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Training Evaluation Using Kirkpatrick Evaluation Model for Well Intervention Pressure Control Training

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Abstract: This study aims to evaluate the effectiveness of Well Intervention Pressure Control training using the Kirkpatrick Evaluation Model which includes four levels: Reaction, Learning, Behavior, and Outcomes. The research method used was a mixed methods approach combining quantitative and qualitative methods. The evaluation was conducted on 62 trainees working in the oil and gas sector, with a randomly selected sample. The results showed that the training was successful in improving participants' understanding of the training material, including pressure control procedures, as well as other technical skills. At the Reaction level, the majority of participants responded positively to the materials and teaching. At the Learning level, there was a significant increase in pre-test and post-test scores, indicating the success of the training in improving participants' knowledge. At the Behavior level, participants successfully applied the skills learned in real field situations, while at the Outcome level, the training was shown to improve operational performance and safety. In conclusion, the training successfully met its objectives of enhancing participants' technical skills and professional attitudes, and contributed to improved organizational performance, especially in terms of safety and operational efficiency in the oil and gas industry.

Keywords: Behavior level; Kirkpatrick evaluation model; Learning level; Reaction level; Results level; Well intervention pressure control training

Introduction

In high-risk industries such as oil and gas, specialized training programs that focus on safety protocols and technical competencies are essential to reduce operational risks and improve employee performance (Aigbedion et al., 2025; Akano et al., 2024; Egbumokei et al., 2024; Egila et al., 2025). These sectors face complex and dangerous working conditions, where even small mistakes can have major consequences (Kim et al., 2022; Schulte et al., 2022). Therefore, effective training is not only beneficial, but also crucial. However, although safety training programs such as Well Intervention Pressure Control Training have been widely implemented, comprehensive evaluations of their effectiveness are still limited (Dyreborg et al., 2022; Edwards et al., 2024; Reynolds et al., 2022). Existing evaluations often only measure short-term outcomes, such as knowledge retention or participant satisfaction, without considering long-term behavior changes or their impact on organizational performance, such as improved safety records and operational efficiency (Gualtieri et al., 2024; Stemp et al., 2022; Ugbebor et al., 2024).

Gaps in training evaluation, especially regarding long-term impacts on organizational behavior and outcomes, are a critical issue in safety-sensitive industries (Liu et al., 2024; ÖZ, 2024; Susita & Busharmaidi, 2024; Chaerudin, 2018). Traditional training evaluation models tend to measure immediate

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reactions or knowledge gains, but fail to assess whether these outcomes translate into sustained behavior change or impact on the organization (Al-Zoubi et al., 2025; Leroy et al., 2024). This is of great concern in high-risk sectors such as oil and gas, where lack of training can lead to accidents, environmental damage, and financial losses (Djajasinga, 2022; Durrani & Zeeshan, 2023; Tang, 2024). In addition, evaluations often ignore the return on investment of training programs in terms of improved safety and operational efficiency, which are key indicators of training success (Dadd & Hinton, 2023; Phillips, 2012; Thusini et al., 2022).

One issue that is often overlooked is the need for a more comprehensive and multidimensional evaluation framework to measure the long-term impact of training on individual competence and organizational performance (Bougoulia & Glykas, 2023; Caley et al., 2021; Dhoopar et al., 2023; Rouse & Putterill, 2003). According to Kirkpatrick & Kirkpatrick (2016), effective training evaluation should include not only participant reaction and knowledge retention, but also behavior change and real impact on organizational outcomes. However, research in high-risk industries still focuses on short-term outcomes, ignoring the long-term effects of training on employee behavior and operational performance. Studies by Efthymiou & Ponis (2021) show that the impact of training on accident reduction, safety improvement, and operational efficiency is under-explored, creating a significant gap in the literature.

This study aims to fill this gap by focusing on Well Intervention Pressure Control Training in the oil and gas sector, using the Kirkpatrick Four-Level Evaluation Model. The uniqueness of this study lies in its attempt to evaluate not only participants' learning and reactions directly, but also long-term behavior changes and their impact on organizational performance, particularly in terms of safety and efficiency. This comprehensive evaluation approach is expected to provide new insights into how training in high-risk sectors affects employee competence and organizational outcomes, thus serving as a reference for future training practices and safety protocols.

