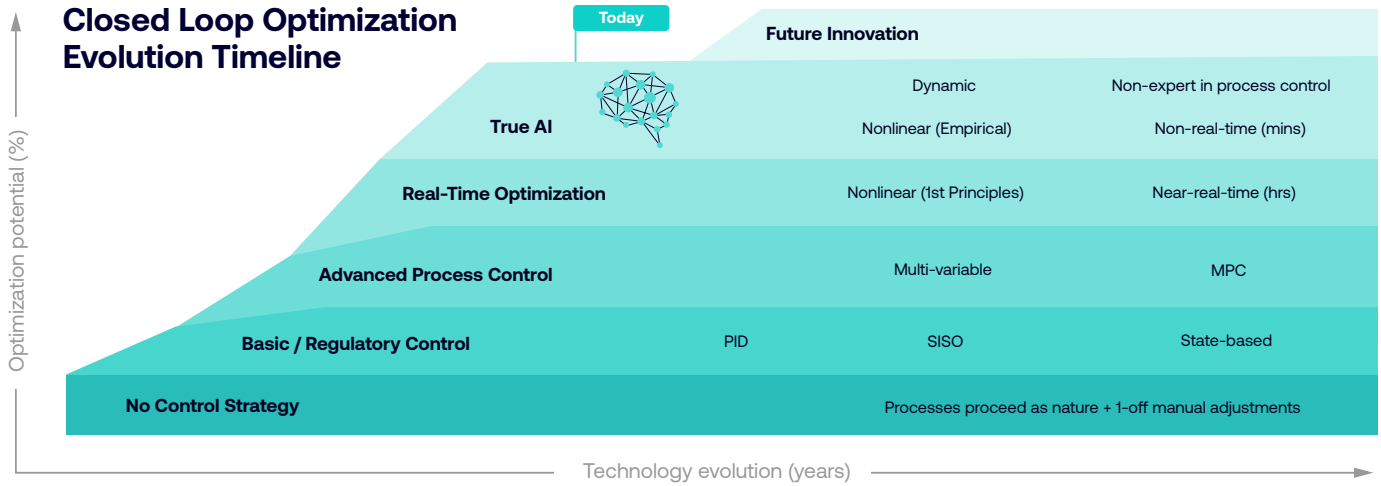
3.4
AI leaders outperformed industry peers by a factor of 3.4
McKinsey & Company

Navigating the vast landscape of plant optimization solutions can be daunting, especially when considering the shift from traditional methods to AI-accelerated solutions. There's a critical need to move past the buzzwords and focus on practical solutions that pave the way for operational excellence in the face of industry complexities.

Hybrid Models vs. True AI

Linear and 1st principles models have helped to drive plant optimization strategy for decades. Hybrid models, which incorporate AI and machine learning technologies on top of 1st principles, have begun to gain popularity in recent years. However, these hybrid models are built, maintained and understood only by their individual owner, inducing opinion-based, rather than evidence-based collaboration. Until now, no model has been able to represent the process from the lens of all groups, fostering highly optimized end-to-end collaboration.

True AI in closed loop takes a data-first rather than 1st principles-first approach to model construction, incorporating data and experience from multiple domains into a model that's understandable to all areas of the organization. It starts by building a neural network model of plant operations based on years of historical data guided by first principles and domain expert experience. Then, leveraging a type of AI called Reinforcement Learning, the model is run through millions of simulations, gaining years of equivalent plant experience under all operating scenarios. With the equivalent experience of the full plant workforce over the life of the plant, the true AI model empowers plants to achieve operational excellence by maximizing yields, reducing emissions, and optimizing the process of human collaboration.



Since the inception of industrial processing, the optimization technology landscape has evolved from 1-off manual adjustments to near-real-time automated optimizations in closed loop.

Advanced Process Control (APC) and hybrid models struggle because the assumptions and first principles they are based on can fail to converge in the nonlinear, dynamically changing, interdependent environment of a refinery. A data-first true AI model doesn't rely on a robust preexisting process model, eliminating the potential pitfalls of traditional model assumptions. True AI handles all levels of nonlinearity amongst process variables, from those that can be explained by 1st principles to those that don't comply with any existing equations of state. Advances in computing have enabled historically real-time optimization to go from real-time optimization of hours to real-time optimization of minutes.

