HUB TECH IA

Deliverable report 16

AI and IAGEN Application Use Case

Construction and installation - Safety - Development of protocols and work guides

I. Introduction

The oil industry in the Neuquén region, specifically in Vaca Muerta, faces fundamental challenges related to safety in the construction and installation of critical infrastructure. These challenges involve maintaining high standards in accident prevention, rigorous risk control, and continuous optimization of operating protocols. Opportunities arise through the implementation of advanced technologies to substantially improve incident prevention and response, thereby increasing operational efficiency.

In recent years, there has been an increase in oilfield activity, which has led to an increase in accidents and incidents. According to records, several oilfield worker deaths have been reported in the area in the last two years. The causes of these incidents are diverse, including on-site accidents, road accidents on poorly maintained roads, collisions between vehicles transporting personnel and materials, falling large objects, and well explosions.

II. IAGEN Specific Application

Generative Artificial Intelligence (GENI) is a branch of artificial intelligence that focuses

on creating new content, such as models, images, code, or text, from existing data. This technology uses advanced algorithms to analyze large amounts of information, identify patterns, and generate new and original content that is often indistinguishable from human-created content.

Generative Artificial Intelligence (GENI), particularly through platforms such as GPT-4 Turbo, Claude 3, and Gemini, can revolutionize the creation and updating of guides, protocols, and training programs specific to critical activities in oilfield construction and installation. These models are capable of generating content tailored to legal regulations, internal protocols, and specific operational situations, and also allow for the creation of virtual simulation scenarios using visual tools such as Stable Diffusion or Midjourney.

a. Creating Guides:

IAGEN can be used to generate customized safety guides for each specific task in oilfield construction and installation.

For example, GPT-4 Turbo can generate a detailed guide for working at height, including safety procedures, necessary personal protective equipment, and emergency measures. This guide could include step-by-step instructions for using harnesses, lifelines, and fall arrest systems, as well as emergency communication and rescue protocols.

Claude 3 can generate guides for handling chemicals, including information on their storage, transportation, and safe handling. These guides could include information on the classification of chemicals, the risks associated with their handling, necessary personal protection measures, and emergency procedures in case of spills or leaks.

b. Preparation of Protocols:

IAGENs can automate the creation of safety protocols, tailoring them to the specific needs of each operation. Claude 3 can generate safety protocols for handling hazardous liquids, including steps to isolate the area, notify supervisors, and conduct

safe cleanup. These protocols could include information on the use of personal protective equipment, spill containment, substance neutralization, and waste management.

c. Training Program Design:

IAGENs can create interactive and customized training programs for workers.

Gemini can generate questions and answers to assess workers' knowledge of safety procedures. For example, interactive learning modules could be created that include questions about the proper use of personal protective equipment, fire evacuation procedures, or the handling of specific tools.

You can also create simulations of risky situations so workers can practice decision-making in a safe environment. These simulations could recreate situations such as gas leaks, fires, or accidents involving heavy machinery, allowing workers to experience the consequences of their decisions and learn from their mistakes without jeopardizing their safety.

d. Generation of Simulation Scenarios:

IAGEN, in conjunction with imaging tools such as DALL-E and Midjourney, can create virtual accident simulation scenarios.

Midjourney can generate images of oil well accident scenes, including fires, gas leaks, and oil spills.

DALL-E can create images of risk scenarios for staff training, such as a worker exposed to a fall from a height.

These images can be used to create virtual reality simulations that allow workers to experience emergency situations in a safe and controlled manner. For example, a fire

evacuation drill on an oil rig could be created using images generated by DALL-E and Midjourney to recreate the virtual environment.

III. Specific Technologies Implemented

Technology	Description	Example of use in Vaca Muerta
GPT-4 Turbo	Advanced language model for text generation.	Generate safety procedures for working at height, including step-by-step instructions for the use of harnesses, lifelines, and fall arrest systems.
Claude 3	Language model specialized in the generation of protocols and technical documents.	Generate safety protocols for handling chemicals, including information on their storage, transportation, and safe handling.
DALL-E	Tool for generating images from textual descriptions.	Create images of risk scenarios for staff training, such as the representation of an oil

		spill at a Vaca Muerta location.
Midjourney	Image generation tool with a focus on industrial design.	Generate images of oil well accident scenarios, including fires, gas leaks, and oil spills, for use in virtual reality simulations.
Stable Diffusion	Tool for generating images and videos with a high degree of realism.	Develop hyper-realistic simulations for virtual immersive training, such as recreating a fire at a gas processing plant.
Drone Inspections	Drones equipped with cameras and sensors for infrastructure inspection.	Conduct safety inspections in hard-to-reach or hazardous areas, such as drilling rigs, pipelines, and storage tanks.