By analyzing Well Intervention Pressure Control Training, this study aims to determine whether the training results in sustained improvements in safety behavior, reduced operational incidents, and improved organizational performance. Given the high risks involved, where inadequate safety training can have serious consequences, a thorough evaluation of training programs is important to ensure their effectiveness in improving safety standards and operational efficiency. The findings of this study are expected not only to fill a gap in academic literature, but also to provide practical recommendations for refining training programs, thereby improving safety, productivity, and operational effectiveness in the oil and gas industry.

Method

Research Methods

This research employs a mixed methods approach, integrating both quantitative and qualitative methods to provide a comprehensive evaluation of the effectiveness of Well Intervention Pressure Control Training in the oil and gas industry. The mixed methods approach is chosen because it allows researchers to explore and confirm findings from multiple perspectives, leveraging the strengths of both quantitative and qualitative data. As Creswell & Clark (2017) emphasizes, mixed methods research enables a deeper and more nuanced understanding of complex phenomena by combining the generalizability of quantitative data with the contextual insights of qualitative data.

To ensure a robust integration of both methods, this study adopts an explanatory sequential design, as recommended by Ivankova et al. (2006), which allows for a phased approach to data collection and analysis. In the first phase, quantitative data will be collected through surveys and performance metrics to measure participants' knowledge retention, behavioral changes, and organizational outcomes such as safety records and operational efficiency. This phase aims to identify patterns and trends related to the training's effectiveness. In the second phase, qualitative data will be gathered through in-depth interviews and focus group discussions with participants, trainers, and safety officers. This phase seeks to provide deeper insights into the underlying reasons for the observed quantitative results, exploring factors such as training implementation, workplace culture, and barriers to behavioral change.

The integration of quantitative and qualitative data will occur during the interpretation phase, where findings from both methods will be compared, contrasted, and synthesized to draw comprehensive conclusions, following the principles outlined by Fetters et al. (2013). This approach ensures that the research not only quantifies the impact of the training but also contextualizes the results within the specific operational and cultural environment of the oil and gas industry. By using an explanatory sequential design, this study aims to provide a holistic understanding of how Intervention Pressure Control Training influences both individual competencies and organizational performance, while addressing the limitations of relying solely on one methodological approach.

Research Procedures

The research procedure used in this study is Kirkpatrick's evaluation method. In this context,

Kirkpatrick's Four Levels of Evaluation Model was used as the evaluation framework, which consists of four levels: Reactions, Learning, Behavior, Results. This model has been recognized as a standard in training evaluation as it provides a structured guide for measuring the effectiveness of training programs (Kirkpatrick & Kirkpatrick, 2016). The data collected in this study aims not only to measure the effectiveness of training but also to provide meaningful feedback to companies, trainers and relevant stakeholders. Figure 1 shows the pyramid shape of Donald Kirkpatrick's method.

Figure 1. Kirkpatrick's four levels of evaluation model

Kirkpatrick's Four-Level Evaluation Model is a widely recognized framework used to assess the effectiveness of training programs. The first level, Reaction Level, evaluates participants' immediate responses to the training. This level focuses on how satisfied participants were with the training content, delivery, and overall experience. In the context of Well Intervention Pressure Control Training, the reaction level would help gauge how well participants perceive the training in terms of its relevance and clarity in addressing operational needs, such as pressure control techniques and emergency response procedures. Positive reactions indicate that the training was engaging and well-received, providing a foundation for subsequent learning and behavior changes.

The second level, Learning Level, assesses the degree to which participants acquire new knowledge, skills, or attitudes as a result of the training. For the Well Intervention Pressure Control Training, this would involve evaluating whether participants demonstrated an improved understanding of essential concepts such as well control procedures, safety protocols, and emergency response techniques. The Behavior Level goes a step further by examining how these newly acquired skills are applied in the workplace. It identifies changes in participants' behavior, specifically whether they can now execute pressure control techniques effectively in high-pressure situations, minimizing risks. Finally, the Result Level measures the ultimate impact of the training on organizational outcomes, such as a reduction in accidents or operational disruptions. In the case of oil and gas operations, this level is critical for assessing whether the training leads to tangible improvements in safety and efficiency, thereby contributing to the organization's overall performance. Evaluating all four levels in the Well Intervention Pressure Control Training will ensure a comprehensive understanding of the training's effectiveness, from initial reactions to long-term results.

