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Risk Analysis and Occupational Safety Control Strategies at Each Workstation in the Production Division of PT XYZ

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Abstract

In facing increasingly intense business competition, companies are required to have human resources with optimal performance in order to achieve organizational goals. Employee performance is influenced by various factors, including work discipline and the implementation of Occupational Safety and Health (OSH). Work discipline reflects employees' compliance with company rules and procedures, while the implementation of OSH plays an important role in creating a safe, healthy, and comfortable working environment, thereby increasing productivity and reducing the risk of workplace accidents. PT XYZ, a manufacturing company engaged in fertilizer production, has implemented OSH programs in accordance with applicable Indonesian regulations, including Law Number 1 of 1970 concerning Occupational Safety and Government Regulation Number 50 of 2012 concerning the Implementation of the Occupational Safety and Health Management System. Effective OSH implementation is carried out through hazard identification and risk assessment to minimize the potential for occupational accidents and work-related diseases. Through practical work activities, students are given the opportunity to apply academic knowledge directly in an industrial environment and to understand work processes, safety culture, and professional work ethics. The synergy between higher education institutions and the industrial sector is expected to create a productive, safe, and sustainable working environment, while also preparing graduates to face the challenges of the professional world.

***Keywords**: Occupational Safety and Health (OSH), HIRADC, Risk Assessment, Workplace Safety, Manufacturing Industry*

1. Introduction

In an increasingly competitive business environment, companies require employees with strong performance to achieve organizational objectives. Employee performance is influenced by various factors, including work discipline and the implementation of Occupational Safety and Health (OSH). Work discipline reflects employees' compliance with rules and procedures, while effective OSH implementation helps create a safe, healthy, and comfortable working environment, thereby increasing productivity and reducing the risk of workplace accidents. Therefore, hazard identification and risk assessment are essential to prevent work-related accidents and occupational diseases [1].

The implementation of Occupational Safety and Health (OSH) is a crucial aspect of industrial operations, as it aims to protect workers from potential hazards and occupational diseases. Poor OSH practices can negatively affect employee productivity and overall company performance. Thus, industries are considered successful not only based on productivity but also on their ability to ensure a safe and healthy working environment.

Universitas Pembangunan Nasional "Veteran" Jawa Timur is committed to developing high-quality human resources who are ready to face the demands of the industrial sector. Through internship programs, students are provided with opportunities to apply theoretical knowledge in real industrial settings, enabling them to better understand workplace dynamics, operational processes, and professional work ethics.

PT XYZ is a manufacturing company engaged in fertilizer production and is committed to implementing standardized management systems to ensure efficiency, safety, and environmental sustainability. The implementation of OSH at the company refers to Law Number 1 of 1970 concerning Work Safety and Government Regulation Number 50 of 2012 concerning the Implementation of the Occupational Safety and Health Management System. Through the internship program at the company, students are expected to gain practical insight into OSH implementation in the industrial sector and effectively apply the knowledge acquired during their academic studies.
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2. Research Method

In the implementation of internship activities, systematic preparation stages are required, including planning, briefing, execution, evaluation, and finalization. This study applies a risk-based management approach using the HIRADC method as a tool to identify potential hazards, assess risk levels, and determine appropriate control measures for work activities. The HIRADC process (*Hazard Identification, Risk Assessment, and Determining Control*) is a method conducted by a team to identify potential hazards associated with a job, evaluate the risks arising from those hazards, and determine control measures for each assessed risk [2]. The objective of this study is to implement HIRADC at each production station in PT XYZ to ensure that all operational activities within the production division are carried out safely, in a controlled manner, and in accordance with risk-based occupational safety and health principles.

2.1. Research problem formulation and objectives

The research problem addressed in this study is:**"**How can the analysis and visualization of HIRADC data at PT XYZ support strategic decision-making in occupational health and safety (OHS) management**?"** The objective of this study **is** to identify and analyze potential workplace accidents and to evaluate existing and proposed control measures in order to minimize risk levels at workstations in the production division of PT XYZ.

