i-SPiKE 2023

INTERNATIONAL EXHIBITION & SYMPOSIUM ON PRODUCTIVITY, INNOVATION, KNOWLEDGE & EDUCATION

"Optimizing Innovation in Knowledge, Education and Design"

EXTENDED ABSTRACT

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"Optimizing Innovation in Knowledge, Education and Design"

EXTENDED ABSTRACT

Editors : Dr. Siti Norfazlina Yusoff
Azni Syafena Andin Salamat
Nurfaznim Shuib

Cover design : Syahrini Shawalludin
Layout : Syahrini Shawalludin

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Assalamualaikum warahmatullahi wabarakatuh,

First and foremost, I would like to express my gratitude to the organizing committee of i-Spike 2023 for their tremendous efforts in bringing this online competition a reality . I must extend my congratulations to the committee for successfully delivering on their promise to make i-Spike 2023 a meaningful event for academics worldwide.

The theme for this event, 'Optimizing Innovation in Knowledge, Education, and Design,' is both timely and highly relevant in today's world, especially at the tertiary level. Innovation plays a central role in our daily lives, offering new solutions for products, processes, and services By adopting a strategic approach to 'Optimizing Innovation in Knowledge, Education, and Design,' we have the potential to enhance support for learners and educators, while also expanding opportunities for learner engagement, interactivity, and access to education.

I am awed by the magnitude and multitude of participants in this competition. I am also confident that all the innovations presented have provided valuable insights into the significance of innovative and advanced teaching materials in promoting sustainable development for the betterment of teaching and learning. Hopefully, this will mark the beginning of a long series of i-Spike events in the future.

It is also my hope that you find i-Spike 2023 to be an excellent platform for learning, sharing, and collaboration. Once again, I want to thank all the committee members of i-Spike 2023 for their hard work in making this event a reality I would also like to extend my congratulations to all the winners, and I hope that each of you will successfully achieve your intended goals through your participation in this competition.

Professor Dr. Roshima Haji Said
RECTOR
UiTM KEDAH BRANCH

WELCOME MESSAGE (i-SPiKE 2023 CHAIR)

We are looking forward to welcoming you to the 3rd International Exhibition & Symposium on Productivity, Innovation, Knowledge, and Education 2023 (i-SPiKE 2023). Your presence here is a clear, crystal-clear testimony to the importance you place on the research and innovation arena. The theme of this year's Innovation is "*Optimizing Innovation in Knowledge, Education, & Design*". We believe that the presentations by the distinguished innovators will contribute immensely to a deeper understanding of the current issues in relation to the theme.

i-SPiKE 2023 offers a platform for nurturing the next generation of innovators and fostering cutting-edge innovations at the crossroads of collaboration, creativity, and enthusiasm. We enthusiastically welcome junior and young inventors from schools and universities, as well as local and foreign academicians and industry professionals, to showcase their innovative products and engage in knowledge sharing. All submissions have been rigorously evaluated by expert juries comprising professionals from both industry and academia.

On behalf of the conference organisers, I would like to extend our sincere thanks for your participation, and we hope you enjoy the event. A special note of appreciation goes out to all the committee members of i-SPiKE 2023; your dedication and hard work are greatly appreciated.

Dr. Junaida Ismail
Chair
3rdInternational Exhibition & Symposium Productivity, Innovation, Knowledge, and Education 2023 (i-SPiKE 2023)

DEVELOPMENT OF REPORTING SYSTEM FOR UNSAFE ACTIONS AND UNSAFE CONDITIONS

Ahmad Saiful Ahmad Suhaimi
Mechanical Engineering Studies College of Engineering
Universiti Teknologi MARA Penang Branch
2020483882@student.uitm.edu.my

Aznifa Mahyam Zaharudin
Mechanical Engineering Studies College of Engineering
Universiti Teknologi MARA Penang Branch
aznifa@uitm.edu.my

