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Door to Door: Preventive Measures Against Fatigue Among Hauler Operators at PT Putra Perkasa Abadi's MIPL Site

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ABSTRACT

Fatigue or work fatigue is one of the main causes of work accidents in hauler operators in the mining sector. In the June-September 2024 period, PT Putra Perkasa Abadi (PPA) Jobsite MIPL recorded 10 incidents, with 5 cases caused by operator fatigue. The analysis showed operators remained working in fatigued conditions and were reluctant to report the condition. Even though the Driving Monitoring System (DMS) has been used, psychological factors and lack of family support have made fatigue control not optimal. This study aims to evaluate the effectiveness of the Door to Door (DtD) approach based on Family Support Safety in reducing incidents due to fatigue in hauler operators. Uses the Quality Control Project (QCP) approach through the Door to Door (DtD) program, which is a direct visit to the operator: P's family home with the highest DMS findings. The program was implemented in October–November 2024 by a cross-departmental team (SHE, Production, and HCGA). The implementation of the program showed a decrease in incidents due to fatigue from 5 cases to 0 cases, as well as a 100% reduction in the company's potential losses from Rp69,907,004 to Rp0. Family Support Safety through Door to Door (DtD) has proven to be effective as a preventive strategy in managing hauler operator fatigue and can strengthen the occupational safety system in the mining sector.

INTRODUCTION

The mining industry is one of the sectors with the highest risk of work accidents in Indonesia. Hauler operators (dump trucks/HD) who work in long rotational shift systems are particularly susceptible to fatigue conditions. Fatigue not only decreases productivity, but also significantly increases the risk of work accidents (Tjendera, 2018; Nugroho et al., 2024).

Work fatigue is defined as a condition of reduced work capacity due to previous activities, which can be physical or mental, and is characterized by decreased concentration, slowed reactions, and increased errors in work (Latief, 2021; Putra, 2023). In the context of mining, fatigue is one of the main risk factors for accidents because hauler operators have to operate large-scale heavy equipment for long working durations, often at night or in extreme weather conditions (Setiawan & Fauzan, 2020; Samosir et al., 2024).

Various internal and external factors contribute to fatigue in mine operators, including high physical and mental workload, sleep quality disorders, night work shifts, work stress, and

lack of adequate rest time (Narpati et al., 2019; Pardyani & Susilowati, 2024; Yikwa et al., 2025). Sari et al. (2025) found that sleep quality and work shifts have a significant relationship with work fatigue. Research by Zakaria et al. (2024) also confirms that fatigue risk factors are multidimensional and require a holistic approach.

PT Putra Perkasa Abadi (PPA) is a mineral and coal mining services company operating in 11 locations throughout Indonesia, including the MIP Lahat (MIPL) Jobsite in South Sumatra. In an effort to realize a culture of mining safety, the company is committed to preventing accidents and dangerous events, as well as protecting workers from all forms of danger (PPA, 2024).

In the June-September 2024 period, Jobsite MIPL recorded 10 incident cases consisting of 2 property damage (PD) and 8 nearmiss (NM). Of these, 5 cases are directly caused by fatigue conditions in hauler operators. Although Driving Monitoring System (DMS) technology has been installed in all hauler units, fatigue cases still occur, indicating that there are gaps in the existing control system (Dewa, 2025; Site, 2025).

An in-depth analysis shows that the root of the main problem is not solely in the technological aspect, but in psychological and social factors—in particular the reluctance of operators to report fatigue conditions (prestige) and the lack of family support in ensuring adequate rest before shifts. This is in line with the findings of Patmasari & Erwandi (2026) which emphasizes the importance of identifying personal risk factors in fatigue management.

The Door to Door (DtD) program as Family Support Safety is designed to address this gap. By visiting directly the families of the operators identified as having the highest DMS findings, the program aims to build collective awareness in the workers' immediate environment to support adequate rest. This study documents the implementation of QCP with the 8-Step method (PDCA) to reduce fatigue incident cases from 5 to 0 at the MIPL Jobsite for the October-December 2024 period.

The research gap in this study lies in the lack of integration between technological and social approaches in managing work fatigue. Previous studies tend to focus on fatigue measurement and control through monitoring systems or individual interventions, while the role of family support as part of the occupational safety ecosystem has rarely been empirically explored, especially in the Indonesian mining sector. Therefore, an innovative approach is needed to bridge both technical and social aspects simultaneously.

