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Measuring the Critical Success Factor of Safety Program in Drilling and Well Intervention Operation at PT. MHK, Ltd.

Ronggo Wiyono Sakuro Putro[1], Utomo Sarjono Putro[2], Valid Hasyimi[3]
[1,2,3] School of Business and Management ITB Indonesia

ABSTRACT: The drilling and well intervention division implements various safety initiatives to prevent incidents. Despite its multiple activities, an assessment has yet to be conducted to determine the program's efficacy. This paper aims to determine the elements that impact the effectiveness of safety program execution in drilling and well intervention operations in MHK, Ltd. The Author conducted measurements utilizing variables related to the critical success factor of the safety program, as outlined in the cross-reference research article. Subsequently, the author introduces a system of incentives in variables quantified as a novelty of this research based on input from subject matter experts. By understanding the variables that influence the efficacy of the safety campaign, the safety campaign initiatives will be more focused on mitigating accidents within the drilling and well intervention divisions. The research was conducted utilizing a quantitative approach, where data was gathered through a questionnaire that employed a Likert scale. The population comprises individuals employed in the Drilling and Well Intervention roles at many locations, including the site, field, barge, rig, and town. The data is further analyzed using the Partial Least Squares Structural Equation Modelling (PLS-SEM) technique, employing the smartPLS4 software. The study findings indicated that three out of five variables examined had a favorable and significant impact on the efficacy of the safety program at DWI MHK, Ltd.: management commitment, reward and punishment, and safety arrangement. We propose strengthening identified elements and addressing weaknesses, including utilizing digitalization and artificial intelligence for safety monitoring.

KEYWORDS: critical success factor, drilling and well intervention, PLS-SEM, safety, SmartPLS4

1 INTRODUCTION

The number of work accidents in the oil and gas industry is increasing yearly. Events in this sector can have very detrimental impacts, both in terms of financial and non-financial impacts. Working accidents can result in several types of losses, such as damage to equipment, loss of materials, environmental harm and pollution, disability, and even death. Companies can face substantial costs because of mishaps, such as the Deepwater Horizon event. The tragedy additionally led to the devastation of marine habitats impacted by pollution and caused the demise of other workers.

Analysis of work accident data in the Indonesian oil and gas industry reveals a declining trend in accidents from 2018 to 2021. However, one fatal accident, one severe accident, six medium accidents, and 67 minor accidents were reported in 2021. In 2022, there was a notable rise in Medium, severe, and Fatal occurrences compared to 2021, while the number of minor incidents remains relatively low compared to the data from the past six years.

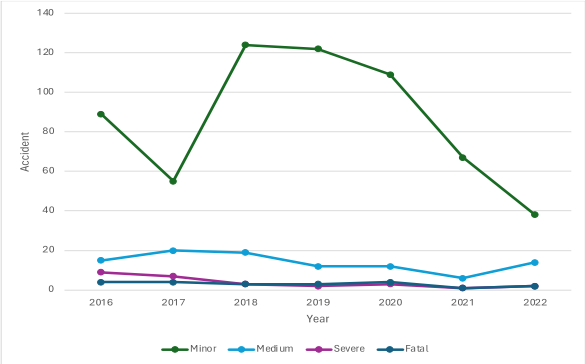

Figure 1 Accident Summary in Indonesia Upstream Oil and Gas Industry (Source: Ditjen MIGAS Report LAKIN 2022)

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While fatal accidents are generally low in the upstream oil and gas sector, the downstream oil and gas sector witnessed an increase in fatal incidents in 2022 and 2021 compared to 2020. In 2022, there was a substantial rise in minor accidents, the highest in the past six years.

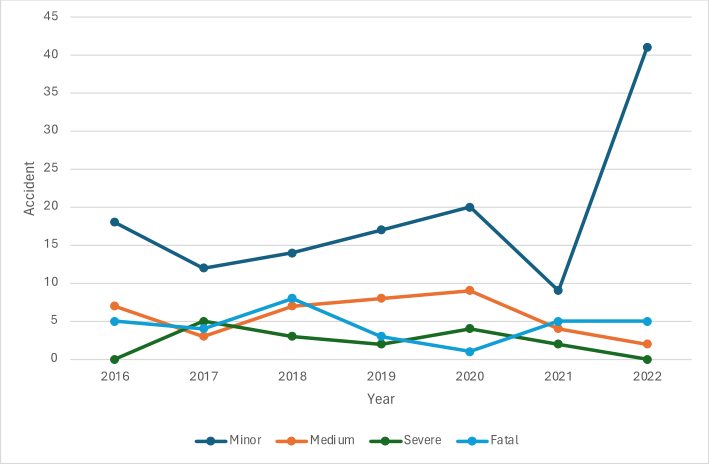

Figure 2 Accident Summary in Indonesia Downstream Oil and Gas Industry (Source: Ditjen MIGAS Report LAKIN 2022)

