JEMSI: Jurnal Ekonomi Manajemen Sistem Informasi
E-ISSN: 2686-5238
P-ISSN: 2686-4916
https://dinastirev.org/JEMSI dinasti.info@gmail.com +62 811 7404 455
DOI: https://doi.org/10.38035/jemsi.v7i6
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Received: 19 June 2026 | **Revised:** 6 July 2026 | **Accepted:** 18 July 2026

The Role of Health, Safety and Environment (HSE) in Mediating the Effect of Safety Behaviour and Dangerous Goods Handling Competency on Operational Performance at Palaran Fuel Terminal Samarinda

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Abstract*:* The oil and gas industry is characterized by a high level of safety risk, particularly in activities involving the handling of fuel products classified as Dangerous goods (DG). Operational performance in high-risk work environments is strongly influenced by safety behaviour, technical competence, and the effectiveness of the Health, Safety, and Environment (HSE) system. This study aims to analyze the effect of safety behaviour and Dangerous goods handling competence on operational performance, with HSE as a mediating variable. This research adopts a quantitative approach using a survey method involving 188 respondents engaged in operational activities. Data were analyzed using Structural Equation Modeling–Partial Least Squares (SEM-PLS). The results indicate that safety behaviour and Dangerous goods handling competence have a positive and significant effect on operational performance. In addition, safety behaviour and DG competence significantly influence HSE. HSE is proven to have a positive effect on operational performance and acts as a mediating variable, mediating the relationship between safety behaviour and operational performance, and more strongly mediating the relationship between DG competence and operational performance. These findings confirm that improving operational performance requires an integrated approach combining safety behaviour, technical competence, and an effective HSE system. This study is expected to contribute both theoretically and practically to the management of safety and operational performance in high-risk industries.

Keyword: Safety Behaviour, Dangerous Goods Competence, Health, Safety and Environment (HSE), Operational Performance.

INTRODUCTION

The oil and gas industry is a strategic sector that plays an important role in supporting energy security, industrial activities, transportation, logistics, and national economic growth (Simanjuntak et al., 2025). Within the energy distribution chain, fuel terminals serve as critical operational nodes that ensure the receipt, storage, and distribution of fuel are conducted safely, on time, in the correct volume, and in accordance with established quality standards. The operational reliability of fuel terminals is therefore essential, as any disruption in energy distribution may directly affect economic activities, public services, and the continuity of energy supply. Accordingly, fuel terminal management should not only focus on operational efficiency, but also incorporate occupational health, safety, and environmental protection as integral and sustainable components.

However, fuel terminal operations are associated with a high level of risk because they involve loading, unloading, storage, and distribution activities of fuel classified as dangerous goods (DG). Fuel possesses flammable characteristics, has the potential to cause environmental pollution, and requires strict handling procedures to prevent leakage, fire, explosion, and other operational disruptions. In the context of terminal and port operations, the handling of dangerous goods requires risk detection capability, clear safety procedures, operational coordination, and adequate personnel competence to ensure that potential incidents can be effectively controlled (Tseng & Pilcher, 2023). Thus, the success of fuel terminal operations is not only determined by the availability of infrastructure and equipment, but also by the ability of human resources to understand, control, and respond appropriately to risks associated with hazardous materials.

In high-risk industries such as oil and gas, human factors are among the key determinants in preventing occupational accidents. Non-compliance with standard operating procedures, lack of discipline in the use of personal protective equipment, weak emergency response, and limited understanding of hazardous material characteristics may increase the likelihood of incidents. Safety behaviour is therefore an important aspect, as it reflects workers' actions in complying with procedures, identifying hazards, reporting unsafe conditions, and participating in safety-related activities. Recent studies in the oil and gas sector indicate that safety culture, safety attitude, safety communication, leadership, and employee involvement influence safety behaviour and the reduction of work-related errors (Hien et al., 2024). Furthermore, other studies have shown that safety knowledge, safety climate, and safety motivation affect safety behaviour and safety performance, indicating that safety behaviour should be understood as the result of interactions between individual factors and organisational systems(Wijaya & Brahmasari, 2024).

