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PERUBAHAN PERILAKU PENGEMUDI DENGAN PENERAPAN TEKNOLOGI PEMANTAUAN KENDARAAN – STUDI KASUS PT FREEPORT INDONESIA

DRIVERS BEHAVIOR CHANGE BY IMPLEMENTING VEHICLE MONITORING TECHNOLOGY – PT FREEPORT INDONESIA CASE STUDY

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ABSTRAK

PT Freeport Indonesia (PTFI) adalah perusahaan pertambangan yang beroperasi di daerah terpencil Pegunungan Jayawijaya Papua, dan berjarak sekitar 3.500 km sebelah timur Jakarta, Indonesia.

Cakupan area operasi penambangan yang terbentang dari dataran tinggi hingga dataran rendah berkaitan erat dengan kondisi jalan dan perubahan cuaca yang ekstrim. Selain tantangan alam tersebut, perilaku pengemudi kendaraan ringan yang tidak aman juga menjadi salah satu faktor penyumbang yang signifikan terhadap risiko terjadinya kecelakaan kendaraan ringan.

Penerapan program teknologi pemantauan kendaraan ringan merupakan salah satu program keselamatan kerja di PTFI dengan tujuan untuk meningkatkan kesadaran berkendaraan sekaligus mendorong perubahan perilaku yang aman. Tulisan ini menjelaskan latar belakang, penerapan, tantangan yang dihadapi, hasil, dan potensi perbaikan di masa mendatang dari program ini untuk memastikan keselamatan pekerja di daerah operasi PTFI.

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ABSTRACT

PT Freeport Indonesia (PTFI) operates mining operations in the remote area of the Jayawijaya Mountains, Papua, and is approximately 3,500 km east of Jakarta, Indonesia.

The coverage of the mining operation area from highland to lowland area is associated with extreme road conditions and weather changes. Apart from these natural challenges, unsafe behavior of light vehicle drivers is also a significant contributing factor to the risk of light vehicle accidents.

The implementation of the vehicle monitoring technology is one of PTFI's safety program that aims to improve driving awareness and encourage driver behavioral changes. This paper elaborates the background, implementation, challenges, results, and potential future improvements of the light vehicle monitoring technology to ensure safety of workers at PTFI.

BACKGROUND

Driving safety research consistently shown that driver behavior causes majority of vehicular crashes (Federal Motor Carrier Safety Administration, 2006; Hendricks, Freedman, Zador, & Fell, 2001; Treat et al., 1977). Data from Indonesia's National Transportation Safety Committee's (KNKT – Komite Nasional Keselamatan Transportasi) shows that human factor is the most dominant cause of road accidents between the year of 2018-2022 (KNKT, 2022). PTFI data shows that in the last 10 years (2014-2023), the average Light Vehicle (LV) incident count for its mining operation is about 330 incidents per year. In 2023 specifically, there were 345 reported incidents involving light vehicles, which associated with 17% of the company's operational light vehicles. Risky driver behavior such as speeding, aggressive driving, and fatigue were concluded as the most significant causal factors contributing to PTFI light vehicle accidents.

Besides driver behavior, PTFI's work site topographic profile also present challenges to the safety of its light vehicle operation. PTFI's business areas spans from the highland mining areas at an altitude of 4.300 meters above sea level to lowland port coastal and swamp areas. This natural environment exposes the company's mobile equipment operation to rugged terrains with extreme elevation changes, highly varied weather, a variety of geological conditions and complex mining processing activities.

PTFI management decided to implement the vehicle monitoring technology in Q2-2021 by utilizing Telematics Device Monitoring with a primary goal to leverage these tools to effectively translate driver awareness into behavioral changes, ultimately improving the overall safety performance. This paper elaborates the journey of PTFI's effort to manage driving behavior, implementation of vehicle monitoring technology, and its impact on driver's behavior.

