

Dominance of Unsafe Acts as the Primary Cause of Occupational Accidents

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ABSTRACT

Occupational accidents remain a significant issue in occupational health and safety (OHS), particularly in manufacturing industries characterized by high production demands. This study aimed to analyze the causal factors of workplace accidents, with a specific focus on unsafe acts and unsafe conditions in a footwear manufacturing industry. A quantitative descriptive analytic design with a cross-sectional approach was employed, using secondary data on occupational accidents at PT X from January to June 2025. Total sampling was applied, and data were analyzed using frequency and proportional distribution to identify the dominant causal factors. The results indicate that unsafe acts were the predominant cause of occupational accidents. Most incidents were classified as first-aid cases with minor severity and occurred repeatedly, suggesting inadequate supervision. Common unsafe acts were closely related to non-compliance with safety procedures, such as failing to maintain a safe distance, adopting unsafe working positions, and not turning off machinery. Unsafe conditions were identified in fewer cases; however, they functioned as contributing factors that potentially exacerbated accident severity. In conclusion, this study explicitly demonstrates that unsafe acts are the dominant cause of occupational accidents in the observed manufacturing setting. Therefore, accident prevention strategies must primarily prioritize behavior-based interventions, supported by systematic improvements in supervision, work systems, and the work environment to ensure more effective and sustainable prevention outcomes.

Keywords: occupational accidents; manufacturing industry; unsafe acts; unsafe conditions

INTRODUCTION

Occupational accidents are events that occur within an employment relationship, including incidents experienced during commuting from home to the workplace or vice versa, as well as occupational diseases caused by the work environment [1]. A workplace accident is a work-related or workplace-associated incident that may result in injury, illness, or death [2]. To date, occupational accidents remain a serious concern requiring sustained attention, as their incidence continues to increase annually. Data from the International Labour Organization (ILO) indicate that 2.93 million workers die each year due to occupational accidents and work-related diseases, accompanied by 395 million non-fatal accidents [3]. In Indonesia, the Ministry of Manpower recorded 462,241 occupational accident cases in 2024, an increase from 370,747 in 2023 and 265,334 in 2022 [4].

A substantial proportion of these accidents occur in the manufacturing sector, which absorbs 13.83% of the national workforce and is characterized by high production pressure as well as significant physical and mental risks to workers [5–7]. Many fatal occupational accidents have also been reported in the manufacturing industry [8]. This situation presents a major challenge in achieving a safe and healthy work environment. Moreover, the high-pressure nature of manufacturing work—excessive workload, strict production deadlines, and demanding physical conditions—often leads to excessive stress, adversely affecting workers' physical and mental health and potentially triggering occupational accidents that ultimately reduce productivity and work quality [6].

The diverse conditions of the work environment may negatively affect occupational health and safety performance in the workplace. A study by Jilcha and Kitaw (2016) found that various OHS problems originate from operational activities, internal and external environments, as well as workplace conditions [9]. These factors inevitably influence work performance and overall outcomes. According to Heinrich's Domino Theory (1931), 88% of occupational accidents are caused by unsafe acts, 10% by unsafe conditions, and 2% by other factors [10]. This theory suggests that unsafe acts constitute the largest contributor to workplace accidents, with personal factors playing a key role in shaping unsafe behavior [11]. This concept is supported by contemporary studies indicating that worker behavior is the dominant cause of occupational accidents. Research in the construction sector shows that although unsafe conditions contribute to incidents, unsafe worker behavior remains the primary cause [12]. Similarly, studies conducted in Indonesian manufacturing settings reveal that behavioral factors (unsafe acts) exert a greater influence on accidents compared to environmental factors (unsafe conditions), consistent with global findings [13]. Additionally, individual factors such as young age, short job tenure, fatigue, and inadequate training significantly contribute to accidents resulting from unsafe acts [8–10].

PT X, a manufacturing company employing approximately 18,000 workers of productive age, continues to experience occupational accidents, with total lost workdays exceeding 100 days in both 2023 and 2024. These figures remain high despite the implementation of various OHS interventions. Notably, two serious incidents occurred in consecutive years, both attributed to unsafe acts, significantly affecting the workers involved and their families [14]. Beyond the health consequences, occupational accidents also result in substantial economic losses and suffering for victims, their families, and business owners, including employee replacement costs, lost workdays, insurance expenses, compensation, and decreased productivity [15]. The high incidence of workplace accidents at PT X represents both a warning and a threat to occupational health and safety for workers and the company alike [16]. This concern is particularly relevant given the large number of newly employed workers who may not yet fully understand workplace safety standards, thereby increasing the likelihood of unsafe behavior and accident risk [17].

