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Application of the HIRADC (Hazard Identification Risk Assessment and Determining Control) Model on Field Testing Activities conducted by Lab X, East Java, Indonesia

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Abstract

As the industrial and labor sectors develop in Indonesia, Occupational Health and Safety (OHS) are becoming increasingly important. To ensure that companies in these sectors are up to standard, industrial labs such as Lab X help these organizations conduct the appropriate tests and surveys. However, Lab X itself has not ensured their own job activities and organizational environment are following the established standards. Thus, the purpose of this research is to conduct a HIRADC model analysis on Lab X activities, specifically on field testing. This research is qualitative with an analytical approach conducted in the lab and in the field during testing activities, between 8 January 2024 and 8 March 2024. The data for this research come from both primary and secondary sources, obtained by observation, interview, discussion, lectures, and other research papers or supporting materials. The HIRADC findings identify chimney testing and field measurement activities as the most hazardous at LAB X, primarily during chimney ladder ascent/descent and working at sampling points. Current controls include the "3 contact" ladder principle and PPE like full-body harnesses. Although risk probability has decreased, severity remains unchanged. New measures focus on providing first aid for fall accidents, including portable first aid kits and collaboration with company personnel. Implementation of these controls aims to decrease severity in the future, enhancing safety at LAB X Surabaya.

Keywords: HIRADC; Work; Identification; Assessment; Control

1. Introduction

Aligned with the developments in the industrial and labor sectors in Indonesia, Occupational Health and Safety (OHS) has emerged as an increasingly significant issue in ensuring a safe and healthy work environment for workers. In East Java, one of the primary industrial hubs in Indonesia, challenges pertaining to company hygiene, health, and safety remain noteworthy. Thus, there is a need for standards or models which examine and analyze all aspects of an organization to ensure it is held to a sufficient standard of safety. Over the years, Lab X has evolved into a hub for testing, inspection, research, and training in this domain, making a substantial contribution towards enhancing awareness and compliance with OHS standards. However, Lab X, after conducting an extensive gap analysis, summarizes that a HIRADC model was needed to ensure the alignment of their own organizational activities with existing standards.

As an occupational health and safety lab, Lab X offers three primary services, employee medical examinations, field testing, and sample analysis. Out of all of these, field testing is the most taxing and dangerous service done by the lab. This is because field testing involves tests done in the field to obtain samples for analyzation. However, to get these samples, lab personnel need to travel according to the customer's needs and personally obtain samples, usually involving dangerous acts, such as climbing a large industrial chimney.

To address this, Lab X has embarked on a comprehensive journey to develop and implement a Hazard Identification, Risk Assessment, and Determining Control (HIRADC) model tailored to the specific challenges and requirements of the

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industrial landscape in East Java. This model aims to systematically identify, assess, and mitigate workplace hazards, thereby promoting a culture of safety and well-being among employees and stakeholders.

According to OHSAS 18001:2007 [1] Clause 4.3.1, HIRADC is the process of identifying, measuring, and evaluating risks, which is a crucial stage in occupational health and safety management (OHS), aimed at identifying potential workplace hazards, assessing the associated risks, and determining whether additional preventive or control measures are required. Key components of the HIRADC model include comprehensive hazard identification methodologies, risk assessment tools, and control measures tailored to the diverse operational contexts prevalent in East Java's industrial sector. Moreover, the model incorporates provisions for ongoing monitoring, evaluation, and continuous improvement to ensure its effectiveness and relevance in a dynamic business environment.

By proactively addressing occupational health and safety concerns through the adoption of the HIRADC model, Lab X seeks to set a new benchmark for organizational excellence and commitment to worker welfare in East Java's industrial landscape. Through collaboration with industry partners, regulatory authorities, and academic institutions, Lab X aims to foster a culture of safety consciousness and compliance, ultimately contributing to the sustainable development and prosperity of the region. Thus, the purpose of this research is to analyze all the field activities conducted by Lab X using the HIRADC model.

