

Analysis of Occupational Health and Safety (K3) Risk Management in PT X Steel Pipe Production Process using the HIRADC Method

Adinda Afifah¹, Aurellia Risma Riandini¹, Ellycia Monica Sastra Widjaya^{1*},
Muhammad Rafli Haidar¹, Muhammad Raihan Aly Assidiq¹, Arya Nur Attabiq²

¹Department Public Health Science, Faculty of Medicine, Universitas Negeri Semarang, Semarang, Indonesia

²Fuzhou University of International Studies Economics and Trade, Fuzhou, China

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

Abstract: The manufacturing industry, particularly steel pipe production, is strategically supporting infrastructure development and national economic growth. However, the production process involves various potential risks that can disrupt operational efficiency and endanger workplace safety. This study aims to analyze risk management applied to the production process at Indonesia Steel Tube Works (PT. X), identify the principal risks faced, and evaluate mitigation strategies implemented by the company. This research uses qualitative methods with descriptive research type to understand the risk management system process using the HIRADC (Hazard Identification Risk Assessment Determining Control) method. Data collection was conducted through direct observation and semi-structured interviews with workers. The results show that the four main production processes (Slitting Line, Pipe Making Line, Galvanizing, and Packing) contain various risks categorized as physical, chemical, ergonomic, and psychosocial hazards. Risk analysis revealed eight high-category risks, 20 moderate-category risks, and four low-category risks. Risk control is implemented through engineering control, administrative control, and personal protective equipment (PPE) following the risk control hierarchy. This study contributes to improving operational efficiency, strengthening workplace safety culture, and providing recommendations for developing more adaptive and sustainable risk management systems in the steel pipe manufacturing industry.

Keywords: HIRADC; risk management; steel pipe production; workplace safety; manufacturing industry

© Universitas Negeri Semarang. This is an open access article under the CC BY license

Submitted: December 18, 2025; **Revised:** April 03, 2026; **Accepted:** September 26, 2026

DOI: <https://doi.org/10.15294/jse.v4i2.28196>

INTRODUCTION

The manufacturing industry, particularly the steel pipe manufacturing sector, is strategically supporting infrastructure development and national economic growth. Steel pipe products are widely used in various sectors, including construction, the oil and gas industry, piping systems, and irrigation. However, the production processes are not without various potential risks that can disrupt operational smoothness and jeopardize workplace safety. According to (Kerzner, 2017), risks in the manufacturing industry are any uncertainties that can affect project objectives or production processes, whether in technical, financial, or operational forms.

Every stage in PT. X has potential risks, from machine failures to workplace accidents and human errors. As (Hillson & Murray-Webster, 2007) explained, failure to manage risks properly can lead to significant losses, not only in financial terms but also affecting reputation and business continuity. The steel pipe manufacturing industry is complex and involves many processes, including slitting, pipe-making, galvanizing, and packing, which can pose physical, chemical, ergonomic, and psychosocial risks. Studies in the welding sector, melting processes, and even engineering campuses consistently show that hazards such as caught, exposure to hazardous materials, and physical fatigue are common in heavy industrial activities. (Ilyasa et al., 2024) state that physical hazards such as falls and being caught in between dominant cases of workplace accidents generally occur at moderate to low-risk levels in the general manufacturing sector.

The application of risk management in a systematic manner is crucial to identify, analyze, evaluate, and control these risks. ISO 31000:2018 defines risk management as 'coordinated activities to direct and control an organization with regard to risk,' emphasizing the importance of risk management as an integral part of the organization's management system. In the steel pipe industry context, risk management is also closely related to occupational

health and safety (OHS), considering the high potential hazard levels in the production environment (Ridley & Channing, 2008). Companies like PT do not have structured risk mapping and controls based on a systematic framework. X is at risk of facing various serious consequences. One of the main impacts is an increase in workplace accidents and health disturbances among workers due to unidentified or poorly controlled hazards (Soesanto & Susanto, 2024). Other potential risks include damage to machinery and products, which can directly affect production continuity and final output quality. These disruptions ultimately reduce operational efficiency and contribute to the company's financial losses (Situmorang et al., 2022). Additionally, the company may face a decline in reputation that impacts consumer and business partner trust. Not only that, the lack of systematic documentation in risk management also increases the likelihood of non-compliance with national and international workplace safety regulations, such as Government Peraturan Pemerintah Nomor 50 Tahun 2012 on the Occupational Health and Safety Management System, as well as ISO standards 45001 and 31000, which require a systematic and documented approach in managing risks at the workplace (ISO, 2018; International Labour Organization, 2022). Therefore, implementing risk identification and control methods such as HIRADC becomes important in ensuring the workforce's safety and the company's operational continuity.

