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A Management: Oriented Hazard Identification and Risk Assessment Framework for Construction Projects at the University of Perpetual Help System Laguna

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ABSTRACT

Construction safety remains a critical concern due to the hazardous nature of construction activities that expose workers to physical, mechanical, and environmental risks. This study developed a management-oriented Hazard Identification and Risk Assessment Control (HIRAC) framework for construction projects at the University of Perpetual Help System Laguna by assessing workers' hazard awareness, identifying common workplace accidents and injuries, evaluating the existing safety culture, and determining the acceptability of a proposed HIRAC Training and Awareness Program. A descriptive quantitative research design was employed, with data collected from construction workers through structured survey questionnaires. Weighted mean and standard deviation were used to analyze the data. Findings revealed that workers demonstrated a high level of hazard awareness, particularly regarding physical injuries and exposure to harmful substances. However, construction activities continued to present significant risks, including slips, trips, falls, and machinery-related accidents affecting the upper and lower extremities. Most incidents were classified as minor to moderate. The institution also exhibited a very high level of safety culture through effective implementation of safety policies and compliance measures, although hazard communication required improvement. Furthermore, the proposed HIRAC Training and Awareness Program received very high acceptability among respondents. The study recommends implementing the framework to strengthen safety practices, reduce workplace risks, and promote a proactive and sustainable construction safety environment.

Keywords: construction safety, hazard awareness, HIRAC, safety culture, training program

INTRODUCTION

The construction industry plays a vital role in fostering economic growth by supporting infrastructure development, employment generation, and overall national progress (International Labour Organization, 2020). Despite its economic contributions, construction work remains one of the most hazardous occupations due to exposure to multiple risks, including working at heights, operating heavy machinery, and handling hazardous materials. These conditions significantly increase the likelihood of workplace accidents, which can negatively affect worker safety, delay project completion, and increase operational costs (Zhou et al., 2020). As construction projects continue to expand in complexity, ensuring effective

safety management practices has become an essential priority for organizations aiming to protect workers and maintain productivity.

Hazard Identification and Risk Assessment (HIRA) is widely recognized as a systematic and proactive approach to managing workplace safety in construction environments. This process involves identifying potential hazards, evaluating the level of risk associated with each hazard, and implementing appropriate control measures to prevent accidents. Studies have shown that the effective implementation of HIRA contributes to reducing workplace incidents and strengthening organizational safety culture by encouraging workers and management to prioritize safety in all operations (Alshammar et al., 2021). In addition, advancements in technology such as Building Information Modeling (BIM) have enhanced safety planning by enabling stakeholders to visualize hazards before construction begins, thereby improving coordination and minimizing risks throughout the project lifecycle (Taherpour et al., 2024).

In the Philippine context, research has emphasized the importance of continuous improvement in safety management systems, particularly in hazard identification and risk assessment practices. While many organizations have adopted safety protocols, gaps still exist in terms of enforcement, training, and stakeholder participation. Findings from local studies indicate that although HIRA is implemented, its effectiveness is often limited by inconsistent application and insufficient monitoring of safety procedures (Causaren & Martin, 2023). Moreover, weak enforcement of safety regulations and lack of structured safety systems remain major challenges that hinder the full effectiveness of safety initiatives in construction settings (Abdi, 2024).

This study is anchored in the Swiss Cheese Model developed by Reason (as cited in Smith et al., 2023), which explains how accidents occur when multiple layers of safety defenses fail simultaneously. Each layer—such as policies, training, hazard identification, and communication—contains inherent weaknesses that may align and result in accidents when not properly managed. Within this framework, HIRA is viewed as a critical defensive mechanism that helps prevent these failures by systematically identifying and controlling risks. The model highlights the importance of strengthening all safety layers, including enforcement, training, and stakeholder engagement, to minimize the likelihood of accidents in construction environments.

