Journal of Safety Education
Volume 1 Issue 1 Year 2023 Pages 13-18

P-ISSN 2986-6391 | E-ISSN XXXX–XXXX
https://journal.unnes.ac.id/sju/index.php/jse

Risk Management and Safety Education in Custom Garage

N. Jamilatul Izyati[1]*, Irman Syahrul A.[1], Nadya Aulia A.[1], Rizki Amelia H.[1], Devina Aura I.[1], Alicia Rosalinda D.[2]

[1]Department of Public Health Science, Faculty of Medicine, Universitas Negeri Semarang, Indonesia
[2]Saint Petersburg State Pediatric Medical University, Russian Federation

*Correspondence to: *nujayy30@students.unnes.ac.id*

Abstract: Workplace accidents and injuries are among the most important preventable health problems worldwide. In custom workshops, there are potential hazards that come from their work processes which consist of welding, painting, and finishing. Risk management systems are mostly not implemented in informal sectors such as car paint and welding workshops. The research was carried out to identify and analyze potential hazards in the Custom Garage. This research is a qualitative descriptive study. Data collection and processing techniques in this study were direct observation and interviews with leaders and owners of the Custom Garage. The research was conducted using the HIRAC (Hazard Identification, Risk Assessment, and Control) sheet instrument. Based on the results of hazard identification, there are 13 work process activities with 47 types of work risks with 15 risks that are included in the high category. The potential risk of accidents in the high category includes inhaling rust dust and residual welding fume, inhaling the smell of toxic substances such as rust, car paint, putty, thinner, and poxy, and there is a high potential for noise hazard.

Keywords: custom garage, hazard identification, risk management

INTRODUCTION

Workplace accidents and injuries are among the most important preventable health problems worldwide. Workplace accidents annually result in permanent bodily damage and even death, resulting in substantial hospital fees and lost wages for injured workers (Jovanović et al., 2004). Therefore, occupational safety must be taken seriously by both management and workers (Abrampa Apreko et al., 2015).

According to the Ministry of Manpower No.5 of 2018 Article 1 Paragraph 4, work accidents occur in connection with work, including diseases that arise due to work relationships, and accidents that appear on the way to work or returning home by the usual route (Kemenaker, 2021). Therefore, occupational health and safety is very important for the company. The effects of occupational safety and health on employees lead to job satisfaction, joy, a safe and conducive work environment, punctuality, and reduced absenteeism. (Sembe & Ayuo, 2017). To protect employees at work, companies must implement an occupational health and safety management system program to reduce the risk of work accidents (Kabul & Yafi, 2022).

A Safety Management System is an organizational tool to develop, plan, measure, analyze, and control the overall safety performance of an organization, and to guide decision-making for selecting safety assurance activities. Safety management systems are widely applied across many industrial sectors, and a large body of literature has been published addressing their design, implementation, effectiveness, and associated challenges. Safety management systems can be seen as a business management approach to safety, which has been argued to be an important aspect of bringing safety to the foreground in executive decision-making (Goerlandt et al., 2022).

Safety management can estimate risks and accidents that occur, which can endanger all workers, so work safety is very important to minimize hazards and risks in a definite and structured manner (SAEED, 2017). Safety culture is part of the organizational culture, and numerous definitions of safety culture have been proposed in the safety literature, and some review papers also address the comparisons of these definitions. Wiegmann et al. noted the commonalities among various definitions of safety culture, including shared value within an organization, safety issues and safety management system concerns, emphasis on contributions by all members, impact on behavior at work, and contingency between reward systems and safety performance (Su, 2021).

It is clear that SMSs are found in many industrial sectors, serving an integrating function of various safety practices and activities. One of them is SMSs which is implemented in the car repair shop. The above-stated industry is formerly known as the auto mechanic industry, in which the primary duty is to provide mechanical and electrical repair and maintenance for cars, bikes, trucks, and all sought-after automobiles. However, petrol sheds, spare parts shops, and car sales are not included in this industry. Auto mechanics and workers face different kinds of dangers in the garage. Sometimes to repair or replace an engine component, various types of harmful substances are required,

and if workers are exposed to these chemicals, it may lead to serious health issues (Aqcuah & Nouban, 2020). Welders are vulnerable to physical hazards such as electric shock, burns, and heat stress due to radiation exposure (Sakariyau & Latip, 2016).

