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Smart Safety Solutions: Leveraging AI and Behavioral Data for Accident Prevention and Optimization in Oil and Gas Worksites (CGD Worksites)

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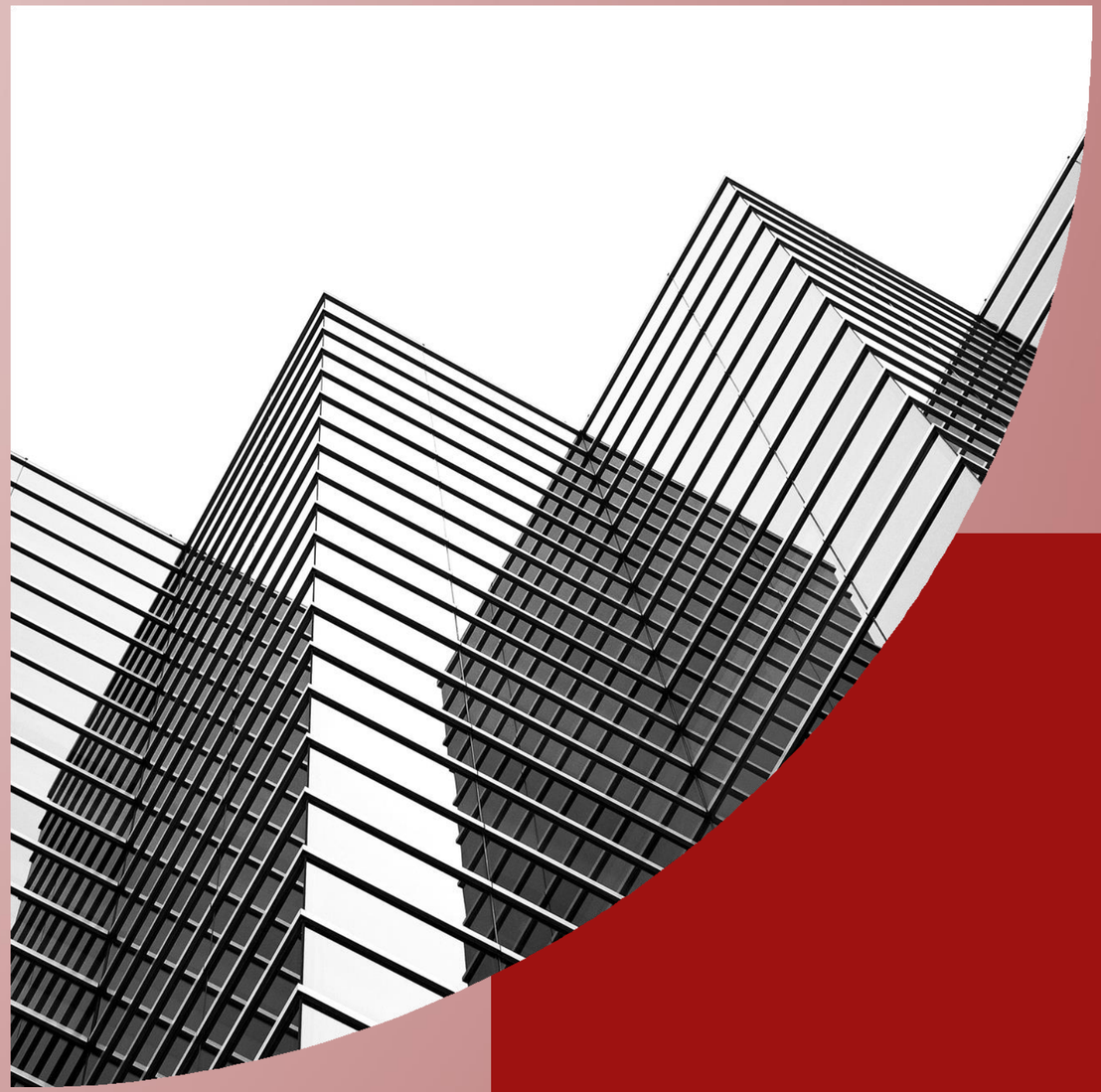
Objective

- **Accident-Free Zone:** Using AI-powered technology to track safety and ensure a completely accident-free workplace.
- **Safety First, Always:** Moving from "fixing problems" to "preventing them" with proactive measures.
- **Data-Driven Protection**: Analyzing worker actions to improve safety and keep everyone protected at all times.



