

Agentic AI Solutions in the Refining & Petrochemical Industry

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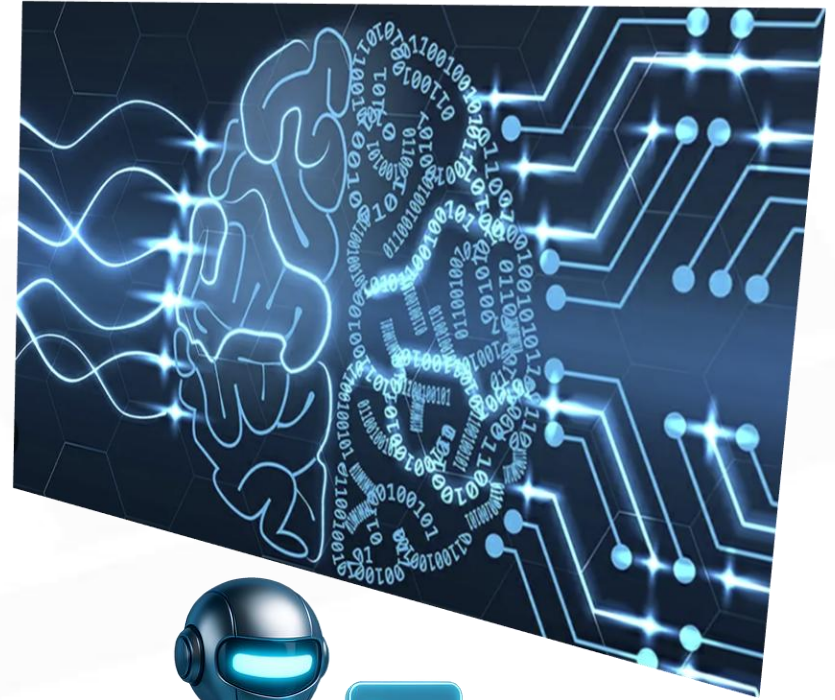
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Agenda

- Introduction
- What is Agentic AI?
- Addressing Industry Pain Points
 - Key Challenges of AI
- Getting Started with Agentic AI
 - What is Required
- Application of Agentic AI
 - Industry Use Cases and Value Realization
- Questions & Answers



