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Unearthing Hazards: Investigating the Root Causes of Workplace Accidents at PT Indo Muro Kencana's Gold Mines

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Abstract

Objective: This study seeks to dissect the occurrences of work-related accidents at PT Indo Muro Kencana (PT IMK) over a period spanning from 2018 to 2023. It aims to pinpoint the contributing factors to these mishaps, analyzing them to forge actionable recommendations and preventive strategies aimed at mitigating accident risks and enhancing workplace safety and health.
Design/Methods/Approach: Employing a quantitative descriptive methodology, this research adopts an observational descriptive design to catalog and scrutinize work accident incidents. The Loss Causation Model serves as the analytical framework, facilitating a thorough evaluation of accident causatives. The study encompasses all PT IMK employees during the specified timeframe, utilizing a total sampling approach. Data compilation hinges on secondary sources, including company accident reports and relevant literature, with SPSS Statistics 25 software facilitating cross tabulation for data analysis.
Findings: Analysis reveals a fluctuating pattern of work accidents over the years, with a significant portion resulting from direct physical interactions such as collisions and strikes. Predominantly occurring in excavation and roadway sectors, these incidents frequently involve heavy machinery and service vehicles. Notably, accidents disproportionately affect younger employees with limited tenure, though veterans are not exempt from risk. Primary accident triggers are identified as unsafe acts—including procedural breaches and poor decision-making—and unsafe conditions like slippery surfaces and subpar equipment. Underlying causes are attributed to human elements, notably inadequate judgment skills, and occupational hazards, including poor hazard awareness and deficient job safety analysis.
Originality/Value: This research pioneers in its focused examination of work accident causatives within PT Indo Muro Kencana's gold mining operations, marking a novel contribution to occupational safety and health literature in the mining sector.
Practical/Policy implication: The insights garnered herein are poised to inform the development of targeted safety programs, underlining the study's utility in propelling occupational safety and health consciousness, alongside facilitating accident risk reduction initiatives.

Keywords: Work Accidents Analysis, Occupational Safety and Health, Accident Prevention Strategies, Safety Program Development

JEL Classification: M1, M2

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Introduction

Occupational safety and health is a program for maintaining the safety and health of workers in a company. For workers, the implementation of occupational safety and health is very important because it creates a safety and health system that can eventually increase worker productivity. A work accident is an event that is clearly unwanted and often unexpected by all that can cause loss of time, property, or life occurring within an industrial work process or related to it (Align, 2024; Hughes & Ferrett, 2023; International Labor Organization, 2018; Morgan, 2022).

Every worker is always faced with potential hazards originating from the work and/or work environment that are at risk of causing work accidents and occupational diseases and injuries (Ismara et al., 2014). On average, a third of a worker's time is spent at the workplace, and they face a double burden of disease, because in addition to experiencing the risk of general diseases, they also face the risk of specific diseases, namely occupational diseases/illnesses, both physically and mentally, as well as the risk of occupational accidents/injuries. All of these often cause sickness, disability, or fatality (Blanch et al., 2019). Factors that influence the occurrence of Work Accidents (KK) and Occupational Diseases (PAK) include workplace condition factors, human/worker factors, and the interaction between workers and elements at the workplace. The image below illustrates the factors influencing the occurrence of KK and/or PAK cases (Fadilah & Herbawani, 2022; Handari & Qolbi, 2021; Sulistyaningtyas, 2021).

According to global data released by the International Labour Organization (ILO), the number of work accidents (KK) and occupational diseases (PAK) worldwide reaches 430 million per year, consisting of 270 million (62.8%) cases of work accidents and 160 million (37.2%) cases of occupational diseases, resulting in the deaths of 2.78 million workers each year. Furthermore, 40% of work accidents and occupational diseases occur among young workers. The estimated economic loss reaches 3.94% - 4% of a country's Gross Domestic Product (GDP). Another reference states that the medical costs associated with work accidents and occupational diseases in the United States are estimated at $67 billion, with indirect costs almost reaching $183 billion (Broek & Beeck, 2022; D'Arco et al., 2016; Iverson & Dervan, 2018).

Indonesia, as a country that still relies on the industrial sector as a contributor to national foreign exchange, also potentially has safety issues in the industrial sector. This is even more so in the mining industry, which is both capital and risk-intensive. Indonesia has potential energy resources, one of which is gold mines. Currently, there are gold mining companies located in several regions. Gold is the most popular precious metal in the world, utilized by people in daily life as jewelry, electronic manufacturing material, basic material for vehicles, and as an investment.

PT Indo Muro Kencana is one of the gold and silver mining companies operating in the area of Olung Hanangan Village, South Tanah Siang Subdistrict, Murung Raya Regency, Central Kalimantan Province. Its operational activities, which include exploration, mining, and processing involving thousands of workers and hundreds of heavy equipment, are not free from the risk of accidents. Based on the Accident Analysis of Trend from PT IMK's HSET Department, here are the accident records from 2018 to 2023:

In 2018, there were 0 deaths, 3 environmental cases, 1 serious injury, 22 minor injuries, 0 fire cases, 72 property damages, 9 near misses, totaling 107 accident incidents,
In 2019, there were 0 deaths, 1 environmental case, 1 serious injury, 30 minor injuries, 1 fire case, 79 property damages, 10 near misses, totaling 122 accident incidents,
In 2020, there were 0 deaths, 2 environmental cases, 0 serious injuries, 19 minor injuries, 0 fire cases, 72 property damages, 8 near misses, totaling 101 accident incidents,
In 2021, there were 0 deaths, 0 environmental cases, 0 serious injuries, 25 minor injuries, 0 fire cases, 91 property damages, 11 near misses, totaling 127 accident incidents,
In 2022, there were 0 deaths, 3 environmental cases, 0 serious injuries, 32 minor injuries, 1 fire case, 106 property damages, 16 near misses, totaling 158 accident incidents,
In 2023, there were 0 deaths, 0 environmental cases, 0 serious injuries, 15 minor injuries, 0 fire cases, 62 property damages, 4 near misses, totaling 81 accident incidents.
(Source: Accident Analysis of Trend PT IMK, HSET Department, 2023)