Research Subject

The population in this study consists of 62 PHM employees who have attended the Well Intervention Pressure Control Training in the Delta Area, including Supervisors, Superintendents, and Engineers. From this population, a sample was selected using the Slovin formula with a 5% margin of error, resulting in a minimum sample size of 54 people. The sample was chosen randomly to ensure fair representation of various positions within the population, so the research results can reflect more general and valid conditions. The use of the Slovin formula allows for resource savings and ensures a representative sample without involving the entire population, thus saving time and research costs. Therefore, the selected sample is expected to provide valid and reliable data to evaluate the effectiveness of the training using the Kirkpatrick evaluation model.

Research Instruments

The research instruments used in this study to evaluate the implementation of the Kirkpatrick Four Levels Evaluation Model for the Well Intervention Pressure Control training program include surveys and interviews. These instruments assess various aspects of the training at each evaluation level. At the Reaction Level, they measure participants' satisfaction with the training program and the instructor. For the Learning Level, pre-tests and post-tests are used to evaluate knowledge acquisition, skill improvement, and attitude change. The Behavior Level is assessed through surveys, interviews, and observations to gauge how participants apply learned skills in the workplace. Finally, at the Results Level, surveys and interviews are used to evaluate the training's impact on organizational outcomes. Instrument validity is ensured through expert judgment, and tests are evaluated for content validity and readability. The research follows a structured approach to ensure the reliability and relevance of data collected for this study.

Data Analysis Technique

This study uses the Kirkpatrick training evaluation model, which consists of four levels: Reaction, Learning,

Behavior, and Results. Data analysis techniques are tailored to each evaluation level. At the Reaction Level, data is collected through quantitative surveys using Likert scales and qualitative open-ended questions to assess participants' perceptions of the training material, facilitator, methods, and facilities. Descriptive statistics and thematic analysis are applied. At the Learning Level, pre- and post-test scores are analyzed using descriptive statistics and percentage increases to measure knowledge or skill improvement. The Behavior Level evaluates changes in participants' on-the-job behavior, using surveys, interviews with supervisors, and observations, analyzed through comparative and thematic analysis. Finally, the Results Level assesses the training's impact on organizational goals, such as productivity and efficiency, using quantitative statistical tests and qualitative interviews with stakeholders. Data from questionnaires, observations, and documentation are selected and analyzed quantitatively, with steps including data selection, classification, tabulation, standardization, and analysis to ensure clarity and consistency. The findings are compared with theoretical frameworks, leading to conclusions and recommendations.

Result and Discussion

Result

Reaction Level

The training evaluation for the Well Intervention Pressure Control program showed strong positive results across various aspects. Material Clarity: A significant 96.43% of participants rated the training material as clear or very clear with an average score of 4.4, indicating that the content was easily understandable. Material Structure: 92.86% of participants rated the material as well-structured or very well-structured (average score 4.3), which suggests that the content was organized in a logical sequence that helped participants follow the flow of the training. Comprehensibility: 92.86% felt that the material was easy to understand or very easy to understand (average score 4.2), demonstrating that the instructors effectively communicated the content to diverse participants. Lastly, Depth of Material related to technical operations such as Wireline, Coiled Tubing, and Snubbing received an excellent rating (average scores of 4.5 and 4.6), showing that the material was comprehensive and relevant to the participants' work.

The effectiveness of the Instructor's Delivery was also highly rated, with 94.54% of participants considering the delivery to be effective or very effective (average score 4.3). This suggests that the instructor was successful in communicating the material clearly and managing the training sessions efficiently. In addition, 91.07% rated the instructor's ability to answer questions as capable or very capable (average score 4.3), showing that the instructor was proficient in providing additional clarifications. Regarding Instructor Engagement, 92.85% felt that the instructor was involved or very involved (average score 4.3), indicating that the instructor fostered an interactive and supportive learning environment. The overall Quality of the Instructor was rated as good or very good by 92.86% of participants, with an average score of 4.2, reflecting the instructor's solid expertise and teaching ability.