Despite the availability of safety guidelines and risk management tools, there is limited research focusing specifically on the implementation and effectiveness of HIRA practices in construction projects within the University of Perpetual Help System Laguna (UPHSL). This gap underscores the need to examine how hazard identification and risk assessment are applied in this particular setting and how they influence safety outcomes and organizational practices. Understanding these factors is essential for developing targeted interventions that can enhance safety performance and reduce workplace incidents.

Guided by the Swiss Cheese Model, this study examines the implementation and effectiveness of HIRA in construction activities at UPHSL. Specifically, it aims to: (1) identify the critical hazards associated with construction activities; (2) assess the severity and frequency of accidents and injuries; (3) evaluate the level of safety culture in terms of stakeholder awareness, safety compliance, policy enforcement, and hazard communication; (4) develop a targeted training and awareness program to improve HIRA practices; and (5) determine the level of acceptability and effectiveness of the proposed program in enhancing risk awareness and reducing accidents. Through this analysis, the study seeks to contribute to improved safety management practices and promote a safer, more sustainable construction environment.

METHODOLOGY

This study employed a descriptive-developmental research design to examine the implementation and effectiveness of Hazard Identification and Risk Assessment (HIRA) in construction activities at the University of Perpetual Help System Laguna (UPHSL). The descriptive method was used to systematically describe existing conditions and assess how HIRA is currently practiced, while the developmental approach guided the design and enhancement of a HIRA training and awareness program aimed at improving safety practices (Kabir, 2020).

The respondents consisted of construction employees at UPHSL, with a total population of 44 workers. Using the Raosoft calculator, a sample size of 40 respondents was obtained at a 95% confidence level and 5% margin of error. A purposive sampling technique was applied to select participants with at least one year of relevant experience, ensuring that only knowledgeable individuals were included in the study (Creswell, 2020).

Primary data were collected using a self-made structured questionnaire, which underwent expert validation and pilot testing to ensure clarity, relevance, and reliability. Reliability analysis using Cronbach's alpha indicated acceptable internal consistency, confirming that the instrument was suitable for data collection. The questionnaire measured hazard awareness, safety culture, and the acceptability and effectiveness of the proposed HIRA training program.

Data collection was conducted through face-to-face survey distribution, supported by interviews when necessary, with prior permission and adherence to ethical standards, including voluntary participation and confidentiality. Descriptive statistics, including frequency, percentage, and weighted mean, were used to analyze the severity and frequency of accidents, safety culture dimensions, and the level of acceptability and effectiveness of the proposed HIRA training and awareness program.

RESULTS AND DISCUSSION

I. Identified hazards

Table 1

Critical Hazards Commonly Associated with Construction Activities at the University of Perpetual Help System Laguna

Severity Level	Weighted Mean	Verbal Interpretation	Rank
1. Falls are one of the most common physical hazards in construction. (Physical hazards)	3.65	Strongly Agree	1.5
2. Noise from machinery can cause long-term hearing damage.	3.53	Strongly Agree	7.5
3. Extreme temperatures (heatstroke or hypothermia)	3.58	Strongly Agree	5
4. Exposure to hazardous substances (e.g., asbestos, lead, solvents, dust, cement)	3.48	Strongly Agree	9
5. Fumes and gases (from welding or engines)	3.63	Strongly Agree	3
6. Animal or insect bites/stings	3.53	Strongly Agree	7.5
7. Lifting heavy materials (can cause musculoskeletal	3.65	Strongly	1.5

injuries)		Agree	
8. Electrical Hazards (expose wire, Overhead power lines, Water and electricity contact)	3.58	Strongly Agree	5
9. Improper handling of flammable liquids and gases can cause fires.	3.58	Strongly Agree	5
10. Biological Hazards (exposure to molds or bacteria)	3.45	Strongly Agree	10
Average	**3.56**	**Strongly Agree**	

Table 1 presents the critical hazards associated with construction activities at the University of Perpetual Help System Laguna. The overall results show that respondents strongly agreed on the presence of these hazards, with an overall weighted mean of 3.56, interpreted as Strongly Agree.