From these accident data based on the root cause of the investigation are as follows:

Unsafe Acts (TTA), for example, violation of procedures, taking shortcuts, not considering, not paying attention to the surrounding environment.
Unsafe Conditions (KTA), for example, inadequate equipment, density and limited space for movement.
Personal Factors (FPRI), for example, low risk assessment ability, inappropriate aggressive attitude, misguided motivation, unidentified safe behavior, physical fatigue.
Work Factors (FPER), for example, inadequate hazard analysis and identification, inadequate communication between sections.

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Literature Review

The definition of an accident, as detailed by Broek & Beeck (2022); Angel et al. (2023), encompasses a broad spectrum of incidents that go beyond mere physical injuries to include illnesses and property damage, highlighting the complex nature of accidents and the imperative need for prevention. Here's a breakdown of the three key aspects outlined:

a. Broad Scope of Accidents: The first aspect expands the definition of accidents beyond physical injuries to include illnesses that can endanger human health. This includes not only immediate physical harm but also conditions that may disrupt the nervous system or lead to mental disorders due to hazardous exposures. This broader understanding underscores the importance of considering all potential harms in workplace safety efforts, recognizing that the impact of accidents can be both physical and psychological.
b. Consequences of Accidents: The second aspect emphasizes that both injuries and illnesses are direct outcomes of accidents. This highlights the importance of accident prevention, given the complex consequences they entail. Preventing accidents is crucial not only to avoid immediate harm but also to mitigate the broader, potentially long-lasting effects that injuries or illnesses can have on individuals' health and well-being. This perspective encourages a proactive approach to safety, focusing on preventing incidents before they occur rather than merely responding to their consequences.
c. Inclusion of Property Damage: The third aspect acknowledges that accidents can also result in property damage, expanding the traditional focus on human injury or illness. This recognizes that accidents can disrupt work processes and lead to significant financial losses, even when no immediate physical harm to individuals occurs. By categorizing property damage as a component of accidents, this definition prompts a more comprehensive approach to safety that considers the full range of potential impacts, thereby fostering environments that prioritize the prevention of all types of accidents.

Overall, Angel's definition encourages a holistic view of accidents, encompassing a wide range of potential harms and emphasizing the importance of prevention. By understanding accidents in this broad sense, organizations and individuals can better appreciate the full spectrum of risks in various environments and implement more effective measures to safeguard human health, well-being, and property.

The Domino Effect Theory by H.W. Heinrich and the Loss Causation Model provide foundational concepts in the field of occupational safety and health. These theories help in understanding the multifaceted nature of work accidents and offer a systematic approach to identifying, analyzing, and preventing workplace hazards (DeCamp & Herskovitz, 2015; Rahiman et al., 2018). Let's delve into the key components of each theory:

Heinrich's theory visualizes work accidents as a series of interrelated factors or events, similar to dominoes falling one after the other. The theory comprises five stages:

1. Working Conditions (Social Environment and Ancestry): This factor encompasses the physical and psychological conditions of the workplace that can pose risks to employees, such as poor maintenance of equipment or an unhealthy work atmosphere.
2. Human Negligence (Fault of the Person/Carelessness): This stage focuses on errors or negligence by employees due to factors like lack of knowledge, inattention, or stress.
3. Unsafe Act (Unsafe Act or Unsafe Condition): This involves behaviors or conditions deviating from established safety procedures, such as misuse of tools or disregard for safety protocols.
4. Accident: This is the occurrence of an unwanted event resulting from unsafe acts, conditions, or human negligence, leading to physical damage or property loss.
5. Injury: The physical harm suffered by an individual as a result of an accident, which can range from minor to fatal injuries.

Developed as an advancement of Heinrich's theory, the Loss Causation Model introduces a structured approach to analyze and understand the root causes of incidents leading to losses (Angel et al., 2023). Key components include:

a. Loss: The adverse outcomes of an accident, affecting humans, property, or processes. Human harm may encompass both physical injuries and illnesses, including psychological impacts.

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b. Incident: The event that directly leads to loss or damage, initiated by the release of energy (kinetic, electrical, thermal, chemical) through various types of contact (e.g., collision, exposure to hazardous materials).
c. Immediate Causes: These are the direct factors causing the incident, which can be actions performed below the required standard or conditions that deviate from the norm.

Both the Domino Effect Theory and the Loss Causation Model emphasize the importance of identifying and addressing underlying causes of workplace accidents, from environmental and human factors to management controls. By understanding these theories, organizations can develop more effective safety and health management systems, aiming to prevent the initial 'domino' from falling and thereby avoiding the cascade of events leading to accidents and losses.