This phenomenon underscores the need for an in-depth analysis of the role of unsafe acts in occupational accidents at PT X. This study aims to descriptively measure the extent to which unsafe acts dominate the causes of workplace accidents using accident data from 2025. By understanding the magnitude of unsafe acts as a causal factor, PT X can develop more effective strategies to prevent high-severity accidents and reduce accident rates toward zero incidents. Such efforts are essential, as occupational accidents are fundamentally preventable when their causes are properly identified, and recurrence can be avoided [18]. The hypothesis of this study is that the proportion of occupational accidents attributable to unsafe acts is higher and more influential than those caused by unsafe conditions in the manufacturing industry of PT X, thereby supporting behavior-based intervention recommendations.

METHODS

This study was conducted at PT X, a manufacturing company, using occupational accident data recorded during the period of January–June 2025. This research employed a quantitative descriptive design aimed at systematically describing a phenomenon or condition by formulating objectives, determining an approach, and collecting data as the basis for reporting [19]. A cross-sectional approach was applied to obtain detailed information at a single point in time without follow-up, thereby providing a snapshot of the causal factors of occupational accidents at PT X [20,21].

The study population comprised all recorded occupational accident cases during the specified period. A total sampling technique was used, whereby all cases meeting the inclusion criteria were selected as research samples.

The primary variable examined was the category of accident causes, classified into unsafe acts and unsafe conditions according to the company's HSE classification system. Unsafe acts included workers' unsafe behaviors, such as not using personal protective equipment (PPE) or not complying with work procedures. Unsafe conditions referred to hazardous environmental or workplace conditions, such as unguarded machinery, slippery floors, and similar risks. Data were collected from secondary sources in the form of the master database of occupational accidents at PT X. The documents included worker identity, accident chronology, severity level, and classified causal factors (unsafe act or unsafe condition) as determined by the HSE team. Data collection was conducted through document review of official accident reports containing detailed descriptions of incidents and their causes. Data were analyzed using quantitative descriptive methods to calculate frequency distributions and proportions for each accident cause category [22]. The findings were presented in tables and/or diagrams to facilitate interpretation and to identify the dominant causal category of occupational accidents within the company.

RESULTS

Following data collection and analysis of occupational accidents at PT X during the period of January–June 2025, an overview was obtained regarding the causes of occupational accidents, levels of severity, types of unsafe acts and unsafe conditions identified, and the distribution of severity levels associated with unsafe acts. The findings are presented in the following tables and descriptions.

The distribution shown in Table 1 indicates that the majority of occupational accidents were caused by unsafe acts (154 out of 173 recorded cases), whereas unsafe conditions accounted for only 19 cases. These findings confirm the dominance of worker behavior as the primary determinant of occupational accidents. The proportional distribution further demonstrates a substantial disparity between the two main causes, with unsafe acts representing 89.02% and unsafe conditions 10.98% of total cases.

Table 1. Distribution of occupational accident causes based on unsafe acts and unsafe conditions

Cause	Frequency	Percentage
Unsafe act	154	89.02
Unsafe condition	19	10.98

Table 2. Distribution of occupational accident severity based on unsafe acts and unsafe conditions

Severity	Unsafe act		Unsafe condition		Total	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
First aid	130	84.42	16	84.21	146	84.39
Minor	21	13.64	2	10.53	23	13.29
Medium	3	1.95	1	5.26	4	2.31
Total	154	100.00	19	100.00	173	100.00

The dominance of behavioral factors is further reflected in Table 2, where first-aid cases were most prevalent and predominantly caused by unsafe acts (130 cases). Although medium-severity cases were relatively few, those resulting from both unsafe acts and unsafe conditions require attention, as they still pose the potential for significant loss. Overall, first-aid cases accounted for 85% of total incidents.

The most frequent unsafe acts were failure to maintain a safe distance (36 cases; 23.38%), unsafe working position (31 cases; 20.13%), failure to turn off machinery (31 cases; 20.13%), and unsafe work methods (28 cases; 18.18%). This distribution highlights the predominance of behavioral factors related to worker discipline and non-compliance with established procedures (Table 3).