Imubit's Optimizing Brain Approach To AI Process Control

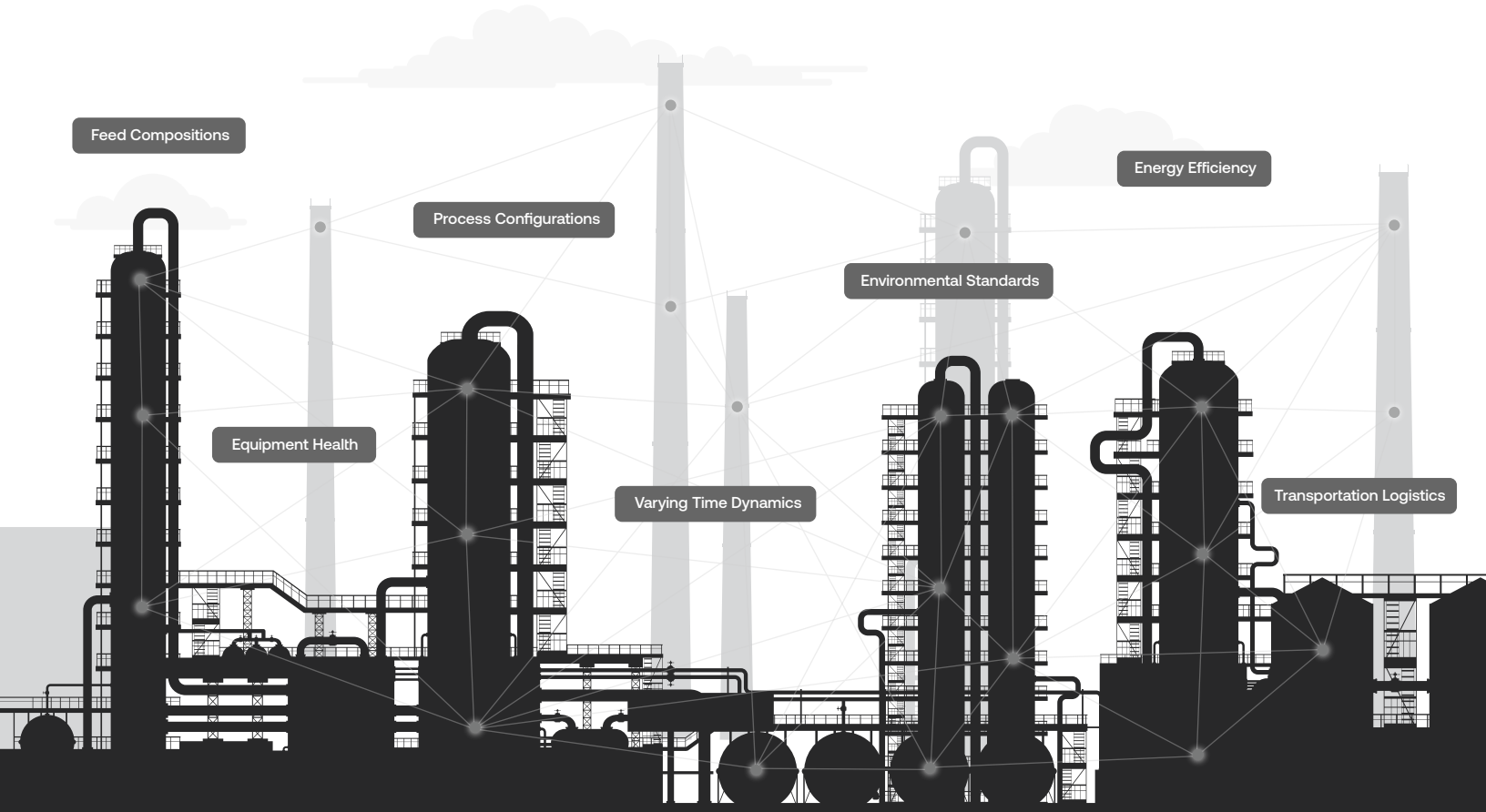
The human brain assimilates data from all our senses simultaneously to build a single perception of reality. This cognitive framework adheres to the fundamental principles of nature, encompassing gravity, friction, momentum, and laws of science. Subsequently, the brain undertakes intricate tasks, acquiring knowledge via direct experience. It can even compensate for missing information as seen here.

Do yuo fnid tihs smilpe to raed?

Your brain fills in the gaps based on experience to complete the picture accurately.