TPM Solutions at a Glance – Consulting & Technology for the Energy Industry

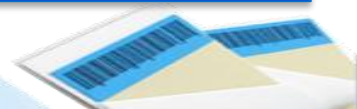
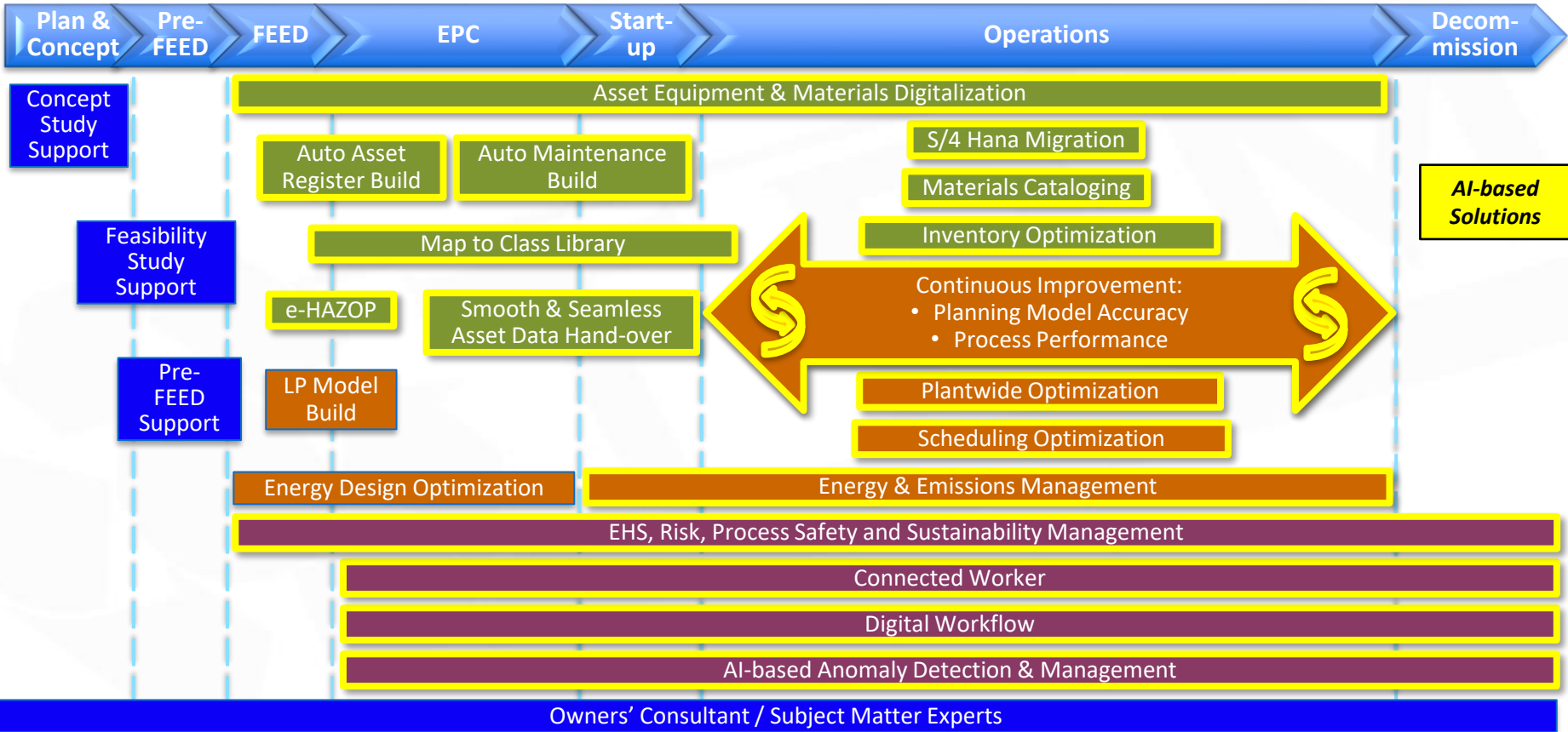
- Founded in 2005 (as R2E)
- USA-based with Singapore subsidiary having Global presence
- Highly experienced Technology & Business Consultants
- Hundreds of plants and facilities visited & reviewed
- Cutting-Edge Solutions
- **Specializing in AI-driven digital operational excellence**

- **AI-Driven Operator Advisory and Digital Asset**
- Digital Transformation / IIOT / Industry 4.0
- Connected Worker & Connected Asset
- Offshore Oil, Gas & LNG Assets
- Optimization and Control, including Energy & GHG Emissions Management
- Advanced Planning and Scheduling, including Backcasting
- FCC Everything



TPM Solutions Covers the Asset Lifecycle

Consulting Optimization
Assets Operations



What is Agentic AI?

From conversational tools to autonomous, goal-directed systems

- **Beyond chatbots: AI that acts, not just responds**
 - Conventional AI answers a question; agentic AI pursues a goal across multiple steps, using tools and making decisions along the way
 - It self-corrects when results are unexpected with no human prompt required at each step
- **Multi-agent architectures mirror how skilled teams work**
 - An orchestrator agent delegates to specialist sub-agents for data retrieval, analysis, reporting, and communication
 - Agents connect to your existing systems – ERP, process historians, scheduling, document repositories – without monolithic replacement
- **Human oversight is a design principle, not an afterthought**
 - Agents operate on a controllability spectrum, tuned to the risk profile of each task
 - In safety-sensitive operations, critical decisions retain human approval gates by design
- **The value: compressing the gap between insight and action**
 - Tasks that take a skilled engineer hours, such as pro-active margin contribution recovery, root cause triage, production reporting, and operational exception handling, can run in minutes
 - The ROI case is operational throughput and decision quality, not headcount reduction



About Tridiagonal.ai (T.AI)

Company overview



Process R&D Roots (20+ Years)