Custome Garage is a VW and Porsche restoration and custom workshop. The work process at Custome Garage consists of three main departments, namely the tile welding department, the paint department, and the finishing department where in the work process the workshop uses a lot of hazardous chemicals such as paint particles and welding metal fumes which can have a toxic impact on workers (Riccelli et al., 2020).

Risk management systems are mostly not implemented in informal sectors such as car paint and welding garages. In developing countries, many mechanics and welders need to apply better work ergonomics. The work process is usually done by bending, standing, sitting, and a combination of these things. Based on observations and interviews with garage workers, most of the workers do not have knowledge of the hazards and risks faced by the work processes they carry out continuously. The absence of a good management system from the owner, results in workers having a high risk of continuous toxic exposure and the risk of work relating illness (Osinaike & Oke, 2018)

Therefore, this research was conducted at a custom garage in Semarang City with the aim of identifying hazards, analyzing potential hazards, and determining risk control in a custom garage.

METHODS

This research is a qualitative descriptive study conducted from March to April 2023 at a Semarang custom garage. The sources of data used in this research were primary data, which is done by observation by direct observation of each work process and interviews with garage leaders and owners. Interviews and direct observations were conducted to get an overview of the risks associated with the hazards in the custom garage (López-Arquillos & Rubio-Romero, 2016).

The research instrument used in this study was the HIRAC worksheet. HIRAC consists of various types of hazards (hazards) and risks (risks) in the workplace that we observed, risk assessment (risk assessment), and risk control (control). The HIRAC method in this study was used to identify chemical hazard risks, risk assessment, and control of toxicant risks in custom garage garages (Rout & Sikdar, 2017).

HIRAC analysis in this study began with the identification of potential hazards and risks in all work process activities in the Custom Garage garage. Every potential hazard and risk found were analyzed and a risk assessment were carried out which was obtained from the multiplication of the severity (severity) and probability (likely) of the risk from toxicant exposure.

The next stage was a risk assessment phase which was carried out to find out the extent to which a hazard might occur, in other words, to carry out a predetermined level of risk for each hazard. Processing techniques and data analysis were guided by the results of interviews and observations of custom garage workers. Risk Assessment was the product of the probability value with the severity value of a risk (Shuaib et al., 2009). Furthermore, the probability and severity values for each potential hazard were recorded and then analyzed using a risk assessment matrix table. The results of this analysis were revealed the level of risk in the potential hazard and whether the hazard was included in the low, medium, or high category. An example of the risk matrix table can be seen below:

Table 1. *Risk Assessment Matrix*

Probability	Severity			
	1 Insignificant	2 Minor	3 Moderate	4 Major
1 (Rare)	LOW	LOW	MEDIUM	MEDIUM
2 (Unlikely)	LOW	MEDIUM	MEDIUM	MEDIUM
3 (Likely)	MEDIUM	MEDIUM	MEDIUM	HIGH
4 (Almost certain)	MEDIUM	MEDIUM	HIGH	HIGH

RESULT AND DISCUSSION

Hazard Identifications

Hazard identification was differentiated based on activities carried out at the custom garage, which included welding, painting, and finishing processes. The welding process included checking the condition of the vehicle, forming the car body, and welding the vehicle frame. The painting process included steel plate cleaning activities, rust cleaning with a grinder, anti-rust coating, caulking, apply poxy, base painting, and painting. The finishing process included the installation of the car body, installation of spare parts, and repair of spare parts and modifications. Hazard identification was carried out to determine the hazards at risk of occurring in each work process.

According to the Malaysian Department of Occupational Safety and Health (2008), the hazard identification stage aims to find out all potential hazards originating from materials, equipment, and work systems. The 5 (five) sources of danger include man, method, material, machine, and environment. In addition, it also includes 5 Occupational Safety and Health hazards, namely Physical, Chemical, Biological, Ergonomic, and Psychosocial Hazards (Beheary et al., 2020).

Hazards identification was carried out in each work process at the Custom Garage, and the results showed that there were potential hazards that might occur in each of the physical, chemical, biological, ergonomics, and psychosocial hazards. Physical hazards in the welding process were the dangers of being pinched, scratched, hit and crushed, splashed fire, noise, electric shock, and radiation exposure (Pramitasari et al., 2021).