ABSTRACT

Incidents in the workplace were the result of unsafe actions and unsafe conditions in working environments. It led to injuries or severe damage. In most cases, reports were made after an accident had already taken place. This study focused primarily on pre-accident conditions. The development of the reporting system involved utilizing Kodular in developing a mobile app as the reporting platform. The app integrated with SQL database to securely store and manage the reported data. The self-report was required to be submitted online for any non-occurrence that involved an unsatisfactory condition, behavior, or procedure which did not immediately endanger individuals, but if left uncorrected or repeated in other foreseeable circumstances, would have posed a hazard. Data extracted from the database was visualized in the HazAware Analytics Dashboard, utilizing Microsoft Power BI to present insights through engaging infographics. This research was significant as it established strategies for preventing workplace incidents and raised public awareness.

Keywords: Incidents, unsafe actions, unsafe conditions

INTRODUCTION

Workplace safety is of paramount concern in industrial settings, where incidents resulting from unsafe actions and conditions can lead to severe injuries and damage. The occurrence of unsafe actions refers to situations where individuals are aware of hazardous conditions or actions but choose to proceed or disregard them. Such behaviors may involve workers taking shortcuts to savetime or effort. On the other hand, unsafe conditions encompass hazards with the potential to cause harm, often arising from improper safety procedures or multifunctional equipment [1]. Additionally,near-miss incidents, which may lead to injuries or harm, are sometimes overlooked due to their unpredictability and occasional lack of recognition as potential accidents.

Herbert W. Heinrich, a prominent representative from the Travelers Insurance Company, hasmade significant contributions to accident prevention and industrial safety [2][10]. His comprehensive analysis of 75,000 industrial accidents in the late 1920s revealed that 88 percent ofincidents were attributed to unsafe actions taken by co-workers, 10 percent were caused by unsafe conditions, and 2 percent were considered unavoidable. Heinrich's research laid the foundation forthe Axioms of Industrial Safety and his domino theory of accident causation. While modern research has challenged certain aspects of his theory, it

remains important for students of industrialsafety to be familiar with his work, as many contemporary ideas in the field can be traced back to his contributions.

In recent years, there has been a shift in safety management approaches, emphasizing the significance of near-miss management and accident precursor analysis for effective risk prevention[1][3][4]. Safety awareness plays a pivotal role in minimizing safety-related risks, with every individual within the workplace bearing the responsibility for safety, regardless of their role. Adherence to safety procedures is crucial for establishing a secure work environment and preventing or mitigating hazards.

The ever-increasing complexity and volume of data generated by industrial processes have posed challenges to conventional reporting methods [8]. In response, innovative technologies suchas the Internet of Things (IoT) and big data analytics have been harnessed to revolutionize data collection, processing, and visualization [8]. The incorporation of IoT devices enables reporting systems to gather real-time data streams, facilitating seamless and continuous data collection and analysis [8].

Big data analytics has played a transformative role in processing and analyzing large and intricate datasets, extracting valuable insights, patterns, and trends [8]. This data-driven approach empowers decision-makers to optimize processes, predict maintenance needs, and identify opportunities for further operational improvements [8]. Relying on objective data analysis allows organizations to enhance resource allocation, streamline processes, and drive efficiency across various aspects of their operations.

Workplace safety is crucial in industrial settings, where incidents from unsafe actions and conditions risk workers and infrastructure. Incident reporting systems are pivotal in identifying andmitigating hazards. Herbert W. Heinrich's contributions and domino theory influence accident understanding [11]. Near-miss management and safety awareness are vital for risk prevention. Integrating IoT devices and big data analytics enhances reporting systems, promoting data-driven decisions and industrial efficiency [8]. Utilizing innovative technologies optimizes safety measures,enhancing workplace safety and success.

Therefore, this project aims to investigate and analyze workplace safety by focusing on potential unsafe conditions and actions. By identifying patterns and factors related to incidents, thestudy intends to enhance our understanding of the contributing factors behind workplace accidents.The research emphasizes the significance of addressing hazards and promoting reporting mechanisms in safety regulations and codes to mitigate risks effectively.

