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Hazard Identification and Analysis of Occupational Safety and Health Risks Using the HIRARC Method in the Production Process at PT Industri Majalaya

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Abstract

The textile industry is one of the manufacturing sectors that has a high potential for occupational safety and health (K3) hazards due to the use of high-speed machines, exposure to dust, noise, chemicals, hot temperatures, and repetitive work activities. Therefore, it is necessary to systematically identify hazards and risk assessments to prevent occupational accidents and occupational diseases. This study aims to identify potential hazards, analyze the level of risk, and determine risk control recommendations in the production process at PT Industri Majalaya using the *Hazard Identification, Risk Assessment, and Risk Control* (HIRE). The research was conducted through field observations, interviews with workers and K3 teams, and data collection at five main workstations, namely Blowing & Carding, Ring Spinning, Weaving, Dyeing, and Finishing. The identification results showed that there were 10 potential hazards consisting of 5 physical hazards, 2 mechanical hazards, 2 chemical hazards, and 1 ergonomic hazard. The results of the risk assessment showed that 8 hazards were in the medium category with a risk value of 6–9 and 2 hazards were in the high category with a risk value of 10, namely spindle cleaning activities without engine shutdown and noise exposure in the weaving area. No extreme category risks were found. Proposed control recommendations include installation *Zero-Speed Switch*, *Acoustic Panel*, improvement of local ventilation, periodic K3 training, and increased compliance with the use of personal protective equipment. The implementation of these recommendations is expected to increase the effectiveness of risk control and support the sustainable implementation of SMK3 at PT Industri Majalaya.

Keywords: Occupational Safety and Health (K3), HIRARC, Hazard Identification, Risk Assessment, Risk Control, Textile Industry.

1. Introduction

1.1 Background

The textile industry is one of the strategic manufacturing sectors that plays an important role in supporting national economic growth through its contribution to labor absorption, increased exports, and downstream industrial development(Wardini et al., 2024). However, the textile industry is also a sector that has a relatively high level of Occupational Safety and Health (K3) risk because it involves various complex production activities, the use of high-speed machines, exposure to chemicals, high working temperatures, noise, textile fiber dust, and repetitive work activities that have the potential to cause ergonomic disturbances. (Kurnianingtias, 2022; Prabaswari, Susanti, Utomo, & Shintira, 2020)

Various studies show that occupational accidents and work-related diseases in the textile industry are still problems that need serious attention (Anggraini, 2022; Suratna et al., 2025). Risks that are often found include workers getting stuck in moving parts of the machine, hearing loss due to prolonged noise (Haque, Alam, Uddin, & Islam, 2025; Suratna et al., 2025), respiratory system disorders due to exposure to cotton dust, irritation due to dyeing chemicals, to musculoskeletal disorders caused by unergonomic working postures (Yani, Anniza, & Priyanka, 2020). If these potential hazards are not identified and controlled appropriately, they can cause work accidents, reduce productivity, increase company operational costs, and have an impact on worker welfare. (Pereira et al., 2024)

The implementation of Occupational Safety and Health (K3) is one of the efforts that must be made by companies to create a safe, healthy, and productive work environment. In Indonesia, the implementation of the Occupational Safety and Health Management System (SMK3) is regulated in Government Regulation Number 50 of 2012 which requires companies to conduct hazard identification, risk assessment, and risk control systematically and sustainably(Indrayana, Personal, Tamin, & Mahani, 2021; Kusuma, Prihastini, Haryawan, & Aryani, 2023). Therefore, every company needs to have an effective method to recognize potential hazards and determine control priorities based on the level of risk at hand.

PT Industri Majalaya is a company engaged in the integrated textile industry that carries out various production processes ranging from fiber processing, spinning, weaving, dyeing, to fabric refinement processes. Each stage of the process has different hazard characteristics (Wardini et al., 2024). Based on the results of initial observations, the company has implemented various K3 programs such as the establishment of an Occupational Safety and Health Advisory Committee (P2K3), the use of personal protective equipment (PPE), the implementation of routine inspections, and the implementation of work operational procedures. However, there are still some potential hazards that require further evaluation to ensure that all occupational hazards have been identified and optimally controlled.

One of the widely used methods in K3 risk management is HIRARC (*Hazard Identification, Risk Assessment and Risk Control*) (Fadilah & Herbawani, 2022). This method allows the identification of hazards to be carried out systematically, followed by an assessment of the level of risk based on the likelihood of occurrence (*Likelihood*) and the severity of the impact (*Severity*), then determine the appropriate control actions based on the risk control hierarchy (Rizky, Widaningrum, & Salma, 2024). The advantage of the HIRARC method over other methods is its ability to prioritize risk control in a structured manner so that companies can focus resources on the most critical risks (Pratiwi, Martina, & Deskafani, 2025).