350+ Professionals

with top talent > 70 % masters / Post Docs



Advanced Modeling



Testing & Validation



Scale-up & Technology Transfer



Global Experience

2500+ Projects (Multi-domain),
Global Delivery Model



Domain-driven AI Consulting and Decision Intelligence (DI-AI) Solutions



Delivery Center – India (Pune)
Program Management / Account Management – San Antonio, Dubai, Houston, Malaysia*

* Future Expansion



Global Customer base



Key Challenges

Key Challenges of existing AI



Visible Symptoms

1 Slow diagnosis-to-action loop

Time lost hunting for data across systems

2 Inconsistent decision-making

Different teams interpret the same issue differently

Visible Challenges

Hidden Challenges

Hidden Root Causes

1 Disconnected operational data

Time-series, asset, and process data are not unified

2 Fragmented tools and workflows

Teams lack a single operational view

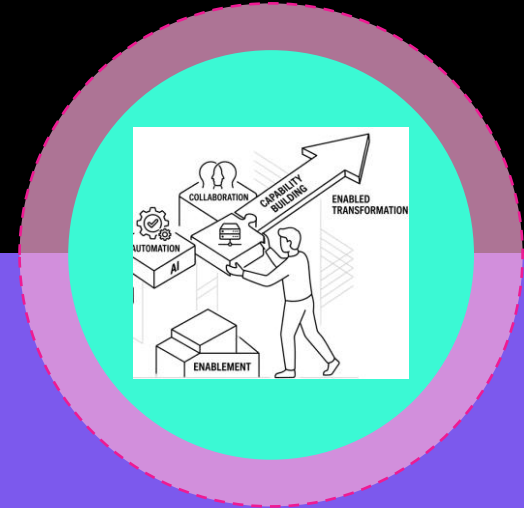
3 Limited process-aware AI

Analytics and LLMs lack plant context

! Operations AI needs unified data, process context, and workflow execution — not just another analytics tool

What is Required

An Operating System - ->
Context-Aware (Domain), Self-Learning, and
Reasoning-enabled AI for Operations Efficiency



Agentic AI in Action

Furnace Performance Monitoring Agent

Preheat Section – Ops Strategy Agent

Operators training – SOP Agent

RCA Agent

Chat P&ID Agent

Steam Methane Reformer Ops. Strategy

Catalyst Health Monitoring Agent

Alarm Prioritization Agent

Work Order Generation Agent



P&ID based Knowledge Graph



- Real time process parameters
- Critical Assets Vibration readings

Time series data



- Raw Material, Production Information
- Asset Hierarchy
- Maintenance, Spare parts, Quality compliances

SAP



- Material / process flow information
- Instrumentation, line daigram, tag information

P&IDs



- Equipment maintenance manuals
- Operating procedues
- SOPs
- Compliances and standards