METHODOLOGY

Hazard classification was conducted to assess and categorize the potential risks associated with the substances or materials. This process involved evaluating the properties, characteristics, and potential dangers associated with specific substances or materials, enabling systematic categorization and prioritization of risks [5]. The classification included mechanical hazards, electrical hazard, chemical hazard, ergonomic hazard, noise hazard, and indoor air quality.

The report questions were designed to gather both qualitative and quantitative data to provide a comprehensive understanding of the study. The questions were structured in a way that allowed for systematic data collection and analysis.

App Development

Mobile applications have emerged as valuable tools for incident reporting in various industries, including safety management. These applications provide a convenient and efficient platform for workers to report incidents, hazards, and near-miss events, thereby contributing to proactive safety measures and risk reduction [6]. The use of mobile applications enables real-time reporting, enhances data accuracy, and improves the overall accessibility and effectiveness of incident reporting systems [6]. By utilizing mobile applications, organizations can streamline the reporting process, facilitate timely communication, and collect valuable data for incident analysis and preventive measures.

The app development process involved the actual development of the reporting app using theKodular App Inventor. This phase encompassed the utilization of the interface, the app's structure andlayout are designed by arranging components such as buttons, text fields, and lists on the screen. User Interface (UI) Design, which was responsible for designing the visual elements and layout ofthe user interface. It involved selecting and arranging elements to create a visually cohesive and aesthetically pleasing interface. Additionally, User Experience (UX) Design was considered such as information architecture, user flows, interaction design, and usability testing to ensure ease of navigation, understanding, and interaction with the system. The need for effective reporting systems arises from the understanding that identifying and addressing unsafe actions and conditions in a timely manner is paramount to mitigating potential accidents and ensuring a safe working environment [13].

Data Collection and Analysis

The collected data was analyzed in infographics dashboard created with Microsoft Power BI. Microsoft Power BI is a powerful data visualization and analysis tool that allows for interactive and insightful reporting. This study aimed to investigate safety compliance behavior and identify the factors influencing safety compliance in a workplace environment [7][12].

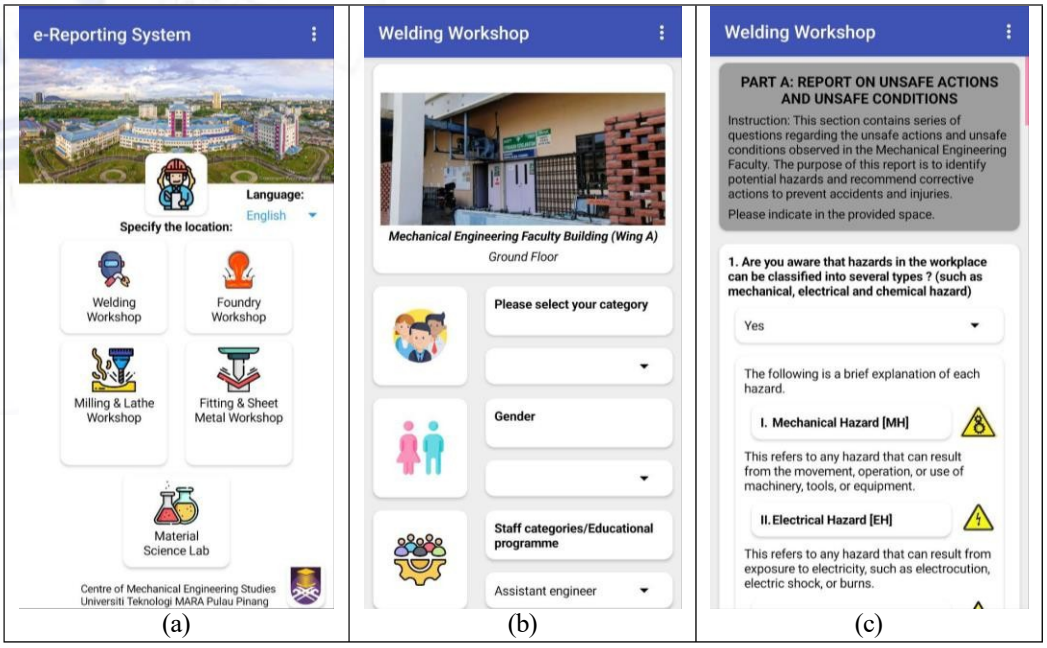
The data analysis utilized various statistical techniques, including factor analysis and regression analysis. This process enabled the researchers to group related variables and simplify the dataset, leading to a more manageable and interpretable analysis [7][9]. Furthermore, regression analysis was used to determine the relationships between safety compliance behavior and the identified factors [7].