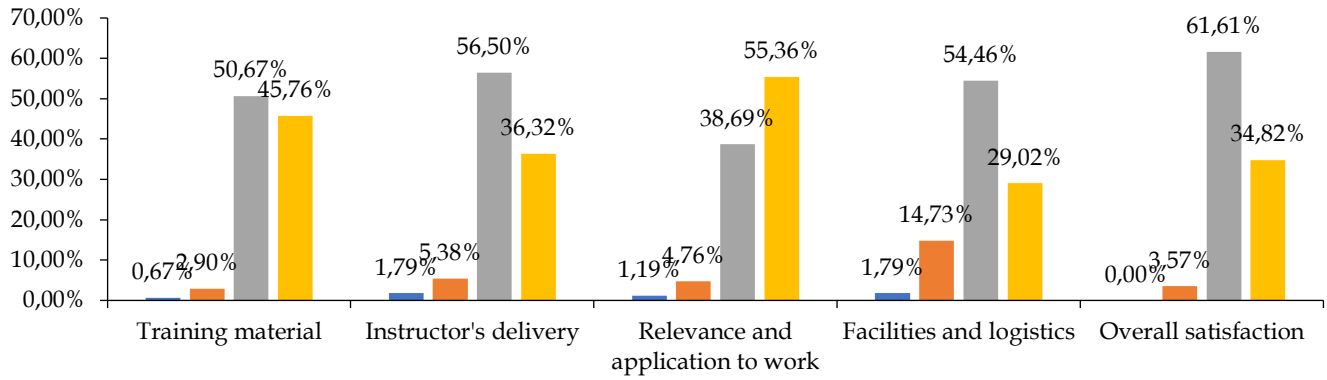

Figure 2. Graphic of summary of reaction level

The Relevance and Application to Work also scored highly, with 94.64% of participants stating that the training was highly relevant to their job (average score 4.6). This suggests that the training materials closely aligned with participants' practical work needs. 89.28% felt they gained new knowledge and skills they could apply in their daily work, with a score of 4.3, indicating effective learning outcomes. Furthermore, 96.22% agreed that the training improved their performance, with an average score of 4.5, demonstrating a significant positive impact on their work. Regarding Facilities and Logistics, 77.14% rated the training room as adequate or

very adequate (score 4.0), and 81.51% were satisfied with the accommodation (score 4.0), though there is room for improvement in these areas. Finally, Overall Satisfaction was extremely high, with 96.43% of participants expressing they were satisfied or very satisfied (average score 4.3), and the same percentage would recommend the training to colleagues, indicating the overall success and value of the training program.

Learning Level

The learning evaluation in the Well Intervention Pressure Control training aims to measure the extent to which participants acquire new knowledge and skills. Based on the results of the pre-test and post-test conducted on various topics, there was a significant improvement in all aspects taught. This improvement reflects the success of the training in enhancing participants' understanding of the materials covering Well Completion Operation, Well Completion Equipment, Wireline Operation, Coiled Tubing Operation, and Snubbing Operation. The evaluation results indicate that this training successfully achieved its goal of deepening participants' knowledge and skills related to well-intervention operations.

In the Well Completion Operations material, the average post-test score increased significantly from 66.57 on the pre-test to 89.46, with the Paired T-Test results showing a Sig. (2-tailed) value of 0.000, indicating a significant effect on participants' understanding. The same occurred with Well Completion Equipment, where the average post-test score increased to 90.66 compared to the pre-test score of 66.80, and the Paired T-Test also showed significant results (Sig. (2-tailed) = 0.000). This demonstrates that the training was successful in significantly improving participants' understanding of both topics. The Wireline Operation, Coiled Tubing Operation, and Snubbing Operation materials also showed significant improvements in participants' understanding. The average post-test score for Wireline Operation increased to 92.35 (from 67.07 on the pre-test), for Coiled Tubing Operation it increased to 92.67 (from 63.62 on the pre-test), and for Snubbing Operation it increased to 88.73 (from 63.76 on the pre-test). All of these materials showed Paired T-Test results with Sig. (2-tailed) = 0.000, confirming that the training was effective in improving participants' skills in each topic. Overall, the Well Intervention Pressure Control training proved effective in improving participants' knowledge and skills related to well-intervention operations, as reflected by the significant improvement across all training materials.