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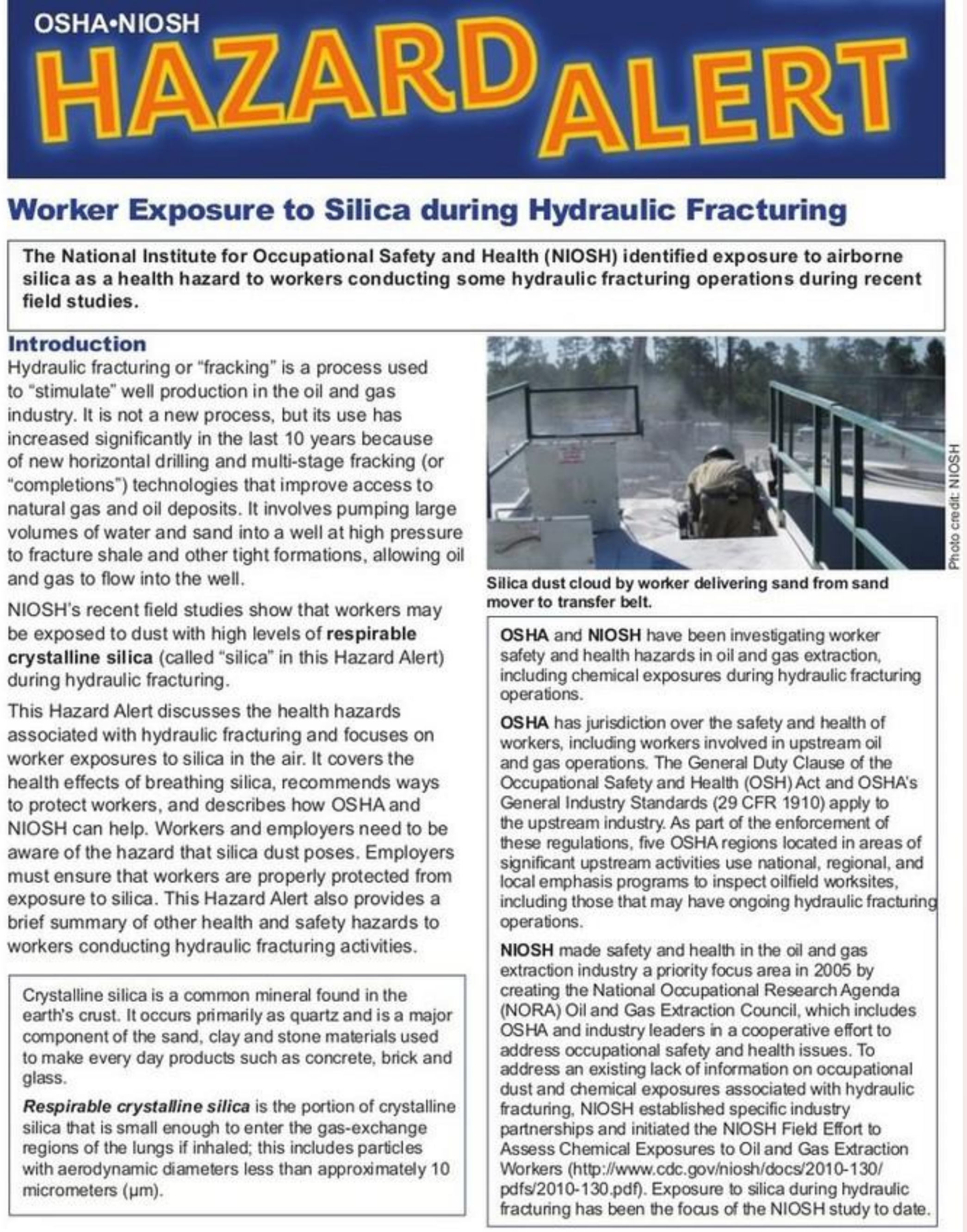
Current Problem Statement

1. Long paper forms and checklists make it hard for workers to report safety issues regularly.
2. Strict rules and limited tools make it hard for workers to share safety problems.
3. Delays in communication between RMs, SMs, and FMs and waiting for past reports to take action, makes safety enforcement inconsistent.
4. Safety relies on checklists and sensors, without smart systems to predict or detect dangers.
5. Current safety rules punish mistakes more than reward good behavior, which reduces motivation.



OSHA•NIOSH

HAZARD ALERT

Worker Exposure to Silica during Hydraulic Fracturing

The National Institute for Occupational Safety and Health (NIOSH) identified exposure to airborne silica as a health hazard to workers conducting some hydraulic fracturing operations during recent field studies.

Introduction

Hydraulic fracturing or "fracking" is a process used to "stimulate" well production in the oil and gas industry. It is not a new process, but its use has increased significantly in the last 10 years because of new horizontal drilling and multi-stage fracking (or "completions") technologies that improve access to natural gas and oil deposits. It involves pumping large volumes of water and sand into a well at high pressure to fracture shale and other tight formations, allowing oil and gas to flow into the well.

NIOSH's recent field studies show that workers may be exposed to dust with high levels of **respirable crystalline silica** (called "silica" in this Hazard Alert) during hydraulic fracturing.

This Hazard Alert discusses the health hazards associated with hydraulic fracturing and focuses on worker exposures to silica in the air. It covers the health effects of breathing silica, recommends ways to protect workers, and describes how OSHA and NIOSH can help. Workers and employers need to be aware of the hazard that silica dust poses. Employers must ensure that workers are properly protected from exposure to silica. This Hazard Alert also provides a brief summary of other health and safety hazards to workers conducting hydraulic fracturing activities.

