



## **Deliverable report 22**

### **AI and IAGEN Application Use Case**

#### **Training through simulation of critical scenarios in the oil industry in Vaca Muerta, Neuquén**

##### **I. Introduction**

The oil industry, particularly the exploitation of unconventional fields like Vaca Muerta, is characterized by its complexity and the inherent risks of its operations. Worker safety and environmental protection are crucial to ensuring the sustainability of operations. In this context, ongoing and effective personnel training is essential to prevent accidents, minimize environmental impact, and optimize efficiency. Generative Artificial Intelligence (Generative AI) is emerging as a tool with enormous potential to revolutionize the creation of training guides, adapting to the specific needs of the industry and improving preparedness for critical situations.

This report examines in detail how Generative AI can be applied to the creation of training guides in the Vaca Muerta oil industry, addressing its benefits, challenges, implementation strategies, and cost-benefit analysis. Generative AI has the potential to transform the way companies train their employees, marking a shift from standardization to customization in learning and development.

##### **II. Generative AI in the Creation of Training Materials**

Generative AI is a branch of artificial intelligence that focuses on creating new content

and ideas, such as models, images, code, or text, from existing data. Its ability to analyze large volumes of data and learn from complex patterns makes it an ideal tool for creating dynamic and personalized training materials. At its core, this technology uses advanced algorithms to analyze vast amounts of information, identify patterns, and generate new and original content that is often indistinguishable from human-created content.

Through advanced algorithms, AI can analyze each individual's performance, learning preferences, and needs, generating tailored content that maximizes knowledge retention and skill development.

In the training field, Generative AI can be used to:

- Personalize content: AI analyzes each individual's learning patterns and preferences to create tailored training materials. This ensures that materials are presented in formats and styles that fit each employee's learning methods, improving engagement and knowledge retention.
- Create interactive simulations: AI enables the development of simulated training environments, offering risk-free, immersive experiences where users can practice complex tasks and develop decision-making skills in a safe virtual environment.
- Generate personalized learning paths: AI-powered platforms adapt learning paths based on each individual's progress, strengths, and areas for improvement. This ensures employees focus on the most relevant and up-to-date content for their development.
- Automate assessments and feedback: AI offers systems that display ratings and feedback immediately, allowing employees to hone their skills in real time. This instant feedback facilitates more efficient learning and accelerated skill development.
- Predicting skills gaps: By analyzing performance data, AI identifies and predicts potential skills gaps within the workforce. This allows companies to anticipate training needs and develop targeted programs to address skills gaps.

### **III. Generative AI for Critical Situation Training**

Generative AI can help create more effective training guides for these critical situations by:

- **Generate realistic simulations:** IAGen can create interactive simulations that replicate critical situations with a high degree of realism, such as oil spills, gas leaks, fires, workplace accidents, or equipment failures. These simulations allow workers to practice decision-making, applying safety protocols, and teamwork in a safe virtual environment, without endangering their physical safety or the environment.
- **Personalize training:** IAGen can tailor the content of the guides to the specific needs of each employee, considering their role, experience, knowledge level, and learning style. This ensures that training is relevant, effective, and engaging for each individual, maximizing knowledge retention and skill development.
- **Provide personalized feedback:** IAGen can analyze workers' performance in simulations and provide targeted, individualized, real-time feedback to improve their skills, knowledge, and decision-making. This allows workers to identify their strengths and weaknesses and focus on areas that need improvement.
- **Improve safety and risk management:** AGI can be used to develop early warning systems that identify risk situations in real time, such as leaks, spills, or equipment failures. This enables a faster and more effective response to potential incidents, minimizing negative consequences.
- **Promoting environmental sustainability:** IAGen can contribute to the development of more sustainable extraction techniques that minimize the environmental impact of operations. It can also optimize the use of energy and resources, reducing the industry's carbon footprint.

### **IV. Application of IAGEN-powered agents to the activity**

#### **1. IAGEN Agents Concept**

In recent years, generative artificial intelligence (GAI) has revolutionized the way we interact with technology, enabling the development of systems capable of generating

content, answering complex questions, and assisting with highly demanding cognitive tasks. From this capability, a new technological architecture has emerged: GAI-powered agents. These agents are not simple conversational interfaces, but autonomous systems that can interpret instructions, make decisions, execute tasks, and learn from their interactions with the environment.

