

## Enhancing Occupational Safety Performance through the Implementation of UCAD in Drilling and Well Intervention Operations

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### Abstract

**Introduction:** The oil and gas industry carries high operational risks, particularly in drilling and well intervention activities, where incidents such as near misses continue to occur despite existing safety systems **Objective:** This study evaluates the implementation of the Upgrading Competency and Awareness Database (UCAD) system in mitigating risks within drilling and well intervention operations **Method:** A qualitative descriptive case study approach was employed, utilizing field observations, technical document reviews, and in-depth interviews with safety officers and operational personnel. **Result and Discussion:** The UCAD system implementation was categorized as poor, with a compliance rate of 38.5%. Significant gaps were identified in data utilization, personnel participation, and well control competency. Critical areas requiring improvement include inspections of well control equipment, dropped objects, hoisting systems, and pressurized systems. **Conclusions:** Cumulative participation in the program has not yet been achieved, and improvements are required in both system implementation and personnel competency development. Strengthening technical training and enhancing supervision are essential to prevent major accident hazards and to improve over all safety performance in drilling and well intervention operations.

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### **Introduction**

The upstream oil and gas industry is recognized as one of the highest-risk industrial sectors due to the complexity of its operational activities, particularly drilling and well intervention (DWI) operations. DWI activities involve hazardous conditions such as exposure to flammable gases, high-pressure systems, heavy equipment movement, and work at height, all of which increase the potential for fires, explosions, and serious occupational injuries. Within Pertamina Hulu Energi, DWI operations contributed 29% of total workplace incidents as of October 2025, making them the leading source of operational accidents compared to other activities such as maintenance, inspection, and testing. The dynamic characteristics of DWI operations, including workforce rotation and continuous equipment mobilization, further increase operational risk exposure. These conditions emphasize the importance of implementing effective Occupational Health and Safety (OHS) systems supported by preventive measures, supervision, and risk mitigation strategies to reduce workplace accidents and improve operational safety performance (Ashari, 2022). In addition, maintaining safety performance in high-risk operations requires not only technical controls but also strong worker awareness and safety culture within the organization (David & Emmanuel, 2025).

Despite the existence of occupational safety regulations and company-level safety programs, workplace accidents in Indonesia's oil and gas industry remain relatively high. Data from PT Pertamina Hulu Energi between January 2023 and June 2025 recorded 3 fatalities and 6 Lost Time Incidents (LTI) in DWI operations, alongside other incident categories such as Restricted Work Day Cases (RWDC), Medical Treatment Cases (MTC), and First Aid Cases (FAC). Several incidents occurring between 2023 and 2025 also indicated that unsafe actions and unsafe conditions remain dominant contributing factors in DWI accidents. This situation demonstrates that existing safety management systems have not yet fully addressed behavioral and operational safety challenges in the field. In response to these conditions, PT Pertamina Hulu Energi implemented the Upgrading Competency and Awareness Database (UCAD) program as part of its effort to strengthen worker competence, hazard awareness, and intervention capability. The UCAD program is intended to empower workers to identify hazards, improve safety compliance, and support proactive accident prevention in high-risk operational environments (Bahtiar *et al.*, 2019).

However, the implementation of the UCAD program has not been fully optimized due to several operational and technical limitations. One of the main challenges is the dependency of the web-based UCAD system on internet connectivity, which becomes problematic in remote operational areas where network access is unstable or unavailable. These limitations make it difficult to monitor personnel who have not completed UCAD assessments or who achieve below-expectation scores during operational activities. In addition, workers frequently experience interruptions during assessments because of unstable connections, resulting in incomplete tests when the allocated time expires. Another issue identified in the implementation process is the integration of offshore and onshore assessment questions within the same system, causing confusion among workers when answering questions unrelated to their operational environment. These findings show that both technological constraints and system design weaknesses reduce the effectiveness of UCAD implementation in supporting operational safety performance.