Risk Assessment

Risk is something that is often inherent in a process/activity. Likewise, in the world of work. Every work process carried out has the potential risk of hazards and accidents. Risk analysis can help company management to reduce the risk of harm that can occur. Hazard risks and health risks, if they occur, will cause consequences and cause losses if the safety management system is not managed properly (Putra et al., 2019). The existence of a risk assessment is a process to determine the priority of controlling the hazard of an accident or occupational disease. Risk assessment is done by multiplying severity with probability (Jensen et al., 2022). The following is a table describing the severity and probability values.

Table 2. Score Severity

Level	Criteria	Explanation
1	*Insignificant*	Can be treated with First Aid (generally due to minor injuries) or Treatment < 5 million
2	*Minor*	Requires special handling / medical / other recovery efforts (due to minor to moderate injuries / fainting at the same time, temporary decrease in health) and does not cause a loss time accident
3	*Moderate*	Moderate to severe injuries that cause loss time accidents. Permanent disability / loss of some limbs but it is still possible for the person concerned to be reemployed
4	*Major*	Fatality, loss of limbs that do not allow re-employment, death or emergency conditions (fire / explosion / mass poisoning etc.)

Table 3. Score Probability

Level	Criteria	Explanation
1	*Rare*	Almost never happens, usually occurs in emergency cases
2	*Unlikely*	Rarely happens, generally occurs in Abnormal or non-routine cases
3	*Likely*	May occurs, generally occurs in routine activities
4	*Almost certain*	Often occurs

Potential hazards in the welding process included being pinched, scratched, hit and crushed, splashed with fire, inhalation of dust and direct contact with rusty objects, as well as infection with the bacterium clostridium tetani. In the painting process, the potential hazards that might occur were scratches, eye irritation, splashes of grit, open wounds, and exposure to toxic materials from paint, thinner, putty, and anti-rust. In the finishing process, the potential hazards that might occur were being pinched, bumped, crushed, electrocuted, splashed with grinding, electrical short circuit, fire, and inhalation of toxic materials from paint and thinner (Qiao et al., 2022).

The potential for noise hazards and musculoskeletal disorders due to non-ergonomic work processes and workplaces appeared in the entire work process at the custom garage. Noise can cause physiological disturbances such as increased pulse and blood pressure, impaired communication between workers, the risk of being easily stressed and tired, and can cause an increase in the threshold of hearing. In the welding section, the danger of welding fumes might seriously threaten respiratory health (Dev & Bhardwaj, 2021). Heavy metals in particular cause

damage to nerves and organs during prolonged periods of exposure and, in some cases, immediate damage if the exposure is heavy and concentrated. The process of painting and cleaning metal and body trim had the potential to be exposed to substances containing epoxy resin, methylene chloride, styrene, and adhesive fumes. All of these airborne chemicals can cause inflammation or respiratory illness, as well as skin rashes and inflammation, allergic reactions, nerve and brain damage, nausea, organ failure, headaches, and vomiting (Cosgrove & Zschiesche, 2016).

Table 4. HIRAC

Process	Risk	Se	P	Risk (Se*P)	Risk Category
Welding	inhalation of rust dust, clostridium tetani bacterial infection	3	4	12	High
	non-ergonomic working position	2	4	8	Medium
	noise	3	4	12	High
	splashed by grinding fire, inhaled galvanized plate dust, inhaled rust dust	3	4	12	High
	welding machine sparks, eye radiation by the welding machine,	3	2	6	Medium
	inhaled rust dust and residual welding fume	3	4	12	High
Painting	inhalation of zinc iron dust through inhalation, noise	3	4	12	High
	non-ergonomic working position, plus repetitive body movements	2	4	8	Medium
	splashed grams of grinding	2	4	8	Medium
	inhaled the smell of anti-rust	3	4	12	High
	inhaling the smell of putty	3	4	12	High
	inhaled the smell of poxy	3	4	12	High
	inhaled thinner vapor and paint smell	3	4	12	High
Finishing	inhaled the smell of dry paint	3	4	12	High
	Unergonomic installation position	2	4	8	Medium
	splashed grams of grinding	3	4	12	High
	noise	3	4	12	High
	Inhaled thinner vapor, splashed thinner	3	4	12	High

Based on the results of hazard identification in custom garage using the HIRAC method, there were low to high potential hazards. Low category risk of accidents that might occur in custom garages such as being pinched, crushed, hit, or scratched, which were still acceptable or included in acceptable risk. We found that there were 13 work processes with 47 potential hazards that might occur in custom garage workers with 4 risks that were included in the low-risk category, 28 risks that were included in the medium-risk category, and 15 risks that were included in the high category. The potential risk of accidents in the high category included inhaling rust dust and residual welding fume, inhaling the smell of toxic substances such as rust, car paint, putty, thinner, and poxy, and there was a high potential for noise hazard.