METHOD

This article is qualitative research with case study method. A case study is defined as a method for developing a complete understanding of a process, program, event, or activity. The case is the implementation of vehicle monitoring technology with PT. Freeport Indonesia (PTFI) as the object/study. Data was collected from secondary data from internal reports and literature studies. Analysis is described into the following topics: Managing PTFI's Driver Behavior, Light Vehicle Telematic Device, Implementation of Monitoring Program, Impact, and Future improvement.

RESULT

Managing PTFI's Driver Behavior

Historically, PTFI has taken numerous initiatives to promote safe Light Vehicle (LV) operation. Proactive approaches in the forms of LV safety campaigns, monitoring vehicle speed using radar guns, enforcing separate licenses for different areas, create scheduled driving refresher trainings, additional psychological test for driver for specific conditions (SAA Test, Safety Awareness Assessment), and other associated programs to reduce mobile equipment incidents including light vehicles have been implemented.

In 2017, PTFI started Fatal Risk Management (FRM), one of PTFI's many safety programs to eliminate and reduce serious injuries and fatalities (Widijanto et al., 2023). The FRM program listed LV accident (associated with vehicle collision, rollover, and its impact on person) as part of identified 24 fatal risks and determined the necessary critical control process. Another practical effort to reduce LV incident in 2019 is the utilization of Realtime Operational Vehicle Reporting System (ROVR) device that records vehicle data and provide insights on driver behavior was implemented. Despite of several initiatives of safe light vehicle operation had been introduced, a serious light vehicle accident occurred in Q2-2021 resulting in one casualty case. The underlying cause for this particular accident was found to be an unnecessary speeding behavior.

One of a decisive milestone made by PTFI's management is to implement a different approach for controlling mobile equipment incidents. The new plan is to use vehicle telematics device monitoring and assign dedicated monitoring and analysis team to continuously monitor vehicle use and promote behavior change. The PTFI Mining Safety Division (MSD) was appointed as the project owner for monitoring light vehicles, while other team look after the bus and truck fleets monitoring. Based on this new plan, the task force was created to acquire, install, and maintain telematic devices on all company light vehicles at the same time as a dedicated group of MSD dispatchers were trained to do monitoring and analysis center.

Light Vehicle Advanced Telematics Device Monitoring

The vehicle monitoring process at PTFI use advanced telematics device monitoring as its main tool to keep track of vehicle usage. A telematics device monitoring is a plug and play device inserted into the vehicle On-Board Diagnostic (OBD) port (Mathew et al, 2019). It has three-axis accelerometer, Global Positioning System (GPS), and tapped into the vehicles' Electronic Control Unit (ECU). Pulling data from the vehicle's ECU allows the Telematics Device Monitoring to collect a measure of engine Revolutions Per Minute (RPM) and other data parameters. Conversely, the Telematics Device Monitoring connected to a cellular network to wirelessly transmit data to a back-office software system (see Figure 1).

Several studies found that using vehicle telematic device can be highly effective in increasing the safety of drivers (Boodlal & Chiang, 2014; Hickman & Geller, 2005; Hickman & Hanowski, 2010; Toledo et al, 2008, Matthew, 2019). For example, by utilizing data collected from telematics device, Matthew (2019) found that an automatically assigned, targeted web-based instruction (WBI) significantly reduced the rate of risky driving behaviors.

Experiences from Other Sites and/or Companies in Utilizing Vehicle Telematics

Several transportation, warehousing, and logistics companies have successfully utilized telematics device to enhance driving safety, and mining sites are now reaping similar benefits. For instance, a surface mine company based in South Dakota, USA was able to keep track of the productivity of employees operating the company's earth-moving equipment used in the surface mining operations (Geotab, 2017).

Some sites use vehicle telematics technology to identify unsafe driving patterns, such as harsh braking, rapid acceleration and excessive speeding, also address these issues through targeted driver training and strict enforcement of safety protocols (Geotab, 2015).

Additionally, a protective insurance company based in Maryland, USA was able use telematics device and paired with a number of safety programs to diminish unsafe driving see a 20% reduction in accident costs (Geotab, 2015).