2. Material and methods

2.1. Research type

This study is a qualitative study using the cross-sectional method. This research also uses the analytical research method, focusing on the implications of the data gathered to reach a conclusion regarding safety standards during field testing using the HIRADC model.

2.2. Location and time

The research was conducted in the lab and in the field during testing activities, between 8 January 2024 and 8 March 2024.

2.3. Data source, collection, and analysis method

The data for this research come from both primary and secondary sources, with the primary data coming from organizational lectures and training conducted by the lab, semi-structured interviews to obtain more in-depth data, discussions between employees pertaining to the HIRADC results, observations made in the field, and inspections conducted by the researchers. The secondary data comes from previously held data of Lab X, and other scientific research done on the topic of HIRADC models, to support the primary data and analysis.

This research also uses an evaluation system based on the AS/NZS 4360:2004 model that has been adapted to the occupational and industrial needs of Lab X.

Table 1 Risk matrix used as basis for HIRADC evaluation

Extreme	17-25
High	10-16
Medium	5-9
Low	1-4

Source: Lab X internal data

3. Results

3.1. HIRADC results

The identification of hazards within the framework of the Occupational Safety and Health Management System (OSHMS), as outlined in Government Regulation Number 50 of the year 2012 [2], constitutes a fundamental endeavor aimed at comprehensively grasping, evaluating, and mitigating potential risks inherent in the work environment. This

systematic approach entails a meticulous assessment of various facets of the work system, encompassing work equipment, workplaces, work processes, and work procedures. At its core, the hazard identification process serves as the cornerstone for the development of robust occupational safety and health risk management strategies. To execute this pivotal step, a multifaceted methodology is employed, involving structured interviews with personnel within the Medical Laboratory and direct observations within the workplace setting. Through these interactions and observations, a panoramic understanding of the intricacies of work activities is attained, particularly in the context of field testing procedures. These activities span the spectrum from pre-field testing preparations to the execution of various testing protocols, including work environment testing, ambient testing, emissions testing, and post-field testing activities. This comprehensive approach yielded a discerning identification of 43 risks and 57 hazards, serving as a foundational framework for subsequent risk mitigation and management initiatives within the Medical Laboratory's operational framework.

Table 2 HIRADC result for the activity of field testing

Activity	Risk of harm	Impact of hazard	Risk level	Risk category
A. Pre-field testing				
Chemical preparations	Exposure to chemicals	Respiratory system disorders	8	Medium
		Scald skin	6	Medium
		Irritation of the skin and eyes	6	Medium
	Slipping due to slippery floor	Cuts, and injuries	2	Low
Tool preparations	Snapped impinger box	Wounds on the hands	3	Low
	Non-ergonomic position	Musculoskeletal disorders and low back pain	9	Medium
	Struck by sampling equipment	Cuts, and injuries	6	Medium
	Slipping due to slippery floor	Cuts, and injuries	2	Low
Transportation	Traffic accidents	Injuries, and fatalities	10	High
B. Work environment testing				
Physical factor testing	Exposure to noise	Hearing reduction	8	Medium
	Exposure to a hot work climate	Dehydration	4	Low
	UV exposure	Skin irritation	6	Medium
		Skin cancer	15	High
	Rainy weather	Struck by lightning	5	Medium
		Exposed to wind & rainwater	9	Medium
	Material drop at the sampling site	Cuts, and injuries	8	Medium
	Tool dropped during use	Cuts, and injuries	8	Medium
Dust and gas testing	Exposed to dust & gasses	Respiratory system disorders	8	Medium
		Scald skin	6	Medium
		Irritation of the skin and eyes	6	Medium
	Rainy weather	Struck by lightning	5	Medium
		Exposed to wind & rainwater	9	Medium
	Material drop at the sampling site	Cuts, and injuries	8	Medium
	Struck by sampling equipment	Cuts, and injuries	8	Medium