3. Result and Discussion

This section presents the results and discussion to highlight the findings obtained from the HIRADC table. The insights generated from the data analysis are used to present risk levels (low, medium, high), types and sources of hazards, as well as the hierarchy and effectiveness of the implemented control measures, thereby providing information that supports more effective and strategic decision-making in occupational health and safety (OHS) management.

3.1. Risk-Based Management

Risk-Based Management (RBM) at PT XYZ as in many other large manufacturing companies, is a strategy used to identify, evaluate, and manage various risks that may affect the company's operations. This procedure establishes the methods and responsibilities for implementing management actions aimed at reducing risks to below the company's tolerance limits, thereby minimizing potential losses and enabling the company to take advantage of existing opportunities.
This procedure governs the initial preparation and periodic review of hazard identification and risk assessment at PT Nusa Palapa Gemilang Tbk, which are conducted for:

a) Routine and non-routine activities
b) Activities involving employees, visitors, and contractors
c) Worker-related or human factors, such as capability and physical capacity
d) Hazards arising from outside the workplace that impact quality, security, occupational health and safety, and the environment within the company's control
e) Hazards occurring in and around the workplace as a result of work activities under the company's control
f) Environmental aspects associated with activities within the factory environment
g) Infrastructure, equipment, and materials at the workplace, whether provided by the company or third parties
h) Changes or proposed changes within the company, including processes, equipment, activities, or materials
i) Relevant legal and regulatory requirements related to risk assessment and the implementation of necessary control measures
j) The design of work areas, processes, installations, machinery/equipment, operational procedures, and work organization, including their adaptation to human capabilities

3.2. Hazard Identification, Risk Assessment, and Determining Control (HIRADC)

Hazard Identification, Risk Assessment, and Determining Control (HIRADC) is a tool used to identify potential hazards or impact aspects, determine risk levels, and plan appropriate control measures. In its implementation, HIRADC consists of four main components, namely:

a. Hazard/Aspect:
condition that has the potential to cause losses in the form of workplace accidents, occupational diseases, environmental pollution, or property damage.

b. Risk/Impact:
The form of loss that arises as a result of workplace accidents, occupational diseases, environmental pollution, and/or property damage.

c. Risk Assessment:
The process of evaluating the likelihood, severity, and level of risk associated with potential hazards or aspects that may arise from a particular activity.

d. Control Measures:
Plans developed to reduce or eliminate risks so that their impacts can be minimized and work activities can be carried out safely and efficiently.

Likelihood		
Likelihood Level	**Description**	**Likelihood of Occurrence**
5	Frequently Occurs	Daily
4	May Occur	Once a Month
3	Rarely Occurs	Once Every Three Months
2	Very Rarely Occurs	Once a Year
1	Unlikely to Occur	Once in Ten Years (Very Rare)

Fig.1 : Probability Table

Severity				
Severity Level	**Impact**	**Health and Safety**	**Loss**	**Environment**
5	Catastrophic	Multiple fatalities or serious health impacts affecting several people	Extremely large material loss (bankruptcy)	Large-scale contamination of soil, water, and air
4	Severe	Single fatal accident or permanent disability, e.g., corrosive burns and silicosis	Material loss > IDR 5,000,000	Hazardous chemical spill into the environment.
3	Major	Reportable injury causing permanent health damage, e.g., hearing loss due to noise exposure	Significant material loss (IDR <500,000 to 5,000,000)	Moderate pollution, such as dust or fertilizer odor
2	Moderate	Injury resulting in lost work time and/or temporary health effects with full recovery	Moderate material loss (IDR 100,000 – 500,000)	Small material or waste spill, easily managed
1	Minor	Minor impact without health disturbance	Very small material loss (< IDR 100,000)	Minor local impact, such as dust or noise.