The incidence statistics in DWI MHK, Ltd. exhibit a similar pattern to the national trend, with a cumulative decline in events in 2021 followed by a nearly twofold spike in 2022. The rising number of incidents is causing apprehension about the possibility of more severe incidents, such as Lost-Time Injuries (LTI) and Fatalities.

Table 1. Case statistics in Drilling and Well Intervention MHK,ltd

Description	2016	2017	2018	2019	2020	2021	2022
Fatality							
LTI		1					
ED/ML/PS			1	1	4		2
RWDC	1			1	6	1	1
MTC	1		4	4	5	1	2
FAC	2	1		3	3	4	6
TOTAL	**4**	**2**	**5**	**9**	**18**	**6**	**11**

Since 2007, DWI MHK, Ltd. has consistently implemented a comprehensive safety campaign, focusing on reinforcing the ZERO LTI (Lost Time Injury) tagline. Subsequently, we have proceeded with a diverse range of safety programs up to the present. Implementing several safety initiatives is anticipated to decrease the frequency of events that transpire during Drilling and Well Intervention operations.

Diverse safety initiatives are implemented to decrease the frequency of incidents and accidents. Some individuals attempt to ascertain the primary aspects that contribute to the effectiveness of the safety campaign. This measure enhances the company's concentration on these elements, amplifying the safety campaign's potential effectiveness in mitigating mishaps. However, specific documentation must be completed with every campaign conducted. Many field workers object to these numerous paperwork documents since they significantly increase their workload. The greater the number of campaign kinds and the frequency of campaign execution, the higher the volume of documentation that needs to be submitted.

The authors identified that a study has yet to be undertaken to determine the success of the safety campaign activities. As a result, the decision to prioritize the implementation of the safety campaign program is solely dependent on the occurrence of events in the upstream sub-holding environment. Furthermore, executing the campaign relies on replicating the prior campaign without considering the aspects that can enhance the campaign's efficacy.

Hence, the author deems it imperative to study the efficacy of safety campaign initiatives and their impact on mitigating fatalities and injuries in Drilling and Well Intervention operations.

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2 LITERATURE REVIEW AND HYPOTHESIS CONSTRUCTION

2.1 Literature Review

Critical success factors are the specific areas where achieving satisfactory outcomes is necessary for a business to attain successful competitive performance (Rockart, 1979). These areas are crucial for the firm to thrive. If the outcomes in these areas are unsatisfactory, the organization's efforts for the given period will not meet expectations. The crucial success elements are specific areas of activity that require continuous and meticulous attention from management. It is essential to consistently assess the current level of performance in each domain and ensure that this information is easily accessible.

Various researchers provide multiple definitions of safety programs. According to Anton's (1989) definition, a safety program encompasses the strategic administration of the work environment, equipment, procedures, and personnel to mitigate inadvertent injuries and losses within the workplace.

According to the Centers for Disease Control and Prevention (CDC), a safety program is a systematic approach to identifying, evaluating, and controlling risk factors within a workplace setting. The primary goal is protecting personnel from current hazards and potential risks. Safety and health programs aim to reduce occupational injuries, illnesses, and fatalities. These programs function as administrative expansions of employer-developed plans or policies to guarantee a safe and protected work environment. These approaches encompass a high level of coordination and comprehensiveness, specifically designed to meet all employees' health and safety needs effectively.

A study was conducted in Saudi Arabia to identify the most critical factors affecting implementing safety programs among construction companies. Based on this research, four main variables contribute to the success of the safety program: safety prevention and control system, worker involvement, safety arrangement, and management commitment. The components used in the study are shown in the table below.