IV. Application of artificial intelligence agents powered by IAGEN

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. Detailed Agentic Flow Proposal for Implementation

- Initial Identification: The specific safety needs and critical scenarios of the operational area are clearly defined. At this stage, interviews with operational personnel would be conducted to identify critical scenarios and specific safety needs in each work area. Historical accident and incident data would also be analyzed to identify patterns and areas for improvement.
- IAGEN Model Selection: Selecting the most appropriate model based on performance and required expertise. The capabilities of different IAGEN models, such as GPT-4 Turbo, Claude 3, and Gemini, would be evaluated to determine which best suits the company's specific needs. Factors such as natural language processing capabilities, text generation, image analysis capabilities, and simulation creation will be considered.
- Specialized Training: Models trained with historical documents, specific regulations, and human feedback for precise customization. IAGEN models would be trained with data specific to the oil and gas industry, including historical safety documents, regulations, internal procedures, and best practices. Feedback from safety experts would also be incorporated to ensure the accuracy and relevance of the generated content.
- Automatic Generation: Instant creation of specific guidelines for each operational

activity. Once trained, IAGEN models can automatically generate guidelines, protocols, and training programs for various operational activities, such as working at height, handling chemicals, operating heavy machinery, and responding to emergencies.

- Automated Validation: Use of validation agents to ensure regulatory accuracy. Supervised AI systems would be implemented to automatically validate documents generated by IAGEN, comparing them with current regulations and industry best practices.
- Training and Simulation: Execution of customized virtual drills using automatically generated scenarios. Image generation tools such as DALL-E and Midjourney would be used to create virtual accident simulation scenarios, which would be integrated into virtual reality platforms for personnel training.
- Monitoring and Feedback: Real-time monitoring of practical use, with continuous feedback to improve the AI system. The use of the guides, protocols, and training programs generated by IAGEN would be monitored, and employee feedback would be collected to identify areas for improvement and fine-tune the AI system.

3. IAGEN Intelligent Agent for Operational Safety in the Oil Industry

a. Initial Identification

- **Objective** : To gain a deep understanding of security needs in critical operational areas.
- **Key actions** :
    - Structured interviews with operational staff.
    - Mapping of hazardous tasks and risk environments.
    - Analysis of historical accident and incident data to identify repetitive patterns.
    - Classification of critical scenarios (work at height, confined spaces, high pressure, hazardous materials).

b. IAGEN Model Selection

- **Objective** : Select the most appropriate generative AI model based on the complexity of tasks and requirements.

- **Selection criteria** :
    - Natural language processing capabilities (clear technical instructions).
    - Coherent generation of protocols and technical documents.
    - Image analysis for scene evaluation.
    - Scenario simulation capabilities.

c. **Candidate models** :
    - GPT-4 Turbo (OpenAI): High competence in text generation, complex contexts.
    - Claude 3 (Anthropic): Focused on alignment with principles of security and robustness.
    - Gemini (Google): Advanced multimodal capability and extended context.

d. Specialized Training

- **Objective** : Adapt the chosen model to the specific domain of oil operational safety.
- **Dataset** :
    - National and international regulations (OSHA, ISO 45001).
    - Internal security procedures.
    - Historical accident cases.
    - Feedback from experts and supervisors.
- **Methodology** :
    - Fine-tuning of the base model.
    - Incorporation of local technical language and petroleum glossary.

e. Automatic Generation

- **Objective** : Create protocols, guides, and training programs tailored to each operation in seconds.
- **Types of generated content** :
    - Protocols for safe work at height, confined spaces, and hazardous energies.
    - Emergency response and evacuation guides.
    - Chemical handling manuals.

    - Training programs by role and task.

f. Automated Validation

- **Objective** : Ensure that each document generated complies with current regulations.
- **Features** :
    - AI validation agents that check for regulatory consistency.
    - Comparison with national and international regulatory frameworks.
    - Automatic alerts in case of deviations.

g. Training and Simulation

- **Objective** : To train staff in simulated scenarios based on real risks.
- **Tools** :
    - Generation of visual scenes with DALL-E or Midjourney.
    - Integration with virtual reality (VR) environments.
    - Virtual simulations guided by the IAGEN model.

h. Monitoring and Feedback

- **Objective** : Keep the system updated and continuously improved.
- **Metrics and action** :
    - Record of use of guides and protocols.
    - Surveys and direct feedback from staff.
    - Analysis of effectiveness in the face of post-implementation incidents.
    - Periodic retraining of the model with new information and best practices.

4. Hypothetical Concrete Example Case

Simulated Scenario: A methane gas leak is simulated in a high-pressure valve located on the main gas collection line at a location in Vaca Muerta. The leak occurs during the afternoon, while preventive maintenance tasks are being performed. The location personnel detect the leak by the characteristic sound and smell of gas. The emergency protocol generated by IAGEN is immediately activated, which includes the following steps:

- Evacuation: Personnel are ordered to evacuate the location to a safe meeting point,

following the evacuation routes indicated on the map generated by DALL-E.

- Alert: Emergency response teams and supervisors are notified using an AI-integrated communication system.
- Leak Control: GPT-4 Turbo-generated instructions are followed to control the leak, including closing valves, activating ventilation systems, and applying containment techniques.
- Monitoring: Smart sensors are used to monitor gas concentrations in the area and ensure they remain within safe limits.
- Investigation: Once the leak is under control, an investigation is initiated using AI to analyze data collected by sensors and security cameras to determine the cause of the leak and prevent future incidents.