This research aims to analyze the risk management of occupational safety and health (K3) applied in the production process at PT X, identify the principal risks faced, and evaluate the company's mitigation strategies. Specifically, it focuses on the main production lines, such as Slitting Line, Pipe Making, Galvanizing, and Packing. The primary objective of this research is to evaluate the implementation of the Hazard Identification Risk Assessment and Determining Control (HIRADC) method in the process of hazard identification, risk level assessment, and the selection of appropriate control strategies by the principles of the risk control hierarchy. This research also aims to reveal the main risks that could potentially lead to workplace accidents or health disturbances, as well as to assess the effectiveness of the controls that have been applied by the company, whether in the form of technical controls, administrative controls, or the use of personal protective equipment (PPE). The results of the analysis are expected to contribute theoretically to the development of occupational health and safety risk management science in the manufacturing sector, as well as to provide practical solutions for companies in improving operational efficiency, strengthening the safety culture, and offering recommendations for the development of a more adaptive and sustainable risk management system. Thus, the results of this research are expected not only to enhance efficiency and workplace safety at PT. X but also to serve as a model for implementing risk management that applies to similar industries in Indonesia.

METHODS

Research on the Occupational Safety and Health (OSH) risk management system using the Hazard Identification Risk Assessment Determining Control (HIRADC) method. This study uses a qualitative method with a descriptive type of research to understand the risk management system process at PT. Indonesia Steel Tubes Works. Data collection was conducted through direct observation at the research site and structured interviews with workers at PT X.

Data processing will be done using the HIRADC method, which includes hazard identification, risk assessment, and determining control. The HIRADC method is used to analyze the consequences of all activities carried out during the pipe manufacturing process at PT X, which includes hazard identification, providing an assessment to determine the level of risk that may occur, and selecting the steps to be taken as control based on the collected data to obtain the HIRADC model. Risk identification serves as the basis for risk management. The stages of implementing risk management based on ISO 31000 – risk management system consist of several essential elements: preparation, risk identification, risk analysis, risk evaluation, risk control, communication and consultation, and monitoring and review. Below is an image of the stages of implementing risk management:

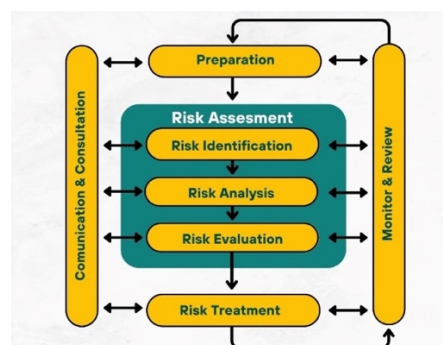


Figure 1. Risk Management Process

RESULT AND DISCUSSION

Communication and Consultation

This stage is carried out by the parties responsible and interested in it. This is done because the assessment of risks also involves their perceptions. The parties involved are individuals who have experience in the field. A successful risk control program is based on the commitment and participation of company management and workers in policy making and the existence of feedback that will lead to continuous improvement of the safety program (Ihsan et al., 2020). Therefore, for this stage, this research also utilizes the assessment from the HSE department of the iron pipe manufacturing company PT X, which is fully responsible for the occupational health and safety of the production unit, starting from the preparation stage, identifying risks, assessing risks, and controlling risks (Ulfa & Immawan, 2021).

Preparation

The preparation stage is carried out to understand the risk management objectives of PT X before entering the risk assessment phase. In addition, this stage also determines the approach applied by PT X. The risk assessment method used is HIRADC (Hazard Identification Risk Assessment Determining Control) because this method can help PT X achieve its objective of controlling the identified risks. This method begins with identifying risks in all processes and activities in the production unit at PT X. Each potential hazard that has been found will be analyzed for its impact and likelihood of occurrence. The risk assessment results will be evaluated to determine the priority of risks that need to be controlled. The results of the HIRADC risk assessment will be used to set goals and targets for occupational safety and health (OSH), which are to prevent, reduce, or even eliminate work accident risks (Handoko & Rahardjo, 2017).

Risk Identification

Based on the results of observations and interviews conducted in the field by the researcher with the production manager of iron pipe manufacturing at PT X, information was obtained that there are several hazards and risks in every work process in the production area of PT X. The observations were made by directly observing each work process. In the production process, the machines and workplaces used to produce a product always contain potential hazards that, if not given special attention, can lead to work accidents (Hasiany et al., 2024). The identification results conducted on workers at PT X analyzed the occupational health and safety risks in four main production processes: Slitting Line, Pipe Making Line, Galvanizing, and Packing. These main production processes have physical, chemical, ergonomic, and psychosocial hazards.

In the slitting line process, there are risks of getting pinched, crushed by the mother coil, cut by the machine blade, severed, noise, electrical shock, scratches from corrosive materials, non-ergonomic working positions, and fatigue. In the pipe-making line process, there are risks of being crushed by slit coils, cut by the machine blade, splashed by sparks, electrical shock, fire, noise, scratches from corrosive materials (rust), muscle injuries due to improper working positions, and fatigue. In the galvanizing process, there are risks of slipping, getting crushed, falling in, fire, contact with skin and eyes, inhaling chemicals, non-ergonomic working positions, and fatigue. In the packing process, there are risks of being crushed by pipes, getting pinched, noise, non-ergonomic working positions, and fatigue. The pipe-making line process has the most risks, while the packing process has the least among the four main production processes.