In addition to safety behaviour, competence in handling dangerous goods is also a crucial factor in ensuring the safety and continuity of fuel terminal operations. Such competence includes knowledge of hazardous material characteristics, skills in implementing safety procedures, the ability to respond to emergencies, and a disciplined attitude in complying with work standards. In high-risk work environments, technical competence cannot be separated from safety training, risk communication, supervision, and the habituation of safe work practices. Recent literature on behaviour-based safety emphasises that strengthening safe behaviour requires leadership commitment, effective communication, worker involvement, learning from errors, and a non-blaming reporting system (Carra et al., 2024). In line with this, studies in the oil and gas industry have shown that Occupational Health and Safety Management practices, Hazard Identification and Risk Assessment, and safety communication contribute to the improvement of safety knowledge and safety performance (Jamil et al., 2025)

Based on these conditions, Health, Safety, and Environment (HSE) can be positioned as a mediating variable that bridges the influence of safety behaviour and dangerous goods handling competence on operational performance. HSE functions as an organisational

mechanism that integrates safety behaviour and technical competence into work procedures, risk control, training, inspection, audit, incident reporting, and emergency preparedness. Recent studies also indicate that Occupational Health and Safety can mediate the relationship between occupational risks and employee performance, suggesting that safety systems function not only as compliance instruments, but also as mechanisms for strengthening operational performance (Azzam et al., 2026). Therefore, this study focuses on the Palaran Fuel Terminal in Samarinda, operated by PT Elnusa Petrofin, to analyse the influence of safety behaviour and dangerous goods handling competence on operational performance, with HSE as a mediating variable. This study is expected to provide theoretical contributions to the development of a safety management model based on behaviour and competence, as well as practical contributions for companies in strengthening safety culture, HSE effectiveness, and fuel terminal operational reliability.

METHOD

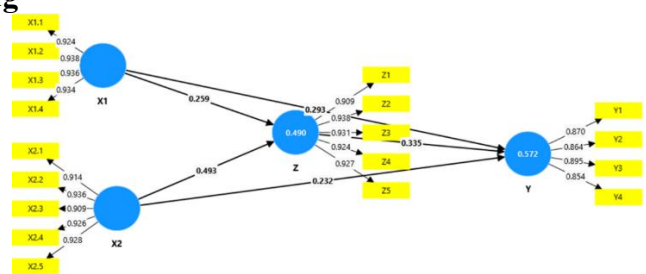
This study employs a quantitative research method with a descriptive and explanatory approach to examine the relationships between safety behaviour, dangerous goods handling competence, Health, Safety, and Environment (HSE), and operational performance at the Palaran Fuel Terminal in Samarinda, operated by PT Elnusa Petrofin. The study was conducted from March to July 2025 at Jl. Simpang Pasir No. 1, Palaran, Samarinda, East Kalimantan. The population consists of all employees of PT Elnusa Petrofin working at the Palaran Fuel Terminal, totaling 351 employees. The sampling technique used in this study is probability sampling with a simple random sampling approach, and the sample size was determined using the Slovin formula with a 5% margin of error, resulting in 188 respondents. Primary data were collected through structured questionnaires using a five-point Likert scale, supported by observation, while secondary data were obtained from journals, books, regulations, company documents, and previous studies relevant to safety behaviour, dangerous goods handling, HSE, and operational performance.

This study applies Structural Equation Modeling based on the Partial Least Squares approach, using SmartPLS version 4 as the analytical tool. The PLS-SEM method was selected because it is suitable for examining complex relationships among latent constructs, including both direct and indirect effects. In this study, HSE is positioned as a mediating variable that explains the relationship between safety behaviour, dangerous goods handling competence, and operational performance. The analysis process consists of assessing the measurement model to ensure the validity and reliability of the indicators, evaluating the structural model to examine the relationships among variables, and conducting hypothesis testing through the bootstrapping procedure. Therefore, this method enables the study to evaluate how safety behaviour and dangerous goods handling competence affect operational performance, both directly and indirectly through HSE.