Manuals



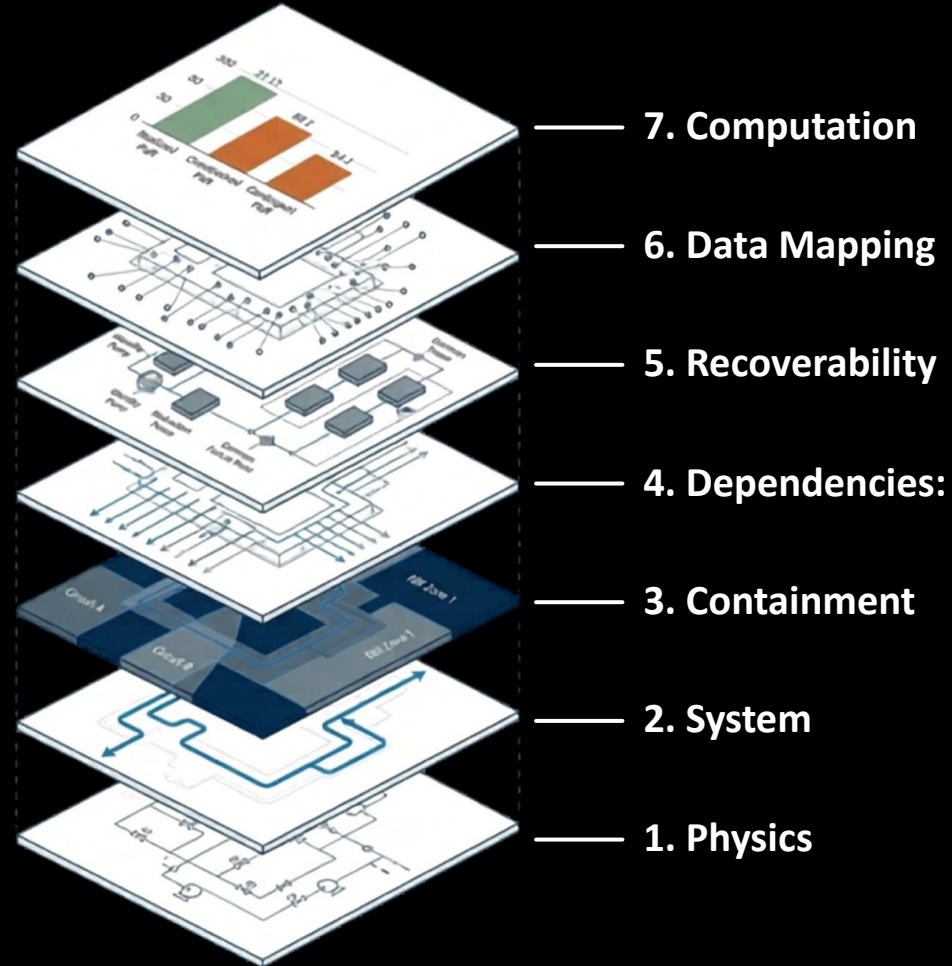
- Analytics
- Simulation
- APM
- Others

3rd party Application

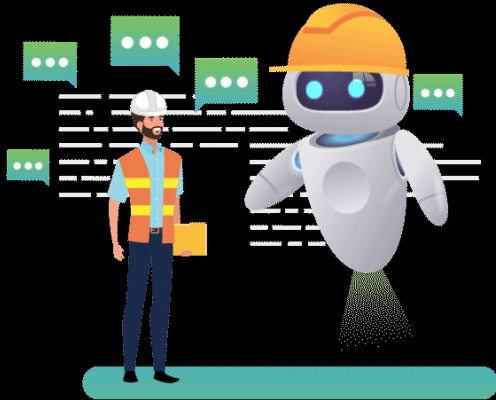
Oil & Energy

The Physics-First Design Framework

Agentic AI in Action



Application of Agentic AI – Use Cases



- Predictive Maintenance → Autonomous Maintenance
- H₂ Network Optimization
- AI-enabled Catalyst Health Monitoring

Use Case #1 — Autonomous Maintenance

Challenge

- ⚙️ Legacy CMMS + manual inspections
- ⌚ Slow work-order approvals
- ↔️ Siloed ERP / IoT / sensor data
- ! Unplanned downtime exposure

Result: maintenance teams stay reactive

Agentic AI Layer



⦿ Sense

ERP · CMMS · IoT

🔄 Plan

work orders + approvals

📊 Guide

RAG from SOPs/P&IDs

✓ Verify

safety + compliance

The agent turns alerts, documents, and data into executable maintenance actions

Business Impact

- ⚡ Faster maintenance cycles
- 💰 Lower emergency repair cost
- ↗️ Higher asset uptime
- 🎯 Single operational view

Other benefits:

- operational visibility
- better scheduling
- explainable actions

💰 Annual savings potential: **\$1.2M–\$2.5M**

Proactive lifecycle planning for a 200,000 bbl/day facility

from reduced downtime, emergency repairs and maintenance premiums

Use Case #2 – H₂ Network Optimization


Challenge

Why H₂ networks need autonomous optimization


-  **Operational instability**
Feed variability, shift changes, demand–supply swings.
-  **Systemic inefficiency**
Manual decisions across fragmented data silos.
-  **Resource waste**
Hydrogen overproduction; loss to flare or fuel gas.
-  **Margin pressure**
Costly, carbon- and energy-intensive utility.
-  **Strategic criticality**
Hydrogen availability drives volume swell and margin.