Risk Analysis

PT X implements risk analysis as part of systematic and structured occupational health and safety (OHS) management. The analysis of risks is conducted by measuring the level of severity and the likelihood of occurrence. The values of these two parameters are calculated to determine the overall risk level, which is then categorized as low, medium, or high. High-level risks must be addressed immediately with control measures. In the slitting line process, there is one low-risk category, seven medium-risk categories, and one high-risk category. In the pipe-making line process, there are two low-risk categories, seven medium-risk categories, and one high-risk category. There are no low-risk categories in the galvanizing process, but there are three medium-risk categories and five high-risk categories. The packing process has one low-category risk, three medium-category risks, and one high-category risk. From the four main production processes, there are eight high-category risks, twenty medium-category risks, and four low-category risks.

In the production work stage of pipe PT X, there are dominant physical hazards, such as the risk of being caught by machinery with a severity level of 3 and a probability of 3, resulting in a risk score of 9 (moderate), indicating potential for serious injury. Additionally, there is the risk of being struck by the mother coil and slit coil due to crane operations, which shows a high severity level (4) with a probability of 3, resulting in a risk score of 12 (high), indicating

potential for fatal injury or permanent disability. Furthermore, the risk of cuts and lacerations from the slitter machine blades has a severity of 3 and a probability of 2, resulting in a risk score of 6 (moderate). Research conducted (Prihatiningsih et al., 2014) on rewinder machine workers found that one of the jobs with a high risk of accidents in the NCR unit is the work related to sharp objects, such as adjusting the slitter on the rewinder machine. Then there is a noise risk with a severity level of 2 but a high probability of 4, resulting in a score of 8 (moderate), indicating the risk of hearing impairment over a long period.

Chemical hazards are identified through exposure to corrosive materials and hazardous chemicals, with risks of contact with skin and eyes from these chemicals showing a severity level of 4 and a high probability of 3, resulting in a risk score of 12 (high), indicating potential burns from chemicals and permanent disabilities. Then, the risk of inhaling chemicals has a severity of 3 and a probability of 4, resulting in a risk score of 12 (high), which indicates a serious threat to the respiratory system. At the same time, the risk of being scratched by corrosive materials has a lower risk level, with a score of 6 (low-moderate).

The identified ergonomic hazard is from an unsuitable workplace design that results in a non-ergonomic working position, showing a severity level of 2 with a high probability of 4, resulting in a risk score of 8 (moderate), indicating the potential for musculoskeletal disorders. The identified psychosocial hazard is fatigue with a severity level of 2 but a probability of 4, which results in a risk score of 8 (moderate), leading to the possibility of triggering workplace accidents and decreasing worker productivity.

Risk Evaluation

Risk evaluation is a stage that is carried out to compare the results with the levels of risk based on the analysis conducted. This helps to determine the priority of risks that must be controlled (Geofanny & Tanaamah, 2022). In implementing Occupational Health and Safety (OHS) risk management, the risk evaluation stage plays a vital role in assessing the level of risk from various potential hazards that have been identified. This evaluation includes determining how likely a hazard is to occur (probability) and how severe its impact is (severity), which are then analyzed using a risk matrix to determine the priority of control measures. Each risk is then analyzed to determine the urgency of its control. The information obtained from this process serves as a reference in designing risk control measures.

Risks categorized as High (score 12) involve hazards with the potential for the most significant impacts, such as being struck by a mother coil, slit coil, and pipes due to crane operations for material lifting. Research conducted by (Soputan et al., 2014) on the construction of building X demonstrated that materials could fall from heights and strike workers, resulting in a very high risk level. Additionally, there are high risks of chemical hazards, such as falling into chemical baths, contact with the skin and eyes, and inhaling chemicals, indicating serious exposure risks. Risks categorized as Moderate (scores 6-10) include hazards such as being caught in machinery, cuts, and lacerations indicating injury risks from machinery operation, noise indicating the risk of long-term hearing impairment, and ergonomic and psychosocial hazards indicating chronic health risks that may develop over time. The low-risk category (score 4) includes electric shocks, scratches from corrosive materials, and several pinching conditions that, although classified as low, still require monitoring. Among the four main production processes, the priority is the risk of being struck, as it has a high-risk classification and is present in all primary production processes. Immediate control measures must be taken to minimize unwanted incidents related to the risk of being struck. Additionally, falling into chemical pits, fires, chemical contact, and inhaling chemicals are priorities that need to be managed because they fall into the high-risk category.