Behavior Level

The Well Intervention Pressure Control Training has demonstrated highly positive results in enhancing participants' capabilities across various aspects. Participants were able to quickly identify well-control issues, accurately differentiate between types of problems, and show high initiative in handling emergencies. Additionally, the application of skills such as pressure control and well-control techniques was rated very well, with an average score of 4.4 on a 5-point scale. This indicates that the training successfully equipped participants with relevant knowledge and skills to tackle field challenges. However, there is still room for improvement in terms of practical simulations and more in-depth case studies to better prepare participants for more complex situations.

In terms of decision-making and action, participants demonstrated quick and effective responses in emergencies, with average scores ranging from 4.3 to 4.4. Active participation in team discussions and the ability to provide appropriate solutions were also highly rated. Team collaboration, a critical aspect of well control, showed satisfactory results, with an average score of 4.5. Participants were able to collaborate effectively, contribute to discussions, and provide valuable input. To further maximize team collaboration, advanced training focusing on strengthening communication and team dynamics under high-pressure situations is highly recommended.

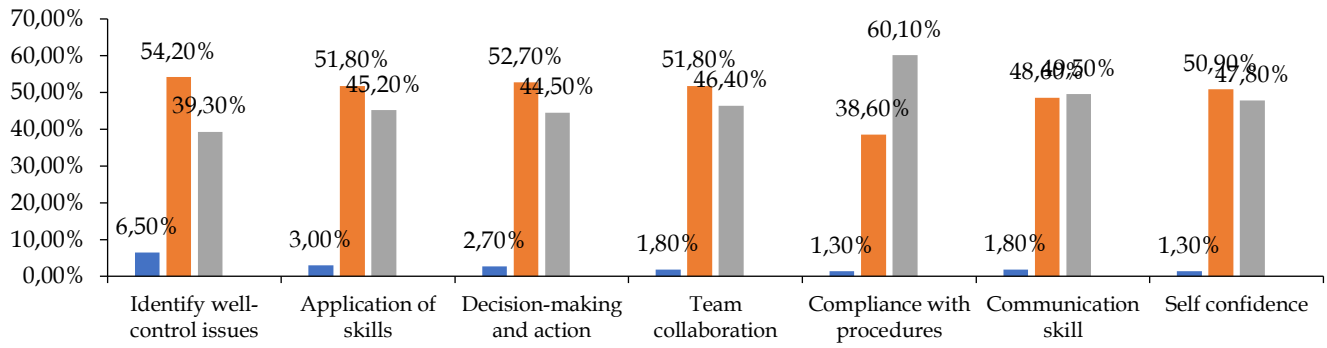

Figure 3. Graphic of summary of behavior level

Compliance with safety and well control procedures was another standout aspect of this evaluation. Participants showed a very high level of discipline in following procedures, with average scores ranging from 4.5 to 4.7. This reflects the training's success in instilling awareness of the importance of safety and operational procedures. However, to ensure this compliance is maintained, regular field audits and more realistic emergency simulations are necessary. Additionally, ongoing training and refresher sessions can help participants retain the skills and knowledge they have acquired.

Overall, the training has had a significant positive impact on participants' ability to face well-control challenges. However, to further enhance the effectiveness of future training, more practical simulations, complex scenarios, and experience-based training should be introduced. A focus on leadership development, communication, and stress management will also be highly beneficial in preparing participants for more challenging field situations. In this way, the training not only improves technical skills but also builds participants' confidence and readiness to handle well control emergencies.

Results Level

The Well Intervention Pressure Control Training has shown a significant positive impact on workplace safety and operational efficiency. The majority of participants were highly satisfied with the implementation of safety procedures taught, with an average score of 4.7, reflecting excellent understanding and application of these procedures. Participants' confidence in handling emergencies also increased, with 55.4% feeling very confident. Additionally, the training improved operational efficiency, with high scores in team response, intervention completion times, and managing well control situations, ultimately contributing to cost savings and the avoidance of additional costs.