The same concept can be utilized in industrial plants. It entails assimilating data from various disciplines, such as planning, economics, process engineering, process control, and operations. This integrated information is used to construct a model of plant reality, optimizing not only the plant's processes but also enhancing collaboration among the various disciplines, i.e., your personnel. Ultimately, transparency is crucial, allowing engineers and operators to observe and comprehend the decision-making process employed by the Optimizing Brain, along with the decisions it intends to execute.

The Optimizing Brain Unlocks Your Plant's Full Potential



Hydrocracker (HCU) **Gas Oil Hydrotreater (GOHT)** **Fluid Catalytic Cracker (FCC)** **Cat Gasoline Hydrotreater (CGHT)**

> **In the process above, there is a Hydrocracker Unit (HCU), a Fluid Catalytic Cracker Unit (FCC), an upstream Gas Oil Hydrotreater (GOHT), and a downstream Cat Gasoline Hydrotreater (CGHT). Numerous factors are constantly disrupting the optimal operating targets.**

From fluctuating feed compositions, degrading catalyst activity, unpredictable ambient conditions, and even coker swings, the challenges are diverse and ever-present. The process is also constrained by external factors such as product prices, inventory limitations, and downstream unit capacity. The task of optimizing this complex system falls on the shoulders of a small cross-functional team, engaging in a daily dance of decision-making. The team is tasked with making crucial decisions, such as the strategic cutting of Vacuum Gas Oil (VGO) and managing Hydrocracker conversions amid unobserved feed composition changes. Additionally, they grapple with the complexities of handling the feed and conversion processes of the Fluid Catalytic Cracker (FCC) and its corresponding yields.

> What sets Imubit apart is their **focus on fostering collaboration and ongoing involvement with personnel**, in contrast to the standalone implementation approach typically seen in APC solutions."
>
> **APC Manager**
> Top 10 US Refiner

The Optimizing Brain

Enter the Optimizing Brain approach, a streamlined method to enhance the optimization process in closed loop. Unlike the conventional approach of each group bringing in its own model, the Optimizing Brain advocates for a unified model that encapsulates the plant's optimization strategy. The key lies in building this singular model that reflects the refining process through the collective lens of all involved groups. This model isn't based on opinions but rather on concrete data and evidence, and it takes shape through the power of deep learning neural networks.

Apply a Deep Learning Neural Network

The Imubit Optimizing Brain approach far surpasses the capabilities of a simple neural network. Imubit utilizes a deep learning neural network with dozens of layers and hundreds of millions of nodes.

> **This sophisticated neural network goes beyond the ordinary, capturing intricate relationships within historical data, and presenting a universal and nonlinear model that adapts to each operational regime.**

Training the Neural Network Simulation

When training a model on historical data, we incorporate first principles such as mass balances. We recognize that nearly every plant has flawed historical data, which may result in the mass balance not always aligning perfectly. Therefore, we fine-tune the model to ensure it adheres to the mass balance principles. This process enables us to develop highly dimensional and dynamic nonlinear models.