Risk control

Risk control can be applied after knowing the main priorities that need to be controlled. The control recommendations are carried out according to the hierarchy of risk control, starting from elimination, substitution, engineering control, and administrative control to personal protective equipment (PPE). Based on the risk evaluation results, it is known that the risk of being struck is a top priority for control because it falls into the high-risk category and is present at all stages of the primary production process. In the Slitting Line, the risk of being struck by the Mother Coil has an initial risk score of 12 (High) that has been successfully reduced to 0 (Low) through administrative controls in the form of creating a safe area for crane use and implementing strict crane operation SOPs. Then, the engineering controls applied include installing alarms during crane operations, installing safety signs, and regular maintenance of the machine. At the same time, PPE consists of safety helmets that must be worn by all workers in the area.

In addition to being struck, falling into the chemical pool during the galvanizing process is also a priority risk that needs to be controlled. The risk score initially was 12 (High) but was successfully reduced to 6 (Moderate) through engineering controls such as the installation of barriers on the chemical basin and the implementation of safety signs as administrative controls. This control is significant as it can result in fatal consequences such as death

if workers fall into the chemical pool. Then, there is a fire risk in the pipe-making line, where control has been applied through substitution by replacing machine cables with stronger and fire-resistant materials. Administrative controls include the preparation of the Fire Emergency Response SOP, creating safe areas and distances during the welding process, and providing hydrants. Engineering controls applied include installing fire alarms and providing fire extinguishers in strategic locations. In the Galvanizing area, similar controls have been implemented, reducing the risk from High to Moderate.

After implementing controls on high-priority risks, controls continue to be applied to low-moderate categorized risks. Control through substitution is carried out by replacing machine cables with stronger and fire-resistant ones and replacing noisier machines with quieter ones. Engineering control measures that can be implemented include installing sensors on slitter machines to prevent pinching and cutting risks, sound and vibration dampers to reduce noise risks, adding ventilation and exhaust fans to control chemical exposure, and designing ergonomic workstations. Administrative control includes the creation of Standard Operating Procedures (SOP) for various work activities, such as the use of cutting machines and welding tools, the installation of safety signs, electrical safety training, proper posture training, the establishment of a safe area for crane use, and educational programs about fatigue with regular stretching. Personal Protective Equipment (PPE) includes cut-resistant gloves for hand protection against cuts, scratches, punctures, and sharp object injuries ((Noventya et al., 2022) Then, safety helmets for head protection, safety glasses and face shields for eye protection, earplugs for ear protection, respirators for respiratory protection, and coveralls for protection against chemicals. This risk control has successfully reduced the level of risk, with most risks becoming insignificant after implementing the recommended additional controls.

At this stage, monitoring and review are conducted on the risk management results that have been carried out for the parties responsible and obligated. This is done to ensure that all processes run smoothly, controls are adequate, and information on newly identified risks and changes that need to be made is obtained. Therefore, the research conducted by the researchers is always accompanied by the responsible parties so that the risk management assessment process in the production unit, especially in the crane operation and galvanizing area of PT X steel pipe company, can run well. Thus, when proposing controls for the highest risk assessment results, the HSE party agrees, and it can be implemented according to the objectives of this risk management, which is to reduce the emergence of risks in the production area of PT X.

CONCLUSION

Based on the research results on the risk management system in the PT pipe manufacturing process at PT. Using the HIRADC method, X can conclude that the company has implemented a systematic and structured risk management approach to the ISO 31000:2018 standards. The risk identification in four main production processes (Slitting Line, Pipe Making Line, Galvanizing, and Packing) successfully identified various types of hazards, including physical, chemical, ergonomic, and psychosocial hazards, with a total of 32 risks consisting of 8 high-category risks, 20 medium-category risks, and four low-category risks. The Galvanizing process shows the highest risk level with five high-category risks. These include the risk of falling into a tank of chemicals, fire, chemical contact with skin and eyes, and inhalation exposure to hazardous chemicals. In contrast, the Packing process has the least risk, dominated by medium and low-category risks. The Pipe Making Line process has the most risks overall, reflecting the complexity of operations involving various machines and pipe-forming processes. Additionally, although ergonomic and psychosocial hazards have a low severity level, they have a high probability that they could lead to long-term chronic health disorders. Risk control measures follow the hierarchy of controls, from substitution, engineering control, and administrative controls to personal protective equipment (PPE) usage to reduce the risk level. This article provides a comprehensive overview of the implementation of risk management in the steel pipe manufacturing industry. It offers a framework similar companies can adapt to enhance operational efficiency and strengthen a safety culture. Implementing a continuous monitoring and review system ensures the sustainability of the effectiveness of risk controls and the identification of new risks that may arise alongside the development of the production process.

DECLARATION OF GENERATIVE AI

The authors declare that no generative AI or AI-assisted technologies were used in the writing process of this manuscript.

DECLARATION OF COMPETING INTEREST

We are thankful to our entire Solara team for giving their inputs and suggestion, which has helped us writing this article.

FUNDING STATEMENT

This research received no external funding.