In terms of intervention quality, the training proved very effective in enhancing participants' ability to assess intervention outcomes and reduce equipment damage and losses. The very high average score of 4.7 indicates that participants felt more prepared and efficient in carrying out interventions, leading to more positive results in the field. Furthermore, cost savings and operational efficiency were achieved thanks to the training, with the majority of participants recognizing the training's contribution to reducing costs and avoiding additional expenses, although some participants were less satisfied with the achieved savings.

The training also played a role in the participants' long-term skill development, increasing their readiness to share the knowledge and skills acquired with their colleagues. Additionally, the training had a long-term impact on career growth, safety culture, and team skill development. Evaluation results showed that participants felt more confident in decision-making and taking initiative in emergencies, enhancing overall team performance. Overall, the training not only improved technical skills but also strengthened team collaboration and improved the safety culture at the workplace.

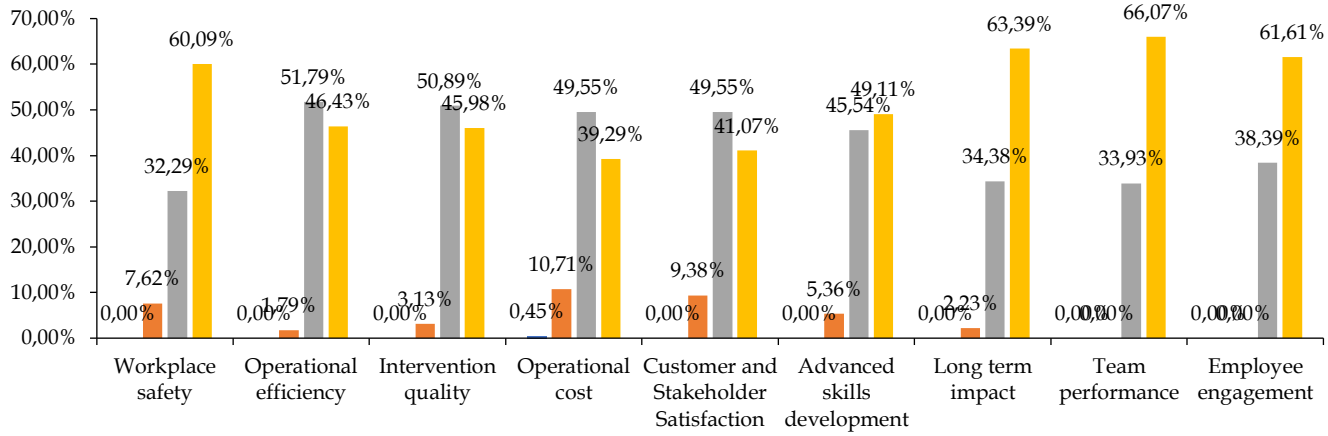

Figure 4. Graphic of summary of results level

Discussion

Evaluation of training is crucial to assess the extent to which a program achieves its intended goals, particularly in high-risk industries like oil and gas. This study evaluates the Well Intervention Pressure Control Training program using the Kirkpatrick Evaluation Model, which includes four levels: reaction, learning, behavior, and results. Each level provides unique insights into the effectiveness of the training, and the interconnections between these levels are critical for understanding the overall impact of the program.

Reaction Level

At the reaction level, the study shows that the majority of participants responded positively to the training. Participants felt that the material was delivered clearly, in a structured manner, and was highly relevant to their job responsibilities. This aligns with Knowles (1984), which emphasizes that adult learners are more engaged when training content is practical and directly applicable to their work. The positive feedback on the instructor's delivery style further supports this, as effective communication and engagement are key to participant satisfaction (Salas et al., 2012; Erbay et al., 2024). However, while the overall reaction was positive, some participants noted the need for more interactive sessions and updated training materials, suggesting areas for improvement.

Learning Level

The learning level evaluation revealed significant improvements in participants' knowledge and skills, as evidenced by the comparison of pre-test and post-test scores. This finding is consistent with Kolb (2014), which highlights the importance of practical application in reinforcing theoretical knowledge. For example, participants showed marked improvement in understanding complex topics such as Well Completion Operations and Coiled Tubing Operations, which are critical for handling pressure control emergencies. This demonstrates that the training not only enhanced theoretical knowledge but also provided practical skills that are directly transferable to the field.