Fig.2 : Severity Table

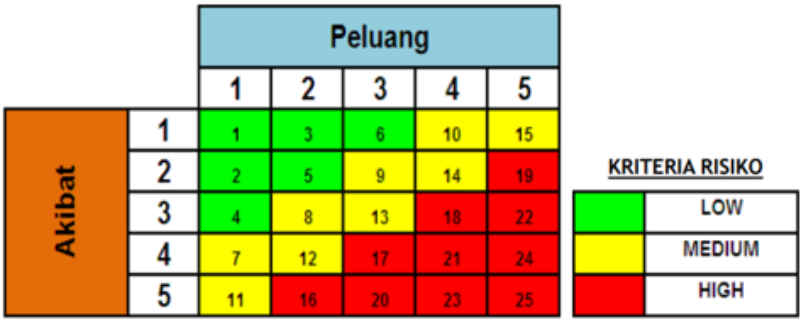

Fig.3 : Risk Matrix

Fig.4 : Hierarchy of Control

No	Kode	Istilah	Penjelasan
1	R (*routine*)	Jenis Aktivitas	Aktivitas kerja yang dilakukan secara berulang dan terjadwal dalam operasional sehari-hari.
2	NR (*Non routine*)		Aktivitas kerja yang tidak dilakukan secara rutin, biasanya bersifat incidental.
3	E (*Emergency*)		Aktivitas yang dilakukan hanya dalam kondisi keadaan darurat.
4	Eliminasi (*E*)	Hirarki Pengendalian Risiko	Upaya pengendalian dengan menghilangkan sumber bahaya sehingga risiko tidak ada lagi.
5	Substitusi (*B*)		Mengganti bahan, alat, atau proses berbahaya dengan yang tingkat bahayanya lebih rendah.
6	Rekayasa *Engineering* (*R*)		Pengendalian risiko melalui perancangan teknis, atau lingkungan kerja untuk mengurangi paparan bahaya.
7	Administratif (*A*)		Pengendalian melalui pengaturan prosedur kerja, SOP, instruksi kerja, jadwal kerja, pelatihan, dan rambu K3.
8	APD / PPE (*P*)		Pengendalian dengan penggunaan Alat Pelindung Diri untuk melindungi pekerja dari potensi bahaya yang masih tersisa.
9	*Low* (L/Rendah)	Tingkat Risiko	Risiko dengan dampak kecil dan kemungkinan kejadian rendah, masih dapat diterima.
10	*Medium* (M/Sedang)		Risiko dengan dampak dan kemungkinan sedang, perlu pengendalian dan pemantauan
11	*High* (H/Tinggi)		Risiko dengan dampak besar dan/atau kemungkinan tinggi, harus segera dikendalikan sebelum pekerjaan dilanjutkan

Fig.5 : Table Notes HIRADC

After the risk values are established, the next step is to identify the control measures required to reduce or manage the risk levels. In this process, the preparation of HIRADC needs to consider various factors, such as, for example, workplace environment factors, the standard of equipment used, ergonomic factors, and lastly, the workers involved. Risk control identification is carried out with reference to the Hierarchy of Control, which includes steps ranging from elimination, substitution, engineering control, administrative control, to the use of personal protective equipment (PPE) as the last effort. Controls include all controls that already exist, have been implemented, or that already exist. Severity refers to numbers based on the available severity matrix, adjusted to the process/work, taking into account the controls that have been implemented. Likelihood refers to numbers based on the available likelihood matrix, adjusted to the process/work, taking into account the controls that have been implemented. Risk Value is the result of multiplying the residual risk likelihood by the residual risk severity. Risk Level is a category based on the resulting risk number (RN), which is adjusted according to the predefined matrix [3].

The following presents the table of Hazard Identification, Risk Assessment, and Determining Risk Controls and Likelihood (HIRADC) for the fertilizer production process at PT. XYZ.