Table 2. Critical Safety Success Factors Related to Worker Participation

Factors	Description	References
Personal Attitude	Personal attitude encompasses an individual's cognitive, emotional, and ideological disposition towards safety rules and practices. Favorable dispositions towards safety result in improved safety outcomes, while unfavourable or apathetic dispositions can heighten the probability of accidents and injuries.	Tam, et al. (2001), Fang, et al. (2006), Aksorn, et al. (2008),
Personal Motivation	Personal motivation in the context of safety performance is multi-faceted, encompassing both internal and external drivers. It plays a crucial role in how individuals perceive, engage with, and prioritize safety in their daily activities	Johnson (2003), Fang, et al. (2006), Strank (1994), Neal (2002).
Safety Meeting	Safety meeting function not only as a forum for disseminating important safety information but also as a tool for fostering a proactive safety culture, encouraging participation, facilitating continuous learning, and promoting a shared responsibility for safety within an organization	El-Mashaleh, et al. (2009)

Table 3. Critical Safety Success Factors Related to Safety Prevention and Control System

Factors	Description	References
Efficient Enforcement System	It refers to the mechanisms and strategies implemented to ensure adherence to safety rules and regulations. It ensures compliance with safety standards through a combination of monitoring, accountability, consistency, feedback, education, adaptability, and a fair approach	Fang, et al. (2004), El-Mashaleh, et al. (2010), Pierce (1995), Michaud (1995),
Suitable Supervision	Suitable supervision encompasses providing guidance, monitoring work practices, enforcing rules, offering training, facilitating communication, supporting and motivating team members, responding to incidents, and adapting to changing safety requirements	Fang, et al. (2004)

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Safety Training	Safety training involves a comprehensive approach to educating and skilling individuals, enhancing awareness, ensuring compliance, fostering a safety culture, preventing incidents, preparing for emergencies, and promoting continuous improvement in safety practices.	Toole (2002), Tam, et al. (2004), Tam, et al. (2001), Cooper, et al. (2000)
Equipment and Maintenance	Equipment maintenance plays a crucial role in safety performance by ensuring that all machinery and tools are in optimal working condition, compliant with safety standards, and operated by well-informed individuals	Toole (2002), Tam, et al. (2004), Cooper, et al (2000)
Personal Competency	Personal competency refers to the combination of skills, knowledge, and attitudes that enable an individual to perform tasks safely and effectively	Mohamed (2002), Tam, et al. (2004), Fang, et al. (2006)
Program Evaluation	Program Evaluation involves systematically assessing the effectiveness of safety programs and initiatives to ensure they meet their intended goals and contribute to a safer environment	Abudayyeh, et al. (2006), Toole (2002), Stranks (2000)

Table 4. Critical Safety Success Factors Related to Safety Arrangement

Factors	Description	References
Communication	Communication is integral to safety performance, encompassing the dissemination of information, feedback mechanisms, building a safety culture, managing emergencies, facilitating training, resolving conflicts, encouraging reporting and transparency, and managing changes	Fang, et al. (2004), Abudayyeh, et al. (2006), Stranks (2000)
Allocation of Authority and Responsibility	Allocation of Authority and Responsibility ensures clarity of roles, empowers individuals to act, creates accountability, enables efficient responses, provides leadership, guides resource allocation, fosters continuous improvement, and ensures inclusivity in safety planning	Abudayyeh, et al. (2006), Anton (1989), Stranks (2000)
Adequate Resource Allocation	Adequate resource allocation involves providing the necessary tools, personnel, training, and financial resources to implement and maintain safety measures	Abudayyeh, et al. (2006), Mohamed (2002), Vredenburg (2002), Rue, et al. (2001), Erikson (1997)

Table 5. Critical Safety Success Factors Related to Management Commitment

Factors	Description	References
Management Support	Management support involves the commitment and involvement of top-level and middle management in advocating, implementing, and maintaining safety protocols and practices	Abudayyeh, et al. (2006), Stranks (2000), Erikson (1997), Rollenhagen, et al. (2001)
Teamwork	Teamwork involves collaboration, communication, and coordination among team members to uphold and promote safety standards	Abudayyeh, et al. (2006), Rechenthin (2004), Herrero et al. (2006), McGowan, et al. (1989)
Clear and Reasonable Objective	These objectives provide a specific and achievable target for safety efforts, guiding and motivating individuals and teams in their safety practices	Abudayyeh, et al. (2006), Krause (1997), Stranks (2000)

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2.2 Conceptual Framework

Upon completing a comprehensive literature research and compiling pertinent references, a conceptual framework was developed, encompassing pivotal aspects that influence the efficacy of the safety program. To assess the applicability of safety-critical elements derived from a literature review to the operational environment of Drilling and Well Intervention MHK, Ltd, the author conducted interviews and administered questionnaires to practitioners and Subject Matter Experts at DWI MHK, Ltd. The selection of essential success variables pertinent to Drilling and Well Intervention operations in MHK, Ltd involves the participation of 13 Subject Matter Experts.