REFERENCES

- Bazarova, M. (2025). Features of Assessing the Effectiveness of Innovation Risk Management of an Educational Organization in the Process of Digital Transformation of Activities. *Journal of Multidisciplinary Sciences and Innovations*, 1(2), 161–164.
- Geofanny, G. K., & Tanaamah, A. R. (2022). Sistem Manajemen Risiko Berbasis ISO 31000:2018 di PT. Bawen Mediatama. *Jurnal Teknik Informatika dan Sistem Informasi*, 9(4), 2870–2878.
- Handoko, J. C., & Rahardjo, J. (2017). Perancangan Hazard Identification, Risk Assessment, and Determining Control (HIRADC) di Schneider Electric Cikarang. *Jurnal Titra*, 5(2), 159–164.
- Haristama, I. S., Zacoeb, A., & Susanti, L. (2023). Risk Analysis of Occupational Hazards Using HIRADC Approach in the Implementation of Occupational Safety and Health Management System. *Journal of Engineering Research and Reports*, 25(6), 28–39.
- Hasiany, S., Difa, G. F., Awan, F. N., & Prasetio, B. (2024). Risk Analysis Using HIRADC Method (Hazard Identification Risk Assessment and Determining Control) in the Palm Oil Processing Plant of PT. Perkebunan Nusantara VII Unit Bekri Lampung Tengah. *World Chemical Engineering Journal*, 8(1), 1–5.
- Hillson, D., & Murray-Webster, R. (2007). *Understanding and Managing Risk Attitude*. Gower Publishing.
- Hopkin, P. (2018). *Fundamentals of Risk Management: Understanding, Evaluating and Implementing Effective Risk Management* (5th ed.). Kogan Page.
- Hughes, P., & Ferrett, E. (2020). *Introduction to Health and Safety at Work: For the NEBOSH National General Certificate in Occupational Health and Safety* (7th ed.). Routledge.
- Ilyasa, H., Syaifudin, A. S., Rohman, A., Sanjaya, N., Deviatin, N. S., & Rahmawati, D. (2024). Analisa Penerapan HIRADC di Tempat Kerja sebagai Upaya Pengendalian Risiko: A Literature Review. *PREPOTIF: Jurnal Kesehatan Masyarakat*, 8(1), 48–58.
- International Organization for Standardization. (2018). *Risk Management: Guidelines* (ISO Standard No. 31000:2018). <https://www.iso.org/standard/65694.html>
- International Organization for Standardization. (2018). *Occupational Health and Safety Management Systems: Requirements with Guidance for Use* (ISO Standard No. 45001:2018). <https://www.iso.org/standard/63787.html>
- Kerzner, H. (2017). *Project Management: A Systems Approach to Planning, Scheduling, and Controlling* (12th ed.). John Wiley & Sons.
- Noventya Cahyani, S., Safirin, M. T., Donoriyanto, D. S., & Rahmawati, N. (2022). Human Error Analysis to Minimize Work Accidents Using the HEART and SHERPA Methods at PT. Wonojati Wijoyo. *PROZIMA (Productivity, Optimization and Manufacturing System Engineering)*, 6(1), 48–59.
- Prihatiningsih, S., & Suwandi, T. (2014). Penerapan Metode HIRADC sebagai Upaya Pencegahan Kecelakaan Kerja pada Pekerja Mesin Rewinder. *The Indonesian Journal of Occupational Safety and Health*, 3(1), 73–84.
- Ramli, S. (2010). *Sistem Manajemen Keselamatan dan Kesehatan Kerja OHSAS 18001*. Dian Rakyat.
- Republik Indonesia. (1970). *Undang-Undang Republik Indonesia Nomor 1 Tahun 1970 tentang Keselamatan Kerja*. Lembaran Negara Republik Indonesia Tahun 1970 Nomor 1. <https://peraturan.bpk.go.id/Details/50664/uu-no-1-tahun-1970>
- Republik Indonesia. (2012). *Peraturan Pemerintah Republik Indonesia Nomor 50 Tahun 2012 tentang Penerapan Sistem Manajemen Keselamatan dan Kesehatan Kerja*. Lembaran Negara Republik Indonesia Tahun 2012 Nomor 100. <https://peraturan.bpk.go.id/Details/5267/pp-no-50-tahun-2012>
- Ridley, J., & Channing, J. (2008). *Safety at Work* (7th ed.). Butterworth-Heinemann.
- Rotinsulu, F. N. C., Dundu, A. K. T., Malingkas, G. Y., Mondoringin, M. R. I. A., & Thambas, A. H. (2023). Risk Potential Analysis Using Hazard Identification, Risk Assessment and Determine Control (HIRADC) and Job Safety Analysis (JSA) Methods. *Asian Journal of Engineering, Social and Health*, 2(10), 1133–1141.
- Situmorang, H. N., Sitorus, H., Firdaus, F., & Ginting, L. M. (2022). The Analysis of Occupational Health and Safety Risks in Engineering Workshop Using the Hazard Identification Risk Assessment and Determining Control (HIRADC) Method. *Proceedings of the 2nd International Conference on Social Science, Humanities, and Public Health (ICOSHIP 2022)*, 1–8.
- Soesanto, D. P. G., & Susanto, N. (2024). Pencegahan Kecelakaan Kerja (Studi Kasus: Kompartemen Jasa Pelayanan Pabrik PT Pupuk Kalimantan Timur). *Industrial Engineering Online Journal*, 13(2), 1–10.
- Soptutan, G. E. M., Sompie, B. F., & Mandagi, R. J. M. (2014). Manajemen Risiko Kesehatan dan Keselamatan Kerja (K3) (Studi Kasus pada Pembangunan Gedung SMA Eben Haezar). *Jurnal Ilmiah Media Engineering*, 4(4), 229–238.