Jenis Kegiatan	DESKRIPSI RISIKO			Perundangan dan Persyaratan K3	Penilaian Tingkat Risiko			Pengendalian Risiko Awal	Penilaian Risiko Akhir		
	Kegiatan	Potensi	Kerugian		Peluang	Akibat	Tingkat Risiko		Peluang	Akibat	Tingkat Risiko
NR	Mixing Process (Pencampuran Formula)	Terpapar debu	Penyakit Akibat Kerja	UU No. 1 Tahun 1970, Pemnaker 38/2016, Pemnaker 08/2020	4	3	M	R: sistem ventilasi, A: SOP jadwal pembersihan area, P: masker debu	1	3	L
		Kebisingan	Penyakit Akibat Kerja		4	3	M	P: earplug	1	3	L
		Getaran mesin	Penyakit Akibat Kerja		3	4	M	R: redesign ergonomis, A: micro break, P: APD sesuai standar	1	3	L
NR	Conveyor (mengalirkan material)	Terpapar Debu	Penyakit Akibat Kerja	UU No. 1 Tahun 1970, Pemnaker 38/2016, Pemnaker 08/2020	4	3	M	R: sistem ventilasi, A: SOP jadwal pembersihan area, P: masker debu	1	3	L
		Terbentur conveyor	Penyakit Akibat Kerja		4	3	M	P: APD sesuai standar	1	3	L
NR	Pan Distribusi	Terpapar debu	Penyakit Akibat Kerja	UU No. 1 Tahun 1970, Pemnaker 38/2016, Pemnaker 08/2020	4	3	M	R: sistem ventilasi, A: SOP jadwal pembersihan area, P: masker debu	1	3	L
		Terpeleset tumpahan material	Lost Time Injury		3	4	M	E: pembersihan berkala, A: housekeeping & rambu peringatan, P: sepatu safety	1	4	L

NR	Mixing Process (Pencampuran Formula)	Terpapar debu	Penyakit Akibat Kerja	UU No. 1 Tahun 1970, Pemnaker 38/2016, Pemnaker 08/2020	4	3	M	R: sistem ventilasi, A: SOP jadwal pembersihan area, P: masker debu	1	3	L
		Kebisingan	Penyakit Akibat Kerja		4	3	M	P: earplug	1	3	L
		Getaran mesin	Penyakit Akibat Kerja		3	4	M	R: redesign ergonomis, A: micro break, P: APD sesuai standar	1	3	L
NR	Conveyor (mengalirkan material)	Terpapar Debu	Penyakit Akibat Kerja	UU No. 1 Tahun 1970, Pemnaker 38/2016, Pemnaker 08/2020	4	3	M	R: sistem ventilasi, A: SOP jadwal pembersihan area, P: masker debu	1	3	L
		Terbentur conveyor	Penyakit Akibat Kerja		4	3	M	P: APD sesuai standar	1	3	L
NR	Pan Distribusi	Terpapar debu	Penyakit Akibat Kerja	UU No. 1 Tahun 1970, Pemnaker 38/2016, Pemnaker 08/2020	4	3	M	R: sistem ventilasi, A: SOP jadwal pembersihan area, P: masker debu	1	3	L
		Terpeleset tumpahan material	Lost Time Injury		3	4	M	E: pembersihan berkala, A: housekeeping & rambu peringatan, P: sepatu safety	1	4	L
R	Compact Machine (Pemerataan Material)	terjepit komponen bergerak	Lost Time Injury	UU No. 1 Tahun 1970, Pemnaker 38/2016, Pemnaker 08/2020	3	4	H	R: Memasang batas jarak aman, A: SOP jarak aman	2	3	M
		Short circuit pada panel mesin	Lost Time Injury		3	5	M	R: sistem proteksi panel, A: SOP kelistrikan & inspeksi berkala	1	5	L
		Paparan debu	Penyakit Akibat Kerja		4	3	M	R: sistem ventilasi, A: SOP jadwal pembersihan area, P: masker debu	1	3	L
NR	Screen Rotary (Penyortiran)	Terpeleset tumpahan material	Lost Time Injury	UU No. 1 Tahun 1970, Pemnaker 38/2016, Pemnaker 08/2020	3	4	M	R: sistem ventilas, A: SOP jadwal pembersihan area, P: masker debu	1	3	L
		Postur kerja tidak ergonomis	Penyakit Akibat Kerja		3	4	M	E: pembersihan berkala, A: housekeeping & rambu peringatan, P: sepatu safety	1	4	L

Fig.6 : Table HIRADC

Based on the results of hazard identification, risk assessment, and risk control in the fertilizer production process at the Production Station of PT. XYZ, it can be concluded that the production process consists of seven main activities, namely: filling raw materials into the material hopper, weighing process, mixing process, material transfer using conveyors, distribution pan, compaction process using the compact machine, and the sorting process using a rotary screen. Each of these activities has different potential hazards with varying risk levels, requiring controls tailored to the characteristics of each task.