An IAGen agent combines large language models with additional components such as external tools, memory, planning, and autonomous execution. This allows them to operate in complex environments, with the ability to break down objectives into steps, coordinate multiple actions, interact with digital systems (such as databases, APIs, or documents), and adapt to context changes in real time. These qualities distinguish them from traditional chatbots and open up a range of more sophisticated and customizable applications.

At the organizational level, these agents are being used to automate processes, generate data analysis, assist in decision-making, and improve the user experience, both internally and externally. For example, they can take on human resources, legal, financial, or logistics tasks, and even tasks linked to the technical areas of production processes, acting as intelligent assistants that collaborate with human teams. This ability to integrate knowledge and execute tasks autonomously transforms the way organizations can scale their operations without losing quality or control.

Furthermore, agentic workflows—structures where multiple agents collaborate to solve complex problems—allow responsibilities to be distributed among different agent profiles, each with specific functions. This creates hybrid work environments where humans and agents coexist, optimizing time, costs, and results. The ability to connect agents with tools such as Google Drive, CRMs, or document management platforms further expands their capabilities.

The development of IAGen-powered agents represents a crucial step toward a new era of intelligent automation.

Among the benefits of authentic workflows powered by generative AI models is the ability to automate entire production processes, end-to-end, and even add value by leveraging the capabilities of language models based on these technologies.

However, its implementation also poses technical, ethical, and legal challenges, ranging from responsible design to human oversight. Therefore, understanding its architecture, operational logic, and potential impacts is critical for its effective and safe adoption in diverse professional contexts.

## **2. Agentic Flow Design Proposal for Implementation**

### **a. Main Capabilities of the Agent**

#### **● User Analysis**

- Collects data on:
  - Role and responsibilities
  - Experience level
  - Learning style and pace
  - Previous evaluations and performance

#### **● Generation of Custom Content**

- Develops adapted teaching materials (videos, PDFs, presentations, interactive guides)
- Use styles and formats compatible with each user's preferences

#### **● Creating Interactive Simulations**

- Generate realistic scenarios such as:
  - Oil spills
  - Gas leaks
  - Electrical failures
  - Accidents in the plant
  
- Includes real-time decision making with multiple consequences

- **Generation of Learning Paths**
  - Create adaptive routes that:
    - Prioritize critical skills
    - They adjust to the worker's progress
    - They integrate reinforcement where there are failures
- **Automatic Evaluation and Feedback**
  - Correct activities and simulations
  - Provides immediate and personalized feedback
  - Recommend new activities or review
- **Predictive Breach Detection**
  - Analyze data to:
    - Identify at-risk skills
    - Anticipate future training needs
    - Propose early interventions
- **Safety and Risk Management**
  - Recommends improvements in security protocols
  - Generates alerts for repeated simulations with critical errors
  - Connect to IoT sensors or real-life incident databases (optional)
- **Environmental and Energy Optimization**
  - Suggests good practices to minimize environmental impact
  - Simulate scenarios with a lower carbon footprint
  - Integrate sustainability KPIs into training.
- **Expected Inputs**
- Employee data (profile, position, seniority, previous knowledge)
- Training objectives (by regulation, by project, by evaluation)
- Types of risks or critical situations that you want to train
- Security policies or internal protocols.
- Contextual information (location, technology used, sector)
- **Agent Outputs**
- Customized training program (with schedule and materials)

- Automatically generated interactive simulation
- Worker evaluation report
- Progress tracking dashboard (per user and per group)
- Automatic recommendations for new workouts or improvements
- Report on detected skills gaps
- Real-time alerts and suggestions in connected environments

#### **b. Practical applications**

- Initial and ongoing training of personnel in oil and gas fields
- Preparation for industrial or environmental emergencies
- Reducing incidents by simulating common errors
- Accelerating the onboarding of new employees in technical roles
- Monitoring critical knowledge in high-risk operations

### **V. Critical Situations in the Oil Industry**

The exploitation of unconventional hydrocarbons presents a series of critical situations that require specific personnel training to ensure the safety, efficiency, and sustainability of operations. These situations can be categorized into different types of risks:

Environmental:

- **Water Pollution:** Hydraulic fracturing, the method used for hydrocarbon extraction in Vaca Muerta, involves the use of large volumes of water and chemicals that can affect the quality of surface and groundwater. The possibility of these substances migrating underground and reaching aquifers used for human consumption is a major concern.
- **Air pollution:** Soil blasting and emissions from hydrocarbon exploration affect air quality, with consequences for the health of people living near the wells or facilities.
- **Soil degradation:** The lack of vegetation and bare soils in the area increase runoff and erosion, which reduces soil fertility.