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Previous studies have highlighted the importance of digital safety systems in improving usability, functionality, and worker engagement in occupational safety programs. Research by Welly Triantoro (2024), showed that web-based and smartphone-based safety applications can improve operational effectiveness through better user interfaces, expanded platform compatibility, and enhanced assessment features incorporating multimedia elements such as images, audio, and video. Other studies also emphasize that occupational safety implementation should not focus solely on administrative compliance but must strengthen behavioral safety aspects and worker participation in identifying hazards (Aderamo *et al.*, 2024). Effective safety communication, supervision, and continuous training are considered essential factors in improving worker compliance and reducing workplace accidents in hazardous industries (Ashari, 2022). Although previous studies have discussed digital safety systems and behavioral safety approaches separately, limited research specifically examines the implementation of UCAD in drilling and well intervention operations within the context of operational risk mitigation and safety performance improvement.

Based on these conditions, this study aims to evaluate the implementation of the UCAD program in drilling and well intervention operations at PT Pertamina Hulu Energi Regional 4 Eastern Indonesia. The study focuses on identifying factors influencing UCAD implementation, assessing its contribution to improving occupational safety compliance, and analyzing challenges affecting worker participation and system effectiveness. In addition, this research proposes improvements through dashboard integration, enhanced monitoring systems, and updated assessment features to strengthen operational safety management. The study also seeks to support the development of a more proactive safety culture by improving worker competence, communication, and awareness regarding operational hazards. Through this approach, the research is expected to provide practical recommendations for optimizing UCAD implementation and reducing workplace accident risks in DWI operations.

### **Method**

This study employed a qualitative approach with a descriptive qualitative research design to comprehensively examine the effectiveness of the UCAD program in reducing workplace accident rates and improving safety compliance in drilling and well intervention (DWI) operations. The qualitative design was selected because the primary objective of this research is to explore and understand complex phenomena related to safety behavior, worker participation, and program implementation within a real operational context. This approach allows for an in-depth analysis of the influence of multiple factors, including workers' understanding of UCAD, the impact of UCAD implementation, and the effectiveness of UCAD-related training on participation levels. Qualitative research is particularly suitable for capturing contextual and experiential data that cannot be fully represented through quantitative measures alone.

The study integrates structured questionnaires, direct field observations, and semi-structured interviews with Health, Safety, and Environment (HSE) personnel, supervisors, and onsite leaders to identify both enabling and inhibiting factors affecting UCAD implementation. The focus of the study includes the level of understanding of UCAD, awareness of occupational risks, effectiveness of communication and campaign media, and the impact of UCAD implementation on accident reduction efforts. This research incorporates the development of updated UCAD assessment materials aimed at

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enhancing workers' learning experiences and strengthening safety awareness in operational settings.

The research was conducted within PT Pertamina Hulu Energi, specifically in the Upstream Subholding operations across DWI operational areas, with a primary focus on Regional 4 PT Pertamina EP Cepu in Eastern Indonesia, covering Zones 11 to 14. These locations were selected due to their high-risk, dynamic, and cost-intensive operational characteristics, as well as the diverse work patterns associated with onshore and offshore activities. The study involved workers directly engaged in DWI operations, who are exposed to high occupational risks, making the UCAD program highly relevant for evaluation. The research period spanned from January 2026 to April 2026. The researcher's position as part of the operations team provided direct access to daily operational activities, enabling participatory observation and deeper insights into real-world practices. This approach aligns with ethnographic principles that emphasize the importance of insider perspectives in understanding social and operational phenomena.

The subjects of this study consisted of oil and gas workers involved in DWI operations and HSSE personnel responsible for supervising and implementing the UCAD program. Participants were selected using purposive sampling, focusing on individuals with direct experience and involvement in DWI activities, both onshore and offshore, across Regional 4 Zones 11 to 14. This sampling technique ensures that the selected participants possess relevant knowledge and experience necessary to provide meaningful insights into the research problem. The object of the study includes UCAD implementation processes, communication practices, supervision mechanisms, and assessment outcomes that influence safety compliance levels in DWI operations. The research focused on active operational projects within the study area during the period from September 2025 to April 2026.

The population of this study consisted of 105 personnel, including workers, supervisors, and HSE teams involved in DWI operations. The sample size was determined using the Slovin formula to ensure representativeness with an acceptable margin of error. The formula used is as follows:

$$n = \frac{N}{1+N \times e^2} \quad (1)$$

where  $n$  represents the sample size,  $N$  is the total population (105), and  $e$  is the margin of error (0.05). Based on the calculation total of 83 respondents were selected proportionally and randomly from the population that met the research criteria. This sampling approach ensures that the data collected accurately reflects the characteristics of the population while maintaining statistical reliability. The use of Slovin's formula is widely accepted in social research to determine appropriate sample sizes when population variability is not fully known.