The urgency of this study is reinforced by the high potential risk of accidents due to fatigue and the significant financial losses that may be incurred by the company. Furthermore, the shift in occupational safety paradigms toward a more holistic approach demands innovation in accident prevention strategies. The novelty of this research lies in the implementation of a Door-to-Door approach based on Family Support Safety, which involves families as key actors in ensuring that operators are in a fit-to-work condition before starting their shifts. This approach is expected to address the “X factors” that cannot be resolved through technology alone.

Based on this background, the objective of this study is to evaluate the effectiveness of the Door-to-Door program based on Family Support Safety in reducing fatigue incidents among hauler operators in the mining environment. This study is expected to contribute theoretically to the development of a more comprehensive fatigue management model, as well as provide practical benefits for companies in improving occupational safety systems. In

addition, the findings are anticipated to serve as a reference for implementing community- and family-based safety policies in other high-risk industries.

METHOD

This study uses the Quality Control Project (QCP) approach with an 8-step method based on the PDCA (Plan-Do-Check-Act) cycle. The research design was descriptive-intervention with an observational approach to DMS data, incident analysis, and evaluation of intervention programs.

Research Location and Time

The research was carried out at PT Putra Perkasa Abadi Jobsite MIPL (MIP Lahat), South Sumatra, Indonesia. The QCP timeline lasts for 4 months, from September 2024 to December 2024 (Table 1).

Tabel 1. Timeline QCC Door to Door (PDCA)

No	Phase	Sep W1	Sep W2	Sep W3-4	Oct	Nov	Des W1-2	Des W3-4	PDCA
1	Activity Determination	✓	✓						P
2	Identify the Cause			✓					P
3	Determination of Solution			✓					P
4	Improvement Plan			✓					P
5	Implementation of Improvement Plan				✓	✓			D
6	Solution Evaluation						✓		C
7	Standardization							✓	A
8	Setting the Next Theme							✓	A

Sourch: Internal project timeline data (QCP Door to Door Program)

Research Subjects and Instruments

The subjects of the study were all hauler operators (dump trucks/HD) at the PT PPA MIPL site identified in the DMS system during the June–November 2024 period. The research team (SHIELD+) consists of 12 people across departments: SHE (5 people), Production (2 people), COE (2 people), HCGA (1 person), and Paramedic (1 person) as health experts.

The instruments used include: (1) Driving Monitoring System (DMS) with yawning and eyes closed detection sensors installed on all hauler units; (2) Realtime notification system via Telegram (Group Transtrack) and WhatsApp (Group DMS); (3) DMS web dashboard (CCR); (4) Daily intervention forms; (5) Fatigue Awareness Module Door to Door; and (6) Improvement evaluation form (ANAKONDA).

Data Collection and Analysis Pipeline

Data collection is carried out through four stages: (1) Monitoring and evaluation of DMS daily report by the CCR team; (2) Validation of DMS notification findings (Eyes Closed and Yawning); (3) Direct intervention by field supervisors based on DMS findings; and (4) Door to Door Program to operator families with the highest DMS findings (Top Three). Cause and effect analysis uses fishbone diagrams (Ishikawa), while solution determination uses weighting matrix based on outcome opportunities, time, cost, and other considerations (Gustian et al., 2025; Mambu et al., 2025).