RESULTS AND DISCUSSION

Outer Model

1. Validity Testing



Source: Research data

Figure 1. Validity Test

Based on the PLS Algorithm output, as shown in Figure 4.1, a validity test was conducted for each variable used in this study. The validity testing is explained in more detail as follows:

Table 1. Validity Testing

Indicator	*Loading factor*
***Safety behaviour* (X1)**	
SB 1	0.924
SB 2	0.938
SB 3	0.936
SB 4	0.934
DG Handling Competency (X2)	
DGC 1	0.914
DGC 2	0.936
DGC 3	0.909
DGC 4	0.926
DGC 5	0.928
Health, Safety, Environment (Z)	
HSE 1	0.909
HSE 2	0.938
HSE 3	0.931
HSE 4	0.924
HSE 5	0.927
Opertational Performance (Y)	
OP 1	0.870
OP 2	0.864
OP 3	0.895
OP 4	0.854

Based on the outer model testing results, all indicators of the variables Safety Behaviour (X1), Dangerous Goods Handling Competency (X2), Health, Safety, and Environment (Z), and Operational Performance (Y) show factor loading values greater than 0.7. These values indicate that each indicator has a strong contribution in explaining the measured variable.

2. Discriminant Validity

Table 2. Discriminant Validity Testing

	SB	DGC	OP	HSE
SB				
DGC	0.741			
OP	0.710	0.715		
HSE	0.633	0.705	0.720	

Based on the validity test results presented in Table 3 above, the cross-loading values of each indicator used in this study show higher values for their respective constructs. This indicates that the latent constructs are able to predict the indicators within their own blocks better than the indicators in other blocks. Therefore, the model satisfies the discriminant validity criteria, confirming that all constructs are sufficiently differentiated and suitable for further structural analysis.

3. Reliability Testing

Table 3. Reliability Testing

	Cronbach's alpha	Composite reliability (rho_c)
Safety Behaviour (X1)	0.950	0.964
Dangerous Goods Handling Competency (X2)	0.956	0.966
Health, Safety, and Environment (Z)	0.894	0.926
Operational Performance (Y)	0.958	0.968

Based on the reliability test results presented in Table 4.10 above, the Cronbach's Alpha values obtained for all constructs in this study, namely Safety Behaviour (X1), Dangerous Goods Handling Competency (X2), Health, Safety, and Environment (Z), and Operational Performance (Y), are ≥ 0.70. Therefore, it can be concluded that the instruments used in this study are reliable.

Outer Model

1. Coefficient of Determination

Table 4. Coefficient of Determination Testing

	R-square	R-square adjusted
OP (Y)	0.572	0.565
HSE (Z)	0.490	0.485

Based on Table 4.12 above, the Operational Performance model produces an R-Square value of 0.572, or 57.2%, which falls into the strong category. Meanwhile, the R-Square value for the Health, Safety, and Environment variable is 0.485, or 48.5%, which falls into the moderate category. Therefore, it can be stated that the model is sufficiently good, or in other words, the predictive accuracy of the model is considered adequate.

2. F-Square Test

Table 5. f-square Test Result

	SB (X1)	DGC (X2)	OP (Y)	HSE (Z)
SB (X1)			0.094	0.065
DGC (X2)			0.051	0.238
OP (Y)				
HSE (Z)			0.134	

Based on the Effect Size (f^2) test results presented in Table 4.12, Safety Behaviour (X1) has a small effect on Operational Performance (Y) with an f^2 value of 0.094 and a small effect on Health, Safety, and Environment (HSE) (Z) with an f^2 value of 0.065. Meanwhile, Dangerous Goods Handling Competency (X2) has a small effect on Operational Performance (Y) with an f^2 value of 0.051, but a moderate effect on HSE (Z) with an f^2 value of 0.238, indicating that this competency plays a more substantial role in improving HSE than in directly enhancing operational performance. Furthermore, HSE (Z) has a small effect on Operational Performance (Y) with an f^2 value of 0.134, suggesting that HSE contributes to improving operational performance, although its effect is not yet dominant.

