Safety Engineering Practices for Welders in Cabanatuan City, Nueva Ecija: A Study for Enhancing Occupational Safety Standards

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Abstract-Welding is a high-risk occupation that exposes workers to various hazards, including toxic fumes, ultraviolet radiation, high temperatures, and electrical injuries. This study investigates the safety engineering practices of welders in Cabanatuan City, Nueva Ecija, to assess their knowledge, attitudes, and compliance with occupational safety standards. The research addresses the ongoing issue of inadequate safety measures, particularly in small-scale workshops with limited resources. Utilizing a descriptive quantitative design, the study involved 50 welder participants selected through purposive sampling. Data were collected using a structured questionnaire based on a Likert scale, which validated through workplace was observations. Statistical analysis, including frequency, percentage, mean, and weighted average, was conducted to evaluate responses. Welding is a high-risk profession that exposes workers to hazards such as toxic fumes, ultraviolet radiation, high temperatures, and electrical injuries. This study investigates the safety practices of welders in Cabanatuan City, Nueva Ecija, assessing their knowledge, attitudes, and adherence to occupational safety standards. The research addresses inadequate safety measures, particularly in small-scale workshops with limited resources. Employing a descriptive quantitative design, the study included 50 welder participants selected through purposive sampling. Data were gathered using a structured Likert-scale questionnaire, validated through workplace observations. Descriptive statistical analysis involved frequency, percentage, mean, and weighted average to evaluate responses. Results

showed that while welders recognize the importance of personal protective equipment (PPE) and hazard awareness, compliance is often hindered by insufficient training, limited access to proper gear, and weak enforcement of safety rules. The study concludes that targeted interventions, such as localized training programs, regular safety audits, and improved collaboration with the Philippine Welding Society (PWS) and the Department of Labor and Employment (DOLE), are crucial. Recommendations include ongoing safety education and better resource allocation to enhance workplace safety and reduce occupational hazards among welders.

Indexed Terms- Welding Safety, Occupational Hazards, PPE Compliance, Safety Practices, Cabanatuan City

I. INTRODUCTION

Welding is widely recognized as a hazardous occupation due to the range of physical, chemical, and ergonomic risks involved. According to Jones and Smith [1], welders are routinely exposed to toxic fumes, intense heat, ultraviolet (UV) radiation, and the possibility of severe injuries such as burns and eye damage.

Prolonged exposure to these hazards may result in chronic respiratory diseases like asthma and pneumoconiosis, as well as acute conditions such as "welder's flash" [2]. In response to these risks, global

organizations including the American Welding Society (AWS), Occupational Safety and Health Administration (OSHA), and the International Organization for Standardization (ISO) have established comprehensive safety guidelines. OSHA mandates the implementation of workplace controls such as proper ventilation systems, protective gear, and regular equipment maintenance [3]. These protocols align with ISO 45001, which emphasizes proactive risk management, continuous employee training, and preventive measures in high-risk professions [4].

In the Philippine setting, the Department of Labor and Employment (DOLE) enforces similar regulations through the Occupational Safety and Health Standards (OSHS) Act. However, Gonzales and Cruz [5] noted that small-scale welding shops, especially in provincial areas, struggle to comply due to limited financial and technical resources. Many workers lack access to proper personal protective equipment (PPE) or adequate training programs [6].

Given these local and global concerns, this study investigates the safety engineering practices among welders in Cabanatuan City, Nueva Ecija. It aims to evaluate their compliance with PPE protocols, awareness of occupational hazards, and the implementation of safety measures. The findings seek to inform policy recommendations and encourage collaborative efforts with the Philippine Welding Society (PWS) and DOLE to strengthen occupational safety standards in provincial welding industries.

Utilizing a descriptive quantitative design, the study involved 50 welder participants selected through purposive sampling. Data were collected using a structured questionnaire based on a Likert scale, which was validated through workplace observations. Statistical analysis, including frequency, percentage, mean, and weighted average, was conducted to evaluate responses.

Welding is a high-risk profession that exposes workers to hazards such as toxic fumes, ultraviolet radiation, high temperatures, and electrical injuries. This study investigates the safety practices of welders in Cabanatuan City, Nueva Ecija, assessing their knowledge, attitudes, and adherence to occupational safety standards. The research addresses inadequate safety measures, particularly in small-scale workshops with limited resources.