RESULTS AND DISCUSSION

The development and deployment of the HazAware self-reporting system resulted in positive outcomes. The system improved incident reporting accuracy and accessibility through mobile applications and IoT integration. Data analytics tools facilitated safety analysis and hazard correlation on unsafe actions and conditions. Key features such as user-friendly interfaces and integration with data analytics contributed to its effectiveness, although challenges such as underreporting and technological limitations need to be addressed.

HazAware Self Reporting System

Figure 1 illustrates the HazAware User Interface, consisting of three integral components: (a) MainPage, (b) Demographic Information, and (c) Report on Unsafe Actions and Unsafe Conditions. TheMain Page offers a user-friendly entry point, facilitating smooth navigation for respondents. In theDemographic Information section, essential data on participants' category, gender, profession background, and educational status are collected, enriching the survey with valuable demographic insights.



(a) (b) (c)

Figure 1: HazAware User Interface (a) Main Page. (b) Demographic Information. (c) Report on UnsafeActions and Unsafe Conditions.

The Report on Unsafe Actions and Unsafe Conditions is a critical element, capturing data on workplace safety and hazard awareness. Participants are prompted to report on factors contributingto unsafe conditions and actions, providing essential insights into potential accident causes and hazard awareness levels. The HazAware User Interface efficiently gathers comprehensive data, empowering the formulation of proactive safety measures and promoting a culture of hazard prevention across diverse study areas.

HazAware Analytics Dashboard

The analysis of Figure 2, presented as the HazAware Analytics Dashboard, offers valuable insightsderived from data collected over five cycles, each lasting one week. A total of 265 participants wereengaged in HazAware Self Reporting System, distributed across various workshops and labs.