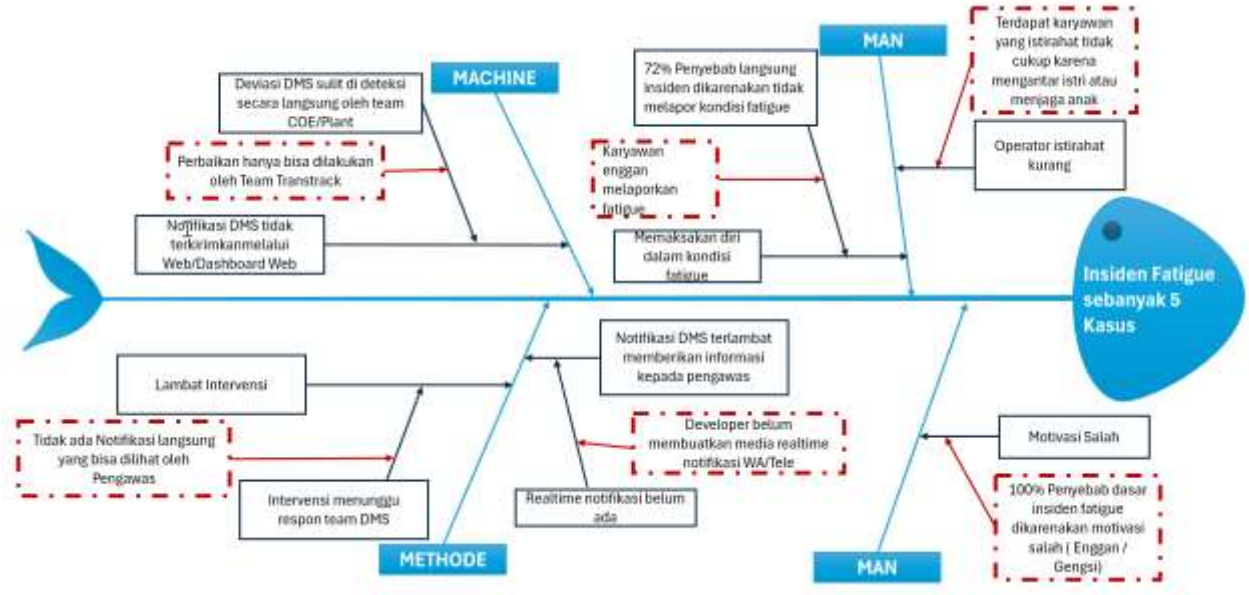

Figure 1. Diagram Fishbone

RESULTS AND DISCUSSION

Problem Identification and Stratification

Based on incident data at the PT PPA MIPL site for the June-September 2024 period, a total of 10 incident cases were found consisting of 2 property damage (PD) and 8 nearmiss (NM). After stratification, 5 out of 10 cases of incidents were caused by hauler operator fatigue. The distribution of incident cases per month is presented in Table 2 below.

Table 2

Moon	Manpower	Total Incidents	Insiden Fatigue	PD	NM
June 2024	1.171	1	1	0	1
July 2024	1.244	2	2	1	1
August 2024	1.303	1	1	1	0
September 2024	1.241	1	1	0	1
TOTAL	**–**	**10**	**5**	**2**	**8**

Sourch: Incident and manpower records from PT PPA MIPL site (June–September 2024)

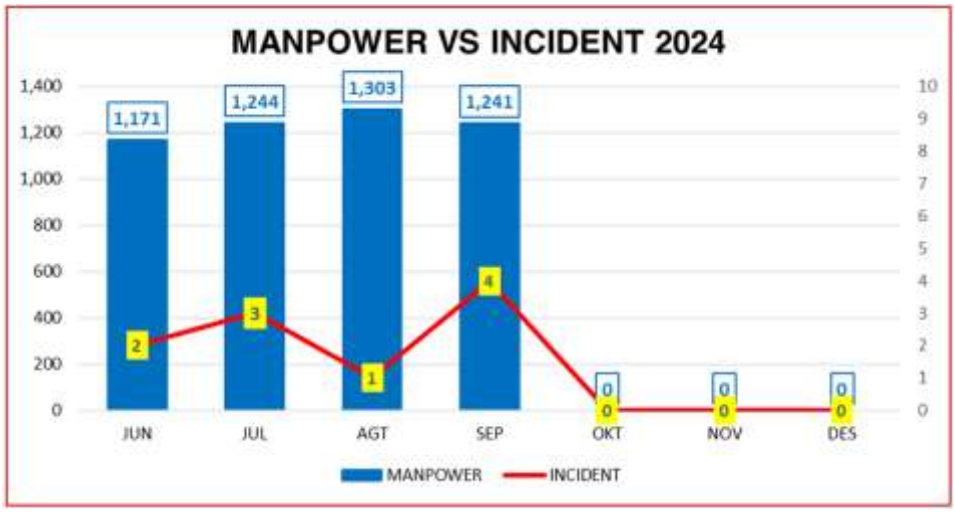

Figure 2. Manpower vs Incident Case

The data in Table 2 shows a consistent trend in fatigue incidence cases every month. The high number of manpower (above 1,100 people) is proportional to the frequency of incidents, which, although relatively small in absolute terms, has a huge potential impact considering the classification of fatigue as a High Potential Risk Incident (HPRI) (Patmasari & Erwandi, 2026). This is in line with the findings of Nugroho et al. (2024) who stated that fatigue is one of the significant risk factors for accidents in dump truck operators.

