



Generative AI, Prompt Engineering, RAG, and Agentic AI

Ayan Chatterjee, Ph.D.

Chief Technology Officer and AI Architect
insAnalytics

Agenda – Applying GenAI in Oil & Gas Enterprises

- In this session, we will understand what Generative AI is and how it differs from traditional predictive AI systems.
- We will learn how prompt engineering improves reliability and control in enterprise environments.
- We will explore Retrieval-Augmented Generation and understand how enterprise data such as SOPs, maintenance manuals, and procurement records can ground AI outputs.

Agenda – Applying GenAI in Oil & Gas Enterprises

- We will study Agentic AI and how multi-step intelligent systems can support refinery operations, supply chain optimization, and procurement workflows.
- We will conclude with a practical demonstration showing how AI can automate document-heavy industrial workflows while maintaining governance and human oversight.

Generative AI in Oil & Gas

- Generative AI systems create structured outputs such as reports, summaries, and recommendations.
- They generate text by predicting the most probable next word in context.
- In oil and gas, Generative AI can draft refinery performance summaries, generate safety audit reports, assist in procurement documentation, and automate customer communication templates.
- This reduces documentation time and improves consistency.

Generative AI in Oil & Gas

1. What is Generative? AI That Creates

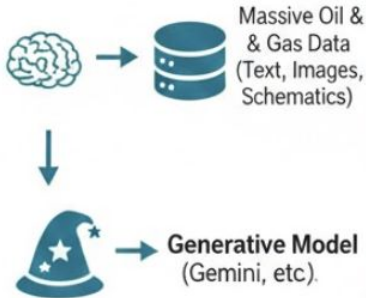


Beyond predicting, GenAI produces new text, images, designs and solutions.

Input: "Forecasted data" "Price will rise."

Input: "Crude oil price" → Predictive price report for Q4"
Generative AI: "Drafts a full report"

2. How it Works: Learning to Create



Learns patterns from HUGE datasets to generate realistic original content.

3. HPCL Examples: Creating Value



Automated Report Generation:
Drafts safety summaries, market analysis.



New Facility Design Concepts
Generates optimal layouts based base to constraints



Simulate Scenarios
Creates synthetic data for training models on rare events.

Prompt Engineering for Industrial Applications

- Prompt engineering is the structured design of instructions given to AI systems.
- Clear prompts define the role, task, context, constraints, and output format.
- For example, the AI can be instructed to act as a refinery operations analyst summarizing daily KPI deviations.
- Proper prompting improves accuracy and reduces ambiguity in regulated environments.

The Example Prompt

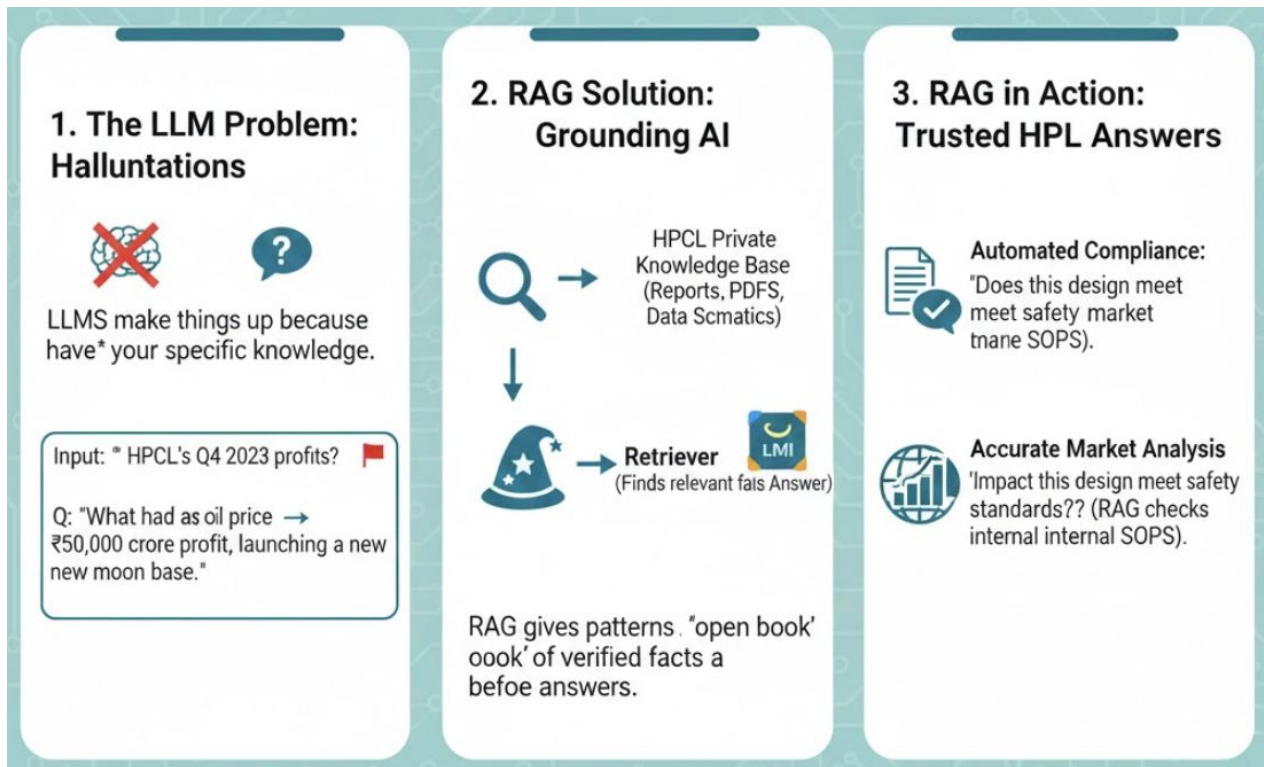
"Role: Act as a Senior Refinery Operations Analyst.