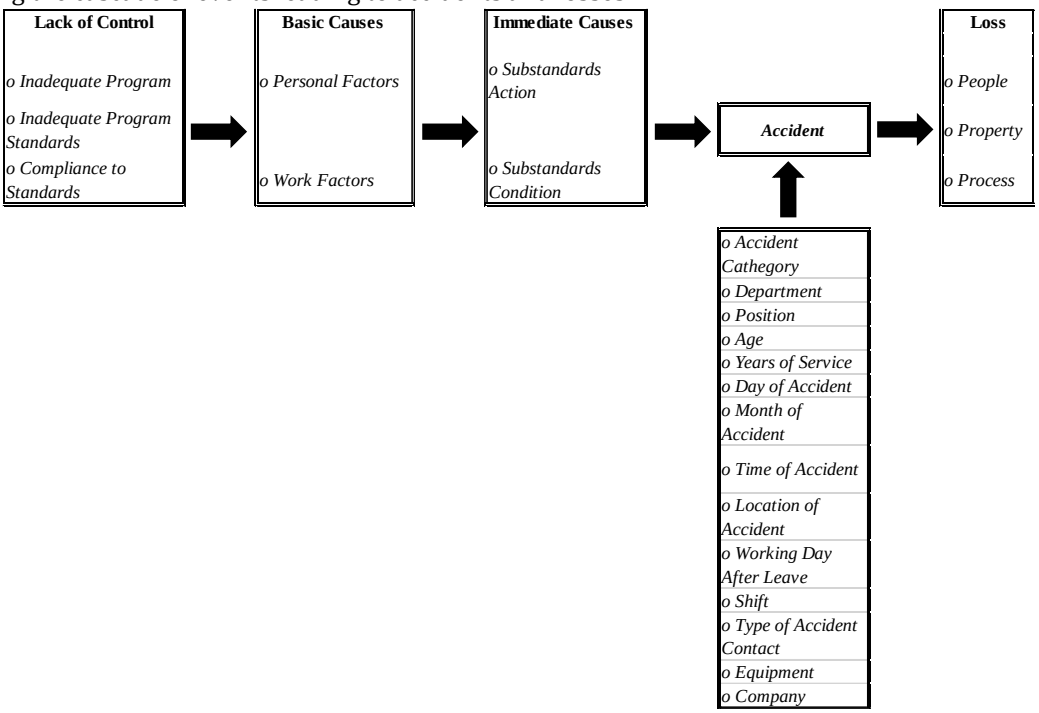

Figure 1. Research Model Loss Causation Model

Research Methods

This research adopts a quantitative approach with a descriptive observational design. It aims to provide an overview of phenomena, focusing on systematic descriptions of activities and prioritizing factual data over conclusions, as outlined by Sugiyono (2017). Observational research is characterized by its non-manipulative or non-interventionist approach towards the subjects; it solely involves making observations. In this study, the author seeks to describe the accidents that have occurred by examining the Incident Investigation Statistics data at PT Indo Muro Kencana over the period from 2018 to 2023. Additionally, the author analyzes the factors contributing to these accidents.

Samples and procedures

In this research, the population comprises all individuals employed at PT Indo Muro Kencana during the period from 2018 to 2023. This includes both direct employees of PT IMK and those employed by contractors, with the workforce numbering between 1,415 and 2,144 employees throughout this timeframe.

The sample utilized in this study is the total count of incidents recorded annually at PT Indo Muro Kencana from 2018 to 2023. The annual frequency of these incidents ranges from 81 to 158 accidents each year.

Measurement

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Accident reports obtained from companies in the form of Incident Investigation Statistics 2018-2023 will be processed through several stages to simplify the analysis process, including:

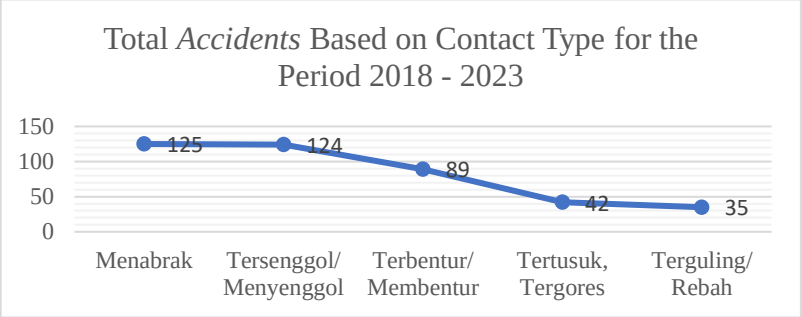
a. Data editing: at this stage, the completeness and uniformity of the accident data is checked
b. Data coding: carried out with a number code for each element studied
c. Sorting data: done by sorting and grouping data according to the desired type
d. Tabulating data: at this stage the data obtained is entered into tables according to analysis needs

Data analysis technique

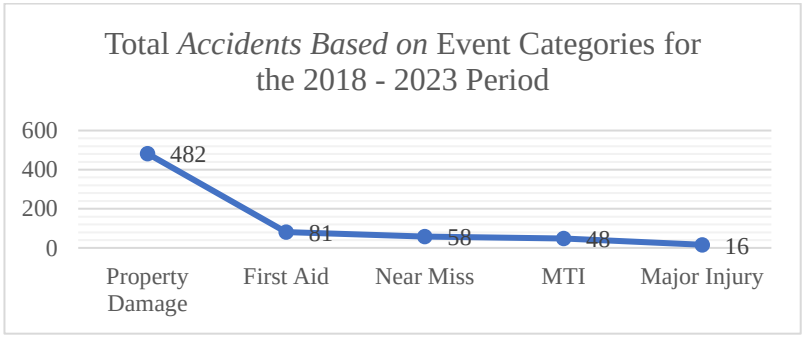
Data analysis was conducted to examine the frequency distribution and percentage of workplace accidents. The analysis performed was a univariate quantitative analysis, grounded in the Loss Causation Model theory formulated by Frank E. Bird. This analysis utilized the SPSS Statistics 25 software to identify hazardous actions and conditions that directly led to accidents. Subsequent analysis focused on human factors and work conditions that precipitated these unsafe actions and conditions. Through this analytical process, the fundamental causes of accidents were pinpointed, enabling targeted and effective accident prevention measures.