3. GOF

Table 6. GoF Testing

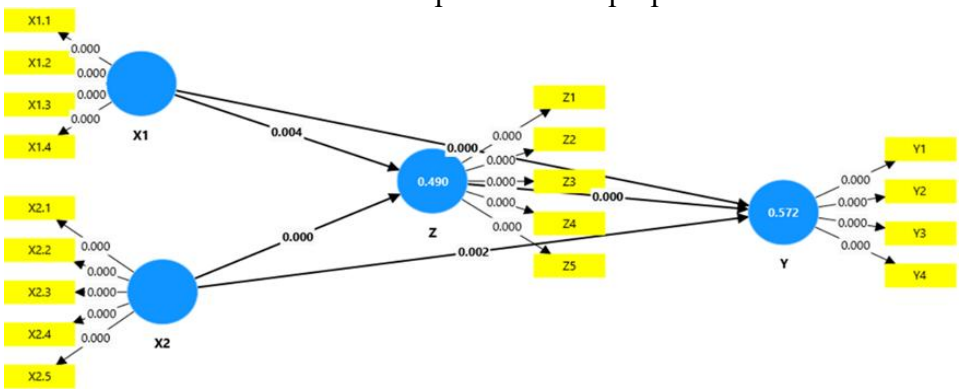
Variable	AVE	R-square adjusted
SB (X1)	0.870	
DGC (X2)	0.851	
OP (Y)	0.759	0.565

HSE (Z)	0.858	0.485
Avarage	**0.835**	**0.525**

Based on the calculation results, the GoF value obtained is 0.662, indicating that the combined performance of the outer model and inner model in this study can be classified into the large GoF category.

Hypothesis Testing

This section presents the results of hypothesis testing using the SEM-PLS approach. The testing was conducted to examine whether the independent variables, namely Safety Behaviour (X1), Dangerous Goods Handling Competency (X2), and Health, Safety, and Environment (Z), influence Operational Performance (Y), either directly or indirectly. Hypothesis testing is conducted by evaluating the path coefficients, T-statistics, and p-values to determine the significance and direction of the relationships within the proposed research model.



Source: Research data

Figure 2. Bootstrapping

Table 7. Hypothesis Testing

Hypothesis	*Path*	Original sample (O)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Description
H1	**Safety Behaviour (X1) influences Operational Performance (Y)**	0.293	0.077	3,807	0.000	Accepted
H2	**Safety Behaviour (X1) influences Health, Safety, and Environment (Z)**	0.259	0.089	2,901	0.004	Accepted
H3	**Dangerous Goods Handling Competency (X2) influences Operational Performance (Y)**	0.232	0.074	3,138	0.002	Accepted
H4	**Dangerous Goods Handling Competency (X2) influences Health, Safety, and Environment (Z)**	0.493	0.092	5,361	0.000	Accepted
H5	**Health, Safety, and Environment (Z) influences**	0.335	0.080	4,195	0.000	Accepted

	Operational Performance (Y)					
H6	**Safety Behaviour (X1) indirectly influences Operational Performance (Y) through Health, Safety, and Environment (Z)**	0.087	0.039	2,248	0.025	Accepted
H7	**Dangerous Goods Handling Competency (X2) indirectly influences Operational Performance (Y) through Health, Safety, and Environment (Z)**	0.165	0.050	3,274	0.001	Accepted

Discussions

1. Hypothesis 1

The hypothesis testing results show that Safety Behaviour has a positive and significant effect on Operational Performance, with a path coefficient value of 0.293, a T-statistics value of 3.807, and a P-value of 0.000. This finding is supported by the study of Tahapary & Laksono (2025), which emphasizes that safety behaviour has a direct relationship with operational performance through increased compliance with procedures and reduced work deviations. This strengthens the argument that safety behaviour is not merely a compliance issue, but also a strategic factor in achieving sustainable operational performance.