Figure 1. Light Vehicle Advanced Telematics Device Monitoring

Implementation of PTFI's Light Vehicle Monitoring Program

As shown in Figure 2, the study for the implementation of PTFI's light vehicle monitoring program included three phases. Phase 1 was the baseline phase. In this phase, 60 trial light vehicles were equipped with the telematics monitoring device that recorded driver speeding behavior. During Phase 1, both the drivers and the vehicle custodians of the trial vehicles did not receive any instructions or feedback on collected data by the Telematics Device Monitoring.

Phase 2 included introducing the drivers with the light vehicle monitoring program. Phase 2 began when drivers and vehicle custodians received daily and weekly emails from the Mining Safety Division (MSD) light vehicle monitoring team, notifying them of the light vehicle monitoring program. This email included a brief description of the program and provided excel spreadsheet details to drivers and division vehicle custodian regarding the speeding infraction. The MSD Telematics Device Monitoring team led socialization and sharing sessions to all PTFI divisions to provide the following information: how the Telematics Device Monitoring program worked, why the Telematics Device Monitoring program was implemented, and details about the program. Additionally, drivers and vehicle custodians had the opportunity to ask questions and discuss concerns with management and the MSD Telematics Device Monitoring team. During Phase 2, the MSD Telematics Device Monitoring team provided instructions to drivers and divisions vehicle custodians to change driving behavior.

Phase 3 included the enforcement of simple sanctions and/or penalty intervention (see Figure 3 for sanction and penalties detail). Supported by PTFI Senior Management commitment, the MSD Telematics Device Monitoring team enforced simple sanctions and penalties focusing on weekly top 25 speeding vehicles. When a driver performed speeding behaviors and is listed on the weekly top 25 speeding report, they become subject to the defined sanctions and/or penalty. During Phase 3, drivers and division vehicle custodians continued with their normal job duties and with no other instructions other than to follow PTFI light vehicle simple sanctions and/or penalty policy.

Impact

The following items are positive impact from the implementation of monitoring technology:

1. *Impact on Driver's Speeding Behavior.*

During baseline period of the 82 weeks study, the mean rate of overall speeding infractions (total speeding event/total telematics unit installed) was 3.07 per month, and during the implementation of simple sanction and/or penalty, the mean rate of overall speeding infractions per month was 0.43. This represents 85.92% reduction in overall speeding behavior. The introduction of Telematics Device Monitoring over the 82 weeks study period has exhibited a discernible influence on driver speeding behavior, as evidenced by Figure 4 and 5

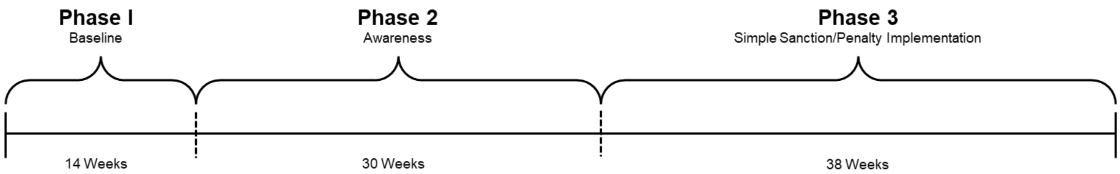

Figure 2 MSD Telematics Device Monitoring Implementation Phases

PHASE 3 MSD TELEMATICS DEVICE MONITORING SIMPLE SANCTION AND/OR PENALTY TABLE

Infraction	1st Violation	2nd Violation	3rd Violation
Tier 1 (11 + Km/hour)	Counseling 1	Counseling 2	1 x Fine
Tier 2 (21 + Km/hour)	Counseling 1	1 x Fine	
Tier 3 (31 + Km/hour)	Counseling 1 1 x Fine + RL1*		

Notes:
- 1 x Fine = Rp 375,000 (Non-Staff) & Rp 625,000 (Staff)
- RL 1 = Revoke License for 1 Month
- This table is a Reduced Version of PTFI's 2022 - 2024 Industrial Relation Guidelines (IRG) Table of Sanctions for Traffic Violation as per PTFI Senior Management's decision.