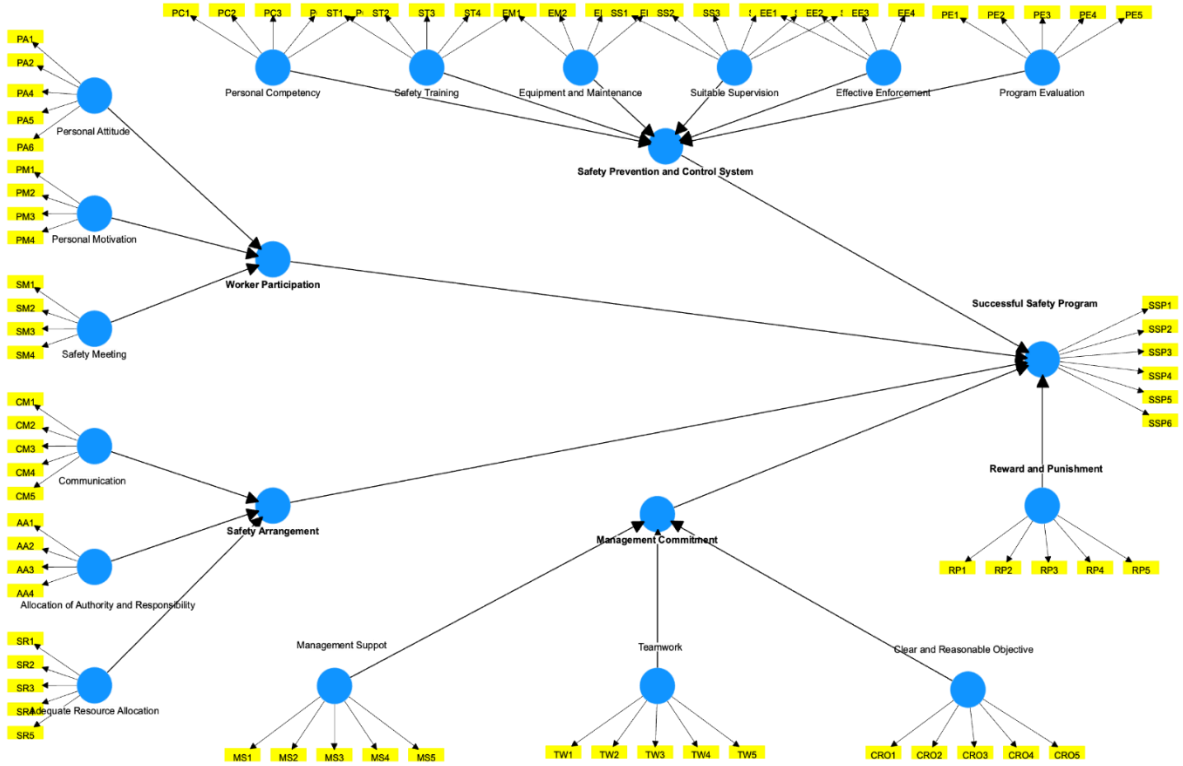

Figure 3. First Order Diagram of Successful Safety Program

3 METHODOLOGY

3.1 Research Design

The study was carried out on the employees of the Drilling and Well Intervention department of PTM. The responders who completed the questionnaire work on the frontline of the operation, such as on a barge, rig, or site, with varying years of experience. They were immediately involved in the operation and were in danger of experiencing the occurrence. The research was conducted by filling out questionnaires and analyzing the literature. The questionnaire assesses the frontline employees' comprehension and opinions on the questions.

3.2 Data Collection

This thesis integrates information obtained from a blend of primary and secondary sources. Questionnaires are used to obtain primary source data by distributing them to employees and subject matter experts online. Questionnaires are administered to subject matter experts, followed by semi-structured interviews to delve deeper into the data and acquire a more comprehensive comprehension. Secondary source data encompasses information derived from multiple sources, including publications, scientific journals, documents, reports, internet-based data, and internal firm documents. Subsequently, the collected data undergoes a meticulous evaluation and screening procedure to ensure quality. As mentioned above, the procedure entails eliminating sensitive data that lacks authorization for distribution within the framework of this thesis.