Problem Impact Analysis and Theme Expectations

The impact analysis of the problem was carried out on all relevant stakeholders, as presented in Table 3.

Table 3. Problem Impact Analysis and Theme Expectations

No	Related Parties	Impact of the Problem	Theme Expectations	Expectations from Related Parties
1	SHE	Incidence due to fatigue increases	Fatigue incidence decreases and disappears	Preventing and reducing fatigue incidents
2	Production	Operator incident fatigue, potential to stop operation, production not achieved	Case fatigue decreases, operators do not have prestige to report fatigue	Operators understand the importance of getting enough rest and report fatigue conditions
3	Plant	Due to operator incidents, damaged units take time to repair	The unit had no damage due to the incident	PA units are maintained and maximally utilized, encouraging increased revenue
4	Operator	Prestige operators to report fatigue	Operators with full awareness report fatigue conditions when operating the unit	Employees can work safely and securely, safe working hours, smooth earnings

5	Customer	Fatigue incidence increases, customer satisfaction decreases/trust issue	The performance of PT PPA'S KP increased and there were no incident cases	Customers are satisfied with KP PPA's performance

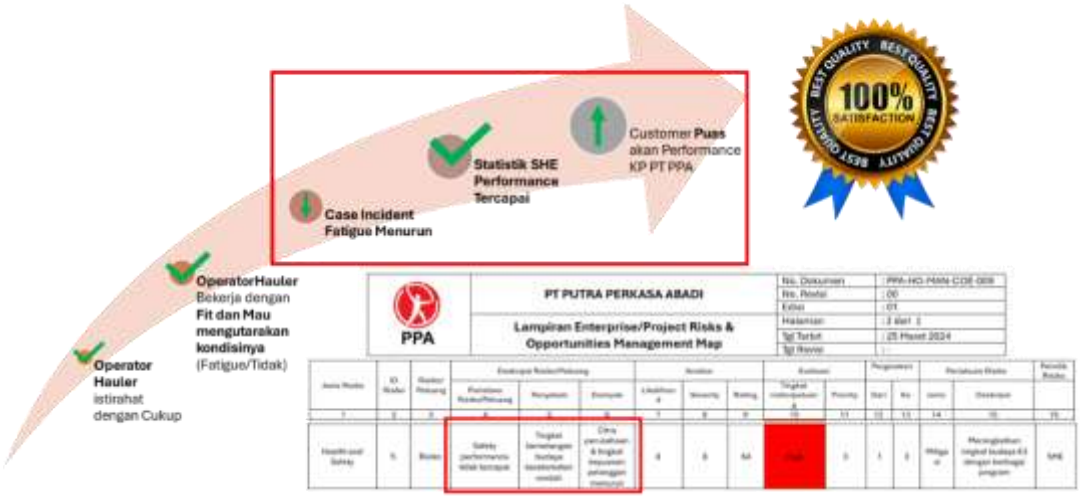

Figure 3. Analysis of the Influence of Themes on Related Parties

Problem Object Review – Analysis of Existing Conditions (ANAKONDA)

Based on incident investigation data and field observations, an analysis of existing conditions (ANAKONDA) was carried out to identify gaps between current conditions and supposed conditions (Table 4). This analysis is a systematic method to decipher the factors that cause incidents based on the categories of Man, Machine, Method, and Material (Hapsari et al., 2025).

Table 4. Analysis of Existing Conditions (ANAKONDA)

Yes	Factors	Problem	Current Conditions	Supposed Conditions
1	MAN	Forcing yourself in a state of fatigue	72% of direct causes of incidents are due to non-reporting fatigue conditions	Employees report fatigue conditions
2	MAN	Wrong motivation	100% of the root cause of fatigue incidents is due to the wrong motivation (Reluctance/Prestige)	Employees do not need prestige to report fatigue conditions
3	METHOD	DMS	DMS is late in providing information to supervisors	DMS can provide real-time automated information to supervisors
4	MACHINE	DMS	DMS notifications are not sent via Web/Web Dashboard	All notifications are sent to the DMS Web Dashboard in CCR

5	METHOD	Intervention	Intervention awaits DMS team's response	Intervention can be carried out directly by the Field Supervisor
6	MAN	Not enough rest	There are employees who do not take enough rest because they take their wives or take care of children	Employee breaks are enough 6–8 hours

Sourch: Field observation and incident investigation data (ANAKONDA analysis)

The results of ANAKONDA's analysis showed that the main problem was centered on the human factor (MAN), where 72% of incidents were caused by operators forcing themselves to work in a state of exhaustion, and 100% of personal factors were in the form of false motivation—reluctance or embarrassment to report fatigue conditions. These findings are consistent with the research of Cristiyanti et al. (2022) who found that work attitudes have a significant effect on work fatigue, and AL-DAISI (2025) who identified personal factors as the main determinants of fatigue.