Table 4. Severity levels of occupational accidents caused by unsafe actions

No	Type of unsafe action	Medium		Minor		First aid		Total	
		Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
1	Unsafe work method	0	0	5	23.81	23	17.69	28	18.18
2	Improper chemical handling	0	0	0	0	12	9.23	12	7.79
3	Improper use of chemicals	0	0	0	0	1	0.77	1	0.65
4	Unsafe working position	2	66.67	4	19.05	25	19.23	31	20.13
5	Failure to turn off machinery	0	0	4	19.05	27	20.77	31	20.13
6	Not using PPE	1	33.33	0	0	0	0	1	0.65
7	Failure to maintain safe distance	0	0	7	33.33	29	22.31	36	23.38
8	Not in accordance with procedures	0	0	1	4.76	13	10.	14	9.09
	Total	3	100	21	100	130	100.	154	100

When behavioral factors were analyzed in relation to severity, unsafe actions such as failure to maintain safe distance, unsafe work methods, failure to turn off machinery, and unsafe working positions occurred more frequently and were associated with both minor and medium injuries. In contrast, other unsafe actions, such as improper chemical handling, predominantly resulted in first-aid cases requiring only basic medical treatment (Table 4).

The number of identified unsafe conditions was considerably lower. The most frequently observed unsafe conditions were improper placement (36.84%) and equipment failure (31.58%), while other factors appeared only in a few instances (Table 5).

DISCUSSION

The results of this study indicate that unsafe acts are the dominant factor causing occupational accidents in the footwear manufacturing industry. This finding is consistent with Heinrich's Domino Theory, which states that unsafe behavior is the primary contributor to occupational accidents [10]. The present study reinforces previous findings showing that more than 80% and even up to 97.1% of occupational accidents originate from workers' own behavior, while environmental factors serve mainly as supporting contributors [23,24]. Ramdhani (2019) likewise demonstrated that unsafe acts exert the greatest influence on the occurrence of workplace accidents [25].

Table 3. Types of unsafe acts identified in the workplace

Type of unsafe act	Frequency	Percentage
Failure to maintain safe distance	36	23.38
Unsafe working position	31	20.13
Failure to turn off machinery	31	20.13
Unsafe work method	28	18.18
Working not in accordance with procedures	14	9.09
Improper chemical handling	12	7.79
Not using PPE	1	0.65
Improper use of chemicals	1	0.65

Table 5. Types of unsafe conditions identified in the workplace

Type of unsafe condition	Frequency	Percentage
Improper placement	7	36.84
Equipment failure	6	31.58
Inappropriate PPE	3	15.79
Machine guard not installed	1	5.26
Slippery floor	1	5.26
Exposure to materials	1	5.26

The dominance of behavioral factors is further supported by the industrial-scale analysis of the Loss Causation Model, which revealed that non-compliance with work instructions doubles the risk of accidents [26]. These findings indicate that behavior contributes more substantially to accident causation than other factors, emphasizing the importance of behavior-focused interventions. Hidayat and Hijuzaman (2014) also confirmed that unsafe acts have a positive and significant effect on occupational accidents [27]. Their findings showed that the higher the unsafe act factor, the greater its contribution to accident rates. Research conducted by Huda et al. (2021) in a building construction project reported that nearly half of workers (49.5%) engaged in unsafe acts and identified a significant relationship between unsafe acts and occupational accidents [28]. These results align with findings that human behavioral factors play a significant role in occupational accidents, exerting a 1.170-fold influence compared to environmental factors (1.116-fold) [24,29]. Therefore, serious attention to behavioral aspects is essential to effectively control this risk factor.

Regarding accident severity, this study found that most cases were classified as first aid cases, totaling 146 cases (85%) out of 173 incidents. Of these, 130 cases were caused by unsafe acts. The high number of first aid cases at PT X indicates frequent incidents with relatively low severity, as they did not require advanced medical treatment [30]. This relatively low severity suggests that the emergency response system and initial case management mechanisms at PT X are sufficiently effective in minimizing the risk of more serious outcomes [31]. Effective first aid management can also shorten recovery time and reduce disruptions to productivity [32].

However, the high and recurrent number of first aid cases reflects weaknesses in behavioral control mechanisms. Ilmansyah Y. et al. (2020) stated that occupational accidents may result from weak supervision or inadequate behavioral control [33]. This pattern warrants concern, as repeated minor incidents without proper control may escalate into more serious conditions [34]. The consistent occurrence of first aid cases also indicates a failure to prevent risky behavior. Therefore, although the emergency response system is functioning adequately, primary prevention through behavioral modification and the development of safe behavior remains crucial to reducing incident rates [35].

In this study, the most frequent unsafe acts were failure to maintain a safe distance, failure to turn off machinery, and unsafe working positions. These factors are closely associated with workers' compliance and discipline in adhering to established procedures. The findings demonstrate alignment between the high number of accidents caused by unsafe acts and the types of unsafe acts identified, particularly those related to procedural compliance. Kirana et al. (2025) emphasized that safe behavior, particularly compliance with procedures, is key to reducing occupational accidents [36]. It is therefore important to identify the causes of non-compliance. Several studies indicate that unsafe acts may stem from insufficient knowledge of procedures and accident risks [37,38]. In addition, unsafe behavior may arise from inadequate supervision [39]. Priyohadi and Achmadiansyah (2021) demonstrated that inspection and corrective actions have a dominant influence on the emergence of unsafe behavior [40].