- Induced seismicity: The injection of fluids into the subsurface during hydraulic fracturing can generate induced seismicity, with potential consequences for nearby infrastructure and populations.

#### Operational:

- Waste management: Drilling and operating wells generate large volumes of hazardous waste, such as oil blankets, drilling muds, and rock cuttings, which require proper treatment and disposal to minimize their environmental impact. The capacity of treatment plants to handle the growing volume of waste is a significant challenge.
- Leaks and spills: There is a risk of gas leaks and oil spills during extraction, transportation and processing operations, with serious consequences for the environment and human health.
- Equipment failures: The machinery and equipment used in the petroleum industry are complex and can fail, leading to accidents or production interruptions.

#### Social:

- Working Conditions: Oil industry workers may be exposed to long hours, extreme weather conditions, and toxic substances, which can affect their health and safety.

#### Economical:

- Price volatility: The oil industry is subject to international price volatility, which can affect the profitability of operations and investment in the region.
- Hidden costs of fracking: The environmental and social costs of fracking are not always accounted for in economic analyses, which can lead to an underestimation of the activity's true impact.
- Energy transition: Growing demand for renewable energy and the transition to a low-carbon economy represent a long-term challenge for the oil industry.

## **VI. Challenges and Limitations of Generative AI**

Despite its potential, implementing Generative AI in the creation of training guides also

presents challenges and limitations that must be considered:

- **Data Dependency:** The quality of the data used to train IAGen models is crucial to the accuracy, reliability, and effectiveness of the generated guidelines. It is essential to have complete, accurate, and representative data of the critical situations to be addressed in training.
- **Content Accuracy:** IAGen does not guarantee the accuracy of the generated content, so review and validation by subject matter experts is crucial. IAGen may make errors or generate incomplete information, so it is essential to have a quality control process to ensure the accuracy of the training guides.
- **Need for an Instructional Design Framework:** IAGen needs a robust instructional design framework to ensure content is relevant, effective, and impactful. It is important to define the learning objectives, content structure, and pedagogical strategies that will guide the creation of training guides.
- **Data Security:** The use of IAGen in business environments raises concerns about data confidentiality and security, especially when processing sensitive information. It is essential to implement security measures to protect data and prevent unauthorized access.
- **Risk of deepfakes:** AI can be used to create "deepfakes," which are fake videos or audio clips that appear real. This can be a problem in training, as deepfakes can be used to spread misinformation or manipulate employees.
- **Algorithm Bias:** IAGen's algorithms can be biased, which can lead to the generation of discriminatory or unfair content. It is important to use diverse and representative datasets to train IAGen models and minimize the risk of bias.
- **AI Hallucinations:** AI systems can produce results that are not based on real or accurate information, known as "hallucinations." It is important to be aware of this risk and validate the information generated by AI.
- **Difficulty in data recovery:** Recovering specific data from IAGen models can be difficult, which can make it difficult to comply with data protection regulations. It is important to consider the implications for data privacy and security when using IAGen.