Falls and lifting heavy materials emerged as the most critical hazards (WM = 3.65, rank 1.5), indicating high risk of physical injury from heights and manual handling. This was followed by fumes and gases from welding or engines (WM = 3.63, rank 3), reflecting concerns on respiratory and chemical exposure. Extreme temperatures, electrical hazards, and improper handling of flammable materials (WM = 3.58, rank 5) were also highly recognized, along with noise from machinery and animal or insect bites (WM = 3.53, rank 7.5).

Lower-rated but still acknowledged hazards include exposure to hazardous substances (WM = 3.48, rank 9) and biological hazards (WM = 3.45, rank 10). Overall, the results show strong awareness of both physical and environmental risks in construction settings, particularly those linked to direct injury and exposure.

The findings affirm with the study of Umer et al. (2023), which highlights that physical hazards such as falls and manual lifting remain the most prominent and highly perceived risks in construction due to their frequent occurrence and immediate injury potential.

Table 2
The Frequency and Percentage of Severity level of the Most Serious Accidents and Injuries resulting from Identified Hazards

Severity Level	Frequency (f)	Percentage (%)	Rank
1.Critical (Life-threatening or permanent disability)	2	5%	4
2.Severe (Required hospitalization)	6	15%	2
3. Moderate (Required outpatient care or clinic visit)	12	30%	1
4. Minor (First aid only, no medical attention needed)	14	35%	3
5. Negligible (No medical attention, recovered quickly)	6	15%	4
Average	40	100%	

Table 2 shows that most construction accidents were minor in severity, with 35% requiring only first aid, followed by moderate cases at 30% that needed outpatient care. Severe and negligible cases both

accounted for 15%, while critical injuries were least common at 5%, indicating that although most incidents are low to moderate, serious risks still exist. This aligns with Abdelrahim (2023), who noted that construction sites are typically dominated by low-severity but high-frequency injuries.

Table 3
The Frequency and Percentage of the Body Part Most Affected by the Accident/Injury

Body Part Affected	Frequency(f)	Percentage (%)	Rank
1. Head or Neck	6	15%	4
2. Upper Limbs (hands, arms)	12	30%	1
3. Lower Limbs (legs, feet)	10	25%	2
4. Back or Spine	7	17.50%	3
5. Internal Organs	3	7.50%	5
6. Other	2	5%	6
Total	40	100%	

Table 3 reveals that the upper limbs were the most affected body parts (30%), followed by lower limbs (25%) and back injuries (17.5%). Head/neck injuries accounted for 15%, while internal organs and other areas were least affected. This suggests that manual labor and site activities primarily expose workers to limb-related injuries. Babalola et al. (2023) emphasize that hand tools and manual tasks make upper limbs the most vulnerable in construction work

Table 2.3
Frequency, Percentage, and Rank of the Primary Cause of Accident/Injury

Primary Cause of Accident/Injury	Frequency(f)	Percentage (%)	Rank
1. Slip, trip, or fall	12	30%	1
2. Vehicular accident	6	15%	4
3. Contact with machinery/object	10	25%	2
4. Physical assault or violence	3	7.50%	6
5. Exposure to harmful substances	5	12.50%	5
6. Other	4	10%	3
Total	40	100%	

Table 2.3 shows that slips, trips, and falls were the leading cause of accidents (30%), followed by contact with machinery (25%) and other causes (10%). Vehicular accidents (15%), exposure to harmful substances (12.5%), and physical violence (7.5%) were less frequent. This indicates that most injuries are preventable and linked to unsafe working conditions. Okpala et al. (2023) found that poor site housekeeping and unsafe surfaces are the main contributors to fall-related construction injuries.