Result

In total accidents for the period 2018 – 2023, crashing accidents have the largest number of accidents, and are followed by bumping/hitting and bumping/bumping accidents.

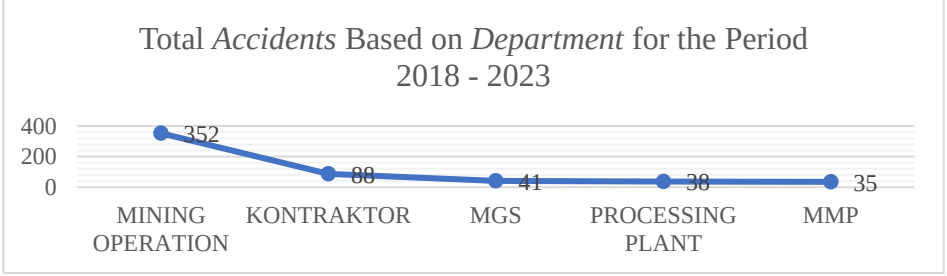


Graph 2 . Graph of the number of accidents for 2018 – 2023 based on contact type



Graph 3. Graph amount accident 2018 – 2023 based on Category Incident

In total, in the last six years 2018 – 2023, the property damage accident category has the largest number of accidents, first aid and near miss.



Graph 4. Graph amount accident 2018 – 2023 based on *Department*

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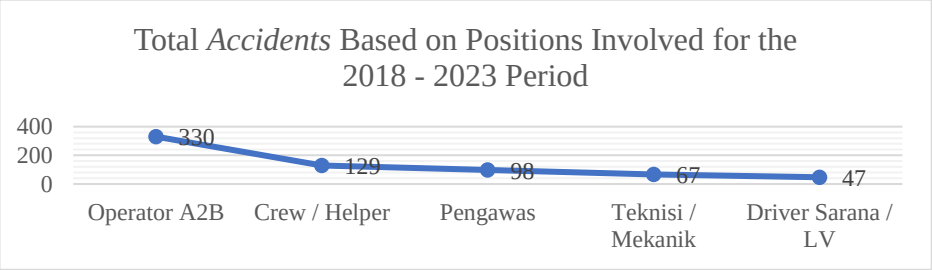
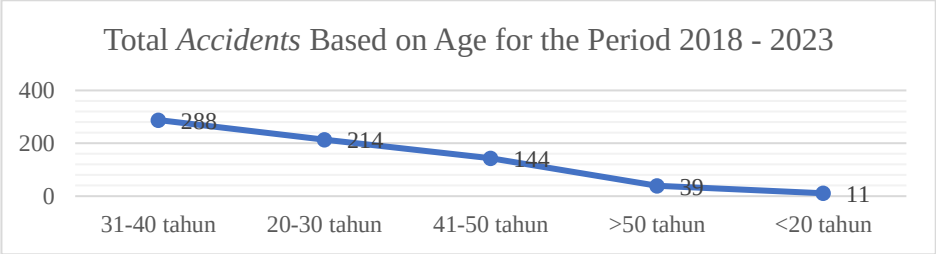
In total, in the last six years 2018 – 2023, the Mine Operation Department is the biggest contributor to accidents, followed by contractors and MGS.



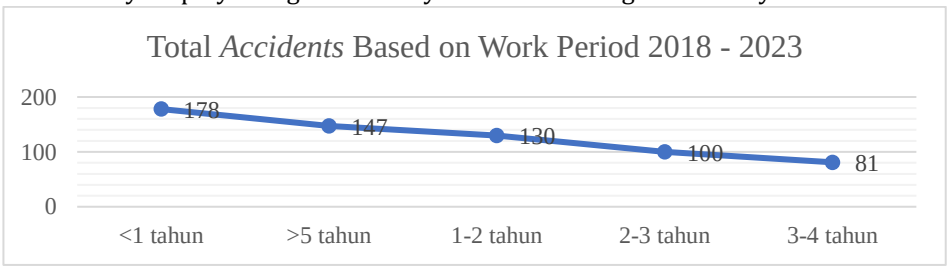
Graph 5. Graph amount accident 2018 – 2023 based on Position

In total, in the last six years 2018 – 2023, the position of A2B operator is the biggest contributor to accidents, followed by crew/helpers and supervisors.



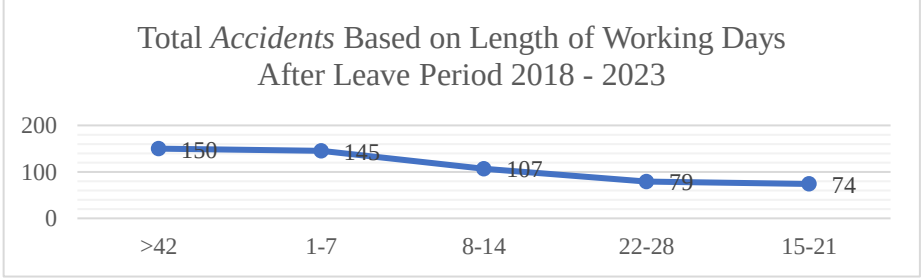
Graph 6. Graph amount accident 2018 – 2023 based on Age

In total, in the last six years 2018 – 2023, those aged 31 – 40 years were the biggest contributor to accidents, followed by employees aged 20 – 30 years and those aged 41 – 50 years.



Graph 7. Graph amount accident 2018 – 2023 based on Years of Service

In total, in the last six years 2018 – 2023, work experience of less than 1 year was the largest contribution to accidents, followed by employees with work experience greater than 5 years.