Based on the results of field observations, custom garage workers did not have an understanding and awareness of Occupational Safety and health. The custom garage manager did not provide safety training for workers regarding the occupational risks of each work process in the workshop and the importance of using PPE. In addition, safety signs such as no smoking while working and reminders of PPE use were not installed. Based on interviews with workers, the reason why workers did not use PPE was that according to them, PPE limits their movement when

working, and consider that PPE is not too important because they do not have an understanding about it (Hassan et al., 2017). Unused PPE can expose workers to many hazards and safety and health risks that can ultimately lead to serious health implications (Ahmad et al., 2016). Small-scale industrial workers are least aware of the safety and health outcomes resulting from exposure, activity, and materials in the workplace (Ahmad et al., 2017).

CONCLUSION

Based on the results of hazard identification using the HIRAC method, the hazard risks in each work process consist of physical, chemical, biological, ergonomic, and psychosocial hazards. There were 13 work process activities with 47 types of work risks. It is suggested to the custom garage to make work SOPs, carry out risk control by providing training to workers regarding the risks of hazards that can be caused by the work process, providing an understanding regarding the importance of using PPE, carrying out routine inspections of machines and work tools used, installing signs safety signs, and carry out warehouse supervision by providing a sign and name for each toxic substance used.

REFERENCES

Abrampa Apreko, A., Sylvia Danku, L., Selase Akple, M., & Faustin Apeletey, A. (2015). Occupational Health and Safety Management: The Use of Personal Protective Equipment (Ppe) by Artisans in The Local Automotive Industry in Volta Region, Ghana. *International Journal of Engineering Trends and Technology*, *19*(4), 201–206. https://doi.org/10.14445/22315381/ijett-v19p236

Ahmad, I., Balkhyour, M. A., Abokhashabah, T. M., Ismail, I. M., & Rehan, M. (2017). Workplace Safety and Health Conditions and Facilities in Small Industries in Jeddah, Saudi Arabia. *Journal of Safety Studies*, *3*(1), 37. https://doi.org/10.5296/jss.v3i1.11104

Ahmad, I., Rehan, M., Balkhyour, M. A., Abbas, M., Jalal, M., Almeelbi, T., & Ismail, I. M. I. (2016). *Issn : 2414-8245 Review of Environmental Pollution and Health Risks At Motor Vehicle Repair Workshops : Challenges and Issn : 2414-8245*. *2*(1), 1–23.

Acquah, E., & Nouban, F. (2020). Occupational Health and Safety Management in Small -Scale Mining: Focus on Female Workers in Ghana. *Academic Research International*, *11*(October), 6-15 Mine coins. https://doi.org/10.13140/RG.2.2.17663.02722

Beheary, M. S., Abdelaal, A., & Matar, S. M. (2020). Occupational Health and Safety Practices Assessment in Damietta Port, North Egypt. *Asian Journal of Advanced Research and Reports*, *8*(4), 17–27. https://doi.org/10.9734/ajarr/2020/v8i430204

Cosgrove, M., & Zschiesche, W. (2016). Arc welding of steels and pulmonary fibrosis. *Welding in the World*, *60*(2), 191–199. https://doi.org/10.1007/s40194-015-0283-7

Dev, M., & Bhardwaj, A. (2021). Respiratory symptoms and spirometric abnormalities among welders in the welding workplace of the Indian unorganized sector. *Work*, *69*(3), 885–894. https://doi.org/10.3233/WOR-213521

Goerlandt, F., Li, J., & Reniers, G. (2022). The landscape of safety management systems research: A scientometric analysis. *Journal of Safety Science and Resilience*, *3*(3), 189–208. https://doi.org/10.1016/j.jnlssr.2022.02.003

Hassan, S. M., Nasir, U., Anwar, K., & Talib, U. (2017). An assessment of the level of awareness and reported complaints regarding occupational health hazards and the utilization of personal protective equipments among the welders of Lahore, Pakistan. *International Journal of Occupational and Environmental Health*, *23*(2), 98–109. https://doi.org/10.1080/10773525.2018.1426259