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"It found that while Personal Protective Equipment (PPE) use and traffic management were properly implemented, visibility of warning signs, especially at night, was often inadequate. These findings underscore the importance of effective signage and safety protocols in construction zones, aligning with your research's focus on enhancing occupational safety standards for welders in Cabanatuan City" Ignacio, J., Santos, E., Socorro, P., Florencondia, N., Pascual, L., & Subia, G. (2019).

Results showed that while welders recognize the importance of personal protective equipment (PPE) and hazard awareness, compliance is often hindered by insufficient training, limited access to proper gear, and weak enforcement of safety rules. The study concludes that targeted interventions, such as localized training programs, regular safety audits, and improved collaboration with the Philippine Welding Society (PWS) and the Department of Labor and Employment (DOLE), are crucial. Recommendations include ongoing safety education and better resource allocation to enhance workplace safety and reduce occupational hazards among welders.

1.2 Objective of the Study

General Objective

To assess the safety engineering practices of welders in Cabanatuan City, Nueva Ecija, and explore potential collaborations with the Philippine Welding Society and DOLE to improve occupational safety standards.

Specific Objectives:

A. To identify common safety hazards faced by welders in Cabanatuan City.

B. To evaluate the current knowledge, attitudes, and practices (KAP) of welders regarding safety protocols.

C. To assess the adequacy and effectiveness of existing safety measures and personal protective equipment (PPE) used by welders.

D. To develop recommendations for improved safety practices in collaboration with the Philippine Welding Society and DOLE.

1.3 Significance of the Study

The significance of this study lies in its potential to enhance the safety and well-being of welders in Cabanatuan City. It provides valuable insights into the real-world challenges faced by workers in implementing occupational safety standards. By assessing the extent of compliance with safety protocols and identifying the limitations in current practices, the research offers evidence-based recommendations for improving safety training, resource distribution, and regulatory enforcement.

This study also serves as a resource for local government units, labor agencies, and industry organizations like the Philippine Welding Society. It can inform the development of targeted training programs, localized safety campaigns, and collaborative efforts aimed at promoting a culture of safety in small to medium-scale welding operations.

II. METHODOLOGY

2.1 Research Design

This study employs a descriptive quantitative research design, which is appropriate for obtaining an accurate profile of current safety engineering practices among welders. The goal is to systematically collect and analyze numerical data related to knowledge, attitudes, and behaviors concerning occupational safety. Through this design, the study seeks to identify patterns and gaps in the use of personal protective equipment (PPE), compliance with safety protocols, and the prevalence of occupational hazards, without manipulating the study environment.

2.2 Research Locale

The research will be conducted in Cabanatuan City, Nueva Ecija, a growing urban center in Central Luzon where a significant number of welding operations are carried out in both formal and informal settings. The choice of location is strategic due to the city's active construction, automotive, and fabrication sectors, where welding is a commonly practiced trade.

2.3 Population and Sampling

The study population includes welders currently employed in Cabanatuan City, whether as part of registered establishments or operating independently in local communities. To ensure relevance and data reliability, purposive sampling will be used to select respondents who have at least one year of welding experience, as they are more likely to be exposed to safety practices and workplace hazards. A sample size of 50 welders will be targeted, sufficient to draw meaningful insights while remaining feasible for detailed data collection and analysis within the study's scope and timeframe.

2.4 Data Collection Method

2.4.1 Survey Questionnaire

A structured and researcher-made survey questionnaire will be distributed to the selected respondents. The instrument will consist of both closed-ended and scaled questions designed to assess the welders' knowledge of occupational safety measures, attitudes toward safety compliance, frequency and consistency in using PPE, and history of workplace-related injuries or near misses. The survey will be validated through expert review and pilot testing to ensure clarity, reliability, and relevance to the study objectives.

2.4.2 Workplace Observation

To supplement and verify the data collected through the survey, the researchers will conduct on-site observations using a standardized checklist. This checklist will include key indicators such as the presence and proper use of PPE (e.g., helmets, gloves, goggles), visible safety signage, fire extinguishing equipment, first-aid kits, and other safety measures. The observation aims to objectively assess the actual implementation of safety practices and identify discrepancies between reported and observed behaviors.