Behavior Level

At the behavior level, the evaluation indicated that participants successfully applied the knowledge and skills gained during training to their daily work. For instance, participants demonstrated improved problem-solving abilities, decision-making skills, and collaboration during emergency simulations. This aligns with Bandura & Walters (1977), which suggests that behavior change is more likely when learners observe and practice skills in a supportive environment. The study also found that participants who had positive reactions to the training were more likely to apply their learning in the workplace, highlighting the interconnectedness between the reaction and behavior levels. However, some participants reported challenges in applying their learning due to workplace constraints, such as time pressure and limited resources, indicating a need for organizational support to reinforce training outcomes.

Results Level

The results level evaluation demonstrated that the training had a positive impact on organizational performance, particularly in terms of safety and operational efficiency. For example, there was a noticeable reduction in well control incidents and operational costs following the training. This finding is supported by Kirkpatrick & Kirkpatrick (2006), who emphasize that effective training should contribute to achieving organizational goals. The study also found a correlation between improved individual performance (behavior level) and enhanced organizational outcomes (results level), underscoring the importance of aligning training objectives with organizational priorities.

Inter-Level Linkages

The findings of this study highlight the interconnectedness of the four levels of the Kirkpatrick model. Positive reactions to the training contributed to higher engagement and learning retention, which in turn facilitated the application of skills in the workplace (behavior level). Ultimately, these behavioral changes led to improved organizational outcomes (results level). This holistic view aligns with Alliger et al. (1997), who argue that the levels of the Kirkpatrick model are not isolated but rather build upon one another to create a cumulative impact.

Implications for Practice

The findings of this study have several practical implications for improving the effectiveness of future training programs. First, training content should be designed to align with adult learning principles, ensuring relevance and practical application. Second, organizations should provide adequate resources and support to enable participants to apply their learning in the workplace. Third, regular evaluations should be conducted to identify gaps and areas for improvement, ensuring that training programs remain aligned with organizational goals. Finally, the integration of technology, such as virtual simulations, could enhance the learning experience and provide more opportunities for practice and feedback.

Conclusion

The evaluation of the Well Intervention Pressure Control Training using the Kirkpatrick Four-Level Model demonstrates its effectiveness in achieving its objectives, while also identifying areas for improvement. At the Reaction Level, participants expressed high satisfaction, with 96.43% rating the material as clear or very clear and 94.54% praising the instructor's delivery. However, some participants suggested incorporating more interactive elements and updating training materials to reflect the latest industry standards. At the Learning Level, pre-test and post-test results revealed significant improvements in knowledge across key

topics. For example, scores in Well Completion Operations increased from 66.57 to 89.46, and in Coiled Tubing Operation from 63.62 to 92.67, with all improvements statistically significant ($p < 0.001$). The Behavior Level evaluation showed that participants successfully applied the skills learned during training to their daily work, particularly in decision-making, teamwork, and adherence to safety protocols, with average scores ranging from 4.3 to 4.7. However, challenges such as time pressure and limited resources were reported, highlighting the need for organizational support to reinforce training outcomes. At the Results Level, the training contributed to improved organizational performance, with participants rating the implementation of safety procedures at 4.7 and 55.4% feeling very confident in handling emergencies. Additionally, the training fostered stronger team collaboration and supported long-term career development. While the training achieved its primary objectives, areas for improvement include integrating advanced simulation tools, providing more frequent refresher courses, and aligning training content more closely with real-world challenges. These recommendations aim to enhance skill retention, practical application, and overall training effectiveness. In conclusion, the Well Intervention Pressure Control Training proved to be a valuable program for improving technical and soft skills, fostering a culture of safety, and enhancing teamwork. However, continuous evaluation and refinement are essential to address identified gaps and ensure the training remains effective in meeting the evolving needs of the oil and gas industry.

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Author Contributions
Writing—original draft preparation, methodology and analysis, K.; Conceptualization, review and editing, formal analysis, K.; Review and editing, formal analysis, A. and M.G.

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Conflicts of Interest
The authors declare no conflict of interest.

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