The research instruments included structured questionnaires, observation checklists, and interview guidelines designed to measure five main variables: level of understanding, work supervision, communication effectiveness, UCAD training, and safety compliance. The questionnaire employed a Likert scale ranging from 1 to 5, representing strongly appropriate (1), appropriate (2), moderately appropriate (3), inappropriate (4), and strongly inappropriate (5). This scaling method allows for the quantification of subjective perceptions related to UCAD implementation and safety behavior. Observations were conducted directly in the field to assess workers' compliance with UCAD procedures, while interviews were carried out with supervisors and workers

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to gain deeper insights into communication, supervision, and implementation challenges. All instruments were developed based on theoretical frameworks and previous studies, and they underwent validity and reliability testing prior to data collection. The triangulation of these instruments enhances the robustness and credibility of the research findings by integrating multiple data sources.

The research process was conducted through several systematic stages, including preparation, data collection, data analysis, and reporting. Data collection involved distributing questionnaires, conducting field observations, and performing in-depth interviews with relevant stakeholders. Data analysis was carried out using a triangulation method, integrating interview data, observational findings, and supporting documents such as standard operating procedures (SOPs). The analysis followed the framework proposed by Miles and Huberman, which consists of data reduction, data display, and conclusion drawing. Data reduction involved filtering and organizing raw data into meaningful categories, while data display facilitated the identification of patterns and relationships. Conclusions were drawn based on recurring themes and validated through cross-verification of multiple data sources. Ethical considerations were strictly observed throughout the study, including informed consent, confidentiality, voluntary participation, and compliance with applicable regulations. Ethical clearance was obtained from the relevant institutional review board, and formal organizational permission was secured from PT Pertamina Hulu Energi.

### Result and Discussion

#### 1. Result

The data analysis in this study utilized a five-point Likert scale, where each questionnaire item was answered by respondents based on their perception of the effectiveness of the UCAD program in DWI operations. Multiple linear regression analysis was applied to examine the influence of UCAD understanding, communication, and UCAD training on occupational safety compliance. This analytical approach aims to identify the extent to which these independent variables simultaneously and partially contribute to improving safety compliance among workers. The interpretation of questionnaire results is based on a predefined effectiveness classification system, ensuring consistency in evaluating the UCAD program's performance. The results of the regression analysis support the relationship between program variables and safety outcomes, reinforcing previous findings that structured safety programs significantly influence worker behavior (Ashari, 2022). The parameter classification used in this study is presented in Table 1.

**Table 1**  
UCAD Program Parameter Classification

Score	Code	Effectiveness Category	Average Score Range
5	SS: Strongly Agree	Very Effective	4.21 - 5.00
4	S: Agree	Effective	3.41 - 4.20
3	CS: Moderately Agree	Moderately Effective	2.61 - 3.40
2	TS: Disagree	Ineffective	1.81 - 2.60
1	STS: Strongly Disagree	Very Ineffective	1.00 - 1.80

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Table 1. presents the conversion parameters used to interpret the average scores obtained from the questionnaire into effectiveness categories. The “Very Effective” category (4.21-5.00) shows that the UCAD program is highly optimal and has a significant impact on reducing workplace accidents in DWI operations. Conversely, the “Very Ineffective” category (1.00-1.80) reflects that the program does not operate optimally and has minimal impact on safety improvement. This classification framework is consistently applied throughout the analysis to ensure objective interpretation of the results. The use of structured categorization enhances the reliability of qualitative-to-quantitative transformation in perception-based studies (Welly Triantoro, 2024). It also allows comparison across different variables influencing safety compliance. Therefore, this parameter serves as the foundation for evaluating the effectiveness of UCAD implementation. The detailed results of the questionnaire analysis involving 100 respondents are showed in Table 2.