- Task: Summarize the daily KPI deviations based on the attached sensor log.
- Context: We are preparing for a morning shift-handover meeting. Focus specifically on any fluctuations in pressure or temperature that exceeded the 5% safety threshold in the distillation unit.
- Constraints: Maintain a neutral, technical tone. Ensure all data points comply with OSHA reporting standards. Do not speculate on root causes unless supported by the log data.
- Output Format: Provide a bulleted list of deviations followed by a 2-sentence 'Action Required' summary."

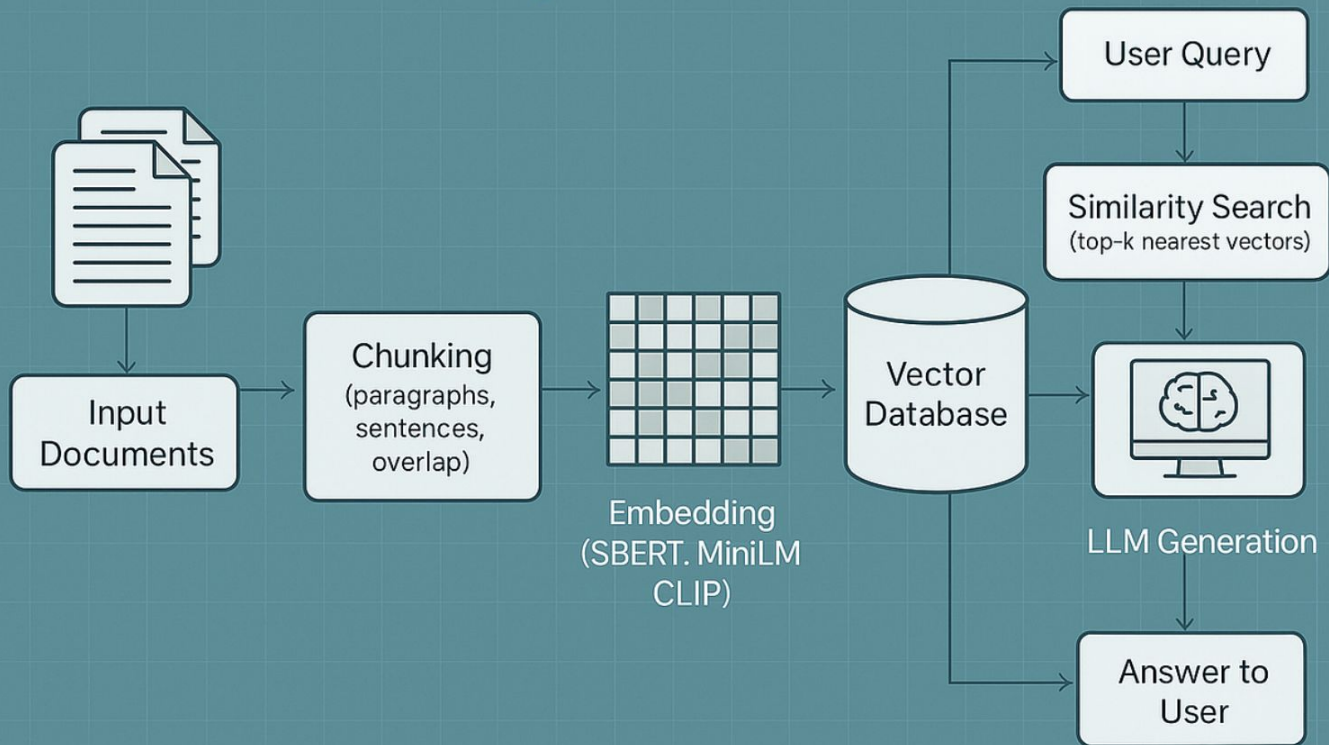
Retrieval-Augmented Generation (RAG)

- Large Language Models may produce incorrect answers when relying only on training data.
- Retrieval-Augmented Generation improves reliability by retrieving relevant enterprise documents before generation.
- Documents such as SOPs, maintenance manuals, safety guidelines, and compliance policies are converted into embeddings and stored in a vector database.
- The LLM generates responses grounded in retrieved company-specific information.