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3.3 Data Analysis

This step involves examining the acquired data using suitable statistical methodologies, specifically descriptive statistics and Partial Least Squares Structural Equation Modeling (PLS-SEM) analysis. Descriptive statistics derive inferences from organized and grouped groupings, illustrating the interrelationships among variables within a sample population (Parampreet Kaur et al., 2018). This study examined the correlation between many variables, including safety preventive and control systems, safety commitment, worker involvement, safety arrangement, reward systems, and management involvement, and the severity of the safety program's effectiveness. Additionally, the author sought to establish a correlation between the efficacy of the safety program implemented and variables such as safety knowledge, intention to apply, behavioral change, and incident reduction.

Structural Equation Modelling (SEM) has risen in popularity in recent decades. This may be attributed to the method's superiority in measuring latent variables and examining the relationships between these variables (Babin et al., 2008). According to Hair et al. (2014), the SEM method was initially employed in a covariance-based manner, but it can also be utilized using the variance-based partial least squares technique. In this study, the application used to perform data processing is SMARTPLS4.

4 RESULTS AND FINDINGS

This section analyzes the data from a questionnaire sent to all DWI employees. The total number of respondents in the survey was 619, representing approximately 25% of the DWI MHK, LTD. workforce population. The data analysis findings have derived the solution and proposed implementation strategy. The conclusion of this chapter will include an implementation plan and its rationale.

4.1 Data Quality Assessment

Before conducting more data processing, a thorough examination of the outcomes of the questionnaire is performed. To guarantee the absence of missing data or suspicious trends in the questionnaire results (Hair et al., 2017). The questions presented in the Google Form are designed to be necessary, ensuring that respondents must complete all questions to submit their completed questionnaire. This is done to guarantee the completeness of the transmitted data. Steps used to assure data quality are data screening and handling missing data, checking for outliers, and assessing respondent misconduct in the survey.

4.2 Respondent Demographic

Based on the questionnaire data received, the demographic data of respondents who filled out the questionnaire is displayed as follows.

Table 6. Respondent Demographics Summary

Items	Questions Code	Count	Percentage
Gender	Male	602	97.25%
	Female	17	2.75%
Working Location	Rig	287	46.37%
	Barge	236	38.13%
	Site Base	50	8.08%
	Balikpapan Base	46	7.43%
Working Affiliation	PT. Pertamina Hulu Mahakam	144	23.26%
	Contractors / Service Company	475	76.74%
Education	Elementary School	0	0.00%
	Middle School	5	0.81%
	High School	402	64.94%
	Under Graduate	194	31.34%
	Post Graduate	18	2.91%
	Doctoral	0	0.00%
Working Experience	< 1 year	68	10.99%
	1-5 years	260	42.00%
	6-10 years	89	14.38%
	10-15 years	128	20.68%
	>15 years	74	11.95%

4.3 Analysis Process and Result

Referring to similar studies conducted previously related to critical success factors of safety programs and adding input from Subject Matter Experts, PLS-SEM modeling was formed as High Order Reflective Formative. The researchers suggested a two-stage

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approach to validate the high-order model as an alternative to a repeated indicators approach. (Wetzel et al., 2009). There are two versions of the two-stage approach: the first is The embedded two-stage approach (Ringle et al., 2012), and the second is the disjoint two-stage approach (Agarwal & Karahna, 2000; Becker et al., 2012).

The embedded two-stage approach's initial step is similar to the standard repeated indicators approach, which has an antecedent construct on the structural model. Researchers do not interpret model estimates but store the values of all constructs present in the model and use this as a latent variable score. In the second step, construct scores obtained in previous calculations are used as indicators in the higher-order construct measurement model.

Evaluations performed on higher-order constructs are generally similar to those applied to other PLS-SEM models (Chin, 2010). However, there are some additional evaluation criteria for Higher-Order Constructs. The first is the measurement models of lower-order components and the measuring model of the higher-order construct, described as relationships of higher-order and lower-order components.

4.3.1 Validation of Lower Order Construct

In this phase, the measurement model on the lower-order component is evaluated internally based on consistency (Cronbach's alpha, composite reliability, ρA), convergent validity (indicator reliability, average variance extracted), and discriminant validity. Since the embedded two-stage approach is used, structural models must be evaluated at stage 1 to obtain latent variable scores as single items (Hair et al., 2019).