**Table 2**  
Questionnaire Results on UCAD Program Effectiveness (n = 100)

No	Question	SS (5)	S (4)	CS (3)	TS (2)	STS (1)	Average Score	Category
1	Workers understand rights and obligations in UCAD implementation	25	60	10	5	0	4.05	Effective
2	Workers can distinguish safe and unsafe conditions	20	65	10	5	0	4.00	Effective
3	Workers understand hazard risk indicators during return-to-duty period	15	60	10	5	0	3.70	Moderately Effective
4	Workers are protected from sanctions when applying UCAD results	15	45	30	10	0	3.65	Moderately Effective
5	Management encourages worker participation in UCAD as safety culture	20	55	20	5	0	3.90	Effective
6	Management consistently communicates hazards through UCAD	15	60	10	15	0	3.70	Moderately Effective
7	HSE officers support safe work through effective communication	25	50	15	10	0	3.90	Effective
8	Two-way communication exists in UCAD assessment	30	65	5	0	0	4.25	Very Effective
9	Follow-up on unsafe conditions is implemented effectively	10	50	25	15	0	3.55	Moderately Effective
10	Formal communication channels for reporting hazards are available	20	60	15	5	0	3.95	Effective
11	Workers receive regular UCAD socialization	25	60	10	5	0	4.05	Effective
12	Understanding of UCAD platform is good	20	65	10	5	0	4.00	Effective
13	UCAD timing aligns with work schedules	15	50	25	10	0	3.70	Moderately Effective
14	Instructions for UCAD assessment are clear	15	45	30	10	0	3.65	Moderately Effective
15	UCAD training increases intervention courage	20	55	20	5	0	3.90	Effective
16	Workers can identify hazards such as hand injuries and major risks	10	45	30	15	0	3.50	Moderately Effective

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17	Workers understand invisible hazards (pressure, fire risks)	25	50	15	10	0	3.90	Effective
18	Workers can assess risk severity via JSA and RA	30	60	5	5	0	4.05	Very Effective
19	Workers can identify risks affecting others	10	50	25	15	0	3.55	Moderately Effective
20	Workers understand consequences of unmanaged risks	20	60	15	5	0	3.95	Effective
<b>Over all Average Score</b>							<b>3.85</b>	<b>Effective</b>

Based on Table 2, the over all average effectiveness score of the UCAD program in DWI operations is 3.85, which falls within the “Effective” category. The highest score (4.25 - Very Effective) was observed in the aspect of two-way communication between management and workers, showing that communication strategies-particularly direct, face-to-face engagement-are the most impactful tools perceived by workers. Respondents acknowledged that communication is effective because it is delivered clearly from supervisors to workers, reinforcing the importance of leadership involvement in safety programs. This finding shows that communication has a significant influence on safety compliance, where improved communication leads to higher adherence to safety procedures. Additionally, workers demonstrated a strong understanding of Risk Assessment (RA) and Job Safety Analysis (JSA), as reflected in high scores for hazard identification and consequence awareness (4.05 and 4.00, respectively). Regular UCAD socialization and training were also rated positively, indicating effective knowledge transfer processes.

However, several aspects were identified as relatively weaker areas in UCAD implementation. The lowest scores were observed in workers’ understanding of major risks, particularly hand injury hazards (3.50 - Moderately Effective), and in the follow-up reporting of unsafe conditions (3.55 - Moderately Effective). These findings suggest that critical safety aspects related to high-risk hazards and reporting mechanisms require further improvement. The low level of understanding regarding major risks may be attributed to insufficient socialization of well control procedures among workers and supervisors. Meanwhile, the relatively low reporting effectiveness is influenced by cultural barriers, such as reluctance to report and fear of sanctions. These findings highlight the importance of strengthening safety culture and ensuring psychological safety for workers to report hazards without fear. Addressing these gaps is essential for optimizing the UCAD program’s impact on accident prevention (David & Emmanuel, 2025).

UCAD implementation has a significant effect on occupational safety compliance. The combined influence of UCAD understanding, communication, and training contributes positively to improving safety behavior among workers. Training programs were found to enhance workers’ confidence in intervening when hazards are identified, reinforcing proactive safety practices. Although the number of respondents (100 individuals) is considered adequate to represent the study population, some respondents indicated that the training received was still insufficient. Over all, the level of safety compliance among respondents is categorized as relatively good, reflecting a positive impact of UCAD implementation. Nevertheless, continuous improvement is necessary to address existing gaps and ensure sustainable safety performance in DWI operations.