Table 4
Frequency, Percentage and Rank of the Type of Medical Treatment

Type of Medical Treatment	Frequency(f)	Percentage (%)	Rank
1. None	5	12.50%	4
2. First aid only	15	37.50%	1
3. Doctor's consultation	10	25%	2
4. Hospital admission	6	15%	3
5. Surgery or rehabilitation	4	10%	5
Total	40	100%	

Table 4 indicates that most workers received only first aid (37.5%), followed by doctor's consultation (25%) and hospital admission (15%). A smaller percentage required no treatment (12.5%), while surgery or rehabilitation was least common (10%). This shows that most injuries were minor but still required immediate response. Hallowell et al. (2023) noted that most construction injuries are low severity and can be managed through basic first aid treatment.

Table 5
Frequency, Percentage and Rank of the Type of the Recovery Time

Recovery Time	Frequency(f)	Percentage (%)	Rank
1. Less than 1 week	14	35%	1
2. 1–2 weeks	10	25%	2
3. 3–4 weeks	6	15%	3
4. 1–3 months	5	12.50%	4
5. More than 3 months	3	7.50%	5
6. Not yet fully recovered	2	5%	6
Total	40	100%	

Table 5 shows that the majority of workers recovered in less than one week (35%), followed by 1–2 weeks (25%) and 3–4 weeks (15%). Longer recovery periods of 1–3 months (12.5%) and more than 3 months (7.5%) were less common, while 5% were not fully recovered. This indicates that most injuries were short-term, but some resulted in prolonged effects. Kaskutas et al. (2023) explain that construction injuries are typically minor and allow quick return to work, although some cases lead to long-term disability.

Table 6
Summary Table of Level of Safety Culture in the Construction Environment of UPHSL

Indicators	**Weighted Mean**	**Verbal Interpretation**	**Rank**
1. Stakeholder Awareness	3.32	Very High Acceptance	3
2. Safety Compliance	3.36	Very High Acceptance	1.5

Indicators	Weighted Mean	Verbal Interpretation	Rank
3. Policy Enforcement	3.36	Very High Acceptance	1.5
4. Hazard Communication	3.29	Very High Acceptance	4
General Average	**3.33**	**Very High Acceptance**	

Table 6 presents the level of safety culture in the construction environment of UPHSL across four dimensions. The overall result shows a high level of safety culture, with a general weighted mean of 3.33 (Very High), indicating strong implementation of safety practices.

Safety Compliance and Policy Enforcement ranked highest (WM = 3.36, rank 1.5), reflecting strong adherence to safety rules and active management support. Stakeholder Awareness followed (WM = 3.32, rank 3), showing that workers are generally well-informed about safety rules and procedures. Hazard Communication ranked lowest (WM = 3.29, rank 4), indicating a need to improve open reporting and communication of hazards among workers.

Overall, UPHSL demonstrates a well-established safety culture, although strengthening hazard communication can further enhance proactive safety practices.The findings are supported by Hassan et al. (2023), who emphasize that strong safety cultures require not only compliance but also active worker participation to achieve more proactive safety management.

The proposed Management-Oriented HIRAC Training and Safety Awareness Program

I. Program Title

Management-Oriented Hazard Identification, Risk Assessment, and Control (HIRAC) Training and Safety Awareness Program for Construction Activities at UPHSL

II. Program Rationale

Construction activities at UPHSL involve various hazards such as falls from height, electrical risks, and falling objects. Despite existing safety measures, gaps in hazard awareness and risk control still exist. This program is proposed to strengthen management involvement, improve safety awareness, and standardize HIRAC practices to reduce accidents and promote a strong safety culture.

III. General Objective

To develop and implement a management- oriented HIRAC training program that enhances hazard identification, risk assessment, and control practices in construction activities at UPHSL.