C. Ambient testing				
Dust and gas testing	Exposed to dust & gasses	Respiratory system disorders	8	Medium
		Scald skin	6	Medium
		Irritation of the skin and eyes	6	Medium
	Rainy weather	Struck by lightning	5	Medium
		Exposed to wind & rainwater	9	Medium
	Material drop at the sampling site	Cuts, and injuries	8	Medium
	Crushed by the ambient box set	Cuts, and injuries	3	Low
D. Emissions testing				
Mobile emissions testing	Exposure to vehicle emission gases	Causes irritation of the respiratory system	6	Medium
	Exposure to noises from sample source	Hearing reduction	8	Medium
	Rainy weather	Struck by lightning	5	Medium
		Exposed to wind & rainwater	9	Medium
	Struck by sampling equipment	Cuts, and injuries	4	Low
	Electric shock	Burns	10	High
	Hit by the sample source vehicle	Cuts, and injuries	4	Low
	Non-ergonomic position during sampling	Musculoskeletal disorders and low back pain	8	Medium
	Exposure to hot temperatures from mobile emissions sources	Burns	6	Medium
Stationary (chimney) emissions testing	Falling while going up & down the chimney ladder	Injuries, & fatalities	20	Extreme
	Falling while on the chimney's board desk / sampling location	Injuries, & fatalities	20	Extreme
	Struck by materiel	Cuts, and injuries	6	Medium
	Bad weather	Struck by lightning	10	High
		Exposed to wind & rainwater	9	Medium
	Exposure to hot temperatures from stationary emission sources	Burns	6	Medium
		Dehydration	4	Low
	Hit by testing equipment from above the chimney	Cuts, and injuries	8	Medium
	Electric shock	Burns, and fatalities	10	High
	Exposed to boiler engine noise	Hearing reduction	8	Medium
	Non-ergonomic position when sampling in the chimney	Musculoskeletal disorders or low back pain	8	Medium
	Exposure to dust	Respiratory system disorders	8	Medium
		Scald skin	6	Medium
		Irritation of the skin and eyes	6	Medium

E. Post-field testing				
Sample transportation	Struck by test equipment when lowering the tool	Cuts, and injuries	8	Medium
	Exposed to chemical spills when lowering samples	Skin irritation	9	Medium
	Non-ergonomic manual handling position when moving tools	Musculoskeletal disorders or low back pain	8	Medium

Source: Primary data

4. Discussion

The findings derived from the Hazard Identification Risk Assessment and Determining Control underscore the paramount significance of rigorous safety protocols during testing endeavors. Through meticulous scrutiny, it became apparent that various hazards exceeded acceptable risk thresholds, necessitating the enforcement of robust control measures. Among these hazards, a particularly concerning issue surfaced: the substantial risk of falls encountered during chimney stack ascent and descent, as well as while maneuvering atop decks or sampling points situated on these structures. These activities were identified as bearing a significant potential for accidents, characterized by a high probability of occurrence. Furthermore, the ramifications of such incidents are severe, manifesting in a markedly heightened fatality rate. Referencing the seminal work by Spearpoint & Hopkin [3], it was unveiled that adults subjected to falls onto rigid surfaces confront a stark reality: a 50% fatality likelihood at a mere 15 meters of descent, escalating to a 90% probability at a distance of 23.8 meters. This compelling data serves as a catalyst for action, accentuating the imperative of vigilance and preemptive measures during testing operations atop chimney stacks.