Dominant Root Cause Analysis

After fishbone (Ishikawa) analysis was carried out to map all the causative factors, 6 dominant root causes were determined, all of which were controllable and correctable (Table 5). Treatment priorities (P1–P6) are determined based on the level of their influence on the incidence of fatigue incidents (Siregar et al., 2022).

Table 5. Dominant Root Causes and Treatment Priorities

No	Root Causes	Factor	Controllable	Improve	Priorities
1	There are employees who do not take enough rest because they take their wives or take care of children	METHOD	Controllable	Improve	P1 ★
2	Employees are reluctant to report fatigue	MAN	Controllable	Improve	P2
3	100% of the root cause of fatigue incidents is due to the wrong motivation (Reluctance/Prestige)	MATERIAL	Controllable	Improve	P3
4	There are no direct notifications that can be seen by the supervisor	MAN	Controllable	Improve	P4
5	Developers haven't created a real-time media for WA/Telegram notifications	MATERIAL	Controllable	Improve	P5
6	DMS repairs can only be done by Team Transtrack	MACHINE	Controllable	Improve	P6

Sourch: Root cause analysis derived from fishbone (Ishikawa) diagram

P1 priority is set on insufficient rest due to domestic responsibilities (taking care of wife/taking care of children), which is an external factor that has been missed by technology handling. This condition illustrates that the phenomenon of fatigue cannot be solved by a mere technical approach, but requires social intervention to the operator's family environment (Jaksa et al., 2026; Muslimin et al., 2025).

Determining the Best Solution – Door to Door Program

Based on the analysis of 6 alternative solutions that have been formulated, the Door to Door (Family Support Safety) program is determined as the best solution with consideration of the 100% chance of results, the duration of implementation of 2 hours per visit, the cost of IDR 50,000 per visit, and the advantages in reaching X Factors that cannot be overcome by technology alone.

Table 6. Best Solution Determination Matrix

No	Alternative Solutions	Outcome Opportunities	Time	Cost (Rp)	Other Considerations
1	Socialization of reporting fatigue – Flyer/Coaching Mentoring	100%	Insidental	-	Mentoring promotion and coaching approach
2	Fatigue Management Training (Internal)	100%	2x/week	100.000	Increase operator and employee knowledge
3	Realtime Notifications by Telegram/WA	80%	Realtime	-	Direct notifications to the supervisor's cellphone and web CCR
4	DMS Repair – Periodic Evaluation + Transtrack Backup	85%	Service schedule	As per the contract	Backup MP while technician is off
5	Direct Intervention of Supervisors via Rotary Notifications	100%	Insidental	-	Rotary as a DMS deviation notification outside the cab
★ 6	**Door to Door – Family Support Safety**	**100%**	**2 jam**	**50.000**	**The dominant family factor in determining adequate rest/not rest**