Supervisors thus play a crucial role in conducting routine monitoring and must possess adequate knowledge and understanding of safe work procedures and process safety standards. Consistent supervision enables early identification and correction of unsafe acts before incidents occur [38]. This is consistent with the Swiss Cheese Theory, which suggests that when supervisory layers fail, hazards may penetrate successive defense layers, leading to unsafe actions and accidents [41]. Beyond knowledge and supervision, systematic observation, constructive direct feedback, and reward mechanisms are necessary to motivate safe behavior [42]. Organizations must create a supportive work environment that encourages workers to consistently choose safe behaviors.

The implementation of Behavior Based Safety (BBS) is therefore essential, as it has been shown to reduce accident rates in high-risk industries such as manufacturing, construction, and oil and gas [42]. BBS not only focuses on correcting unsafe behavior but also builds a safety culture through active worker involvement in hazard identification and risk control. However, successful implementation requires strong commitment from top management and active participation from workers. Without top management support, BBS initiatives are unlikely to be sustained or achieve long-term reductions in accident rates [43].

Another finding of this study is the significant difference between accidents caused by unsafe acts and unsafe conditions, with unsafe condition cases being considerably fewer. Nevertheless, although less frequent, both factors contribute to occupational accidents and require attention [12]. Identified unsafe conditions—such as equipment failure, improper material placement, and inappropriate PPE—may increase accident risk. Disorganized or poorly maintained conditions can create hazardous workplaces and trigger accidents [44]. Furthermore, unsafe acts may also be influenced by unsafe conditions, such as weak supervision or unclear procedures [37]. In essence, occupational accidents result from the interaction between unsafe behavior and substandard environmental conditions [45].

Therefore, although unsafe acts are the dominant factor, accident prevention strategies must be comprehensive and not focus solely on individual behavior [46]. The dominance of unsafe behavior reflects not merely individual shortcomings but also complex interactions among organizational culture, production pressure, supervision quality, and work system design [47,48]. Preventive efforts should thus include engineering controls, routine safety inspections, equipment maintenance, and strengthening organizational safety culture. Interventions targeting individuals alone will be less effective without concurrent improvements in organizational climate and structure [49]. An integrative approach, such as the implementation of an Occupational Health and Safety Management System (SMK3), which combines behavioral, technical, and managerial controls, is likely to be more effective in sustainably reducing occupational accident rates [50].

Overall, this study confirms the dominant role of worker behavior in occupational accidents, particularly at PT X. However, several limitations should be acknowledged. The cross-sectional design provides only a snapshot within a single time period and does not allow direct causal inference between unsafe acts and accident occurrence. Additionally, other potential influencing factors—such as individual characteristics (age, job tenure, educational level), OHS management systems, safety climate, and physical or organizational environmental conditions—were not analyzed in this study.

Future research is therefore recommended to employ analytic designs with primary data collection through field observations and in-depth interviews to more comprehensively examine the relationships among behavioral, systemic, and environmental factors in occupational accidents. Furthermore, future studies may develop and evaluate behavior-based intervention models, such as Behavior Based Safety (BBS), to assess their effectiveness in sustainably reducing occupational accident rates at PT X and within the broader manufacturing sector.

CONCLUSION

This study demonstrates that unsafe acts constitute a substantially greater proportion of occupational accidents at PT X compared to unsafe conditions. The findings confirm that unsafe behavior is the dominant factor contributing to workplace accidents, reinforcing the central role of human factors in accident causation. The predominance of minor cases further indicates weaknesses in procedural compliance and supervision of safe work practices. Although less frequent, unsafe conditions remain contributory factors and should not be overlooked.

Therefore, accident prevention efforts should prioritize behavior-based safety interventions, strengthened supervision, and continuous safety training, while simultaneously improving technical, managerial, and environmental systems. An integrated approach supported by a strong

organizational safety culture and active involvement from both workers and management is essential to achieving sustainable accident reduction and preventing serious incidents in the long term.

Ethical consideration, competing interest and source of funding

-Ethical considerations were maintained by ensuring the confidentiality of workers' identities and company information. The study was conducted with formal authorization from the HSE department of PT X.

-There is no conflict of interest related to this publication.

-Source of funding is authors.

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