Crystalline silica is a common mineral found in the earth's crust. It occurs primarily as quartz and is a major component of the sand, clay and stone materials used to make every day products such as concrete, brick and glass.

Respirable crystalline silica is the portion of crystalline silica that is small enough to enter the gas-exchange regions of the lungs if inhaled; this includes particles with aerodynamic diameters less than approximately 10 micrometers (μm).

Photo credit: NIOSH

Silica dust cloud by worker delivering sand from sand mover to transfer belt.

OSHA and **NIOSH** have been investigating worker safety and health hazards in oil and gas extraction, including chemical exposures during hydraulic fracturing operations.

OSHA has jurisdiction over the safety and health of workers, including workers involved in upstream oil and gas operations. The General Duty Clause of the Occupational Safety and Health (OSH) Act and OSHA's General Industry Standards (29 CFR 1910) apply to the upstream industry. As part of the enforcement of these regulations, five OSHA regions located in areas of significant upstream activities use national, regional, and local emphasis programs to inspect oilfield worksites, including those that may have ongoing hydraulic fracturing operations.

NIOSH made safety and health in the oil and gas extraction industry a priority focus area in 2005 by creating the National Occupational Research Agenda (NORA) Oil and Gas Extraction Council, which includes OSHA and industry leaders in a cooperative effort to address occupational safety and health issues. To address an existing lack of information on occupational dust and chemical exposures associated with hydraulic fracturing, NIOSH established specific industry partnerships and initiated the NIOSH Field Effort to Assess Chemical Exposures to Oil and Gas Extraction Workers (http://www.cdc.gov/niosh/docs/2010-130/pdfs/2010-130.pdf). Exposure to silica during hydraulic fracturing has been the focus of the NIOSH study to date.

Hindustan Times

New tech developed to explore oil, gas

Wadia scientists have come up with AI-based technology to analyse data

Kalyan Das

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DEHRADUN: Scientists at the Wadia Institute of Himalayan Geology (WIHG) have come up with a new artificial intelligence (AI) based technique to analyse data from seismic waves (natural or induced by explosive material) to ascertain the type of rock formation and geological features beneath the surface which could help in exploring hydrocarbons like oil and natural gas in less time with high efficiency.

The technique was first tested by WIHG scientists in the Taranaki Basin of New Zealand.

The research on the new technique was conducted by WIHG director Kalachand Sain and WIHG's other research associate Priyadarshi Chinmoy Kumar. Their research on the technique named 'Machine learning tool for interpretation of Mass Transport Deposits from seismic data' was published in the noted journal Nature Scientific Report on August 24.

Terming the new technique a very significant one, the researchers claimed that they have received several requests

A view of Wadia Institute of Himalayan Geology. HT PHOTO

companies have also contacted them to share the research on the new technique.

Director Sain said the new technique interprets various aspects of a sub-surface (beneath the surface) area using the data acquired from the surface in 'very less time but with high accuracy and efficiency'.

"In the existing technique available for the study of various aspects of the sub-surface area like rock formation, geometry or architecture of rocks, shifting of tectonic plates and others, is mainly done manually which is a very time consuming and laborious process.

This new AI-based technique just needs to be fed surface data acquired, to study the sub-surface area and give highly efficient and accurate results in a

hours and even days to interpret the sub-surface area manually.

"Conventionally, the interpretation is done manually, in a phase-by-phase manner which sometimes takes days to complete that too with chances of human errors which can prove very costly.

This machine learning tool or AI-based technique developed by us, interprets the data with minimum human involvement in few seconds with almost zero room for error," said Sain.

"This technique is very significant in the exploration of oil or natural gas in the sub-surface area and analysis of complex sub-surface features of any area by producing the end result in the form of a 3D image."

Sain's co-researcher in finding the technique, Priyadarshi

naki Basin of New Zealand.'

"During the test, it produced very accurate results.

We compared the time taken by it for giving the result with that of conventional one with human involvement, in which we found that it took just 21 seconds while the latter took about 40 hours," said Kumar.