Agentic AI Solution


Refinery Hydrogen Network Optimization combines process data, domain rules and AI/ML agents.

 **Data Fabric**
DCS/SCADA + operations + market data




 **Process-aware causal AI**
Maps disturbance → network impact



 **Hybrid optimization engine**
Symbolic rules + ML + what-if simulation





 **Decision support**
Explainable set-points and actions


Agents: monitor constraints • enforce rules • simulate scenarios • recommend best action


Business Impact

A concise value case for a 200,000 bbl/day refinery

 **30–40% Hydrogen losses reduced**
Less flare / fuel-gas diversion

 **2–3% Energy cost reduction**
Optimized generation and use

 **Faster Operational response**
Quicker adaptation to disturbances

 **ESG Lower carbon intensity**
Reduced hydrogen waste





Other benefits: margin optimization • agility • explainable recommendations • critical decision support

 **Annual savings potential: \$1.1M–\$2.2M** from reduced losses, energy savings and lower hydrogen overproduction

Use Case #3 – AI-enabled Catalyst Health Monitoring

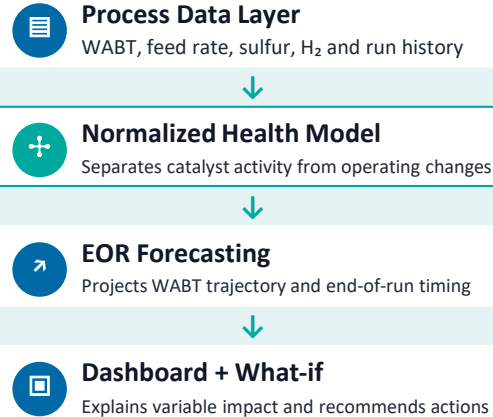
Challenge

Why catalyst health needs autonomous monitoring

-  **Rising WABT**
Higher temperature needed to maintain product specs.
-  **Noisy operations**
Feed, sulfur and H₂ changes mask true catalyst decline.
-  **Manual monitoring**
Trend reviews are reactive and hard to scale.
-  **Limited site visibility**
Reactor-level insights are fragmented across sites.

Agentic AI Solution

Model-based catalyst activity tracking with explainable EOR forecasts.







Agents: monitor activity • forecast EOR • explain drivers • recommend operating actions

Business Impact

Proactive lifecycle planning for a 200,000 bbl/day facility



-  **Earlier EOR planning**
 -  **Lower Downtime risk**
 -  **Better Reactor performance**
 -  **Multi-site Visibility**
- Other benefits: explainability • faster diagnosis • planning confidence

\$ Annual value potential: \$0.6M–\$1.2M

from proactive catalyst lifecycle management and fewer operating disruptions

Health monitoring + EOR control

T.AI Oil & Gas Solution(s) Capabilities - Breadth and Depth



AI-based Process Optimization

Compressor & lift optimization,
Production constraint management,
Energy-efficient throughput
maximization

Advanced Analytics

Real-time production diagnostics,
Soft sensors, Integrity early-warning
analytics, Emissions & energy
intensity tracking



Predictive and Prescriptive Maintenance

RUL prediction, Surface equipment
degradation modeling, Risk-based
maintenance prioritization, Failure
mode analytics (RCM/RBI integrated)

Sustainability & Safety

Real-time emissions monitoring,
Barrier management & risk
visibility, Process safety
intelligence (PSM)



Modeling & Simulation

Steady state / dynamic simulation
(OTS), Blending, movement automation,
Heat-integration studies, process
debottlenecking / improvement, etc.

Decision-Ops

Enterprise Decision Intelligence for
integrated production-maintenance-
integrity optimization, Real-time risk
scoring aligned to RBI, RCM, and
criticality frameworks





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OTTAGROUP



Thank You

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www.thailandrnp.com