## **VII. Strategy for Implementing Generative AI**

To implement Generative AI in the creation of training guides for the Vaca Muerta oil industry, the following strategy is proposed, which incorporates specific recommendations from the research:

1. **Needs assessment:** Identify specific training needs in critical situations, considering the risks, challenges, and regulations specific to the Vaca Muerta operation. This involves analyzing previous incidents, best practices, and areas where training can have the greatest impact on safety and efficiency.
2. **Data Collection:** Gather relevant data on critical situations, safety protocols, best practices, worker performance, environmental conditions, and applicable regulations. Ensuring the quality, integrity, and representativeness of the data is essential for training IAGen models.
3. **Short-term investment in AI agent implementation teams in technology and training:** Investment is required in proofs of concept and pilot testing. The focus here must be on developing the talent needed to implement these solutions, as there is a trend toward cost reduction in systems that enable "no-code" and "low-code" automation. For the first stage, it is also recommended to recruit teams with experience in AI agent design and implementation. Finally, it is key to form an in-house team to support and foster an agentic culture that redefines human-machine interaction.
4. **Creating training guides:** Use IAGen to create interactive simulations, multimedia content, customized assessments, and guides tailored to different roles, experience levels, and learning styles. It's important to ensure the guides are clear, concise, engaging, and easy to understand.
5. **Validation and Evaluation:** Validate the accuracy, effectiveness, and relevance of the guidelines generated by IAGen with the participation of subject matter experts, experienced workers, and local community representatives. Validation should ensure that the guidelines reflect best practices, regulations, and the specific conditions of Vaca Muerta.

6. **Implementation and Monitoring:** Implement training guides in a controlled environment and monitor their impact on worker performance, operational safety, and process efficiency. Monitoring should include collecting data on worker participation, knowledge retention, and application of learned skills on the job.
7. **Continuous improvement:** Adjust and improve training guides based on employee feedback, data analysis, and technological advances. Continuous improvement should be an iterative process that optimizes training effectiveness over time.
8. **Training and Change Management:** Implement a training program for staff who will be using IAGen tools and effectively manage change to ensure acceptance and adoption of the technology.
9. **Ethical Considerations:** Establish a governance framework to address ethical dilemmas that may arise with IAGen, such as issues of bias, data privacy, and the generation of deepfakes.
10. **Regulatory Compliance:** Ensure that IAGen tools comply with the most current legal and regulatory requirements regarding data use, privacy, and intellectual property rights. It is important to stay up-to-date on regulations and adapt IAGen tools to ensure compliance.
11. **Data Strategy:** Develop a robust data strategy that ensures the quality, availability, and security of the data used to train AI models. This involves implementing data collection, cleaning, labeling, and storage processes.

## **VIII. Cost-Benefit of Generative AI**

Implementing Generative AI in the creation of training guides requires an initial investment in software, hardware, staff training, and model development. However, the long-term benefits can outweigh the costs, generating a significant return on investment (ROI):

- **Cost reduction:** AI can automate tasks, optimize production, predict equipment failures, and improve energy efficiency, resulting in significant savings. Large-scale adoption of AI in the oil and gas industry could result in a 10–20% cost reduction.
- **Improved efficiency:** AI can accelerate content creation, personalize training,

provide real-time feedback, and optimize workflows, increasing the efficiency of the training process and freeing up employees' time to focus on more strategic tasks. On average, employees using Generative AI save 1.75 hours per day.

- Increased safety: AI can improve operational safety by providing realistic simulations of critical situations, empowering workers in decision-making, identifying risky situations in real time, and developing early warning systems.
- Increased knowledge retention: AI can personalize content, learning paths, and feedback, improving knowledge retention, skill development, and employee motivation.
- Improved customer service: Generative AI can provide fast, accurate, and personalized responses to customer queries, leading to higher levels of satisfaction and loyalty.
- Increased productivity: AI can automate routine tasks, freeing employees to focus on higher-value activities.

The ROI of Generative AI in training can be significant, especially in high-risk industries like the oil and gas industry, where safety, efficiency, and sustainability are crucial.

## **IX. Conclusions**

Generative AI has the potential to transform the creation of training guides in the Vaca Muerta oil industry. By generating realistic simulations, personalizing content, providing targeted feedback, improving safety, and promoting sustainability, AI can improve worker preparation for critical situations, increase operational safety, and optimize the efficiency of the training process.

While there are challenges and limitations, a proper implementation strategy, the selection of the right tools, and the involvement of subject matter experts can maximize the benefits of Generative AI. Investment in this technology can generate a significant long-term return, improving the safety, efficiency, and sustainability of the Vaca Muerta oil industry. Adopting Generative AI can provide a competitive advantage for companies,

allowing them to optimize operations, reduce costs, and improve safety more effectively than those that do not adopt this technology.

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