Figure 3 Phase 3 MSD Telematics Device Monitoring Enforcement of Simple Sanction and/or Penalty Table

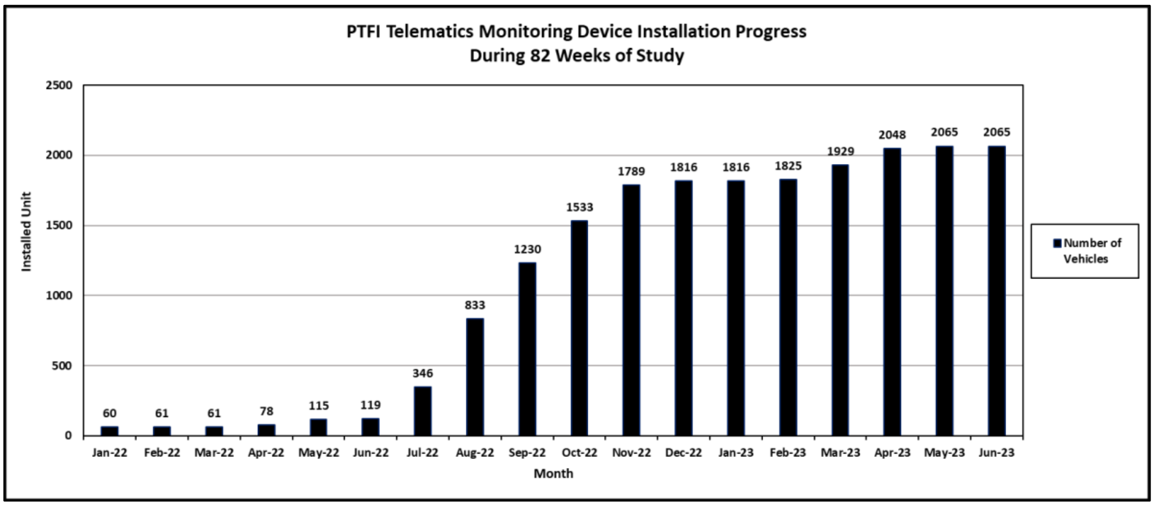

Figure 4 PTFI Telematics Monitoring Device Installation Progress

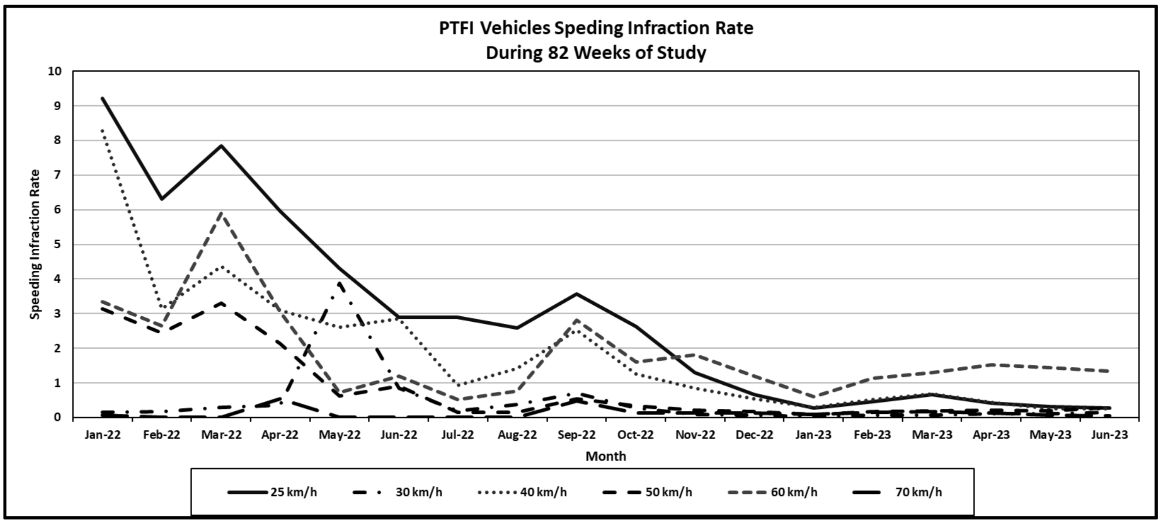

Figure 5 PTFI Vehicles Monitored Speeding Infraction Rate

Initially, prior to the implementation of the device, a consistent trend of frequent speeding incidents was observed. However, following the installation and activation of the telematics system, a notable decline in instances of speeding becomes prominently evident. The graph distinctly displays a steady decrease in speeding incidents, marked by a significant downward trajectory. This trend signifies a direct correlation between the integration of telematics technology and a substantial reduction in tendency for drivers to exceed speed limits. Such a demonstrable shift highlights the efficacy of Telematics Device Monitoring in promoting safer driving practices and fostering a culture of compliance with speed regulations among drivers.

2. Effects on Incident Types

The implementation of vehicle monitoring technology at PTFI has provided valuable data that reveals an important trend: While the overall number of driving incidents has not seen a significant reduction, the severity of these incidents has decreased markedly (see Figure 7). Furthermore, by examining the conditions