When assessing a reflective measurement model, the first thing to do is evaluate an indication loading. If the outer loading values are below 0.4, the indicators should be excluded and not included in the final model (Hair et al., 2017). The data processed using PLS-SEM shows that the outer loading value is more significant than 0.4, meaning that all the indicators are reliable in the indicator reliability criteria. The next test is the internal consistency of reliability. The value of Cronbach Alpha indicates this; the higher the value, the higher the internal correlation, and the acceptable value of Cronbach Alpha is more than 0.6 (Hair et al., 2017). The average Variance Extracted indicates the convergent validity value. The minimum value of AVE is 0.5 (Hair et al., 2017). From the following table, the Cronbach Alpha values are all above 0.6.all variables have an AVE value above 0.5

Table 7. AVE, CR, and Cronbach's Alpha of First Order

Parameters	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Adequate Resource Allocation	0.867	0.874	0.904	0.655
Allocation of Authority and Responsibility	0.861	0.866	0.906	0.707
Clear and Reasonable Objective	0.892	0.893	0.921	0.699
Communication	0.864	0.865	0.902	0.649
Effective Enforcement	0.791	0.795	0.864	0.615
Equipment and Maintenance	0.810	0.817	0.875	0.638
Management Suppot	0.923	0.924	0.942	0.765
Personal Attitude	0.789	0.841	0.843	0.518
Personal Competency	0.855	0.858	0.897	0.635
Personal Motivation	0.800	0.801	0.870	0.625
Program Evaluation	0.886	0.887	0.917	0.688
Reward and Punishment	0.844	0.846	0.889	0.616
Safety Meeting	0.766	0.766	0.851	0.587
Safety Training	0.891	0.891	0.919	0.696
Successful Safety Program	0.930	0.931	0.945	0.741
Suitable Supervision	0.863	0.864	0.898	0.595
Teamwork	0.919	0.919	0.939	0.755

The next step is to assess discriminant validity. This is done to check whether the construct differs empirically from the other construct in the structural model. Based on the criteria of Fornell and Larker (1981), each construct's AVE must be compared with the squared inter-construct correlation of the same construct and the entire reflective measured construct present in the structural model (Hier et al., 2019). Based on these criteria, the created construct has met Fornell Larcker's criteria.

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4.3.2 *Validation of Higher Order Construct*

The study's higher-order construct was a successful safety program, and the five lower-order constructs were a safety prevention and control system, worker participation, safety arrangement, management commitment, and reward and punishment. Several different steps were taken to validate the higher-order formative construct.

The next step is to assess the significance and relevance of outer weights. The P value indicates the significance of the outer weight, while the Statistics T value shows the relevance of the external weight. A P value of 0.00 means that the element is significant, whereas a T value greater than 0.5 indicates that the aspect is relevant. Second-order Outer loadings on the model studied have values of more than 0.5, and a P value of 0 indicates that the outer loadings are relevant and significant.

The next step is to perform a collinearity assessment. This assessment's measured value is the Variance Inflation Factor (VIF). VIF 5 or more indicates a collinearity problem (Hair et al., 2021). In this model, the collinearity value is below 5, indicating no issue with collinearity in the studied model.

Table 8 Variance Inflation Factor Second Order Model

	VIF
LV scores - Adequate Resource Allocation	2.952
LV scores - Allocation of Authority and Responsibility	3.689
LV scores - Clear and Reasonable Objective	3.430
LV scores - Communication	3.635
LV scores - Effective Enforcement	2.584
LV scores - Equipment and Maintenance	2.956
LV scores - Management Suppot	2.261
LV scores - Personal Attitude	1.022
LV scores - Personal Competency	3.225
LV scores - Personal Motivation	1.652
LV scores - Program Evaluation	3.594
LV scores - Safety Meeting	1.680
LV scores - Safety Training	3.945
LV scores - Suitable Supervision	2.556
LV scores - Teamwork	2.941

4.3.3 *R^2 Rating, SRMR, and Q Square Predict*

R2 Rating is used to measure the accuracy of the measured model and how much variance can be explained by the endogenous construct. Based on recommendations from Cohen (1988), an R2 rating value of more than 0.25 has a significant effect, 0.09 has a moderate impact, and 0.01 has a small effect. From this value, the model has an R2 value of 0.794, which means it can explain 79% of the variance of the Effective Safety Program.

According to Karin Schermelleh et al. (2003), SRMR values below <0.1 are considered an acceptable and a good fit. The SRMR value of the model is 0.05 (<0.1). This indicates that the result of the matrix correlation model calculation is close to the correlations of empirical data.

Q-square is predictive relevance, which measures whether or not a model has predictive relevance. Q-square values above zero indicate that the values are well reconstructed and the model has predictive relevance. The Q-square successful safety program scored 0.784, based on Haier et al. (2019), which indicates that the model has high predictive accuracy.

4.3.4 *Hypothesis testing*

From the table, we can find a summary of the relationship between independent variables and dependent variables. Dependent variables are said to have a significant effect if t>1.96 and p<0.05 (Hair et al.,2017).