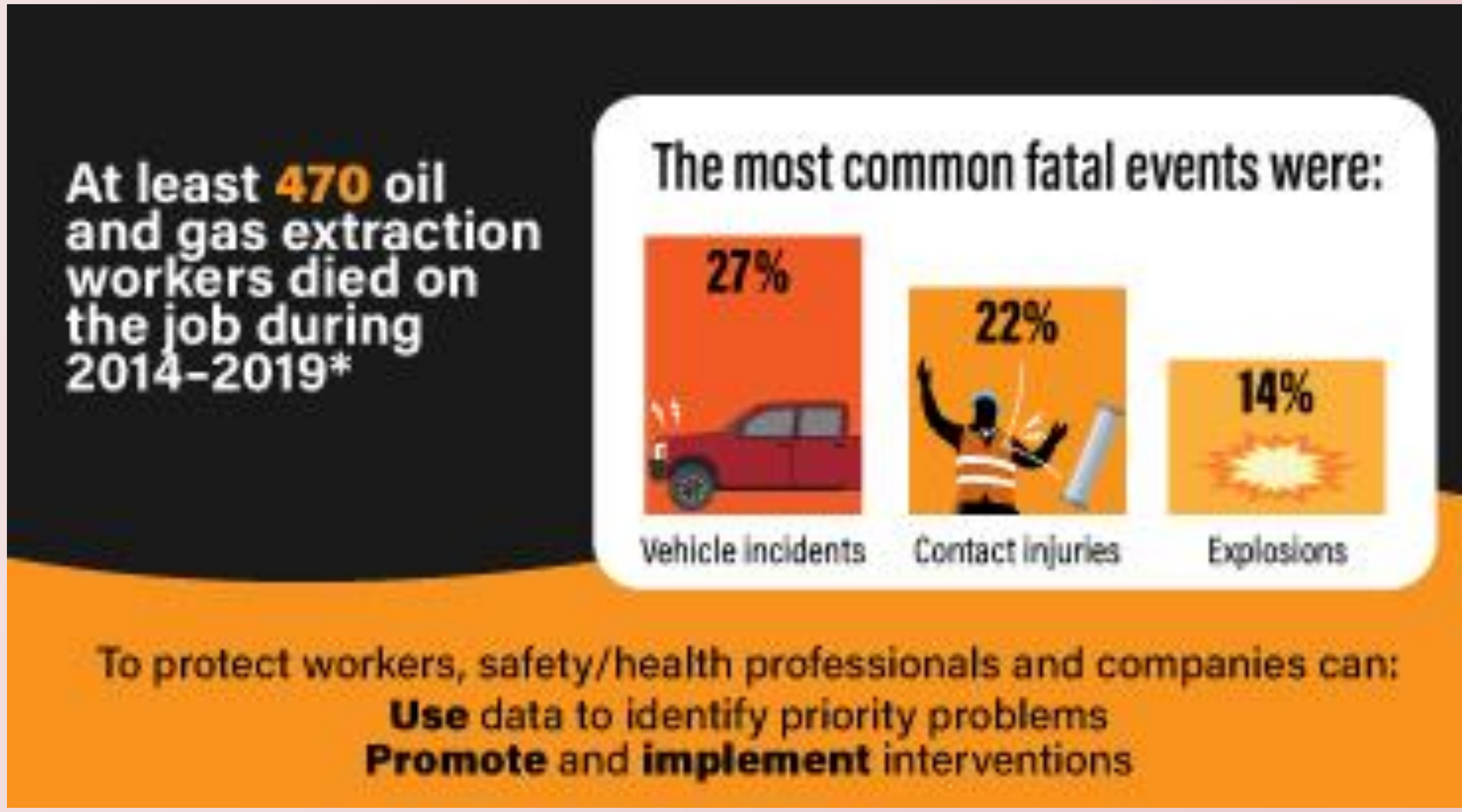
Explaining the significance of the technique Kumar said, "It is one of the most sought-after techniques in oil and gas exploration industry around the world and in the field of geoscience."

He informed that in the process of analysing any geo-surface area, there are three phases including acquiring data from seismic waves, its processing and then interpretation. The new AI-based technique becomes important in the interpretation phase.

"In the whole analytical process, the interpretation of processed data is very important. A mistake in it would reflect in the end result which could result in heavy loss of resources, especially in oil and gas exploration. If the end result is faulty, then the people involved in drilling will drill at the wrong place which would result in a significant amount of money and time going to waste.

Our technique produces reliable, accurate and efficient interpretation results, almost ruling out the above possibility," he said.

"The technique could be also



Health and Safety in Oil and Gas Extraction

Reducing the exposure of oil and gas workers to health and safety hazards

Introduction

Hundreds of thousands of people work in oil and gas extraction in the United States;[1] ensuring their health and safety is a major concern for employers, regulators, trade associations, industry groups, and local communities. Work in this industry involves physical labor, 24/7 operations, heavy machinery, hazardous chemicals, often-remote locations, and all weather conditions, resulting in an elevated risk of physical harm and the need for special protections to reduce this risk.