2.4.3 Interviews

Semi-structured interviews will be conducted with selected welders, supervisors, and shop owners to gain deeper insights into real-world safety challenges and areas for improvement. This flexible format allows participants to share their experiences with PPE usage, training, and safety incidents, as well as their awareness of DOLE and PWS standards. Responses will be thematically analyzed to supplement survey data and provide context-driven recommendations for enhancing safety practices.

2.5 Data Analysis

Quantitative data gathered from the survey questionnaires will be analyzed using descriptive statistics, including frequencies, percentages, and mean scores. This will provide a clear overview of prevailing safety practices, levels of compliance, and areas needing improvement. Observation data will be synthesized to support or contrast survey findings, enhancing the validity of the conclusions drawn from the research.

2.6 Ethical Considerations

This study upholds ethical standards in the conduct of research involving human participants. Informed consent will be obtained from all respondents after explaining the nature, purpose, and voluntary nature of participation. Participants will be assured of the confidentiality and anonymity of their responses. No personally identifiable information will be published, and data will be used exclusively for academic and policy development purposes. The researchers will also seek approval from relevant institutional and local authorities prior to data collection.

III. RESULTS AND DISCUSSION

This portion of the study shows the analysis and interpretation of the gathered data from the group of respondents.



Figure 1.

The most represented age group is 20–24 years old with 13 respondents (23.64%), showing that a large portion of respondents are young adults, likely early in their welding careers. This is followed by the 30–34 age group with 11 respondents (20%). There is a gradual decline in the number of respondents as age increases, which may suggest fewer older welders participated or that the profession is attracting younger workers more actively.



Figure 2.

The majority of respondents are male, with 49 out of 55 respondents (89.09%), which reflects the maledominated nature of the welding industry. Female respondents account for only 6 individuals (10.91%), indicating a low representation of women in the welding field within the surveyed population.





The largest group of respondents (17 individuals or 30.91%) has 1 to 3 years of welding experience, indicating many are still early in their careers. The 4 to 6 years category closely follows, with 16 respondents (29.09%), showing a significant number of welders with intermediate experience. Only 6 respondents each (10.91%) reported over 11 years of experience, reflecting fewer long-term professionals in the sample.



Figure 4.

The majority of respondents completed TESDA Welding Courses, with 20 individuals (36.36%) indicating this as part of their highest educational background. This suggests a strong inclination toward skills-based and technical training specific to welding, which is highly relevant to their field of work. 19 respondents (34.55%) reported being high school graduates, and another 19 (34.55%) indicated completion of a vocational course. These findings imply that many welders enter the workforce with secondary education and pursue vocational skills training, aligning with the industry's preference for practical, hands-on competencies. A smaller portion, 7 respondents (12.73%), were college graduates, which shows that a few individuals advanced to higher education levels, potentially for supervisory or managerial roles in the welding or engineering field. respondents (5.45%)reported 3 elementary graduation as their highest level of education, reflecting a minor segment of the population that may have entered the trade at a younger age or with limited formal schooling.





The data for highest educational attainment shows the following distribution: for those who are self-employed, 24 individuals (40%) have reached this level. Among those employed in the private sector, 22 individuals (36.67%) fall under this category. One individual (1.67%) is employed in the government sector, and 10 individuals (16.67%) are freelancers.





For the usage of a welding helmet with UV/IR filter, 1 respondent (1.82%) answered "Never," 5 respondents (9.09%) answered "Rarely," 10 respondents (18.18%) answered "Sometimes," 14 respondents (25.45%) answered "Often," and 25 respondents (45.45%) answered "Always."



For the usage of welding gloves made of leather or fire-resistant material, 3 respondents (5.45%) answered "Never," 6 respondents (10.91%) answered "Rarely," 14 respondents (25.45%) answered "Sometimes," another 14 respondents (25.45%) answered "Often," and 18 respondents (32.73%) answered "Always."





For the usage of welding aprons made of leather or fire-resistant material, 10 respondents (18.18%) answered "Never," 14 respondents (25.45%) answered "Rarely," 11 respondents (20.00%) answered "Sometimes," 10 respondents (18.18%) answered "Often," and 10 respondents (18.18%) answered "Always."



Figure 8.

For the usage of safety boots with steel-toe protection, 10 respondents (18.18%)answered "Never," 11 respondents (20.00%)answered "Rarely," respondents (25.45%)14 answered "Sometimes," 12 respondents (21.82%) answered "Often," and 8 respondents (14.55%) answered "Always."