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### **2. Discussion**

The implementation of the UCAD program in DWI operations at PT Pertamina Hulu Energi Regional 4 Eastern Indonesia has reached a relatively good and effective level. Workers' understanding of UCAD is categorized as adequate, and this condition is strongly influenced by the effectiveness of safety communication, which is also considered to be relatively good. UCAD training results suggest that most respondents perceive the training as sufficient, although a small proportion still consider it inadequate. Meanwhile, the level of occupational safety compliance among workers is generally categorized as good, showing that most respondents adhere to established safety procedures. This finding is supported by the questionnaire results showing an over all average score of 3.85, which falls within the "Effective" category. Several indicators related to workers' understanding of UCAD, including understanding of rights and obligations (4.05), hazard identification capability (4.00), and understanding of consequences of unmanaged risks (3.95), also showed relatively high effectiveness levels. These findings show that UCAD functions not only as a compliance tool but also as a behavioral reinforcement mechanism in high-risk operational environments. The results are consistent with the study by Welly Triantoro (2024), which emphasizes that the success of UCAD implementation in DWI operations depends heavily on synergy between management, workers, and field supervisors. Failures in this synergy, such as lack of personal protective equipment (PPE) verification, unreliable equipment, improper procedures, and incomplete Job Safety Analysis (JSA), have been identified as contributing factors to fatal incidents. These findings align with Muhammad and Susilowati (2021), who argue that occupational safety implementation in Indonesia remains largely administrative and has not fully addressed behavioral change. However, in this study, the discussion is specifically supported by field findings showing that workers with better UCAD understanding and regular socialization tended to demonstrate higher compliance with operational safety procedures. Therefore, the integration of Behavior-Based Safety (BBS), as proposed by Altawal *et al.* (2024), becomes essential to shift safety culture from reactive to proactive by increasing workers' awareness of risks.

The findings related to UCAD understanding show that cognitive input plays a essential role in shaping occupational safety compliance. Workers' understanding of UCAD extends beyond theoretical knowledge and is reflected in their ability to recognize hazards, assess risks, and implement preventive measures in real operational settings. This condition is reflected in the questionnaire results where the ability to assess risk severity through Risk Assessment (RA) and Job Safety Analysis (JSA) achieved a score of 4.05 categorized as "Very Effective." In addition, workers' understanding of invisible hazards such as pressure systems and fire risks achieved a score of 3.90, showing that most respondents were able to recognize operational hazards in DWI activities. This supports the theoretical perspective that risk comprehension involves the ability to identify hazard sources, evaluate the probability of accidents, and estimate the severity of potential consequences (Lestari *et al.*, 2020). In this study, UCAD understanding has been translated into concrete preventive actions, reinforcing the argument that cognitive awareness is a prerequisite for safe behavior, particularly in high-risk industries such as oil and gas operations. This finding is also consistent with Liu *et al.* (2021), who highlight that risk awareness significantly influences safety compliance behavior in hazardous work environments. However, the study also identified weaker aspects, particularly workers' understanding of hand injury hazards and major risks, which only achieved a

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score of 3.50 categorized as “Moderately Effective.” This finding indicates that certain high-risk hazard topics still require stronger reinforcement and more intensive socialization within UCAD implementation. The absence of workplace accidents during the study period further suggests that a strong combination of worker knowledge and organizational safety support contributes to improved safety outcomes. Therefore, UCAD understanding can be interpreted as an interaction between individual input (knowledge and awareness) and organizational input (safety facilities and supervision systems).

Communication, as a relational input, was found to have a significant positive influence on occupational safety compliance and UCAD implementation. The regression results indicate that effective communication between management and workers directly contributes to higher levels of safety compliance. This result is consistent with the questionnaire findings showing that two-way communication during UCAD implementation achieved the highest score of 4.25 and was categorized as “Very Effective.” Workers also perceived that communication delivered by supervisors and HSE personnel was relatively clear and supportive, as reflected by scores of 3.90 for HSE communication support and 3.95 for formal communication channels related to hazard reporting. This finding suggests that communication is not merely a tool for delivering instructions but also a mechanism for building trust, engagement, and responsiveness to safety issues. The presence of two-way communication channels enables workers to actively participate in identifying hazards and reporting unsafe conditions. This aligns with Shen *et al.* (2017), who emphasize that effective safety communication involves interactive dialogue and rapid feedback mechanisms rather than one-way information dissemination. Nevertheless, this study also found that the follow-up process for unsafe condition reporting remained relatively weak, with a score of 3.55 categorized as “Moderately Effective.” Interview findings indicated that several workers were still hesitant to report unsafe conditions due to concerns about negative responses or sanctions. In the context of this study, communication practices include both formal and informal channels, such as safety briefings, direct supervision, and digital communication platforms. Enhancing communication quality through targeted training for supervisors, strengthening feedback loops, and expanding the use of digital tools can further improve safety compliance.