Physical Safety: Fatalities

From 2007 to 2016, more than 1,000 workers were killed in oil and gas extraction operations, a fatality rate six times higher than the average rate for all U.S. workers (21.6 vs. 3.5 per 100,000 workers).[2] Transportation events were the leading cause of death during this time period, making up 42% of all fatalities; most of these were the result of motor vehicle crashes. Worker fatalities also resulted from contact with objects/equipment (25%), fires/explosions (14%), exposure to harmful substances/environments (9%), and falls (8%). While the industry's fatality rate remains high, it decreased by 36% between 2003 and 2013 – a period during which the industry workforce was growing rapidly – suggesting that safety efforts may be yielding positive results.[3]

Chemical Exposure: Health Hazards

While fatal work injuries have been well studied, less is known about other health hazards. Since 2010, the National Institute for Occupational Safety and Health (NIOSH) has conducted field studies in partnership with industry to better identify chemical exposure hazards.[4] The major hazards identified through these studies were respirable crystalline silica dust during hydraulic fracturing and exposure to hydrocarbon gases and vapors when manually sampling oilfield tanks:[5]

Silica dust – Large quantities of silica sand are used during hydraulic fracturing. Loading and transferring this sand at the well site generates respirable-sized silica dust particles in concentrations that may exceed occupational exposure limits.[6]

Silica dust clouds from delivery trucks loading into sand movers at a hydraulic fracturing site. Inhalation of this silica is a major hazard associated with oil and gas operations. Image credit: Michael Breitenstein, National Institute for Occupational Safety and Health.[7]

Other processes that generate silica dust at the well site may include drilling with air and mixing cement to construct or plug a well. Inhalation of silica dust is associated with silicosis, other respiratory issues, and potentially other adverse health effects.[8] NIOSH recommends monitoring worker exposure and, when necessary, controlling exposure with engineering controls and improvements to work practices and procedures.[9] New Occupational Safety and Health Administration (OSHA) standards for silica take effect on June 23, 2021 for hydraulic fracturing operations, which are expected to implement engineering solutions that limit silica exposure.[10]

Hydrocarbon gases and vapors – Tanks holding crude oil or produced water are common in the oilfield. These tanks may be manually measured and sampled, which may expose workers to dangerous levels of hydrocarbon gases and vapors given off by these liquids. Between 2010 and 2014, at least nine oilfield workers died as a result of this exposure. In response, NIOSH and OSHA published a hazard alert related to manual tank gauging, which recommends using alternative systems to measure and sample

Behaviour-Based Safety (BBS)

- Behavior-Based Safety (BBS) is a systematic, proactive approach to improving workplace safety by focusing on identifying, observing, and addressing unsafe behaviors and conditions.
- The primary objective of BBS is to reduce workplace accidents and injuries by promoting safe practices and fostering a culture of accountability and continuous improvement.
- BBS emphasizes observing employee actions and workplace conditions, engaging in direct counseling at the workplace, and involving key stakeholders such as workers, supervisors, officers in charge, department heads responsible for job execution, and leadership roles, including functional heads who oversee safety permits and execution.
- Additionally, BBS integrates structured feedback to management, profiling safety trends, identifying training needs, and ensuring the implementation of necessary safety measures.

Key Elements of BBS

- Systematically monitor employee work practices and workplace conditions to identify at-risk behaviors and hazards.
- Observations focus on improving safety without assigning blame to individuals.

- Anyone in the organization (e.g., AGCL) can conduct BBS observations, discuss findings, and upload evidence with suggestions for improving safety.
- Trends, like those in the CGD Area, are tracked and analyzed to recommend actions that prevent future incidents.

Observation

Counselling & Collaboration

- Conduct workplace counseling sessions with workers, supervisors, and department heads to address safety concerns and promote awareness.
- Foster open communication at all organizational levels to encourage shared accountability for safety.

Agreement During BBS

Feedback

- Provide timely and constructive feedback to reinforce safe behaviors and conditions.
- Offer coaching and support to correct unsafe practices.
- Share insights and observations with management to guide strategic safety decision-making.

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Key Elements of BBS

- Actively involve employees in identifying hazards and proposing practical solutions.
- Empower workers to take responsibility for their own safety and the safety of their colleagues.

Employee Involvement

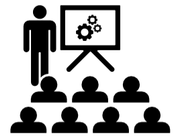
Leadership Commitment

- Engage leaders, including functional heads and safety officers, to lead by example and prioritize safety initiatives.
- Integrate safety responsibilities into leadership roles, including safety permit approval and execution oversight.

- Collect and analyze observation and feedback data to identify patterns, trends, and high-risk areas.
- Use data insights to design targeted training programs and implement safety interventions effectively.

Data-Driven Approach

Training & Development



- Profile employees to identify specific training needs based on observed behaviors and conditions.
- Conduct regular training sessions to enhance safety awareness and improve safety-related skills.