Deep Reinforcement Learning

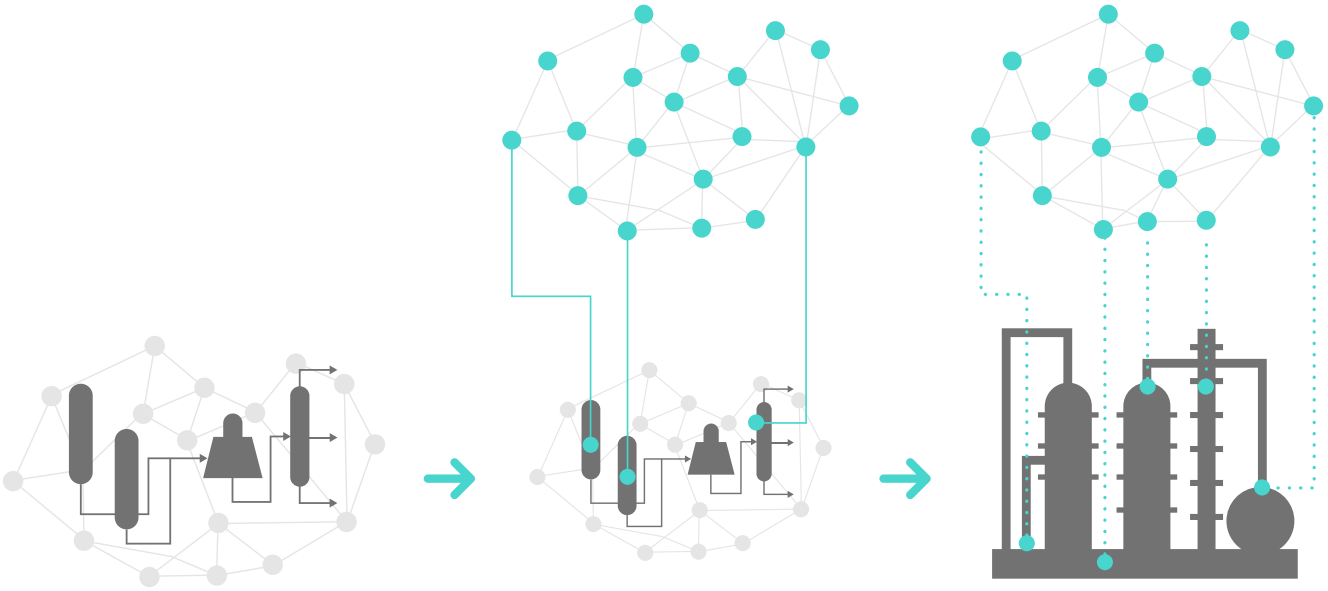
We train a neural network to learn through experience, which is a field of machine learning called deep reinforcement learning. We first create a reinforcement learning model of the plant's behavior. We define process constraints and let the model run through thousands of simulated years. This is a rigorous process, enabling it to master complex control. This isn't just about driving to targets; it's about optimizing the very heartbeat of the refinery. The result is a synchronized dance of efficiency and precision that not only enhances the plant's performance but elevates the synergy among the diverse groups involved.

After it's trained, analyzed, and verified by engineers, we take it out of the cloud and deploy it in closed loop control. This approach allows us to handle the noisy and suboptimal environment of a real plant.

> **It understands patterns, corrects for them, and drives operations in a way that is the most profitable, reliable, sustainable, and safe.**

Transparency in Decision Making The Imubit Platform

Before transitioning into closed loop control, users must understand how the Optimizing Brain makes decisions. Imubit has simplified this process with a platform comprised of applications that enable engineers, operators, and economists to explore the relationships between variables using their actual site data. No complex control theory or theoretical equations are involved – just a focus on process, constraints, objectives, and economic parameters. This transparency empowers users to analyze, adjust, and witness how the model reacts, providing valuable insights into optimal production moves.



Neural network simulation of actual plant

Recreate the plant's true dynamics, based on historial plant data

Deep reinforcement learning

Through millions of simulations over thousands of simulated years

Minute-by-minute control of plant

Driven by closed loop neural network

Digital Transformation Beyond Technology

Transforming an organization takes more than technology alone – it takes people and processes. The customer success team at Imubit is a strategic partner, an extension of the plant's team, working to ensure the plant maximizes and sustains value. Their expertise, proactive application monitoring, and change management efforts drive operational excellence. Imubit is committed to being accountable for the plant's Key Performance Indicators (KPIs) and regularly reports on the value generated.

The Optimizing Brain approach isn't a theoretical concept. With over 70 closed-loop applications running worldwide, seven of the ten largest US refiners are experiencing tangible benefits. These refiners are generating $0.30 to $0.50 per barrel and achieving a remarkable 15-20% improvement in energy efficiency, all thanks to the Imubit Optimized Brain approach.

As AI continues to make inroads into the energy sector, the path forward holds immense promise. The Optimizing Brain uses historical data and weaves the wisdom of past experience to arrive at the plant's optimization strategy. Goals that once seemed elusive become attainable with the precision and optimization that AI brings to the table. The industry, once perceived as a technology laggard, has emerged as an early adopter of AI innovation. Leaders like Marathon, Citgo, and Motiva are accelerating digital transformation and operational excellence with Imubit, an Optimizing Brain for their plants.

Why is Imubit Trusted by 7 of the 10 Largest US Refiners?

15-20%
Improvement in Energy Efficiency

$.30-.50/bbl
Margin Improvement

70+
Closed Loop Applications

6+
Years of Successful Engagements

Dare to Duel?

Engineer vs AI Optimization Duel

See if your plant can beat the AI model and achieve a higher objective function. Put your optimization and controls expertise to the test against our Optimized Brain and see who can beat the AI.

To learn more visit: imubit.com/duel