The initial risk assessment results show that most activities fall into the moderate (M) and low (L) risk categories. Based on the data in the table, only one activity has a high (H) risk level, namely the Mixing Process. The high risk in this activity is caused by the potential of being caught in machine parts if the work is performed without implementing the Lock Out Tag Out (LOTO) safety procedure, which could result in serious injuries or lost time injuries (LTI). Other activities, such as the material hopper, weighing process, conveyor, distribution pan, compact machine, and rotary screen, initially have moderate and low risk levels. These risks are generally caused by hazards such as dust exposure, the potential of getting caught in the conveyor, non-ergonomic working postures, and the risk of slipping due to material spills. Although these activities are not in the high-risk category, they still require adequate controls to prevent work-related accidents and occupational diseases.

After implementing risk controls according to the Hierarchy of Control, which includes engineering controls (installation of guards, emergency stops, safety sensors, electrical installation improvements, and ventilation systems), administrative controls (preparation and implementation of safe work SOPs, LOTO implementation, housekeeping, training, and designation of safe zones), and the use of personal protective equipment (PPE) according to standards, the risk levels decreased. The high risk in the mixing process was successfully reduced to a moderate (M) risk, while most of the moderate risks in other activities were lowered to low (L). Activities that initially had low risk levels could be maintained at that level through proper housekeeping and adherence to work procedures.

Overall, based on the final risk assessment after all risk control measures were fully implemented, it can be concluded that activities initially at moderate risk (M) gradually decreased to low risk (L), and no work activities were found in the high-risk (H) category in the fertilizer production process at the Production Station of PT. XYZ. This condition reflects that the implementation of risk controls, including engineering measures, administrative controls, and the use of PPE, has been carried out systematically and consistently, effectively reducing the potential for work accidents and occupational diseases. Nevertheless, activities that remain at moderate risk still require special attention through supervision, monitoring, and periodic evaluation to ensure the continued effectiveness of the applied controls and to prevent possible future work accidents and occupational diseases.

Risk control throughout this process has followed the regulations referenced in the table, namely:

a) Law No. 1 of 1970
b) Minister of Manpower Regulation No. 38 of 2016
c) Minister of Manpower Regulation No. 08 of 2020

These three regulations form the basis for hazard identification, risk assessment, and the implementation of occupational health and safety controls at the fertilizer production station. By implementing various control plans as listed in the risk evaluation table — ranging from installing guards at pinch points, adding safety sensors on machines with moving components, installing emergency stops along conveyor

paths, developing and implementing more structured safe work SOPs, improving electrical installations that previously posed hazards or short circuits, to the mandatory use of PPE in accordance with OHS standards — all these measures together have significantly reduced the risk levels of each work activity. The combination of engineering controls, procedural improvements, and disciplined use of PPE has proven effective in lowering risk categories from high or moderate to low, ensuring a safer and more controlled operational process. This method has the potential to be replicated in other industries with similar risk characteristics, such as the oil and gas sector and construction [4].

4. Conclusion

HIRADC (Hazard Identification, Risk Assessment, Determining Control) di PT XYZ digunakan untuk mengidentifikasi bahaya, menilai risiko, dan merencanakan pengendalian di setiap stasiun kerja Divisi Produksi. Aktivitas dikategorikan sebagai rutin, non-rutin, atau darurat, dengan risiko dinilai menggunakan metode L × S (Low, Medium, High) dan dikendalikan sesuai hierarchy of control. Berbagai potensi bahaya berhasil diminimalkan melalui guard, perbaikan instalasi listrik, SOP & LOTO, penggunaan APD, pengaturan area aman, dan peningkatan housekeeping. Melalui magang ini, saya memperoleh pengalaman langsung dalam penerapan HIRADC, memahami sistem K3, dan mengembangkan kemampuan analitis, teknis, serta profesional untuk mendukung budaya kerja yang aman, efisien, dan berkelanjutan.