2. Hypothesis 2

The test results show that Safety Behaviour has a positive and significant effect on Health, Safety, and Environment (HSE), with a path coefficient value of 0.259, a T-statistics value of 2.901, and a P-value of 0.004. This finding is in line with the study by Wijaya & Brahmasari (2024), which found that individual safety behaviour has a significant influence on the effectiveness of occupational health and safety management systems. This strengthens the argument that the quality of HSE largely depends on the quality of safety behaviour demonstrated by human resources.

3. Hypothesis 3

The test results show that Dangerous Goods (DG) Handling Competency has a positive and significant effect on Operational Performance, with a path coefficient value of 0.232, a T-statistics value of 3.138, and a P-value of 0.002. This finding is consistent with the study by Pourmazaherian & Musonda (2022), which states that workers' safety competence and technical knowledge have a significant influence on operational performance through increased compliance with procedures and reduced unsafe behaviour. This indicates that workers with a high level of competency tend to be more capable of performing tasks consistently, minimizing operational deviations, and maintaining the stability of work processes, thereby positively contributing to organizational performance.

4. Hypothesis 4

The test results show that Dangerous Goods (DG) Handling Competency has a positive and significant effect on Health, Safety, and Environment (HSE), with a path coefficient value of 0.493, a T-statistics value of 5.361, and a P-value of 0.000. This finding is consistent with the study by Rospela & Herlina (2022), which states that workers' safety competency and technical knowledge have a significant influence on the effectiveness of occupational health and safety systems. They emphasize that workers with a high level of competency tend to be

more compliant with safety procedures, more capable of identifying potential hazards, and more responsive in implementing preventive actions, thereby directly contributing to improved HSE performance.

5. Hypothesis 5

The test results show that Health, Safety, and Environment (HSE) has a positive and significant effect on Operational Performance, with a path coefficient value of 0.335, a T-statistics value of 4.195, and a P-value of 0.000. This finding is consistent with the study by Mulyawati et al. (2024), which states that the implementation of a good occupational health and safety system has a positive relationship with organizational performance. This indicates that investment in HSE not only provides safety benefits but also generates operational and economic benefits.

6. Hypothesis 6

The test results show that Safety Behaviour has a positive and significant indirect effect on Operational Performance through Health, Safety, and Environment (HSE), with an indirect path coefficient value of 0.087, a T-statistics value of 2.248, and a P-value of 0.025. This finding is consistent with the framework proposed by Bautista-bernal et al. (2024), which explains that safety behaviour serves as an important mediator between individual factors and organizational outcomes, although its effectiveness is strongly influenced by the existing safety system. In this context, HSE functions as a mechanism that strengthens and directs safety behaviour so that it aligns with the organization's operational objectives.

7. Hypothesis 7

The test results show that Dangerous Goods (DG) Handling Competency has a positive and significant indirect effect on Operational Performance through Health, Safety, and Environment (HSE), with an indirect path coefficient value of 0.165, a T-statistics value of 3.274, and a P-value of 0.001. This finding is consistent with the study by Pourmazaherian & Musonda (2022), which states that workers' safety competency has a significant effect on organizational performance when mediated by an effective safety management system. Therefore, HSE functions as an institutional mechanism that ensures individual competencies are applied consistently and in accordance with standardized work practices.

CONCLUSIONS

Based on the hypothesis testing and discussion, it can be concluded that safety behaviour and Dangerous Goods (DG) handling competency have positive and significant effects on employee operational performance at Terminal BBM Palaran Samarinda PT Elnusa Petrofin, both directly and indirectly through Health, Safety, and Environment (HSE). These findings indicate that safe work behaviour, compliance with procedures, risk awareness, and technical competency in handling dangerous goods contribute to improving operational effectiveness, efficiency, productivity, and workplace safety. Furthermore, HSE is proven to play an important role as a mediating mechanism that strengthens and structures the relationship between individual behaviour, DG competency, and operational performance. Therefore, improving operational performance in high-risk work environments requires the integration of strong safety behaviour, adequate technical competency, and consistent, sustainable HSE management.

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