IV. Specific Objectives

- The program aims to:
- Improve hazard identification skills among workers and supervisors
- Enhance risk assessment and prioritization of construction hazards
- Strengthen application of safety control measures
- Promote management accountability in safety enforcement
- Increase safety awareness and compliance on construction sites

V. Program Content / Modules

Module 1: Management Role in Construction Safety

- Leadership and safety responsibility
- Safety policies and enforcement

- Safety culture development

Module 2: Hazard Identification (HI)

- Types of construction hazards
- Unsafe acts and unsafe conditions
- Site inspection techniques

Module 3: Risk Assessment (RA)

- Risk matrix (likelihood vs severity)
- Risk classification (low, medium, high, extreme)
- Prioritization of hazards

Module 4: Risk Control (C)

- Hierarchy of controls:
- Elimination
- Substitution
- Engineering controls
- Administrative controls
- PPE

Module 5: Safety Awareness and Communication

- Reporting systems (HIRAC forms)
- Toolbox meetings
- Safety communication flow

Module 6: Emergency Preparedness

- Evacuation procedures
- Fire and accident response
- First aid awareness

Module 7: Monitoring and Evaluation

- Safety audits and inspections
- Compliance monitoring
- Post-training evaluation

VI. Training Methodology

- Lecture-discussion
- Group activities and workshops
- Case studies
- Site simulations
- Role-playing exercises
- Visual presentations (photos/videos of hazards)

VII. Program Duration

- Recommended: 1–2 days training program
- Modular weekly sessions depending on schedule availability
- VIII. Target Participants
- Construction workers

- Site engineers
- Supervisors
- Safety officers
- Project managers

IX. Expected Output

- Improved hazard awareness among workers
- Reduced construction-related accidents
- Proper implementation of HIRAC system
- Stronger safety culture at UPHSL
- Active management participation in safety enforcement

X. Evaluation Plan

- Pre-test and post-test assessment
- Participant feedback questionnaire
- Observation of safety compliance
- Weighted mean evaluation of acceptability
- Perspective of the Proposed Management-Oriented HIRAC Training

Safety Awareness Program

The HIRAC perspective of the proposed HIRAC Training Program for the University of Perpetual Help System Laguna is centered on proactive safety management. It focuses on preventing accidents before they happen through systematic hazard identification, risk assessment, and implementation of appropriate control measures.

For Construction Activities at UPHSL

1. Management Perspective

From a management standpoint, the proposed Management-Oriented HIRAC Training and Safety Awareness Program serves as a strategic tool to strengthen safety governance in construction activities at UPHSL. It emphasizes leadership accountability in enforcing safety standards, ensuring that safety policies are not only formulated but also consistently implemented.

Management views the program as essential in:

- Reducing accident-related costs and project delays
- Ensuring compliance with occupational safety standards
- Promoting a proactive safety culture within construction operations
- Improving overall project efficiency and risk control

2. Engineering and Supervisory Perspective

For engineers and site supervisors, the program provides a structured approach in identifying hazards and evaluating risks before and during construction activities. It enhances technical decision-making through standardized HIRAC procedures.

From this perspective, the program:

- Improves hazard detection during site inspection

- Supports systematic risk prioritization
- Strengthens coordination between management and field operations
- Encourages consistent application of safety control measures

3. Workers' Perspective

From the workers' point of view, the program increases awareness and understanding of workplace hazards and proper safety practices. It also empowers them to actively participate in maintaining a safe working environment.

The benefits include:

- Better understanding of site hazards and risks
- Increased confidence in reporting unsafe conditions
- Improved compliance with PPE usage and safety procedures
- Reduced exposure to preventable accidents and injuries

4. Safety Officer Perspective

For safety officers, the program provides a comprehensive framework for monitoring, documentation, and enforcement of safety protocols. It supports systematic safety management through clear procedures. This includes:

- Standardized hazard reporting and documentation (HIRAC forms)
- Easier monitoring of compliance and safety performance
- Improved coordination during inspections and audits
- Stronger implementation of emergency response procedures

5. Institutional Perspective (UPHSL)

From an institutional perspective, UPHSL benefits from a safer and more controlled construction environment. The program contributes to institutional development by promoting safety as a core value.