Graph 8. Graph amount accident 2018 – 2023 based on working days after paid leave

In total, in the last six years 2018 - 2023, employees who have worked 42 days after being on leave are the biggest contributor to accidents, followed by employees who have only been on leave for 1 - 7 years.

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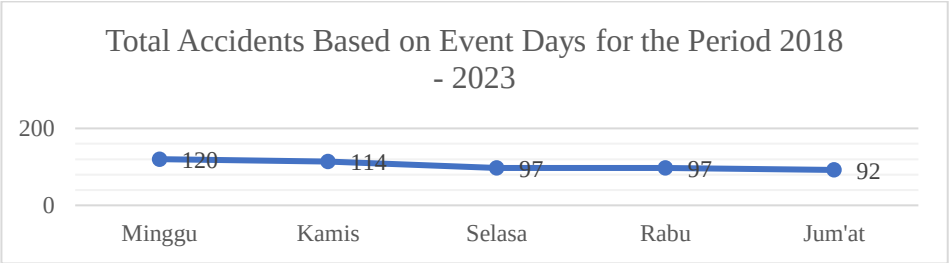
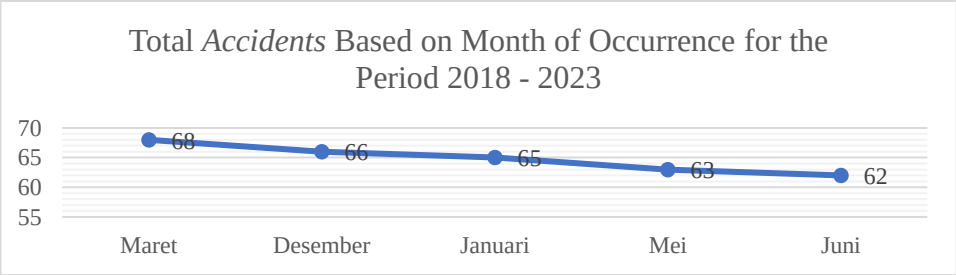


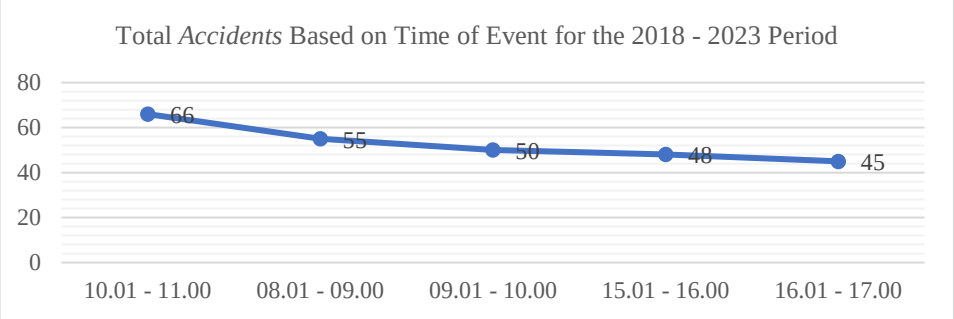
Graph 9. Graph amount accident 2018 – 2023 based on Event Days

In total, in the last six years 2018 – 2023, Sunday dominates the largest contribution to accidents, followed by Thursday and Tuesday.



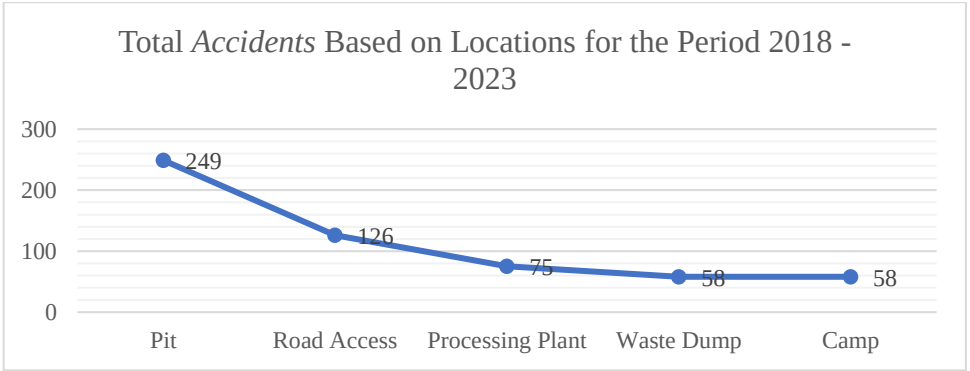
Graph 10. Graph amount accident 2018 – 2023 based on Month Incident

In total, in the last six years 2018 – 2023, March is the dominant month with the largest contribution to accidents, followed by December and January.



Graph 11. Graph amount accident 2018 – 2023 based on time Incident

In total, in the last six years 2018 – 2023, 10.01 – 11.00 is the dominant event with the largest contribution to accidents, followed by days 08.01 – 09.00 and 09.01 – 10.00.



Graph 12. Graph amount accident 2018 – 2023 based on Location Incident

In total, in the last six years 2018 – 2023, accidents in the pit are the biggest contributor to accidents, followed by road access and processing plants.