For the usage of safety goggles, 1 respondent (1.82%) answered "Never," 12 respondents (21.82%)

answered "Rarely," 9 respondents (16.36%) answered "Sometimes," another 9 respondents (16.36%) answered "Often," and 19 respondents (34.55%) answered "Always."





For the usage of respiratory protection such as a welding fume respirator, 14 respondents (25.45%) answered "Never," 15 respondents (27.27%) answered "Rarely," 10 respondents (18.18%) answered "Sometimes," 6 respondents (10.91%) answered "Often," and 10 respondents (18.18%) answered "Always."





For the usage of hearing protection, 15 respondents (27.27%) answered "Never," 13 respondents (23.64%) answered "Rarely," another 13 respondents (23.64%) answered "Sometimes," 6 respondents (10.91%) answered "Often," and 8 respondents (14.55%) answered "Always."





Regarding knowledge of Basic Occupational Safety and Health (BOSH) principles, 2 respondents (3.64%) answered "Never," 4 respondents (7.27%) answered "Rarely," 16 respondents (29.09%) answered "Sometimes," 19 respondents (34.55%) answered "Often," and 14 respondents (25.45%) answered "Always."



Figure 13.

Regarding understanding of electrical hazards and grounding techniques in welding, 1 respondent (1.82%) answered "Never," 4 respondents (7.27%) answered "Rarely," 9 respondents (16.36%) answered "Sometimes," 20 respondents (36.36%) answered "Often," and 21 respondents (38.18%) answered "Always."



Figure 14.

Regarding knowledge of fire prevention and control procedures for welding areas, 1 respondent (1.82%) answered "Never," 5 respondents (9.09%) answered "Rarely," 19 respondents (34.55%) answered "Sometimes," 13 respondents (23.64%) answered "Often," and 17 respondents (30.91%) answered "Always."





Figure 15.

Regarding ensuring proper ventilation when welding indoors or in confined spaces, 1 respondent (1.82%) answered "Never," 4 respondents (7.27%) answered "Rarely," 16 respondents (29.09%) answered "Sometimes," another 16 respondents (29.09%) answered "Often," and 18 respondents (32.73%) answered "Always."







Regarding regularly inspecting tools and equipment before starting work, 2 respondents (3.64%) answered "Never," 5 respondents (9.09%) answered "Rarely," 17 respondents (30.91%) answered "Sometimes," 10 respondents (18.18%) answered "Often," and 21 respondents (38.18%) answered "Always."





Regarding strictly following welding safety protocols and procedures, 3 respondents (5.45%) answered "Never," 5 respondents (9.09%) answered "Rarely," 17 respondents (30.91%) answered "Sometimes," 12 respondents (21.82%) answered "Often," and 18 respondents (32.73%) answered "Always."



Figure 18.

Regarding awareness of DOLE and PWS regulations on welding safety, 1 respondent (1.82%) answered "Never," 10 respondents (18.18%) answered "Rarely," 18 respondents (32.73%) answered "Sometimes," 10 respondents (18.18%) answered "Often," and 16 respondents (29.09%) answered "Always."

I have attended formal safety training related to welding. 55 responses 16 (32.7%) 12 (21.6%) 2 (3.6%) 1 2 3 4 5



Regarding attending formal safety training related to welding, 2 respondents (3.64%) answered "Never," 12 respondents (21.82%) answered "Rarely," 18 respondents (32.73%) answered "Sometimes," 8 respondents (14.55%) answered "Often," and 15 respondents (27.27%) answered "Always."





Figure 20.

answered "Rarely," 14 respondents (25.45%) answered "Sometimes," 14 respondents (25.45%) answered "Often," and 14 respondents (25.45%) answered "Always."





Regarding employer support for safety training and compliance with safety standards, 2 respondents (3.64%) answered "Never," 9 respondents (16.36%) answered "Rarely," 14 respondents (25.45%) answered "Sometimes," 17 respondents (30.91%) answered "Often," and 13 respondents (23.64%) answered "Always."







Regarding the belief that safety seminars and refreshers should be conducted regularly, 1 respondent (1.82%) answered "Never," 7 respondents (12.73%) answered "Rarely," 8 respondents (14.55%) answered "Sometimes," 14 respondents (25.45%) answered "Often," and 25 respondents (45.45%) answered "Always."