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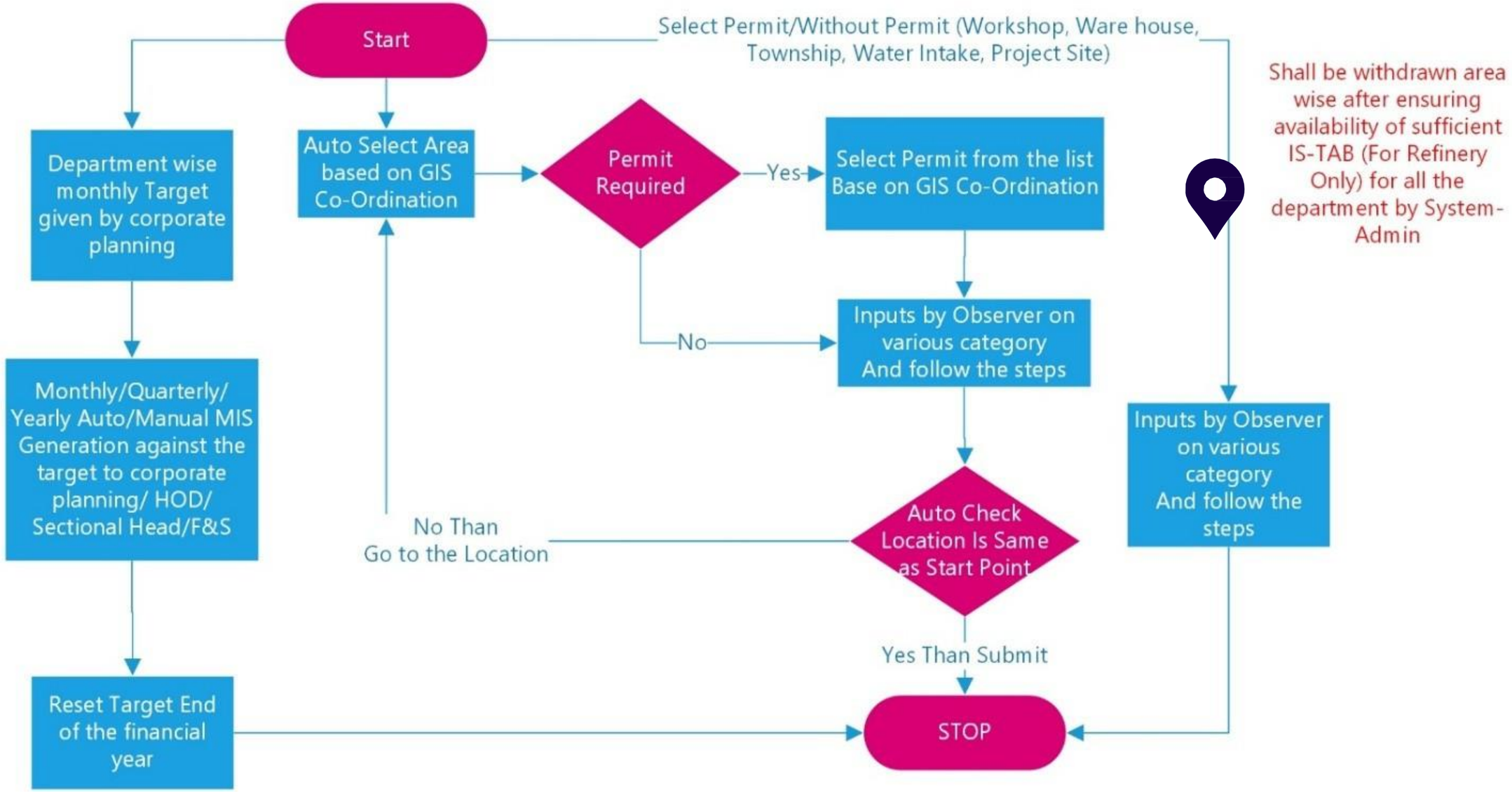