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Table 9. Model Result

	T statistics (|O/STDEV|)	P values
Management Commitment -> Successful Safety Program	5.660	0.000
Reward and Punishment -> Successful Safety Program	3.714	0.000
Safety Arrangement -> Successful Safety Program	2.651	0.008
Safety Prevention and Control System -> Successful Safety Program	1.489	0.136
Worker Participation -> Successful Safety Program	1.318	0.188

(1) Management Commitment -> Successful Safety Program

The relationship between Management Commitment and a Successful Safety Program is statistically significant, as indicated by a high T statistic and a P value of 0.000 (less than the typical alpha level of 0.05). This suggests that the Management Commitment strongly predicts a Successful Safety Program. Management commitment positively correlates with and significantly affects the Successful Safety Program.

(2) Reward and Punishment -> Successful Safety Program

This relationship is also statistically significant, with a high T statistic and a P value of 0.000. It indicates that Reward and Punishment practices are significant predictors of the success of a Safety Program. Reward and punishment, introduced as a novelty in this research, have gained a positive correlation and significant effect on the successful safety program.

(3) Safety Arrangement -> Successful Safety Program

The relationship is significant, as the P value is less than 0.05. The T statistic suggests a moderately strong relationship, indicating that Safety Arrangements contribute positively to the success of a Safety Program. Safety Arrangements have a positive correlation and significant effect on successful safety programs.

(4) Safety Prevention and Control System -> Successful Safety Program

This relationship is not statistically significant, as indicated by the P value greater than 0.05. The lower T statistic suggests a weaker relationship. This means that the Safety Prevention and Control System, as modeled, may not be a strong predictor of a Safety Program's success within this study's scope. The Safety Prevention and Control System has a positive correlation but no significant effect on the Successful Safety Program. Based on the interview, the authors identify that the presence of a safety system does not guarantee its effective implementation. There might be a gap between the system's design and its actual execution on the ground. Other factors not included in the model, such as leadership styles, employee training, or organizational policies, might mediate or moderate the impact of safety systems. Lastly, how the Safety Prevention and Control System is conceptualized and measured might need to capture its effect on the safety program's success. The indicators used may need to reflect the construct adequately.

(5) Worker Participation -> Successful Safety Program

In examining the relationship between Worker Participation and the success of the Safety Program, it was found that this correlation was not statistically significant, as indicated by a P value exceeding 0.05 and a low T statistic. Despite a positive correlation, Worker Participation did not demonstrate a significant impact on the Safety Program's success within this study's context. Several potential explanations for this lack of significance are worth considering. Firstly, workers' engagement levels may vary, with some superficial participation. Genuine engagement necessitates active involvement in safety discussions, decision-making processes, and problem-solving initiatives, which may only sometimes be achieved to the required extent. Secondly, the organizational hierarchy could play a role, as workers within specific organizational structures may have limited authority or feel less empowered to express their concerns or provide suggestions, thereby reducing the effectiveness of their participation. Lastly, limitations in measurement methods may contribute to the lack of significance observed. Similar to the challenges encountered in measuring the Safety Prevention and Control System, there may be issues in accurately assessing worker participation. The indicators utilized may fail to fully capture the essence of effective participation or may need to align better with the construct's impact on the safety program's success. These possible explanations shed light on the complexities surrounding the relationship between Worker Participation and the success of Safety Programs, suggesting areas for further investigation and improvement in future studies.

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5 DISCUSSION

According to the analysis of the questionnaire data, it was determined that three of the five variables examined had a substantial impact on the safety program's success, while two variables did not. The author suggests multiple alternatives and implementation plans to enhance the efficiency of the safety program. Generally, the recommended approach follows the following strategy.

5.1.1 Strengthen Management Commitment

Management commitment is the key aspect that must be strengthened and focused on. This section introduces a new initiative called Management Night Stay, which promotes increased interaction between management and frontline employees through formal and informal communication channels. Management's presence in the workplace is expected to boost employees' enthusiasm and show an evident dedication to prioritizing workers' safety.

Assistant managers and engineers must visit the field more often and interact with the workers in addition to senior management. Balikpapan's middle-level managers and engineers will show their dedication to safety through their contact; by comprehending the present scenario, challenges faced, and operational and social obstacles, municipal administration is anticipated to develop precise and effective safety initiatives.