There is adequate support and supervision in our workplace for safe welding practices. 55 responses





Regarding the adequacy of support and supervision in the workplace for safe welding practices, 2 respondents (3.64%) answered "Never," 13 respondents (23.64%) answered "Rarely," 14 respondents (25.45%) answered "Sometimes," 11 respondents (20.00%) answered "Often," and 15 respondents (27.27%) answered "Always."



Figure 23.

Regarding whether government and industry organizations provide sufficient guidance and support to improve welding safety, 6 respondents (10.91%) answered "Never," 7 respondents (12.73%) answered "Rarely," 11 respondents (20.00%) answered "Sometimes," 15 respondents (27.27%) answered "Often," and 16 respondents (29.09%) answered "Always."



Figure 24.

Workplace Safety Observation Results

The workplace safety inspection conducted across four welding fabrication sites in Cabanatuan City shows moderate compliance with standard safety practices. Among the categories assessed, *Equipment and Tools* received the highest average score (3.6), suggesting that most workshops maintain their tools, organize cables and hoses properly, and follow safe storage for gas cylinders. *Safety Practices and Compliance* followed with an average score of 3.2, indicating some adherence to protocols such as emergency planning and start-up procedures, though there is still room for improvement in regular safety training and inspections.

Personal Protective Equipment (PPE) received an average rating of 3.0. While helmet use is fully compliant, the use of respiratory protection and appropriate footwear scored low, highlighting critical gaps in protecting workers from airborne toxins and foot injuries. The *Work Area and Environment* category showed the lowest average score (2.9), largely due to inadequate ventilation, lack of hazard signage, and limited fire prevention readiness.

These results reflect a pressing need to enhance environmental controls and ensure the consistent use and maintenance of PPE. The findings also emphasize the importance of continued safety training and stricter enforcement of regulations to reduce occupational risks in welding operations.

IV. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

4.1 Summary of Findings

A. Survey Questionnaire

The survey results highlight key demographic and behavioral patterns among welders in Cabanatuan City. The majority of respondents were young adults aged 20–24 years old (23.64%), with a notable decline in participation among older age groups. The welding profession remains heavily male-dominated, with 89.09% of respondents identifying as male.

In terms of experience, most welders (30.91%) reported having 1–3 years in the field, suggesting a predominantly early-career workforce. Educational backgrounds indicate a strong reliance on vocational training, particularly through TESDA, with 36.36% of respondents identifying it as their highest form of education. High school graduates and vocational course completers also made up significant

proportions, while only a small percentage (12.73%) had attained college education.

Regarding the use of Personal Protective Equipment (PPE), items such as welding helmets and gloves had relatively high usage rates, with nearly half of respondents indicating they "always" use them. However, usage rates declined for aprons, safety boots, respiratory gear, and hearing protection, with a notable percentage of respondents reporting rare or no use.

In safety knowledge and practice, most welders claimed moderate to high understanding of safety protocols, but consistency in application varied. Awareness of DOLE and PWS standards, as well as participation in formal training programs, showed room for improvement. While many expressed a belief in the importance of regular safety seminars, some indicated inadequate workplace support and limited government outreach.

B. Interviews

Based on the interview responses, welders identified several key challenges to maintaining safety, including exposure to toxic fumes due to poor ventilation, risks of burns and electric shocks, improper handling of equipment, and the lack or poor quality of personal protective equipment (PPE). Many cited insufficient safety training and limited knowledge of basic welding safety as contributing factors to workplace hazards. To address these issues, respondents recommended more frequent and jobspecific safety training programs, improved and government-subsidized PPE, better workplace ventilation, regular equipment checks, and stronger employer support. They also emphasized the need for a clear safety culture backed by regular seminars, clearer guidelines, and stricter enforcement of safety rules.

C. Workplace Observation

The workplace safety observation of four welding fabrication sites in Cabanatuan City reveals moderate overall compliance with safety standards. The highest-rated area was *Equipment and Tools* (average

rating: 3.6), indicating that most workshops maintain equipment properly and minimize physical hazards. Safety Practices and Compliance followed with an average of 3.2, suggesting that basic safety protocols are being observed, though training and supervision remain inconsistent. Personal Protective Equipment (PPE) averaged 3.0, with helmet usage fully observed but significant gaps found in the use of respiratory protection and proper footwear. The lowest scoring category was Work Area and Environment (2.9), due to poor ventilation, lack of safety signage, and insufficient fire prevention measures. These findings highlight the need for improved PPE compliance, better environmental safety controls, and more frequent training and inspections to ensure safer welding workplaces.