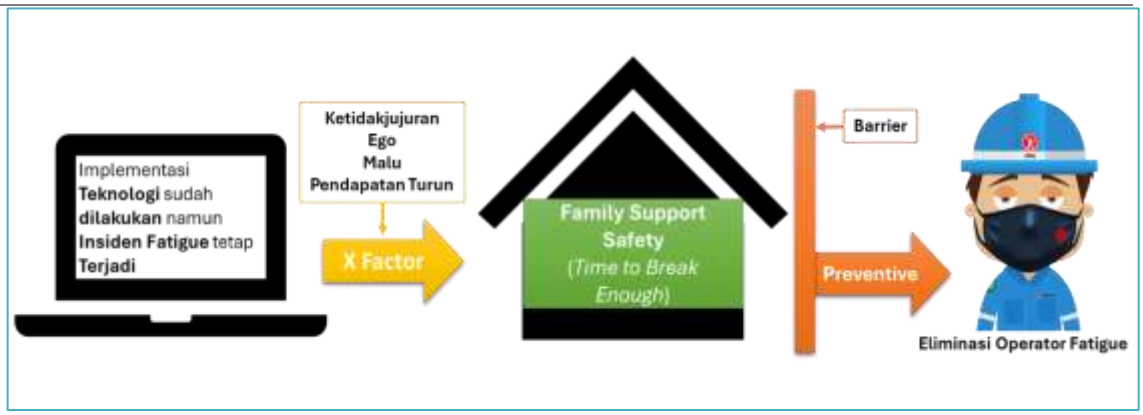

Figure 1. Reasons for Determining the Best Solution

The Door to Door program was chosen because the implementation of technology—even though it is already running—is not able to overcome the X Factors in the form of dishonesty in fit-to-work reporting, ego, prestige, shyness, and fear of losing income. Family is the strongest barrier that can encourage operators to get enough rest and dare to report fatigue conditions. Similar approaches have been proven effective in various industrial K3 contexts (Parmasari, 2024; Prosecutor et al., 2026).

Improvement Plan (5W1H)

The improvement plan is prepared using the 5W1H method (What, How, Why, Who, When, Where, How Much) as listed in Table 7.

Table 7. Improvement Plan (5W1H)

Category	What	How/Why	Who	When	Where	How Much
MAN	Employees are reluctant to report fatigue	Socialization via Flyer & Coaching Mentoring – instilling a mindset of reporting fatigue	SHE & All Dept	Sep-24	Site MIPL	–
MATERIAL	Lack of knowledge about fatigue	Management Fatigue Training – increases operator awareness	SHE & All Dept	Oct-24	Site MIPL	IDR100,000
MATERIAL	DMS notifications are not real-time	Realtime Notifications by Telegram/WA – minimize response delays	COE	Oct-24	Site MIPL	As per DMS contract
METHODS	DMS does not record realtime	DMS repair + Transtrack Manpower Backup while off	COE	Sep-24	Site MIPL	As per PPA x Transtrack contract
MAN	No field visual notifications	Supervisory intervention via Rotary Notifications	PLT, PRO, SHE	Nov-24	Site MIPL	–
METHODS	Operators' breaks disrupted by family factors	Door to Door – Family Support Safety (top OTT operators' home visits)	SHE, PRO, HCGA	Oct-24	OTT House	IDR 50,000

Sourch: Improvement plan based on 5W1H internal project framework

Implementation of the Door to Door Program

The Door to Door program will be carried out in October-November 2024 by targeting operator families that occupy the top three positions in the DMS (Top Three OTT – Highest

Finding Operator) findings. The implementation team consists of 3 departments (SHE, Production, HCGA) so that the approach is comprehensive from the aspects of safety, operations, and human resources (Muslimin et al., 2025).

Resources prepared in the implementation of the program include: (1) Group Transtrack Telegram for real-time reports from hauler units; (2) DMS WhatsApp Group for coordination of findings and interventions; (3) Family Support Safety Banners; (4) Door to Door special Fatigue Awareness Module; (5) Flyer awareness fatigue via Canva; and (6) Howen VSS application for DMS monitoring via smartphone.

Table 8. Resources Prepared for the Door to Door Program

Yes	Resources	Quantity	Status	Remarks
1	Group Transtrack Telegram	1	Fulfilled	Real-time reports from hauler units in the field
2	Group DMS WhatsApp	1	Fulfilled	Coordination and update of DMS deviations and interventions
3	Canva App/Account	1	Fulfilled	Banner and flyer awareness fatigue design
4	Modul Fatigue Awareness Door to Door	1	Fulfilled	Means of delivering material to the operator's family
5	Howen VSS App	1	Fulfilled	DMS monitoring via smartphone by field supervisors
6	Modul Fatigue Management Training	1	Fulfilled	Training facilities for operators/employees in the field