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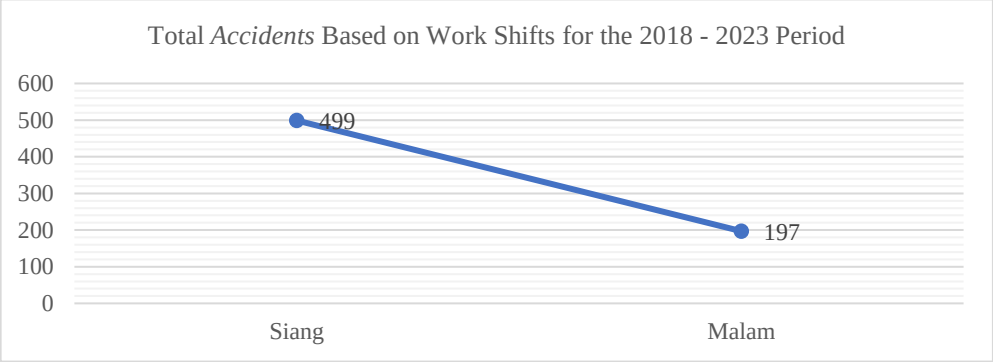
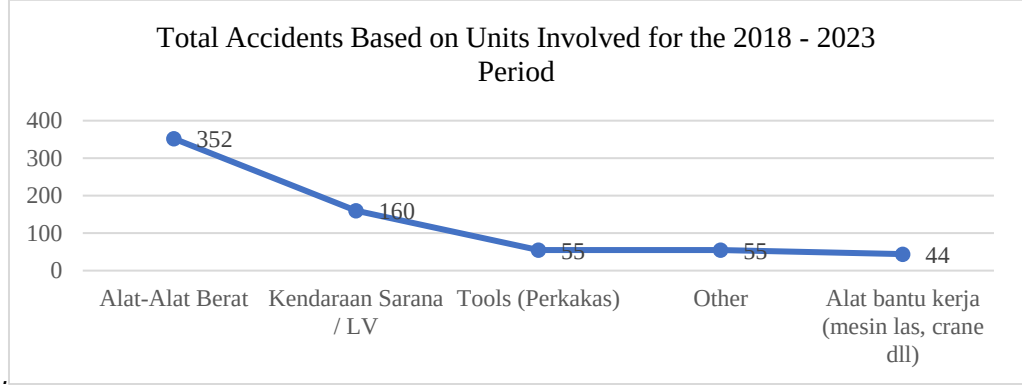


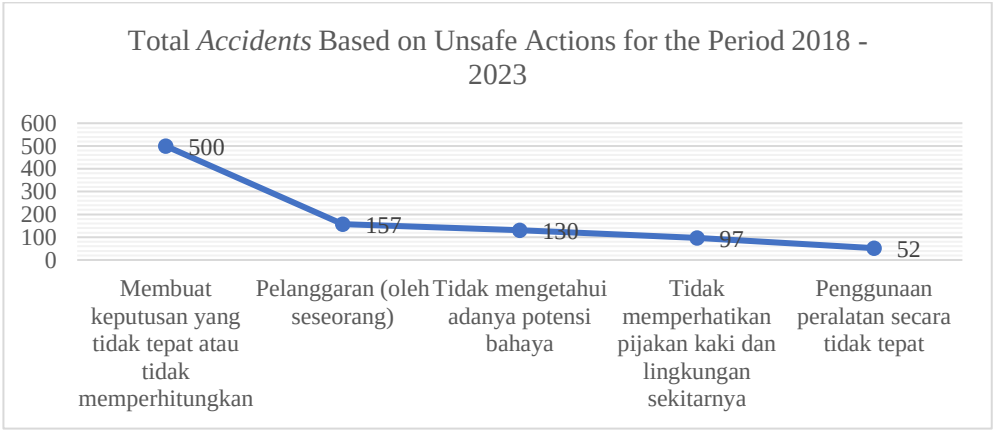
Graph 13. Graph amount accident 2018 – 2023 based on work shifts

In total, in the last six years 2018 – 2023, shift Daytime is the dominant contributor to accidents, followed by night shift.



Graph 14. Graph amount accident 2018 – 2023 based on the units involved

In total, in the last six years 2018 – 2023, heavy equipment was the dominant unit contributing to the largest number of accidents, followed by vehicles/facilities and tools.



Graph 15. Graph amount accident 2018 – 2023 based on Action No safe

In total, in the last six years 2018 – 2023, making inappropriate decisions or not taking them into account was the dominant unsafe act that contributed the most to accidents, followed by someone's violation and not being aware of potential dangers.

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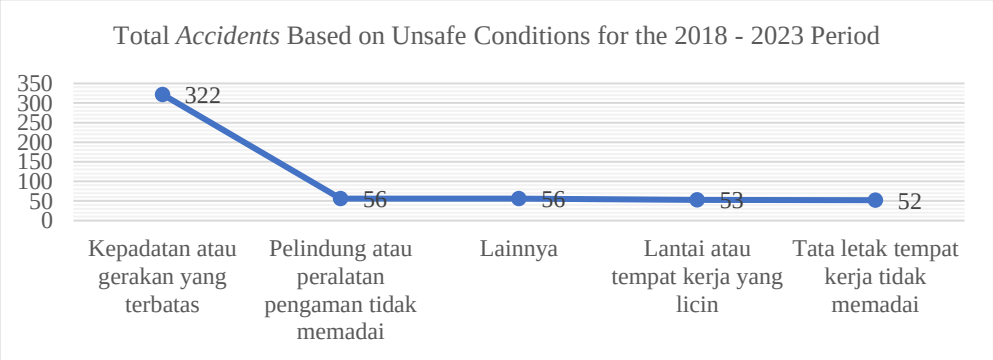
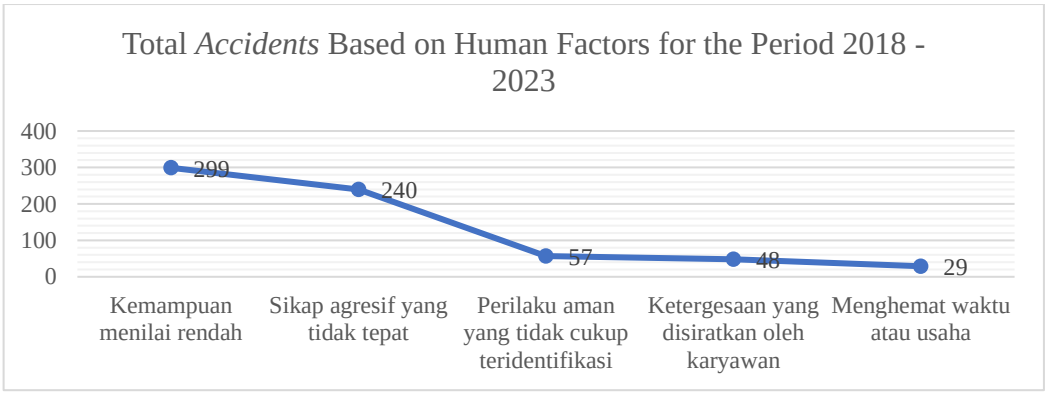