- Tarwaka. (2014). *Keselamatan dan Kesehatan Kerja: Manajemen dan Implementasi K3 di Tempat Kerja* (Edisi ke-2). Harapan Press.
- Ulfa, A. A., & Immawan, T. (2021). Analisis Manajemen Risiko dengan Penerapan ISO 31000 pada Proses Machining (Studi Kasus: Perusahaan AB). *Integrasi: Jurnal Ilmiah Teknik Industri*, 6(2), 42–50.
- Yazdi, M., Zarei, E., Adumene, S., & Beheshti, A. (2024). Navigating the Power of Artificial Intelligence in Risk Management: A Comparative Analysis. *Safety*, 10(2), Article 42.

APPENDIX

T

SEVERITY CATEGORY	
1 (Insignificant)	Treatable with first aid (generally due to minor injuries) or Countermeasures < 5 million
2 (Minor)	a. Need special/medical treatment / other recovery efforts (due to mild to moderate injury/fainting / momentary health decline) and does not cause loss of time accident b. A momentary decline in health, (Occupational Disease) referred to here such as Asthma, ARI, dermatitis, allergies, irritation, inflammation, dizziness/headache etc. c. Or loss of 5 million - < 50 million.
3 (Moderate)	a. Moderate to severe injury causing loss of time accident b. Permanent disability / partial loss of limbs but the person concerned is still possible to be re-employed c. Permanent decline in health/onset of occupational disease, including if exposed to stage Carcinoma (cancer) and can still be handled as a result of work activities d. Permanent impairment of health, (Occupational Disease) K in question such as Spontaneous abortion, liver, and digestive system disorders (Hepatitis / other liver diseases) e. Loss of 50-500 million
4 (Major)	a. Fatality, loss of limbs that do not allow re-employment, death or emergency conditions (fire/explosion/mass poisoning) loss > 500 million b. Required in other relevant legislation/requirements, eg: Aircraft Lift Operators must have an SIO. c. Occupational disease (PAK) that occurs if it has been affected by Carcinoma (cancer) stage 3 and 4 due to work activities, vascular and heart abnormalities (heart failure), genetic disorders (somatic effects)

PROBABILITY CATEGORY	
1 (Rare)	a. Rarely happens. Generally, occurs in emergency cases. b. At least within 3 years there has never been an incident (accident)
2 (Unlikely)	a. Rarely occurs. It occurs typically in abnormal or non-routine cases. b. For incidents, at least within the last 2 years there has never been an incident (accident). c. For ergonomic exposure/risk, occurs in non-routine activities min. 1 month (eg. during routine maintenance).
3 (Likely)	a. Likely to occur, generally occurs in routine activities b. For incidents, at least within the last 1 year - 6 months have occurred c. For exposure and ergonomic risk, it occurs in routine activities, at a minimum. once a month
4 (Almost Certain)	a. Frequent occurrence. b. For Incidents, at least within the last 6 months. c. Occurred in routine activities due to the absence of program & / training & / maintenance

Risk Category = Severity x Probability				
Severity (S) \ Probability (P)	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

CONTROL CATEGORY	
1	No specific controls are currently in place to minimize risk
2	a. Controls that have been carried out in the form of curative & / remedial actions b. Provision of PPE c. Visual management
3	There have been efforts to minimize risks, including; a. Provision of resources (machines / tools / personnel) / &t b. Preparation of personnel competencies including the necessary training c. Procedure development d. But there is no consistency of control & maintenance
4	Controls are carried out properly & consistently (corrective & preventive) in minimizing risks, including ; a. Provision of resources (machines/tools/personnel etc) b. Competence of personnel including the necessary training has been carried out Procedures have been made & socialized. c. Routine/periodic maintenance programs are made that ensure consistency of control or elimination/substitution / re-engineering efforts. d. Monitoring of these activities is carried out

AWARENESS CATEGORY	
1	There is no concern from employees in related areas. a. Employees do not understand the OHS hazards & risks that can occur
2	Employees in related areas are somewhat concerned. a. Employees understand the OHS hazards & risks that can occur b. Employees do control but have not met the established OHS standards
3	Concern has been obtained from related areas a. Employees understand the OHS hazards & risks that can occur b. Employees carry out control according to the results of the evaluation of OHS Hazards-Risks
4	There is a very concerned condition in the related area. a. Employees understand the OHS risks that can occur b. Employees understand and have carried out the controls set out c. There is a commitment from employees, an area in charge/management in providing facilities/tools that meet OHS standards & / OHS-related regulations & / or conduct periodic control.