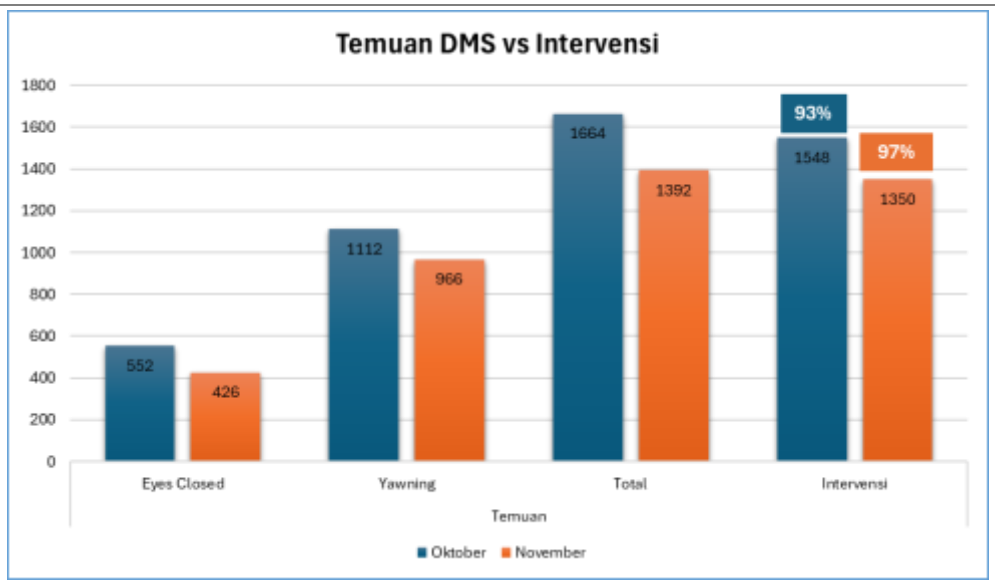

Figure 5. Findings and Interventions of DMS for the Period of October-November 2024

The stages of DMS intervention that are carried out include 4 steps: (1) Direct intervention by the CCR Team when receiving DMS notifications; (2) Repeated findings are confirmed to the field supervisor for a Wake Up Call and fatigue check directly; (3) The implementation of check fatigue with the target of Top Yawning/Eyes Closed operators during

the shift period is run by the SHE Team, Paramedics, and Area Supervisors; (4) Monthly data is a reference for the implementation of Door to Door in the Top Three operators with the highest findings.

DMS and Intervention Findings Data

During the implementation period (October-November 2024), the DMS system recorded data on the findings of fatigue parameters (Eyes Closed and Yawning) along with the level of intervention carried out. This data is presented in the following Table 9.

Table 9. Comparison of DMS and Intervention Findings – October vs November 2024

Parameter	October (Findings)	October (Intervention)	November (Findings)	November (Intervention)	% Intervention
Eyes Closed	552	426	426	–	–
Yawning	1.112	966	966	–	–
TOTAL	**1.664**	**1.392**	**1.548**	**1.350**	**October: 93% | Nov: 97%**

Sourch: Driving Monitoring System (DMS) findings and intervention data (October–November 2024)

The data in Table 9 shows that the effectiveness of the intervention system increased from 93% in October to 97% in November 2024. The decrease in the total number of findings (from 1,664 to 1,548) also indicates a trend of improving fatigue conditions in the field. This high level of intervention is the result of the strengthening of real-time notification systems and Door to Door programs that motivate operators to get enough rest before work (Sufi et al., 2023; Yuliana Susilowati, 2024).

Before-After Analysis

The evaluation of the results of the QCP program was carried out by comparing fatigue incident and revenue loss data before and after the implementation of the Door to Door program. The full comparison is presented in Table 10.

Table 10. Comparison of Results Before and After Door to Door Program

Indicator	Before (Jun–Sep 2024)	After (Oct–Nov 2024)	Changes	% Change
Fatigue Incident Cases	5 cases	0 cases	- 5 cases	100% ↓
Loss Revenue	IDR69,907,004	IDR0	- IDR 69.907.004	100% ↓
DtD Program Fees	–	IDR100,000	–	–
Net Benefit	**–**	**–**	**IDR69,807,004**	**99,85%**
DMS Intervention Level	< 90%	93–97%	+ > 7%	Increase

Sourch: Comparative evaluation data before and after program implementation

The results of the evaluation showed that the Door to Door program succeeded in reducing fatigue incidents from 5 to 0 cases, with a savings in potential revenue losses of IDR 69,907,004 (100%). The net benefit of project improvement reached IDR 69,807,004

(99.85%), far exceeding the program cost of only IDR 100,000 (Pramita et al., 2026; Alief, 2026).

Target Achievement Analysis (QCDSM)

The evaluation of the achievement of QCP targets was carried out using the QCDSM (Quality, Cost, Delivery, Safety, Morale) framework as presented in Table 11.