This simulation, created with Stable Diffusion, allows workers to experience the emergency situation in an immersive way and practice safety measures in a safe virtual environment.

V. Direct Operational and Strategic Benefits

- Safety Optimization: Significant reduction in workplace incidents and accidents thanks to clear, real-time protocols. For example, early risk detection using AI-powered security camera image analysis would identify unsafe behaviors or dangerous conditions in the work environment, such as the lack of use of personal protective equipment or the presence of obstacles in high-traffic areas, which in turn would facilitate timely intervention to prevent accidents. Combining AIGEN with real-time data from sensors can create a proactive safety system that anticipates and prevents accidents.
- Productivity Improvement: Saving 40% of the time typically spent on manual documentation and review. Automating the generation of security documents and protocols with IAGEN would free up valuable time for security professionals to focus on more strategic tasks, such as security planning, regulatory compliance monitoring, and risk management.

- Workload Optimization: AIGEN would be used to optimize workload and prevent physical stress on workers. By analyzing data such as individual performance, hours worked, and tasks completed, AI could recommend breaks at key times or redistribute tasks to prevent fatigue and fatigue-related injuries.
- Economic Savings: Reduction of operating expenses related to traditional in-person training by 30%. Implementing virtual simulations with IAGEN would reduce the need for costly in-person training, reducing costs in logistics, materials, and employee downtime.

VI. Expected Tangible Results

- Expected reduction in the workplace accident rate. This reduction would be achieved through a combination of proactive accident prevention using AI, improved staff training, and optimized safety protocols.
- Measurable increase in the accuracy of field procedure implementation. Accuracy in procedure implementation would be measured through real-time sensor data analysis, which would record workers' actions and compare them with established protocols. For example, sensors could be used on personal protective equipment to verify its correct use and on tools to monitor their proper handling.
- Improved emergency preparedness for staff through more effective and personalized virtual drills. The effectiveness of virtual drills would be measured by evaluating workers' performance in the simulation, including their ability to make sound decisions, follow emergency protocols, and work as a team.

VIII. Key Challenges and Implementation Strategies

- Technical challenges: Requires the integration of advanced technologies with existing systems. For example, integration with legacy systems would be achieved through the development of specific adapters that enable communication between new AI technologies and legacy systems. It would also require the implementation of a robust technological infrastructure that supports the processing of large

volumes of data and the execution of complex simulations. In addition, the need for personnel trained in the use of these technologies and in the interpretation of the data generated by AI must be considered.

- Cultural resistance to change: Staff accustomed to traditional methods may resist technological change. To overcome this resistance, pilot programs would be implemented with select groups to quickly demonstrate tangible benefits. Communication campaigns would also be conducted to inform workers about the advantages of AIGEN and how this technology can improve their safety and efficiency at work. It is essential to involve workers in the implementation process and provide them with clear information about the benefits of AIGEN to encourage acceptance.
- 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.

IX. Metrics and Impact Assessment

- Documented reduction in operational incidents. Real-time dashboards will be used to monitor incident reduction, comparing data before and after AIGEN implementation. AI-generated incident reports will also be analyzed to identify trends and areas for improvement.
- Significant reduction in downtime resulting from incidents. Worker downtime and production losses caused by incidents will be measured, comparing data before and after the implementation of IAGEN.
- Improved regulatory compliance through automatic and timely updates. Periodic audits will be conducted to assess compliance with security regulations, using AI to

analyze generated documents and protocols.

X. Conclusions

The implementation of IAGEN in the Vaca Muerta oil industry has the potential to revolutionize safety in construction and installation activities. By generating customized guides, protocols, and training programs, IAGEN can improve accident prevention, emergency response, and regulatory compliance. Despite the technical and cultural challenges, IAGEN offers significant benefits in terms of safety, productivity, and cost savings. The adoption of this technology is crucial to ensuring a safer and more efficient future for the Vaca Muerta oil industry.

Beyond the immediate benefits, AI can contribute to a long-term cultural shift in the industry, fostering greater awareness of safety and risk prevention. AI's ability to analyze data, identify patterns, and predict potential incidents can lead to the creation of a proactive safety culture, where prevention becomes a priority. To maximize these benefits, it is essential that AI implementation be accompanied by a continuous improvement process, adapting the technology to the changing needs of the industry and new regulations.

Recommendations

- Implement an IAGEN pilot program in a specific area of Vaca Muerta. This will allow for evaluating the technology's effectiveness in a real-world setting and making any necessary adjustments before large-scale implementation.
- Create a multidisciplinary team that includes security, technology, and IAGEN experts. This team will be responsible for planning, implementing, and monitoring the IAGEN program.
- Train staff on the use of IAGEN tools and new safety protocols. It is essential that workers understand the benefits of IAGEN and how this technology can improve

their safety and efficiency at work.

- Establish a monitoring and evaluation system for IAGEN's impact on security. This will allow for measuring the technology's effectiveness and making continuous improvements.
- Promote collaboration between oil companies, technology providers, and government institutions. Collaboration is crucial to ensure successful implementation of the IAGEN in Vaca Muerta.

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