Total = (Severity x Probability) - (Control x Awareness)	
Significant Risk?	Classify the results of the total value whether the activity / object in question is included in a significant risk or not. If the total value > 0, the risk is significant and must be controlled. If the total value is ≤ 0, but the risk value is ≥ 12, it is still a significant risk and must be controlled.
Final Risk Category	Classification of risk value results after assessment of employee control and concern. Employee control and concern, will automatically affect the decrease in risk level Risk Score ≥ 12, then categorized as HIGH Risk; Score 3-11, then categorized as MEDIUM Risk; Score 1-2, then categorized as LOW See Risk Category Matrix

FINAL RISK CATEGORY		
RISK LEVEL	POTENTIAL RISK	CONTROL ACTION
High	> 12	NOT ACCEPTABLE (STOP) Work should not be performed until the risk level is reduced. If the risk cannot be reduced even with unlimited resources, the work is stopped and should not be performed.
Medium	3-11	Additional controls must be implemented to reduce the risk level. Additional controls must be implemented over a period of time, but the work can still continue.
Low	1-2	No additional controls are required. Monitoring is required to ensure existing controls are maintained and implemented.

No	Processes and Activities	Hazard	Risk	Scoring (1)			Initial Risk Category	Existing Control			Scoring (2)			Significant Risk?	Final Risk Category	Control Measures (Elimination / Substitution / Engineering Control / Administrative Control / PPE)
				Severity	Probability	Risk Assessment		Infrastructure	Administrative	Personnel	Control	Awareness	Total			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Slitting Line	Physical	Pinched	3	3	9	Moderate	Machine guard, Emergency stop	Safety sign	Safety gloves	3	4	-3	Not Significant	Low	Engineering Control: Installation of sensors on the machine. PPE: Cut-resistant gloves.
			Fallen Mother Coil	4	3	12	High	Alarm during crane operation	Safety signs, routine maintenance on machines	Safety helmet	3	4	0	Significant	Low	Administrative Controls: Create a safe area for crane use and work by crane operating SOPs.
			Slashed by machine blade	3	2	6	Moderate	Machine guard, Emergency stop	Safety Line, Safety sign, Routine maintenance on machines	Safety gloves	2	2	2	Significant	Low	PPE: Cut-resistant gloves.
			Truncated	3	2	6	Moderate	Machine guard, Emergency stop	Safety Line, Safety sign, Routine maintenance on machines	Safety gloves	3	4	-6	Not Significant	Low	Engineering Control: Installation of sensors on the machine. PPE: Cut-resistant gloves.
			Noise	2	4	8	Moderate			Earplug	2	3	2	Significant	Low	Substitution: Replacing noisy machines or processes with quieter ones. Engineering Control: Using sound and vibration dampers around the engine. Administrative Controls: Training on noise hazards and safe procedures.
			Electrocution	4	1	4	Low		Safety sign, routine check on electricity	Safety gloves	2	3	-2	Not Significant	Low	Engineering Control: Periodic cable inspection. Administrative Controls: Work according to the slitter. machine SOP and electrical safety training. PPE: Insulating safety gloves and insulating shoes.
		Chemical	Scratched by corrosion materials (rust)	2	3	6	Moderate			Safety gloves	2	2	2	Significant	Low	PPE: Cut-resistant glove.
		Ergonomics	Unergonomic working position	2	4	8	Moderate	Ergonomic work desk			1	2	6	Significant	Moderate	Engineering Control: Design of an ergonomic workstation Administrative Controls: Training on proper working positions.
		Psychosocial	Fatigue	2	4	8	Moderate				2	1	6	Significant	Moderate	Engineering control: Improving the workplace design to be ergonomic and enhancing ventilation and lighting. Administrative Controls: Training and awareness programs on fatigue management for workers and stretching for 2–3 minutes.
2	Pipe Making Line	Physical	Impaled on Slit Coil	4	3	12	High	Alarm during crane operation	Safety signs, routine maintenance on machines	Safety helmet	3	4	0	Significant	Low	Administrative Controls: Creating a safe lifting area using a crane.
			Slashed by machine blade	3	2	6	Moderate	Machine guard, Emergency stop	Safety Line, Safety sign, Routine maintenance on machines	Safety sign	2	2	2	Significant	Low	Engineering Control: Installation of sensors on the machine. PPE: Cut-resistant gloves.
			Truncated	3	2	6	Moderate	Machine guard, Emergency stop	SOP for the use of cutting machines, Safety Lines, Safety signs, Routine maintenance on machines	Safety gloves	3	4	-6	Not Significant	Low	Engineering Control: Installation of sensors on the machine. PPE: Cut-resistant gloves.
			Eyes exposed to sparks	2	3	6	Moderate		Safety sign	Safety glasses and face shield	2	2	2	Significant	Low	
			Electrocution	4	2	8	Moderate		Safety sign, routine check on electricity		2	3	2	Significant	Low	Administrative Controls: Working according to the welder usage SOP and electrical safety training. PPE: Electrical insulating safety gloves.
			Fire	4	1	4	Low		Fire Emergency Response SOP, fire alarm, fire extinguisher		3	3	-5	Not Significant	Low	Substitution: Replacing machine cables with stronger and fireresistant ones. Administrative Controls: Providing a safe area and distance during the welding process and supplying a fire hydrant.
			Noise	2	4	8	Moderate			Earplug	2	3	2	Significant	Low	Substitution: Replacing noisy machines or processes with quieter ones. Engineering Control: Using sound and vibration dampers around the engine. Administrative Controls: Training on noise hazards and safe procedures.
		Chemical	Scratched by corrosion materials (rust)	2	2	4	Low			Safety gloves	2	2	0	Not Significant	Low	PPE: Cut-resistant gloves.