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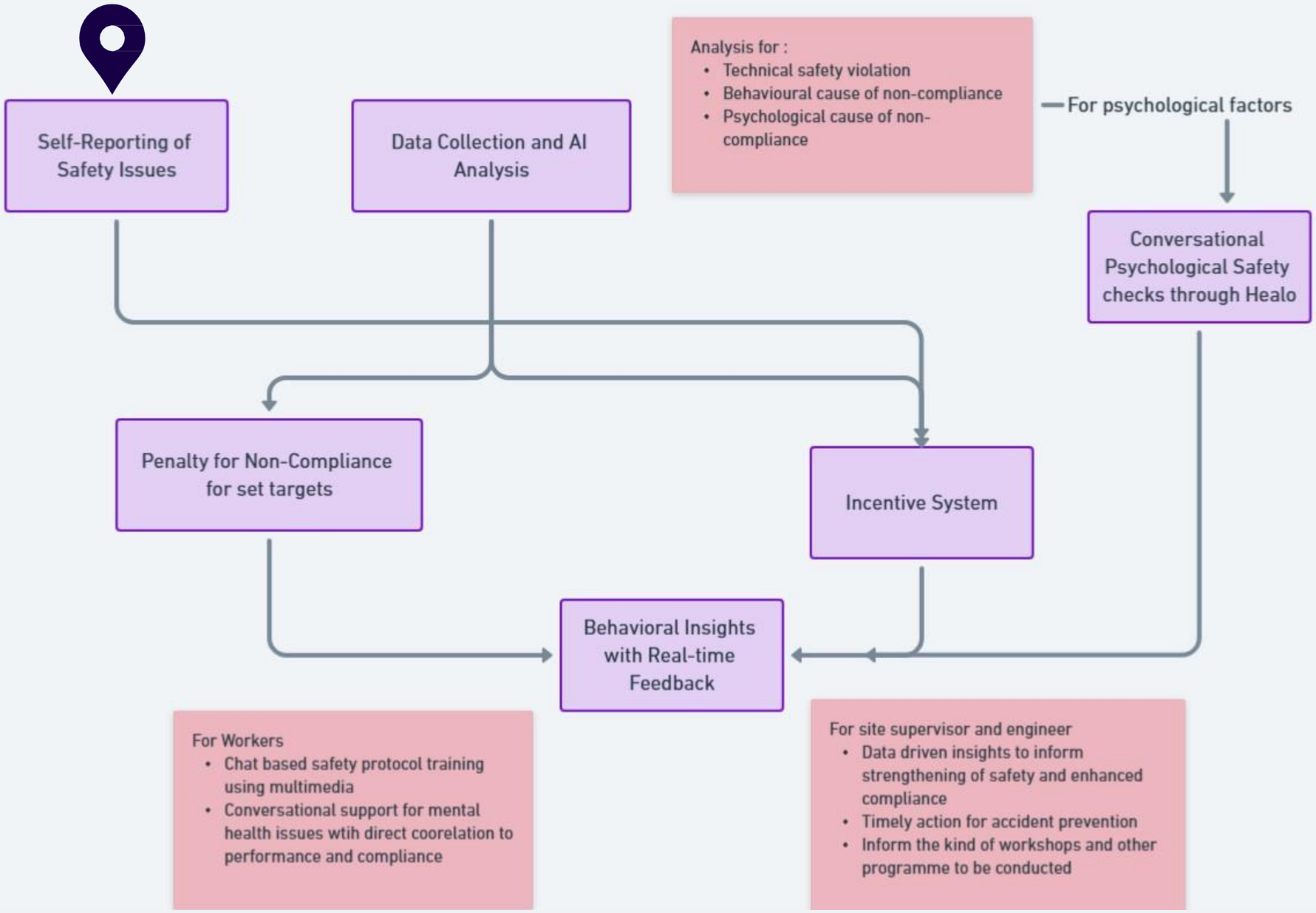

Leveraging AI for a Proactive Safety Culture

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AI-Powered Chat Application

User-friendly chat application integrated with WhatsApp, leveraging AI to understand worker sentiment and safety concerns. This conversational approach encourages worker participation and provides a platform for continuous feedback.

Conversational Safety Checks

The AI chatbot incorporates subtle safety-related questions into casual conversations, making safety checks feel less intrusive and more natural. This approach increases the likelihood of honest and comprehensive responses.

Auto- Data Collection and Analysis

System collects data on worker well-being, safety practices, and reported hazards through chat. This data is analyzed to identify patterns, trends, and potential risks, enabling managers to make informed decisions.

Self-Reporting of Safety Issues

Workers can report safety issues or non-compliance directly through the chat application. This empowers workers to be active participants in safety, promoting a culture of accountability and responsibility.

Building a Culture of Safety: Incentives and Feedback

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Incentive System

A points-based incentive system rewards workers for active participation in the chat application and for reporting safety issues. Points can be exchanged for rewards, such as bonuses, extra leave, or other benefits.

Penalty for Non-Compliance

Workers who consistently ignore safety protocols or fail to participate in the chats may receive penalties based on scoreboard (visible to workers) . This system encourages behavioral changes and ensures that everyone takes safety seriously.

Behavioral Insights and Feedback

The AI analyzes worker interactions and identifies potential safety risks. It provides personalized feedback to workers during their chats in local language at their literacy level, promoting awareness and encouraging safer practices.

Emergency Reporting (SOS Button)

An SOS feature allows workers to instantly report emergencies to site, regional, or floor managers. This ensures a rapid response to critical situations and minimizes potential risks.