5.1.2 Optimize Reward and Punishment System

Based on the results of interviews and brainstorming with the subject matter expert, reward and punishment were added to the critical safety success factors. However, the rewards currently being given still need to be increased, focusing only on the core workers, so it seems necessary to add rewards to the support workers to motivate them to improve safety. Some incidents occurred to support workers less involved in various safety activities. The reward and punishment system also needs to be strengthened for the new workers who are, in number, the largest population of DWI workers in the Tribunal. Programs are given specifically for them that are expected to accelerate the safety learning process.

5.1.3 Re-evaluate and Enhance Safety Arrangements

The third aspect that requires attention and strengthening is the Safety Arrangement. A new program called TKI and TKO workshops has been developed, along with constructing the portal "*Curhat Dong Boss*." Enhancing the training for TKI & TKO is essential due to the high number of new employees in DWI MHK, LTD. These workers must be educated on DWI MHK, LTD's work protocols and safety regulations. A new digital gateway is being designed to enable field personnel to express their knowledge and concerns directly to DWI management without being obstructed by their superiors. Its goal is to eliminate the communication obstacles present in specific incident investigations.

5.1.4 Improve Safety Prevention and Control System

One part that is still not optimal and needs to be improved is the Safety Prevention and Control System component. This component adds three new programs: Full Cycle Observation, DWI Mobile Application with HSSE Passport Integration, and Smart CCTV. The full-cycle operation program is expected to see the potential hazards in DWI operations in more detail and depth, trying to uncover hidden dangers that were previously unidentifiable and ideally mitigated.

To maintain employees' compliance throughout the DWI while performing monitoring, we created DWI Mobile and HSSE Passport applications. The application will compile an entire dashboard summary of employee data along with medical check-up status, level of compliance with training and certification, length of day work in the field, work experience, and experience and skills. With this application, unqualified workers will be identified in advance, so only qualified workers can work in the field. Workers' outflow will be better monitored.

Artificial intelligence is also used to help monitor unsafe conditions that may occur. The integration of AI, Image recognition, and CCTV technology is made into a smart CCTV application. It helps monitor operations 24 hours a day and provides automatic and instant notifications when unsafe conditions are detected.

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5.1.5 Improve Worker Participation

Efforts are also being made to increase the active participation of workers in safety activities. The new program proposed is HSSE Family Coaching, a health and safety-related training program involving family members. This activity aims to ensure that the implementation of health and safety can start from the home and the lifestyle of workers to become healthier both at home and in the field. In addition, the activities are also aimed at reducing the potential non-work related illness fatality caused by heart attacks that occur several times in the corporate environment.

The next thing to do to increase active employee participation is to increase employee involvement in implementing safety meetings and safety campaigns. Employees can be ambassadors of safety and various knowledge, experience, and lessons learned from other employees.

Another thing that is supported is the increase in the quantity and quality of safety training implementation, especially for the new workers who still need more work experience in the Court and more understanding of the existing safety rules. The field workers have also requested these training activities because they need more safety skills.

6 CONCLUSION

This study investigates the elements influencing the efficacy of the safety program implemented in the MHK, LTD: drilling and Well Intervention function. Additionally, the study intends to identify the primary components that contribute to the safety program's effectiveness. This research concludes by addressing the research questions based on data analysis from 619 respondents using the PLS-SEM method. Factors that affect the effectiveness of safety programs in Drilling and Well Intervention MHK, LTD. are Management Commitment, Safety Arrangement, and Reward System. The most dominant factors in the safety program's effectiveness at DWI MHK, LTD. Is Management Commitment. Based on the research results, the reward system significantly influences the effectiveness of safety programs.

To enhance the safety program's efficacy, it is crucial to incorporate worker involvement, safety arrangements, and management commitment as reinforcing aspects during its implementation. Further research is required to simulate the impact of raising the intensity of the safety program on its effectiveness. Additionally, it is imperative to perform simulations to assess the effects of concurrently implementing many safety programs, determining whether this enhances the safety program's efficacy or has the opposite effect. Determining the order and combination of safety initiatives to be implemented will be significant.

Additional research could investigate the precise categories of incentives and penalties that yield the most efficacy in improving safety protocols. Do intrinsic rewards, such as recognition, have a more significant impact than extrinsic rewards, such as bonuses, or is the opposite true? Research can also investigate the psychological and behavioral factors that impact employee attitudes and behaviors regarding the safety of these systems.

Lastly, the lack of relevance attributed to Worker Participation implies that its impact on achieving safety objectives is multifaceted. Subsequent investigations may delve into the obstacles impeding the efficacy of worker engagement in safety initiatives.

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