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References

[1] Permatasari, E. D., Handriyanto, C. F., Fanani, T. Al, & Nurika, G. (2025). Rekomendasi Pengendalian Risiko Dengan Metode Hiradc Pada Industri Pengolahan Tahu Tuna Di Jawa Timur. *J-KESMAS: Jurnal Kesehatan Masyarakat*, *11*(1), 55. https://doi.org/10.35329/jkesmas.v11i1.6099

[2] Markus, A. Y., & Djunaidi, Z. (2024). Hazard Identification, Risk Assessment and Determining Control (Hiradc) Pada Kegiatan Perawatan Rolling Stock Equipment Di Tambang Bawah Tanah Pt. X. *Jurnal Ilmiah Manajemen, Ekonomi, & Akuntansi (MEA)*, *8*(2), 479–497. https://doi.org/10.31955/mea.v8i2.4002

[3] Marwah, D. S., Naufal, M., Zata, K. N., & Amri, M. F. (2024). HIRADC dan HIRADC dalam proses industri dan manajemen risiko K3. *Journal of Disaster Management and Community Resilience*, *1*(1), 19–27. https://doi.org/10.61511/jdmcr.v1i1.603

[4] Nur Fahmi Dwiyansah, Tri Ngudi Wiyatno, & Dwi Indra Prasetya. (2025). Analisis Risiko Keselamatan dan Kesehatan Kerja (K3) Menggunakan Metode Hira. *Jurnal Teknologi Dan Manajemen Industri Terapan*, *4*(3), 888–895. https://doi.org/10.55826/jtmit.v4i3.1068

[5] W. A. Jabbar, W. K. Saad, and M. Ismail, "MEQSA-OLSRv2: A multicriteria-based hybrid multipath protocol for energy-efficient and QoS-aware data routing in MANET-WSN convergence scenarios of IoT," *IEEE Access*, 2018, doi: 10.1109/ACCESS.2018.2882853.

[6] D. Niyigena, C. Habineza, and T. S. Ustun, "Computer-based smart energy management system for rural health centers," 2016, doi: 10.1109/IRSEC.2015.7455005.

[7] F.-Z. Younsi, A. Bounnekar, D. Hamdadou, and O. Boussaid, "SEIR-SW, Simulation Model of Influenza Spread Based on the Small World Network," *Tsinghua Sci. Technol.*, vol. 20, no. 5, pp. 460–473, 2015.

[8] A. Karmakar, S. S. Roy, F. Vercauteren, and I. Verbauwhede, "Efficient finite field multiplication for isogeny based post quantum cryptography," 2017, doi: 10.1007/978-3-319-55227-9_14.

[9] A. M. H. Pardede, M. Zarlis, and H. Mawengkang, "Optimization of Health Care Services with Limited Resources," *Int. J. Adv. Sci. Eng. Inf. Technol.*, vol. 9, no. 4, pp. 1444–1449, 2019, doi: 10.18517/ijaseit.9.4.8348.

[10] A. M. H. Pardede, Y. Maulita, and R. Buaton, "Application modeling ipv6 (internet protocol version 6) on e-id card for identification number for effectiveness and efficiency of registration process identification of population," in *Journal of Physics: Conference Series*, 2018, vol. 978, no. 1, doi: 10.1088/1742-6596/978/1/012017.

[11] Muammar Khadapi and V. M. Pakpahan, "Analisis Sentimen Berbasis Jaringan LSTM dan BERT terhadap Diskusi Twitter tentang Pemilu 2024", *JUKI*, vol. 6, no. 2, pp. 130–137, Nov. 2024.

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