4.2 CONCLUSIONS

Based on the combined results of the survey questionnaire, interviews, and workplace safety observations, it is evident that while welders in Cabanatuan City demonstrate moderate awareness of safety practices, significant gaps remain in implementation and compliance. The survey highlighted that while many welders possess basic knowledge of safety protocols and acknowledge the importance of PPE, actual usage especially of respiratory protection, safety goggles, and hearing protection-is inconsistent. Interview responses reinforced these findings, revealing that common challenges include lack of access to quality PPE, insufficient training, and poor ventilation in work areas. Respondents also expressed a strong desire for more frequent safety seminars, better PPE provision, and stricter enforcement of safety rules.

Workplace observations conducted by a PWS welding inspector confirmed these self-reported challenges. The average ratings across observed safety categories ranged from 2.9 to 3.6, suggesting partial compliance with best practices. The lowest scores were in environmental controls and PPE use specifically in areas like ventilation, fire safety, and use of respiratory protection—which aligned closely with both the survey and interview results.

There is a clear correlation between the three research methods. The survey revealed trends in behavior and awareness; the interviews provided context and reasoning behind those trends; and the workplace inspections validated these issues in practice. Together, they paint a coherent picture: welders have foundational knowledge of safety but face structural and resource-related barriers to full compliance. The findings indicate an urgent need for coordinated efforts among employers, regulatory bodies, and training institutions to provide consistent safety education, accessible PPE, and ongoing supervision in the welding industry.

4.3 RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made to improve welding safety practices in Cabanatuan City:

- 1. Enhance Safety Training Programs It is essential to provide regular and comprehensive safety training for welders. This should include both theoretical knowledge and hands-on practice in proper welding techniques, the use of PPE, and emergency procedures. Collaboration with institutions like TESDA to offer welding safety certifications would ensure that all workers are adequately trained and knowledgeable about hazards specific to their work environment.
- 2. Improve Availability and Quality of PPE Employers must prioritize the provision of highquality, well-fitting, and durable PPE for all workers. This includes not only helmets, gloves, and protective clothing but also respiratory protection, safety boots, and eye protection. Employers should ensure that PPE is maintained in good condition and is regularly replaced to ensure its effectiveness.
- Strengthen Workplace Safety Inspections and Compliance Regular safety inspections by supervisors should be mandated and documented. Employers should establish a system to monitor the condition of the workplace and equipment, ensuring compliance with safety standards. This should include checking ventilation systems, ensuring fire safety

measures are in place, and confirming that safety protocols are followed.

- 4. Enhance Ventilation and Environmental Controls Proper ventilation, especially in confined spaces, is a critical issue that must be addressed. Employers should invest in effective fume extraction systems to reduce exposure to harmful gases and improve air quality in welding areas. In addition, ensuring a clean and organized workspace free from flammable materials will reduce the risk of accidents and improve overall safety.
- 5. Conduct Regular Safety Seminars and Awareness Campaigns Regular safety seminars and awareness programs should be organized to refresh welders' knowledge of safety practices and keep them up to date with the latest regulations. This can also serve as a platform to discuss emerging risks in the welding industry. The involvement of government and industry organizations, such as DOLE and the Philippine Welding Society (PWS), will ensure that these programs are effective and widely accessible.
- 6. Employer Support for Safety Culture Employers should create a safety-first culture by setting clear expectations, encouraging safe work practices, and leading by example. A clear and enforced set of safety rules should be implemented, with penalties for non-compliance. In addition, workers should be encouraged to report safety hazards without fear of retaliation, fostering an environment where safety is prioritized.
- 7. Government and Industry Collaboration Government agencies such as DOLE should collaborate with industry groups to improve welding safety standards. This could involve subsidies for training programs, PPE provision, and conducting nationwide safety campaigns. In addition, stricter enforcement of safety standards, particularly for smaller and informal welding operations, will ensure better compliance across the sector.
- 8. Invest in Research and Technology Continued research into welding safety hazards and the development of new technologies or methods to mitigate these risks is essential.

Investment in innovative safety equipment and protective gear, such as smart helmets or airpurifying respirators, could dramatically improve safety outcomes for welders.

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