Key institutional gains include:

- Strengthened safety culture within the university
- Reduced liability from construction-related accidents
- Improved reputation in infrastructure safety management
- Alignment with national occupational safety standards

X. Evaluation Plan

- Pre-test and post-test assessment
- Participant feedback questionnaire
- Observation of safety compliance
- Weighted mean evaluation of acceptability

Table 7

The Level of General Acceptability of the Respondents on the Proposed HIRA Training and Awareness Program

Indicator	Weighted Mean	Verbal Interpretation	Rank
1. Respondents often find the HIRA training relevant when it directly addresses the specific hazards and risks encountered in their work environment.	3.68	Very High Acceptance	1.5

2. Respondents tend to appreciate training that is clearly structured, with easy-to-understand language and visuals.	3.55	Very High Acceptance	3
3. Training programs that incorporate hands-on exercises, case studies, simulations, and group discussions are rated more positively by participants.	3.43	Very High Acceptance	5
4. Many respondents express greater awareness of potential hazards and demonstrate improved attitudes toward safety practices after training.	3.38	Very High Acceptance	6
5. Workers value the training more when they see that management supports and enforces the principles taught in the program.	3.68	Very High Acceptance	1.5
6. Training that is scheduled during regular hours, held at accessible locations, and provided in the workers' native language is more favorably received.	3.50	Very High Acceptance	4
Average	**3.53**	**Very High Acceptance**	

Table 7 presents the level of general acceptability of the proposed HIRA Training and Awareness Program among respondents. The overall result shows a very high level of acceptability, with a weighted mean of 3.53, indicating strong support for the program's implementation.

The highest-rated indicators (WM = 3.68, rank 1.5) show that respondents strongly value training that is relevant to actual workplace hazards and supported by management enforcement. Clear and easy-to-understand training followed (WM = 3.55, rank 3), along with accessible scheduling and location (WM = 3.50, rank 4), highlighting the importance of organization and convenience. Interactive methods such as simulations and group discussions ranked next (WM = 3.43, rank 5). The lowest-rated but still very high indicator was improved safety awareness and attitudes after training (WM = 3.38, rank 6).

Overall, the results indicate strong acceptance of the HIRA program, especially when it is work-relevant, well-supported, and well-structured.The findings affirm with Nnaji et al. (2023), who emphasize that safety training is most acceptable and effective when it directly reflects the actual hazards experienced by workers in their workplace.

Conclusion and Implications

This study examined construction hazards, accident severity and frequency, safety culture, and the acceptability of the proposed HIRA Training and Awareness Program at the University of Perpetual Help System Laguna. The findings revealed that construction activities involve multiple significant hazards, particularly falls, lifting heavy materials, and exposure to harmful substances, indicating strong awareness of workplace risks but persistent safety challenges that require continuous intervention.

The results further showed that most accidents are minor to moderate in severity, primarily affecting the upper and lower limbs and caused by slips, trips, falls, and machinery contact. Although most injuries require only first aid and short recovery periods, their frequency highlights the need for stronger preventive measures and improved safety management practices.

In terms of safety culture, UPHSL demonstrated a very high level across all dimensions, including safety compliance, policy enforcement, stakeholder awareness, and hazard communication. However, hazard

communication ranked lowest, suggesting the need to strengthen reporting systems and improve worker participation in safety communication to enhance proactive safety behavior.

The study also found a very high level of acceptability for the proposed HIRA Training and Awareness Program. Respondents strongly supported training that is relevant to actual workplace hazards, management-supported, clearly structured, and accessible. Interactive and practical training methods were also well received, indicating readiness for implementation.

The findings support the importance of a structured HIRA program that integrates hazard identification, risk assessment, and control measures to improve safety practices. Strengthening training, enforcement, and communication systems can further reduce risks and promote a stronger safety culture in construction activities.

The study concludes that while UPHSL maintains a strong safety culture and high acceptance of the HIRA program, continued improvement in hazard communication and structured safety training is essential. The proposed HIRA program has strong potential to enhance hazard awareness, reduce construction-related risks, and promote a more proactive and sustainable safety environment when fully implemented and supported by management.

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