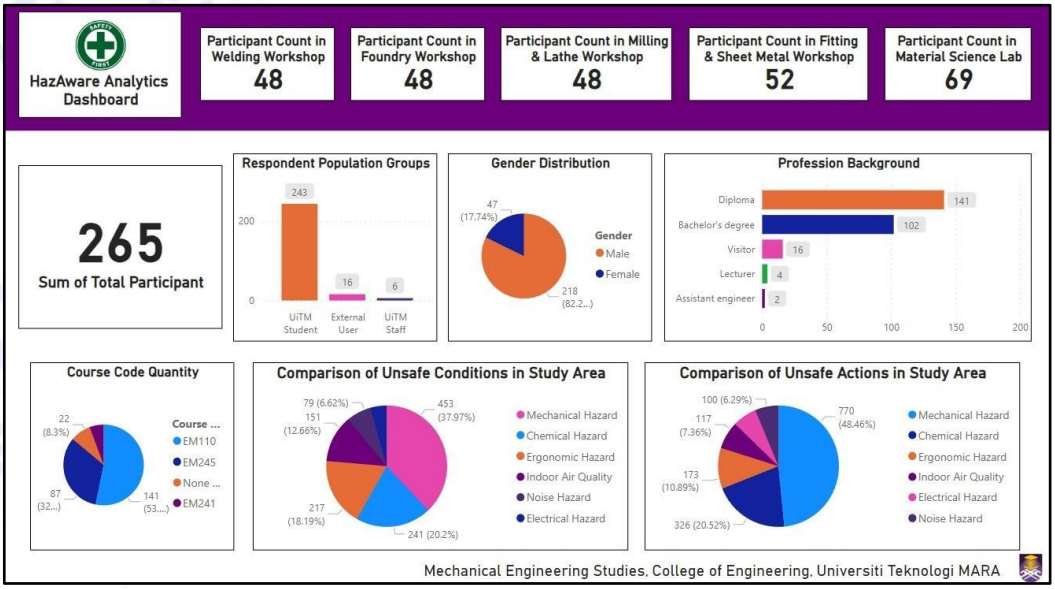


Figure 2: HazAware Analytics Dashboard

The dashboard presented a comprehensive safety perspective by comparing the occurrences of unsafe conditions and unsafe actions in the study area. From a safety standpoint, the data revealssignificant insights. Unsafe conditions related to mechanical hazards are the most prevalent, with a total of 453 reported cases, warranting focused attention to address potential mechanical risks. Chemical hazards follow closely, with 241 reported cases, indicating the need for stringent safety measures when dealing with hazardous substances.

Furthermore, ergonomic hazards account for 217 reported cases, highlighting the importanceof ergonomics in minimizing workplace injuries. Concerns related to indoor air quality aresignificant, with 151 reported cases, emphasizing the importance of ensuring a healthy work environment. Moreover, noise hazards and electrical hazards are also notable, with 79 and 52 reported cases, respectively, stressing the need for noise control measures and electrical safety protocols. In terms of unsafe actions, the study area reports a total of 770 cases related to mechanical hazards, raising awareness of unsafe practices in mechanical tasks. Chemical hazards are once againprominent, with 326 reported cases of unsafe actions.

Additionally, ergonomic hazards account for 173 reported cases, underscoring the significance of promoting ergonomic practices to reduce workplace injuries. Moreover, 117 reported cases are attributed to unsafe actions concerning indoor air quality, necessitating measuresto enhance indoor air conditions. Noise hazards and electrical hazards record 100 and 103 reported cases, respectively, highlighting the importance of addressing noise exposure and electrical safety procedures. Hazard identification aims to identify all potential hazards, categorizing them based on workplace activities, equipment, and job functions [12]. By breaking down processes into manageable nodes and analyzing each node individually, potential risks can be identified. It is essential to document and record all identified hazards, regardless of their severity.

The pie charts of Figure 3 revealed valuable safety perspectives on the comparison of unsafe conditions and unsafe actions resulting from mechanical hazards in various workshops and the Material Science Lab. Figure 3 highlighted the prevalence of unsafe conditions related to mechanical hazards in each workshop and the lab, with the Welding Workshop exhibiting the highest reported cases, followed by the Foundry Workshop, Milling & Lathe

Workshop, Fitting &Sheet Metal Workshop, and the Material Science Lab. This emphasized the need for targeted safetymeasures and protocols in these areas to address specific mechanical risks and promote a safer working environment.