Retrieval-Augmented Generation (RAG)



RAG Pipeline Overview



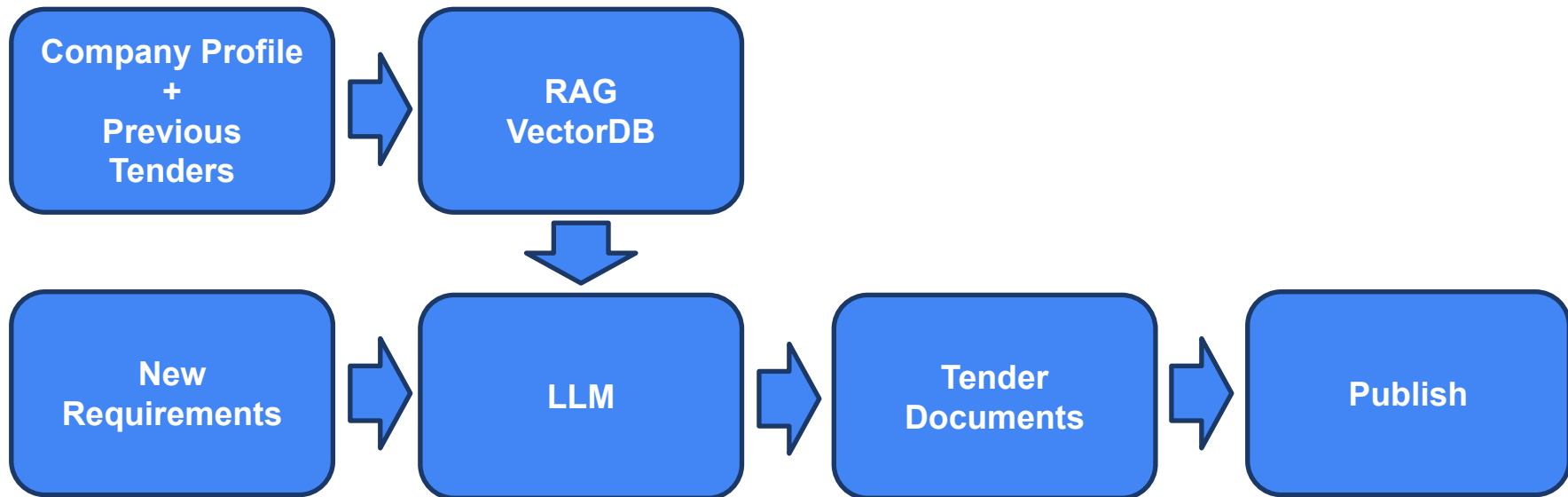
Example – Enterprise Knowledge Assistant

- An enterprise knowledge assistant ingests internal documents across departments.
- Employees can ask questions about refinery processes, HR policies, procurement rules, or safety procedures.
- The system retrieves relevant documents and generates grounded responses.
- This improves decision speed and reduces dependency on manual document search.