Jensen, R. C., Bird, R. L., & Nichols, B. W. (2022). Risk Assessment Matrices for Workplace Hazards: Design for Usability. *International Journal of Environmental Research and Public Health*, *19*(5). https://doi.org/10.3390/ijerph19052763

Jovanović, J., Aranđelović, M., & Jovanović, M. (2004). Multidisciplinary aspects of occupational accidents and injuries. *Working and Living Environmental Protection*, *2*(4), 325–333. http://facta.junis.ni.ac.rs/walep/walep2004/walep2004-12.pdf

Kabul, E. R., & Yafi, F. (2022). Hirarc Method Approach As Analysis Tools in Formingoccupational Safety Health Management and Culture. *Sosiohumaniora*, *24*(2), 218. https://doi.org/10.24198/sosiohumaniora.v24i2.38525

Kemenaker. (2021). *Permenaker_5_2021.pdf*. https://jdih.kemnaker.go.id/asset/data_puu/Permenaker_5_2021.pdf

López-Arquillos, A., & Rubio-Romero, J. C. (2016). Analysis of Workplace Accidents in Automotive Repair Workshops in Spain. *Safety and Health at Work*, *7*(3), 231–236. https://doi.org/10.1016/j.shaw.2016.01.004

Osinaike, O. O., & Oke, S. A. (2018). A risk assessment of two automobile repair centres: A Nigerian case study. *Engineering and Applied Science Research*, *45*(2), 95–106. https://doi.org/10.14456/easr.2018.12

Pramitasari, R., Haikal, H., Yuantari, M. C., Dwi, K. I. K., & Treesak, C. (2021). Job Safety Analysis and Hazard

Identification of Welding Process in Semarang - JSA Method AS/NZS 4360:2004. *Disease Prevention and Public Health Journal*, *16*(1), 62–69. https://doi.org/10.12928/dpphj.v16i1.4613

Putra, R. D., Sukandari, B., & Wihartono, W. (2019). Risk Management of Occupational Safety and Health in Kri Docking Project Using Hazard Identification, Risk Assessment and Risk Control (Hirarc) Method Case Study: Pt. Pal Indonesia. *Journal Asro*, *10*(2), 76. https://doi.org/10.37875/asro.v10i2.131

Qiao, W., Huang, E., Guo, H., Liu, Y., & Ma, X. (2022). Barriers Involved in the Safety Management Systems: A Systematic Review of Literature. In *International Journal of Environmental Research and Public Health* (Vol. 19, Issue 15). https://doi.org/10.3390/ijerph19159512

Rout, B. K., & Sikdar, B. K. (2017). Hazard Identification, Risk Assessment, and Control Measures as an Effective Tool of Occupational Health Assessment of Hazardous Process in an Iron Ore Pelletizing Industry. *Indian journal of occupational and environmental medicine*, *21*(2), 56–76. https://doi.org/10.4103/ijoem.IJOEM_19_16

SAEED, Y. S. (2017). Safety Management in Construction Projects. *The Journal of The University of Duhok*, *20*(1), 546–560. https://doi.org/10.26682/sjuod.2017.20.1.48

Sembe, F., & Ayuo, A. (2017). *Effect of Selected Occupational Health and Safety Management Practices on Job Satisfaction of Employees in University Campuses in Nakuru Town, Kenya*. *5*(5), 70–77. https://doi.org/10.11648/j.jhrm.20170505.11

Shuaib, N. A., Ghazali, M. F., Asyraf, C. D. M., & Azmi, H. (2009). Applications of HIRARC at UniMAP laboratories. *National Symposium on Advancements in Ergonomics and Safety*, *December*, 1–2.

Su, W.-J. (2021). The Effects of Safety Management Systems, Attitude and Commitment on Safety Behaviors and Performance. *International Journal for Applied Information Management*, *1*(4), 187–199. https://doi.org/10.47738/ijaim.v1i4.20

Wiegmann, D. a, Zhang, H., Thaden, T. Von, Sharma, G., & Mitchell, A. (2002). Aviation Research Lab Institute of Aviation. *Federal Aviation Administration Atlantic City International Airport NJ*, *DTFA 01-G-*(June), 21. http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Modality+Differences+in+Advanced+Cockpit+Displays:+Comparing+Auditory+Vision+and+Redundancy+for+Navigational+Communications+and+Traffic+Awareness#0