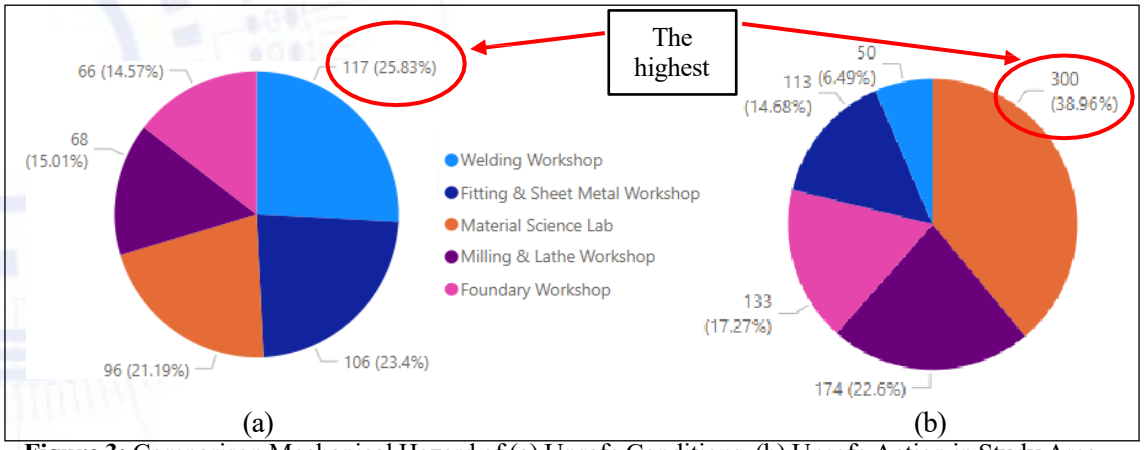


Figure 3: Comparison Mechanical Hazard of (a) Unsafe Conditions. (b) Unsafe Action in Study Area.

On the other hand, the data emphasizes the significance of unsafe actions in the Material Science Lab, with the highest reported cases, followed by the Milling & Lathe Workshop, Fitting & Sheet Metal Workshop, Foundry Workshop, and Welding Workshop. This highlights theimportance of safety training and vigilance to prevent unsafe practices and enhance safety culture,particularly in laboratory settings and machining operations. The analysis of this Figure offers valuable insights to safety professionals, aiding in the formulation of effective safety strategies, interventions, and preventive measures to mitigate mechanical hazards and foster a culture of hazardawareness and prevention in the study area.

Figure 4 offered crucial safety insights into the comparison of unsafe actions and conditions in the Welding Workshop, shedding light on potential hazards and risk factors. Regarding unsafe actions, the Welding Workshop reported 50 instances of mechanical hazards, 42 instances of indoorair quality concerns, 78 instances of ergonomic hazards, 66 instances of chemical hazards, and 25 instances of inadequate personal protective equipment usage. This emphasized the need for reinforcing safety protocols and promoting proper use of personal protective equipment to minimizeunsafe actions in welding operations.