Demo – Intelligent Document Automation

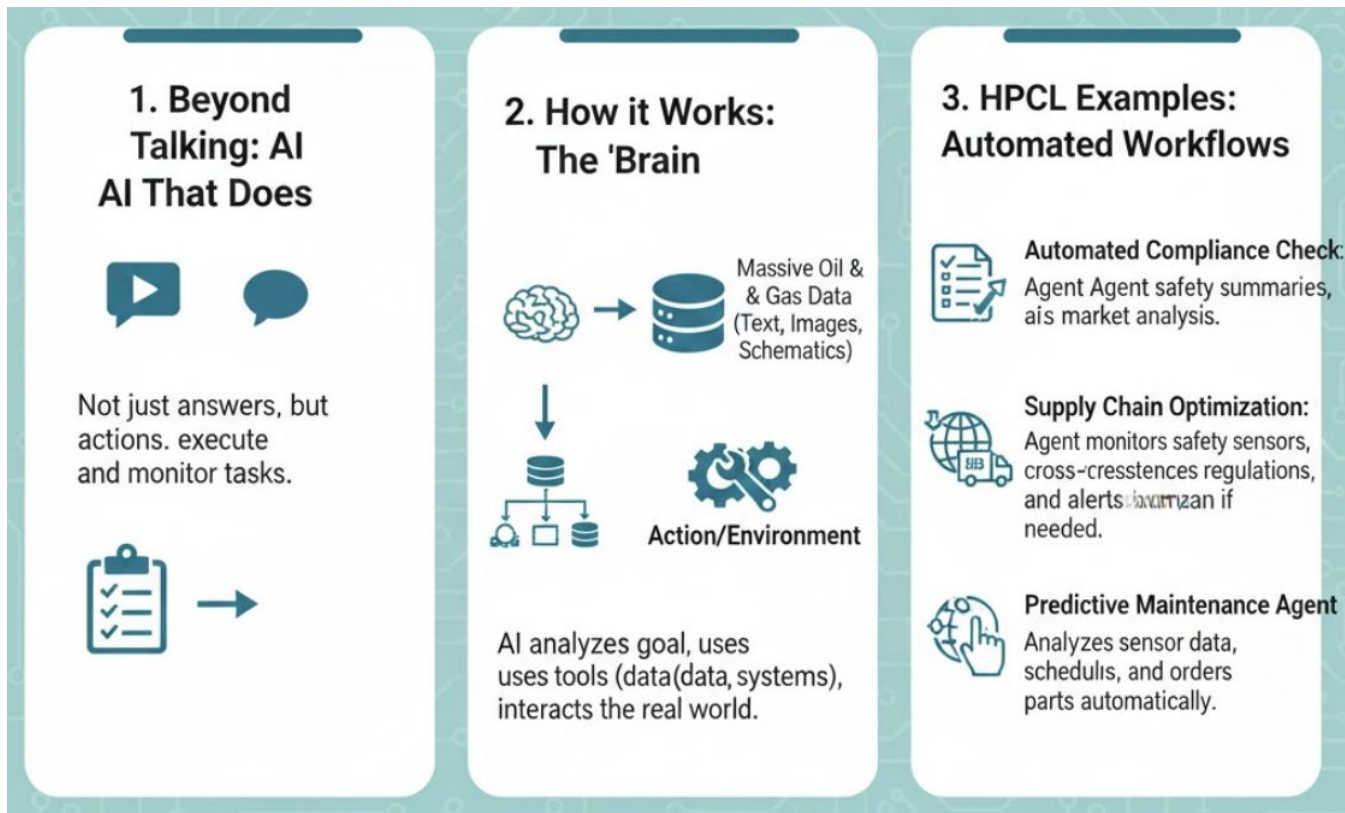
- The demonstration showcases how AI can ingest industrial documents and generate structured outputs.
- The system retrieves relevant internal information before drafting responses.
- It can summarize technical requirements, generate structured reports, and compare compliance clauses.
- This demonstrates how AI supports procurement, operations, and knowledge management workflows.

Tender Creation



Demo: https://github.com/insAnalytics/insa_tender_generation,
https://github.com/insAnalytics/insa_tender_response

Agentic AI in Oil & Gas Operations



Agentic AI in Oil & Gas Operations

- Agentic AI systems can plan, reason, and execute multi-step tasks.
- An AI agent can monitor refinery KPIs, detect anomalies, retrieve relevant SOPs, and recommend corrective actions.
- In supply chain operations, an agent can track depot inventory, predict shortages, and suggest optimized dispatch plans.
- Agentic AI acts as an intelligent co-pilot for operational teams.

Demo: Agentic AI

- **Autonomous Operations:** This demo showcases Agentic AI managing real-time refinery operations without manual supervision.
- **Intelligent Reasoning:** The system uses Gemini 2.5 Flash to analyze telemetry data and prioritize critical safety risks.
- **Data Integration:** The agent bridges data silos by connecting live sensor feeds with safety manuals and ERP systems.
- **Safety Compliance:** It automatically identifies hazardous conditions and retrieves required PPE and safety protocols.
- **End-to-End Automation:** The agent handles the entire maintenance lifecycle from fault detection to scheduling work orders.
- **Operational Efficiency:** Intelligent tool-calling reduces response times and ensures "Safety First" refinery management.

Risks, Security, and Governance

- Generative AI systems must operate within strict data governance frameworks.
- Sensitive operational data and commercial information must be securely managed.
- Outputs must undergo human validation before regulatory submission or operational execution.
- Responsible AI practices ensure transparency, auditability, and compliance.

Summary

- Generative AI enhances documentation, knowledge access, and decision support across oil and gas enterprises.
- Prompt engineering improves reliability and control.
- RAG grounds AI outputs in enterprise data.
- Agentic AI enables multi-step intelligent automation across operations, supply chain, and compliance.

Q&A

Thank You



- Dr. Ayan Chatterjee
- ayanc.notes@gmail.com