Table 11. Analysis of the Achievement of QCDSM Targets

Dimensions	Achievements
Quality	Cases of fatigue incidents decreased from 5 to 0 cases (target reached 100%)
Cost	Decrease in potential loss/loss revenue from IDR 69,907,004 to IDR 0 (decrease of 100%)
Delivery	Door to door activities run optimally; Delivery of Fatigue Understanding to Families Acceptable
Safety	Increased family understanding of operator fatigue risks; Families support adequate rest to prevent fatigue cases from happening again
Morals	Families support and care about the safety of their members (Family Support Safety); the formation of the culture of "Dare to Report, Fatigue is Safe!"

Sourch: QCDSM performance evaluation based on internal project outcomes

The findings of this study strengthen the argument that fatigue management in the mining industry cannot rely on technology alone. Even though the DMS has been installed and functioning, cases of fatigue incidents still occur due to the presence of the X Factor—a combination of psychological factors (prestige, shame, fear of losing income) and social factors (disruption of rest from the family environment). This phenomenon is consistent with the findings of Mambu et al. (2025) who emphasized the importance of personal factors in the management of work fatigue, and Pardyani & Susilowati (2024) who found work stress and sleep quality as the main determinants of fatigue.

The Door to Door program adopts the principle of Family Support Safety which places the family as an agent of change in the prevention of fatigue. This approach is novel in the context of the Indonesian mining industry and has yielded significant results in a short period of time (2 months). Its effectiveness can be explained through three mechanisms: first, families gain a direct understanding of the risk of fatigue and its impact on life safety; second, families are encouraged to actively ensure that their members get enough rest before going to work; and third, the operator feels strong social support from the family to report the fatigue condition without shame.

Family-based interventions in K3 have been recognized to be effective in a variety of contexts. Jaksa et al. (2026) emphasized the importance of empowering safety culture in the logistics worker ecosystem, which includes the family dimension. Gustian et al. (2025) also mentioned that social support is a critical component in seafarer fatigue management—a principle that can be adapted for mine hauler operators.

From a technological point of view, the integration of DMS with real-time notification systems (Telegram and WhatsApp) has been proven to increase the effectiveness of interventions from < 90% to 93–97%. However, without a Door to Door program that touches on the root of the problem (family and psychological factors), technology improvements alone

will not be enough. This supports the opinion of Hapsari et al. (2025) that fatigue measurement requires a multidimensional approach that includes both technical and social aspects.

The standardization of QCP results is realized through the revision of the SOP Driving Monitoring System (DMS) PPA-MIP-SOP-COE-011 which includes the addition of a notification method via the DMS web dashboard and the integration of the door to door method in the protocol for handling repeated DMS findings. The socialization of this new SOP was carried out through the COE Department's Safety Talk and Pre-Shift Meeting (P5M) on December 21-23, 2024.

CONCLUSION

This study concludes that: (1) The Door to Door (Family Support Safety) Program as an innovative solution in the Quality Control Project is effective in reducing fatigue incident cases from 5 to 0 cases in hauler operators at PT PPA site MIPL during the October-November 2024 period. (2) The dominant root causes of fatigue incidents are human factors in the form of operator reluctance to report fatigue conditions (wrong motivation) and domestic factors in the form of disturbances in family rest—two factors that cannot be overcome with DMS technology alone. (3) The family-based approach is the most effective preventive barrier in the work ecosystem of mining hauler operators, resulting in a net benefit of Rp69,807,004 (99.85%) with a program cost of only Rp100,000. (4) A combination of technological interventions (DMS, real-time notifications), social approaches (Door to Door), and employee empowerment (fatigue training, promotion of dare to report) is the optimal comprehensive strategy in mining fatigue management.

Some recommendations for future program development: (1) Increase the frequency of Door to Door implementation to 2 times per month to maintain program sustainability. (2) Prepare technical instructions (juknis) for follow-up intervention if the same operator is found in the DMS Top Three findings in the following month. (3) Completing Transtrack's manpower backup agreement when the technician is on leave so that DMS monitoring is not disturbed. (4) Conduct continuous evaluation and monitoring of DMS notification deviations through the Web Dashboard. (5) Replicate the Door to Door program to all PT PPA sites in Indonesia as a community-based fatigue management best practice.

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