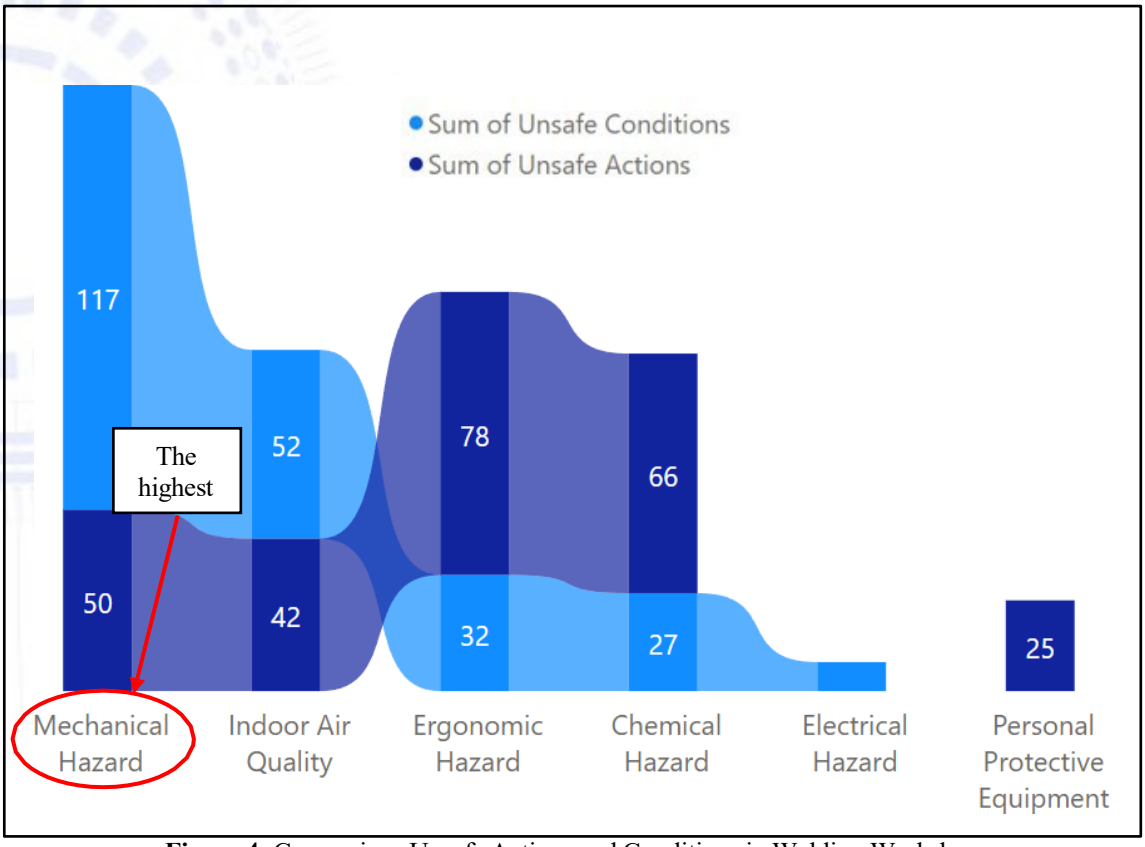


Figure 4: Comparison Unsafe Actions and Conditions in Welding Workshop

In terms of unsafe conditions, the Welding Workshop recorded 117 cases of mechanical hazards, 52 cases of indoor air quality issues, 32 cases of ergonomic hazards, 27 cases of chemical hazards, and 8 cases of electrical hazards. This highlighted the importance of addressing mechanicalhazards and indoor air quality concerns, as they emerged as significant contributors to unsafe conditions in the workshop.

The identified factors contributing to unsafe actions and conditions further elucidated potential risks. Ergonomic hazards were associated with distractions, proximity to flammable materials, and poor working conditions. Mechanical hazards were linked to inadequate lighting andobstructed views, while chemical hazards were related to improper storage and proximity to flammable materials. Poor indoor air quality resulted from inadequate ventilation and exhaust systems, leading to potential inhalation of toxic fumes and gases during welding operations.

This analysis underscored the necessity of targeted safety measures, including improved ventilation, proper storage of flammable materials, and adherence to ergonomic guidelines to enhance safety in the Welding Workshop. By addressing these unsafe actions and conditions, safety professionals could foster a safer working environment, reduce the likelihood of accidents, and promote a culture of hazard awareness and prevention in welding operations.

CONCLUSION

In conclusion, this study aimed to address workplace safety by developing a system for self- reporting unsafe actions and conditions and creating an infographic report based on the collected data. The objectives of the study were successfully achieved, leading to valuable insights into safetyissues in the study area. By adopting a proactive approach to reporting and analyzing pre-accident conditions, the HazAware Self Reporting System was developed using Kodular to create a mobileapp.

The HazAware Analytics Dashboard visualized the data, revealing essential safety perspectives. From the findings, mechanical hazards emerged as the most prevalent unsafe conditions, warranting attention in addressing potential risks. Chemical hazards, ergonomic hazards, indoor air quality concerns, noise hazards, and electrical hazards were also significant contributors to unsafe conditions. Additionally, unsafe actions related to mechanical and chemical hazards werenotable in the study area.

By comparing the safety issues across the workshops and labs, it becomes evident that certain aspects, such as PPE usage, equipment maintenance, and hazardous material handling, require attention and improvement throughout the study area. Overall, the HazAware Self Reporting System and the HazAware Analytics Dashboard offer valuable tools for identifying, reporting, and mitigating workplace hazards, fostering a safer work environment, and raising public awareness. The development of a reporting system for unsafe actions and unsafe conditions in the workplace benefited not only the workers but also the entire community. These proactive strategies for preventing workplace incidents are vital in enhancing safety practices and promoting a culture of hazard awareness and prevention within the study area and beyond.

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