Indeed, there exist preventive measures to mitigate such occurrences. An analysis conducted by Anantharaman *et al* [4], focusing on the characteristics of injuries resulting from falls within the construction industry, revealed a striking finding: falls occurring while workers were equipped with personal protective equipment (PPE), such as safety harnesses, constituted a mere 4.1% of the total falls recorded. This compelling statistic underscores both the effectiveness and significance of PPE utilization in safeguarding workers from fall-related injuries. Furthermore, the efficacy of PPE usage as a preventive measure is corroborated by a study conducted by Sehsah *et al* [5], which underscores a compelling correlation: low PPE usage serves as a predictive indicator of heightened workplace accidents, including falls from elevated heights. Building upon this empirical foundation, it becomes increasingly evident that the consistent and proper application of PPE holds immense potential in curtailing the incidence and severity of workplace accidents, thereby enhancing overall safety standards within industrial settings.

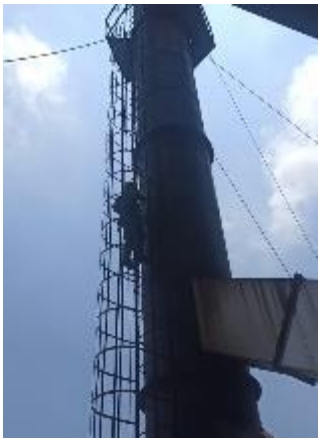

Figure 1 Stationary (chimney) emission field tests

In order to mitigate the high level of risk associated with these hazards, Lab X has implemented several control measures. These measures include ensuring adherence to the 3-contact principle recommended by the Health and Safety Executive [6], when ascending and descending chimney stacks, utilizing full-body harness personal protective equipment (PPE), and ensuring a safe working environment. The 3-contact principle is a ladder usage guideline developed by the Health and Safety Executive (HSE), stipulating that at all times during ladder use, a minimum of three points of contact with the ladder should be maintained to preserve balance and minimize the risk of falling. The use of

full-body harness PPE is also employed to reduce the likelihood of falls, as it can prevent a person from falling by restraining them when working at height. Lastly, environmental checks are conducted to ensure that the work area is prepared for chimney inspections.

These three control measures are deemed effective, as upon reassessment, the risk ratings for both hazards were found to have decreased to a medium level. The implemented controls are considered highly effective in reducing the likelihood of falls. However, the severity ratings remain at the highest level. This underscores the primary concern in developing further controls for the high-risk hazard of falling. Consequently, two control suggestions have been developed for future implementation. First, preparing portable first aid kits (FAKs) to administer initial medical assistance, along with coordinating with company personnel to provide first aid in the event of a fall. These suggestions are devised to address the high severity rating associated with the risk assessment of falls. Given the inherent difficulty in minimizing injuries and complications once a fall occurs, the focus on reducing severity lies in preventing the occurrence of further complications. Swift and proper administration of first aid can promptly address injuries and minimize the development of additional complications.

5. Conclusion

HIRADC stands for Hazard Identification, Risk Assessment, and Determining Control. It represents a systematic approach to identifying potential hazards in the workplace environment, assessing the risks associated with these hazards, and establishing controls or preventive measures to reduce or eliminate these risks. HIRADC is utilized to enhance workplace safety and mitigate the likelihood of accidents or incidents occurring on-site.

The findings of this HIRADC reveal that the two most hazardous aspects of work activities at LAB X involve chimney testing and measurement activities in the field, particularly during the ascent and descent of chimney stacks, as well as when working on board decks or sampling points of chimneys. These hazards are managed by LAB X through the implementation of the "3 contact" principle when using ladders, utilizing personal protective equipment (PPE) such as full-body harnesses, and ensuring the safety of the measurement area before conducting tests. Consequently, while the risk levels of both hazards have significantly decreased in terms of probability, there has been no reduction in severity.

Thus, further control measures have been developed to reduce the severity rating in the future. These controls focus on providing first aid in the event of fall accidents, such as preparing portable first aid kits (FAKs) and collaborating with company personnel to administer first aid. With the planning of these controls, it is hoped that LAB X Surabaya will implement these measures to decrease the severity rating of the risk levels associated with both hazards.

Compliance with ethical standards

Disclosure of Conflict of interest

All researchers declare that there is no conflict of interest.

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