		Ergonomic	Muscle injury due to incorrect working position	2	5	10	Moderate	Ergonomic work desk			1	2	8	Significant	Moderate	Engineering Control: Design of an ergonomic workstation. Administrative Controls: Training on proper working positions.
		Psychosocial	Fatigue	2	4	8	Moderate				2	1	6	Significant	Moderate	Engineering control: Improving the workplace design to be ergonomic and enhancing ventilation and lighting. Administrative Controls: Training and awareness programs on fatigue management for workers and stretching for 2–3 minutes.
3	Galvanizing	Physical	Slipped	4	2	8	Moderate		Safety Sign	Safety shoes	2	2	4	Significant	Moderate	Administrative Controls: Immediate cleaning of liquid spills.
			Overwhelmed	4	3	12	High	Alarm during crane operation	Safety sign, routine maintenance on the machine	Safety helmet	4	4	-4	Significant	Low	Administrative Controls: Creating a safe lifting area using a crane.
			Splashed	4	3	12	High		Safety Sign		2	3	6	Significant	Moderate	Engineering Control : Installation of barriers on chemical tanks.
			Fire	4	3	12	High		Fire Emergency Response SOP, fire alarm, fire extinguisher		3	3	3	Significant	Moderate	Substitution: Replacing machine cables with stronger and fireresistant ones. Administrative Controls: Providing a safe area and distance during the welding process and supplying a fire hydrant.
		Chemical	Contact with skin & eyes	4	3	12	High		Safety sign	Safety glasses, safety gloves, wear pack	3	3	3	Significant	Moderate	PPE: Use of face shields and chemical-resistant wear packs.
			Chemical inhalation	3	4	12	High		Safety Sign	Masker respirator	3	3	3	Significant	Moderate	Engineering Control: Create a local ventilation system and maximize exhaust function.
		Ergonomic	Unergonomic working position	2	4	8	Moderate				1	2	6	Significant	Moderate	Engineering Control: Design of an ergonomic workstation. Administrative Controls: Training on proper working positions.
		Psychosocial	Fatigue	2	4	8	Moderate				2	1	6	Significant	Moderate	Engineering control: Improving the workplace design to be ergonomic and enhancing ventilation and lighting. Administrative Controls: Training and awareness programs on fatigue management for workers and stretching for 2–3 minutes.
4	Packing	Physical	Hit by a pipe	4	3	12	High	Alarm during crane operation	Safety sign	Safety helmet	2	3	6	Significant	Moderate	Administrative Controls: Creating a safe lifting area using a crane.
			Pinched	2	2	4	Low		Safety sign	Safety gloves	3	4	-8	Not Significant	Low	Engineering Control: Installation of sensors on the machine. PPE: Cut-resistant gloves.
			Noise	2	4	8	Moderate			Earplug	2	3	2	Significant	Low	Substitution: Replacing noisy machines or processes with quieter ones. Engineering Control: Using sound and vibration dampers around the engine. Administrative Controls: Training on noise hazards and safe procedures.
		Ergonomic	Unergonomic working position	2	4	8	Moderate	Ergonomic work desk			1	2	6	Significant	Moderate	Engineering Control: Design of an ergonomic workstation. Administrative Controls: Training on proper working positions.
		Psychosocial	Fatigue	2	4	8	Moderate				2	1	6	Significant	Moderate	Engineering control: Improving the workplace design to be ergonomic and enhancing ventilation and lighting. Administrative Controls: Training and awareness programs on fatigue management for workers and stretching for 2–3 minutes.