and behaviors leading up to each incident, site managers can implement measures to prevent similar occurrences in the future. This proactive approach helps in creating a safer driving environment overall, even if the total number of incidents remains relatively unchanged.

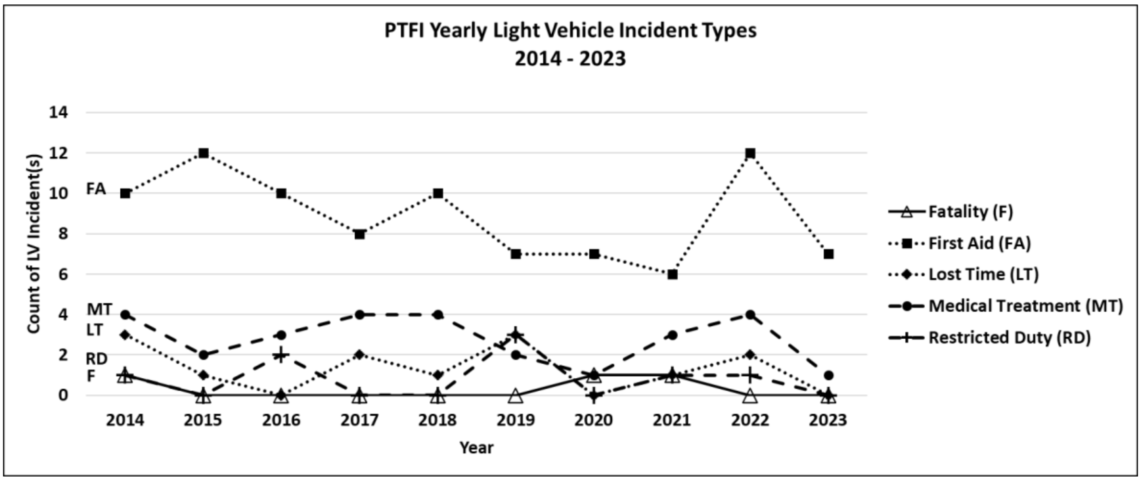

Figure 6 PTFI Yearly Light Vehicle Incident Types

3. *Evaluation on Routine Maintenance and Accident Cost*

An additional analysis explored how the implementation of monitoring technology has helped decrease PTFI's LV routine maintenance and accident cost through a change in driver awareness and better driving behaviors. The total average of routine maintenance and accident cost was reduced by approximately 9% through an increase of light vehicle spare parts lifespan, and a decrease of the severity of vehicle parts destroyed during an accident (see Table 1).

Year	Routine Maintenance (US$)	Accident (US$)	Total Cost (US$)
2021	1,430 *A*	12 *A*	1,442 *A*
2022	1,310 *A*	13 *A*	1,323 *A*
2023	1,235 *A*	16 *A*	1,251 *A*

Note: *A* is a multiplier to allow comparison of routine maintenance and accident cost per year.

Table 1 Yearly Routine Maintenance and Accident Cost Comparison for PTFI Light Vehicles

Lessons Learned

There are several valuable lessons which correlated with the improvement of the safety maturity level, coaching programs, and driver behavior changes.