UCAD training, as a learning input, also demonstrates a significant influence on occupational safety compliance. The results indicate that improvements in the quality and frequency of UCAD training lead to increased adherence to safety procedures among workers. Training programs not only enhance technical knowledge but also build confidence and courage among workers to intervene when potential hazards are identified. This finding is supported by the questionnaire result showing that UCAD training increased workers’ intervention courage with an average score of 3.90 categorized as “Effective.” In addition, regular UCAD socialization activities achieved a score of 4.05, indicating that most respondents considered the training and information dissemination process beneficial in supporting operational safety awareness. This is particularly important in high-risk environments where proactive intervention can prevent serious incidents. The regression analysis provides empirical evidence that investing in innovative and continuous training methods, including the integration of digital technologies, is essential for strengthening UCAD implementation. These findings are consistent with previous studies emphasizing the importance of training as a key factor in improving safety performance (Welly Triantoro, 2024). However, several training-related indicators still received moderate effectiveness scores, including assessment

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timing suitability (3.70) and clarity of assessment instructions (3.65). These findings indicate that improvements are still needed in scheduling and delivering UCAD assessment procedures to ensure better worker participation and understanding. Continuous training also supports the development of a learning-oriented safety culture, where workers are encouraged to update their knowledge and skills regularly.

The development of UCAD as an output product in this study highlights the importance of integrating technology into safety management systems. The enhanced UCAD system includes improvements such as updated standard operating procedures (SOPs), identification mechanisms for workers who do not complete assessments, redesigned dashboards for better usability, and an expanded question bank from 115 to 225 items categorized based on operational characteristics (onshore and offshore). Additional features include management-level access for monitoring assessment schedules, results, and crew performance, as well as user-level assessment classifications ranging from “Excellent” to “Not Present.” These improvements aim to increase accessibility, usability, and effectiveness of the UCAD program in real operational contexts. Field observations in this study identified that unstable internet connectivity in remote operational areas frequently disrupted assessment activities and made it difficult to monitor personnel who had not completed UCAD assessments. In addition, the combination of offshore and onshore questions within the same assessment system caused confusion among several workers because some questions were not relevant to their operational tasks. These operational findings support the need for system improvements, particularly regarding accessibility, monitoring functions, and question categorization based on operational characteristics. Despite these advancements, this study acknowledges several limitations, including the relatively short observation period (January 2025-March 2026), the limited sample size of 100 respondents, and the descriptive nature of the research, which restricts the ability to measure causal relationships quantitatively. Additionally, the effectiveness of the proposed UCAD system improvements has not yet been empirically tested due to its prospective nature. Nevertheless, these limitations do not diminish the academic and practical contributions of the study, as the findings provide valuable insights and actionable recommendations for improving safety systems in DWI operations.

### **Conclusion**

Based on the results of this study, the level of UCAD participation has proven to play a significant role in reducing workplace accident rates in drilling and well intervention (DWI) operations. UCAD functions as a control tool in the form of an application that supports early supervision of personnel before entering the worksite, while also enhancing workers’ competence, awareness, and readiness regarding workplace conditions and personal safety. The system facilitates more effective monitoring of personnel within DWI operational areas at PT Pertamina Hulu Energi Regional 4. The findings show that optimizing UCAD data utilization by DWI leaders is essential to reinforce personnel competence, as safety incidents are often the result of interconnected factors forming a chain of causation, consistent with the Swiss Cheese Model of accident causation. In addition, increasing participation remains a critical priority, particularly by ensuring that all rig crew members have access credentials in using the UCAD application across available digital platforms.

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Continuous accessibility and usability improvements are necessary to support consistent engagement. As a recommendation, the implementation of leading indicator monitoring at the zone level is essential, including systematic tracking of UCAD assessment results and the application of visual identifiers or targeted supervision for personnel categorized as “Below Expectation” or those who fail to participate. Such measures, combined with constructive reinforcement strategies such as assigning safety ambassador roles, are expected to strengthen safety culture, improve compliance, and ultimately contribute to a sustainable reduction in workplace accidents.

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