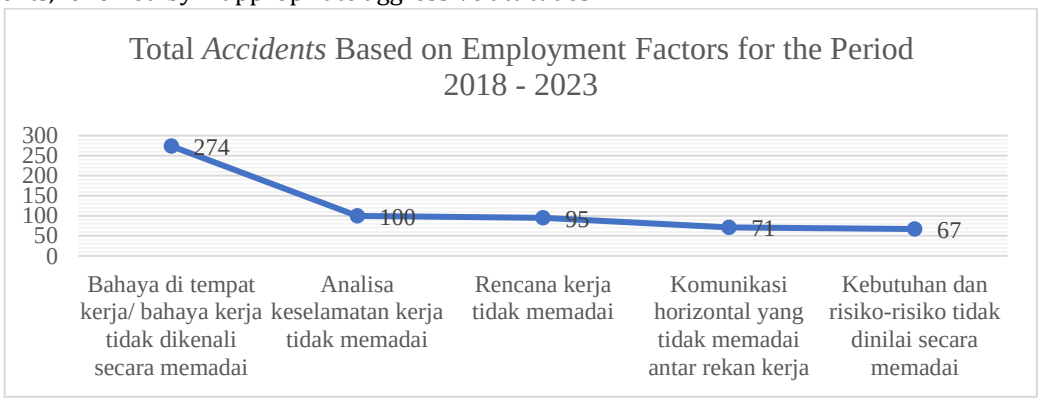
Graph 16. Graph amount accident 2018 – 2023 based on Condition No safe

In total, in the last six years 2018 – 2023, crowding or limited movement was the largest number of accidents.



Graph 17. Graph amount accident 2018 – 2023 based on factor man

In total, in the last six years 2018 – 2023, low judgment ability was the biggest contribution to accidents, followed by inappropriate aggressive attitudes.



Graph 18. Graph amount accident 2018 – 2023 based on factor work

In total, in the last six years 2018 – 2023, workplace hazards/work hazards that are not adequately recognized are the biggest contribution to accidents.

Discussion

Accident numbers fluctuate annually, yet there's an overall decline in 2023, attributed to the proactive and consistent implementation of the Safety Accountability Program that year. While the predominant types of accidents evolve, incidents involving property damage, first aid, and near misses emerge as the most frequent. A significant proportion of accidents involve the Mine Operations Department,

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particularly affecting young heavy equipment operators with under a year of work experience. Both young and newly hired workers, as well as those with over five years on the job, are identified as groups at risk, necessitating targeted attention. Accidents are notably more common during day shifts, particularly at the beginning and end of shifts, though night shift safety also demands vigilance. The distribution of accidents across days and months is fairly uniform, with spikes in March, December, and January, possibly linked to national holidays and their effect on worker vigilance. Accidents primarily stem from unsafe actions and conditions within the work environment. Preventive measures should concentrate on enhancing worker awareness, skillsets, and supervision, alongside ameliorating hazardous conditions. Human and workplace factors stand as fundamental accident causes, suggesting that prevention efforts should aim to comprehend and manage these elements, through improved safety consciousness, training, job safety assessments, solid work planning, and robust workplace communication.

The study reveals consistent findings over the past six years, indicating that crash accidents are the most frequent type of accident recorded at PT IMK. While in 2018, crash accidents were the fourth most common, they have consistently ranked as the third most frequent from 2019 to 2023.

The primary causes of these crash accidents are identified as human factors—including low judgment ability, impulsive actions by employees, poor decision-making, and fatigue from insufficient rest—and work-related factors, such as inadequate safety analysis. These underlying causes point to the inadequacy of the current training program for heavy equipment operators and supervisors. Therefore, there's a pressing need to develop a comprehensive and effective training program that addresses these issues, including specific training on managing fatigue.