One of the key lessons learned is the importance of combining data reliability, notifications/reminders, and implementation of simple sanction and/or penalties. The Vehicle Telematics Device Monitoring system provided accurate and real-time data on vehicle performance, speeding violations, and other critical parameters. By leveraging this reliable data, notifications and reminders were sent to drivers and light vehicle custodians thus, creating awareness and promoting accountability. This combination of data-driven insights and intervention proved instrumental in fostering positive driver behavior changes.

Another essential lesson learned was the significance of providing clear and simple rules regarding traffic management and the consequences of non-compliance. The implementation of speed limits, geofencing speed limit zones, and fines/penalties required a transparent and well-communicated framework. By ensuring that drivers understood the rules and consequences, it facilitated compliance and minimized infractions. Clear guidelines and expectations fostered a culture of responsible driving and contributed to overall safety improvement.

In response to the observed improvements in driving behaviors as captured by the Telematics Device Monitoring, proactive measures have been undertaken to enhance road safety. These measures encompass adjustments to road speed limits and the optimization of traffic signs. By leveraging the insights gleaned from the telematics data, areas demonstrating better driving behaviors have undergone reassessment and subsequently, witnessed modifications in speed regulations and signage. This strategic alteration aligns road conditions more closely with the observed positive driving practices.

The success of the project implementation also relied on the collaborative efforts of various stakeholders and the importance of obtaining "buy-in" from clients, particularly large organizational units. By involving and engaging these key stakeholders from the early stages, their support and commitment were secured. Collaboration and teamwork ensured consistent implementation and adherence to safety protocols across the organization. This collaborative approach, combined with effective communication, facilitated the alignment of goals and objectives, ultimately driving positive changes in driver behavior.

Future Improvement

Moving forward, there are several areas where PTFI can focus on for future improvement in the Vehicle Telematics Device Monitoring project implementation:

1. [System] Advanced Analytics: PTFI can explore the utilization of advanced analytics tools to gain deeper insights from the collected telematics data. By leveraging machine learning and predictive analytics algorithms, the organization can identify patterns, trends, and potential risks more effectively. This will enable proactive decision-making and targeted interventions to further enhance safety and operational efficiency.

2. [System] Integration with Maintenance Systems: Integrating Vehicle Telematics Device Monitoring data with the organization's maintenance systems can streamline maintenance processes and improve asset management. By automatically generating maintenance alerts based on vehicle performance data, PTFI can ensure timely servicing, reduce breakdowns, and optimize maintenance schedules. This integration will result in better fleet availability and overall operational effectiveness.

3. [Process] Driver Training and Coaching: PTFI can invest in driver training and coaching programs to reinforce safe driving behaviors and improve overall driver competence. Utilizing the insights provided by the Vehicle Telematics Device Monitoring system, customized training modules can be developed to address specific areas of improvement for individual drivers. Continuous coaching and feedback will help sustain a culture of safety and further enhance driver performance.

4. [Process] Expansion of Vehicle Telematics Device Monitoring Functionality: PTFI can explore additional functionalities and features offered by Vehicle Telematics Device Monitoring to address specific operational needs. Data collected from the devices can help for more accurate and efficient hours-of-service tracking, incorporating driver behavior scorecards to incentivize safe driving practices, and integrating with other systems such as dispatch and route optimization tools to further enhance operational efficiency.

By focusing on these future improvement areas, PTFI can continue to enhance the effectiveness of the Vehicle Telematics Device Monitoring project, further improving safety outcomes, operational efficiency, and overall performance. The organization's commitment to ongoing improvement and innovation will enable it to stay at the forefront of safety management practices in the industry.

CONCLUSION

In conclusion, the implementation of the Vehicle Telematics Device Monitoring project at PTFI has brought significant improvements in safety, operational efficiency, and driver behavior. Through the installation of Vehicle Telematics Device Monitoring units and the utilization of telematics data, PTFI has been able to monitor and manage its fleet of light vehicles more effectively.

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