Impact: Transforming Safety Culture and Performance

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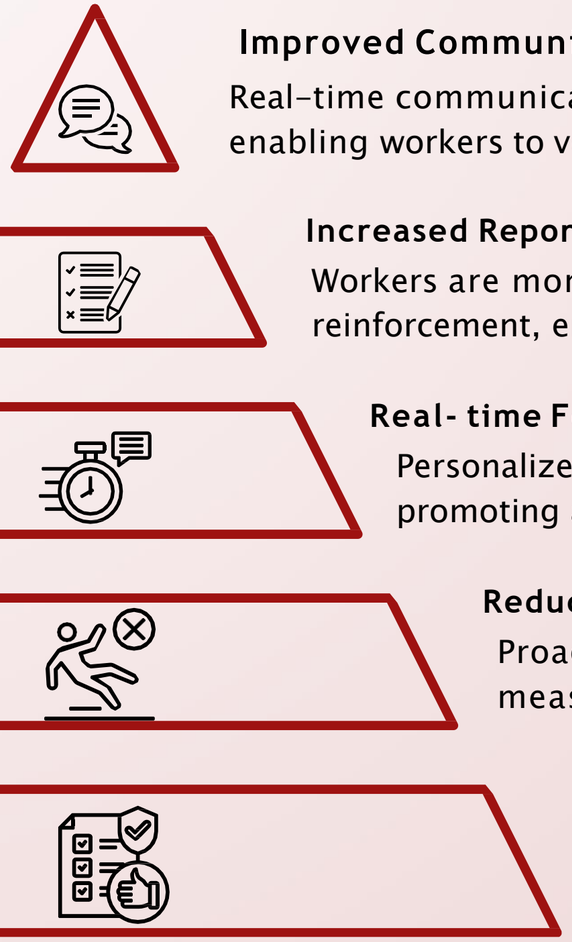

Improved Communication

Real-time communication fosters a more collaborative and transparent work environment, enabling workers to voice concerns and receive immediate feedback.

Increased Reporting

Workers are more likely to report safety issues due to the easy-to-use platform and positive reinforcement, enhancing proactive safety measures.

Real- time Feedback and awareness

Personalized feedback and interactive conversations reinforce safety procedures, promoting a culture of awareness and responsibility among all workers.

Reduced Accidents and Quick Addressal

Proactive hazard identification, timely interventions, and a focus on preventative measures lead to a significant reduction in accidents and incidents.

Improved Compliance

The incentive system and consistent feedback drive a higher level of compliance with safety regulations, creating a safer work environment.

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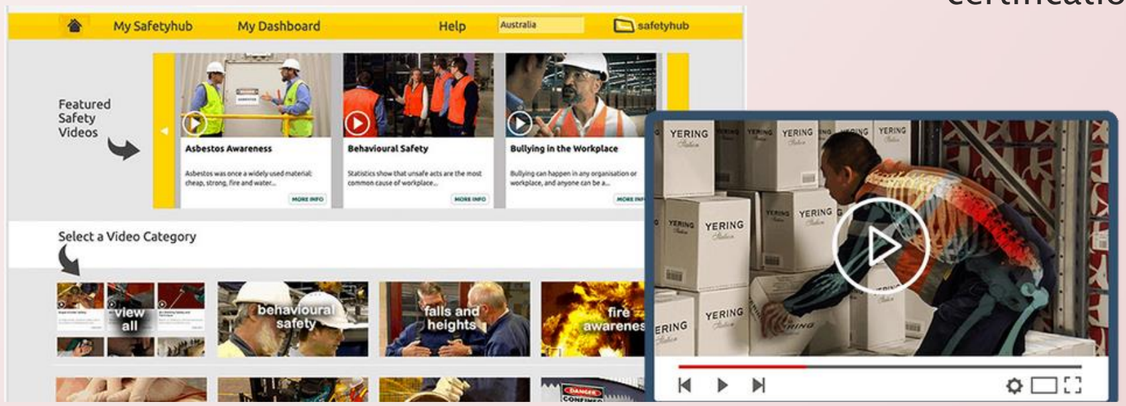
Safety Awareness and Education

Digital Safety Hub

Launch a digital Safety Awareness Hub with interactive safety modules, multilingual training videos, and scenario-based learning tailored to oil and gas operations.



Proactive Learning

Conduct simulation exercises and gamified quizzes for proactive learning and compliance reinforcement. Implement a real-time progress dashboard accessible to Reporting Managers (RM) and Site Managers (SM) to monitor participation rates and completion of mandatory safety certifications.

Data Monitoring via CCTV and Sensor Integration

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AI-Enhanced CCTV

Install AI-enhanced CCTV systems to monitor critical zones for: PPE compliance (e.g., helmets, gloves, visibility gear). Restricted zone entry detection. Group gatherings violating safety protocols.

Sensor Integration

Integrate AI-analyzed temperature and air quality sensors to monitor environmental conditions. Real-time alerts through site-wide speakers and on-screen notifications for immediate hazard warnings. Cloud-based storage for safety data, ensuring accessibility for safety officers and management.

AI-Powered Real-Time Safety Analytics

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Hazard Detection

Implement AI-powered assessment tools capable of real-time hazard detection through: Unsafe movement analysis (e.g., improper lifting techniques). PPE usage monitoring with entry restrictions for non-compliance.

Proactive Risk Reporting

Automated risk assessment reports generated from CCTV and sensor data. Identification of patterns for recurring safety breaches. Define Key Performance Indicators (KPIs) such as: Reduction in safety violations. PPE compliance rates. Incident reporting frequency.

Wearable Safety Devices with AI

Introduce smart helmets and vests with integrated sensors to: Track worker vitals (heart rate, stress levels) for fatigue monitoring. Detect proximity to hazardous areas and provide audio alerts in real time.