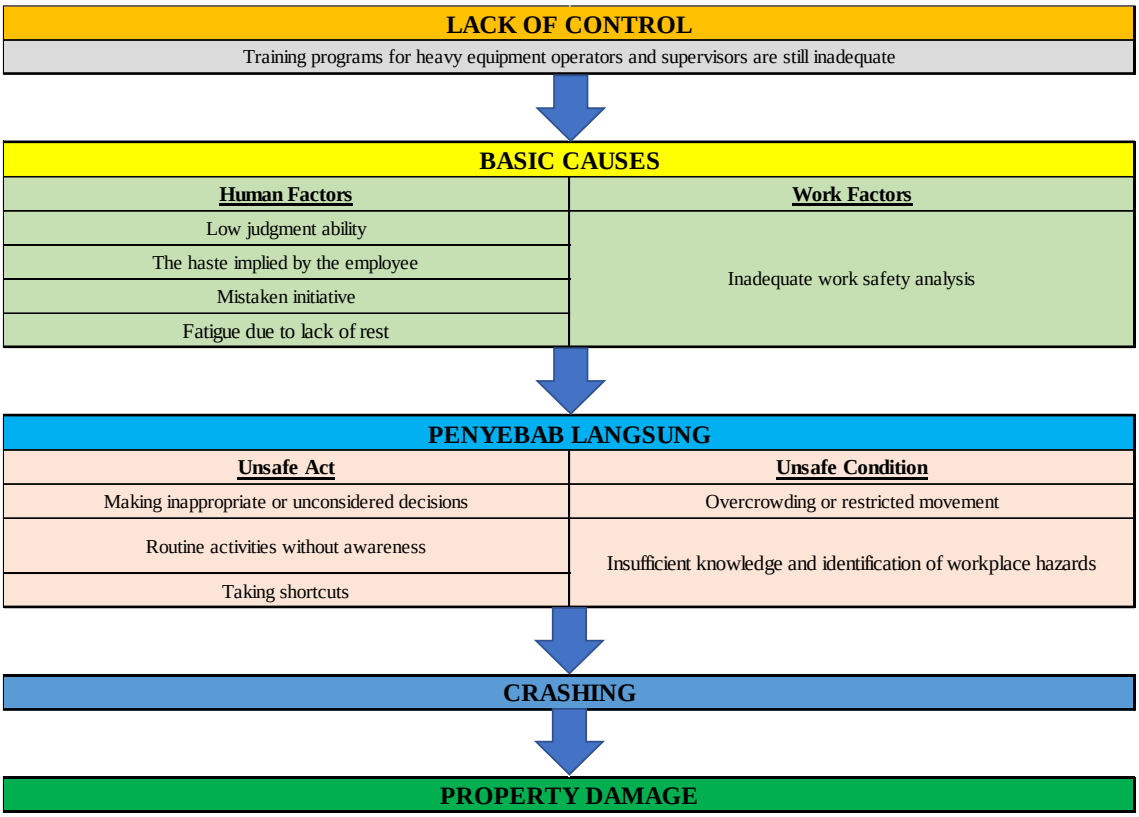

Figure 1. Crashing Accident Scheme Based on Accident Reports for 2018 - 2023

Conclusion and Future Direction

The conclusions from research on work accidents at PT Indo Muro Kencana during the period 2018 to 2023 highlight several important findings that can be the basis for improving safety and preventing accidents in the workplace, namely shift patterns are not very significant with fluctuations in the number of accidents from year to year and a decrease The most significant impact on the incidence of accidents is in 2023. The dominant types of accidents vary, with crashing, bumping/hitting, and bumping/hitting as the

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most common. The dominating accident categories are property damage, first aid and near miss. Pit and road access areas are the most common accident locations involving heavy equipment and utility vehicles/LV. Second, the majority of accidents that occur in the Mine Operation Department involve heavy equipment operators aged 20-40 years with less than 1 year of experience who are prone to accidents. Young and newly joined workers are prone to accidents, workers with more than 5 years of experience also need attention. Year-to-year fluctuations in accidents, increasing after 42 working days post-leave, may be due to fatigue or burnout. Third, the majority of work accidents occur during the day shift, a shift that has a higher risk compared to the night shift, which may be caused by increased work activity, fatigue, lack of concentration at certain hours, and accidents tend to occur at the start of the shift until late breaks are between 08.00 – 11.00 and towards the end of the shift, namely 15.00 – 17.00. Even so, it is important to pay attention to work safety during the night shift. Fourth, the highest accidents occur on Sundays with an even distribution of accidents in certain months. March has the highest accident incidence in total, followed by December and January. Factors such as national holidays and semester breaks for school children influence workers' vigilance and caution. In general, every working day and working month has the potential for accidents to occur, so vigilance must always be consistent by all employees. Fifth, in the case where the direct cause of an accident is dominated by unsafe actions, the most dominant cause of an accident is making inappropriate decisions, or not taking into account violations by someone, ignorance of potential dangers, use of inappropriate equipment. Contributing unsafe conditions include crowding or limited movement, slippery floors, inadequate protection or safety equipment, and poor workplace layout. Prevention focuses on increasing awareness, skills, and improving unsafe conditions in the work environment. Sixth, namely the basic causes that cause accidents at PT IMK are human factors in the form of low judgment ability, inappropriate aggressive attitudes, inadequately identified safe behavior). Meanwhile, work factors also contribute, namely in the form of a lack of recognition of hazards, inadequate safety analysis, poor work plans.

Some suggestions proposed by researchers to improve the company's occupational safety and health performance include creating and implementing a Mental and Physical Development Program (Bintalsik) for new employees and employees who have the opportunity to develop skills. This program aims to improve the integrity, team spirit and responsibility of employees at work, especially heavy equipment operators, as well as increasing productivity. Second, the Post-Incident Comprehensive Refresh Coaching Program is aimed at all employees involved in incidents during the 2018-2023 period, especially heavy equipment operators and crew in the Mine Operations Department. The material presented covers basic security aspects, safety-based behavior, and professional work ethics. The three Basic Mining Supervisory (BMS) Programs are aimed at supervisors of various levels, especially those who have just been promoted or who have been involved in incidents. The material provided covers basic safety aspects, good mining practices, and leadership responsibilities. Fourth, run and implement a Safety Accountability Program which provides targets for each safety activity, such as safety meetings, inspections and safety behavior observations. This program has been implemented actively and consistently in 2023 and involves all departments.

Implication

The results of this research can be implemented as a basis for determining strategies and occupational health and safety programs in mining companies, thereby minimizing occupational health and safety risks.

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