Based on this description, research is needed on hazard identification and K3 risk analysis using the HIRARC method in the production process of PT Industri Majalaya. This research is expected to provide an overview of the level of risk in each work activity, determine the risk priorities that must be controlled immediately, and produce effective control recommendations to support the improvement of K3 performance and the sustainable implementation of SMK3 in the company.

1.2 Problem Formulation

Based on the above background, the formulation of the problem in this study is:

1. What are the types of hazards identified at each production process workstation at PT Industri Majalaya?
2. What is the level of K3 risk based on likelihood and severity values using the HIRARC method?
3. What are the appropriate risk control recommendations according to the hierarchy of control and priorities?

1.3 Research Objectives

The objectives to be achieved from this research are:

1. Identify potential hazards in the areas of blowing, carding, ring spinning, weaving, dyeing, and finishing.
2. Analyze the level of risk with the HIRARC semi-quantitative matrix based on the consensus of the internal K3 team.
3. Formulate priority risk control recommendations that can be integrated into the company's K3 program.

1.4 Research Benefits

This research is expected to provide benefits:

1. For companies: As an input to increase the effectiveness of hazard control and reduce the near miss rate.
2. For workers: Increase awareness of potential hazards in their respective work environments.
3. For knowledge development: Adding references for the application of HIRARC in the medium-scale textile industry.

2. Research Methods

2.1 Design and Research Object

This study uses a descriptive method with a qualitative and semi-quantitative approach using the Hazard Identification, Risk Assessment and Risk Control (HIRARC) method (Fadilah & Herbawani, 2022). The descriptive method is used to describe the actual conditions of the implementation of Occupational Safety and Health (K3) in the production process of PT Industri Majalaya and identify various potential hazards contained in

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each work activity. A semi-quantitative approach is used to assess the level of risk based on the value of the likelihood of harm (Likelihood) and the severity of the impact caused (Severity).

The selection of the HIRARC method is based on its ability to systematically identify hazards, determine the level of risk, and prepare control recommendations based on the risk priorities found. This method is widely used in the implementation of the Occupational Safety and Health Management System (SMK3) because it can provide a comprehensive picture of risk conditions in the work environment (Kusuma et al., 2023).

The object of the research is all work activities contained in the main production process of PT Industri Majalaya which includes Blowing and Carding, Draw Frame and Ring Spinning, Weaving, Dyeing, and Finishing units. The five areas were chosen because they are the main processes in the textile industry that have potential physical, mechanical, chemical, and ergonomic hazards (Kurnianingtias, 2022; Wardini et al., 2024). The research was carried out at PT Industri Majalaya located in Majalaya District, Bandung Regency, West Java in March 2025.

2.2 Data Collection and Research Instruments

The data used in the study consisted of primary data and secondary data. Data collection is carried out to obtain complete information about working conditions, potential hazards, risk levels, and controls that have been implemented by the company.

2.2.1 Primary Data

Primary data was obtained directly from the research site through field observations, interviews, and work environment measurements.

Observations were carried out at all workstations to observe worker activities, the use of personal protective equipment (PPE), the condition of machinery and equipment, the layout of the work area, and the conditions of the work environment that have the potential to cause danger. Observations were carried out during two work shifts so that they could describe operational conditions as a whole.

Interviews are conducted in a semi-structured manner to workers and parties involved in the management of the company's K3. Respondents consisted of 15 production operators, 2 senior operators, 3 production supervisors, 1 engineer, and 1 company K3 officer. The purpose of the interview is to obtain information about work experience, accident or near miss, level of compliance with safety procedures, and workers' perception of potential hazards. In addition to observations and interviews, work environment measurements were also carried out to obtain quantitative data on factors that can affect the health and safety of workers (Haque et al., 2025).

2.2.2 Secondary Data

Secondary data is obtained from various company documents and relevant literature. The data includes:

1. Occupational Safety and Health Management System (SMK3) Document.
2. Standard Operating Procedure (SOP).
3. Work accident and near miss data.
4. Work safety inspection report.
5. Workers' medical check-up data.
6. Machine maintenance data.
7. Scientific journals, books, and regulations related to K3 and the HIRARC method.

Secondary data is used to support the results of observations and interviews so that the analysis is more comprehensive. (Kusuma et al., 2023)

2.3 Research Instruments

The instruments used in this study include:

1. HIRARC observation sheet to record work activities, sources of hazards, risks, and controls that have been implemented.
2. Sound Level Meter (SLM) to measure noise levels in production areas.
3. Dust Sampler to measure the concentration of cotton dust in the Blowing and Carding area.

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4. Thermohygrometer to measure the temperature and humidity of the working environment.
5. Semi-structured interview form.
6. Documentation cameras to record field conditions.

The instrument is used to obtain accurate data and support the hazard identification process and risk assessment.

2.4 Research Flow Diagram

The stages of research are systematically arranged starting from problem identification to the preparation of risk control recommendations. The research flow diagram is shown in **Figure 1.**

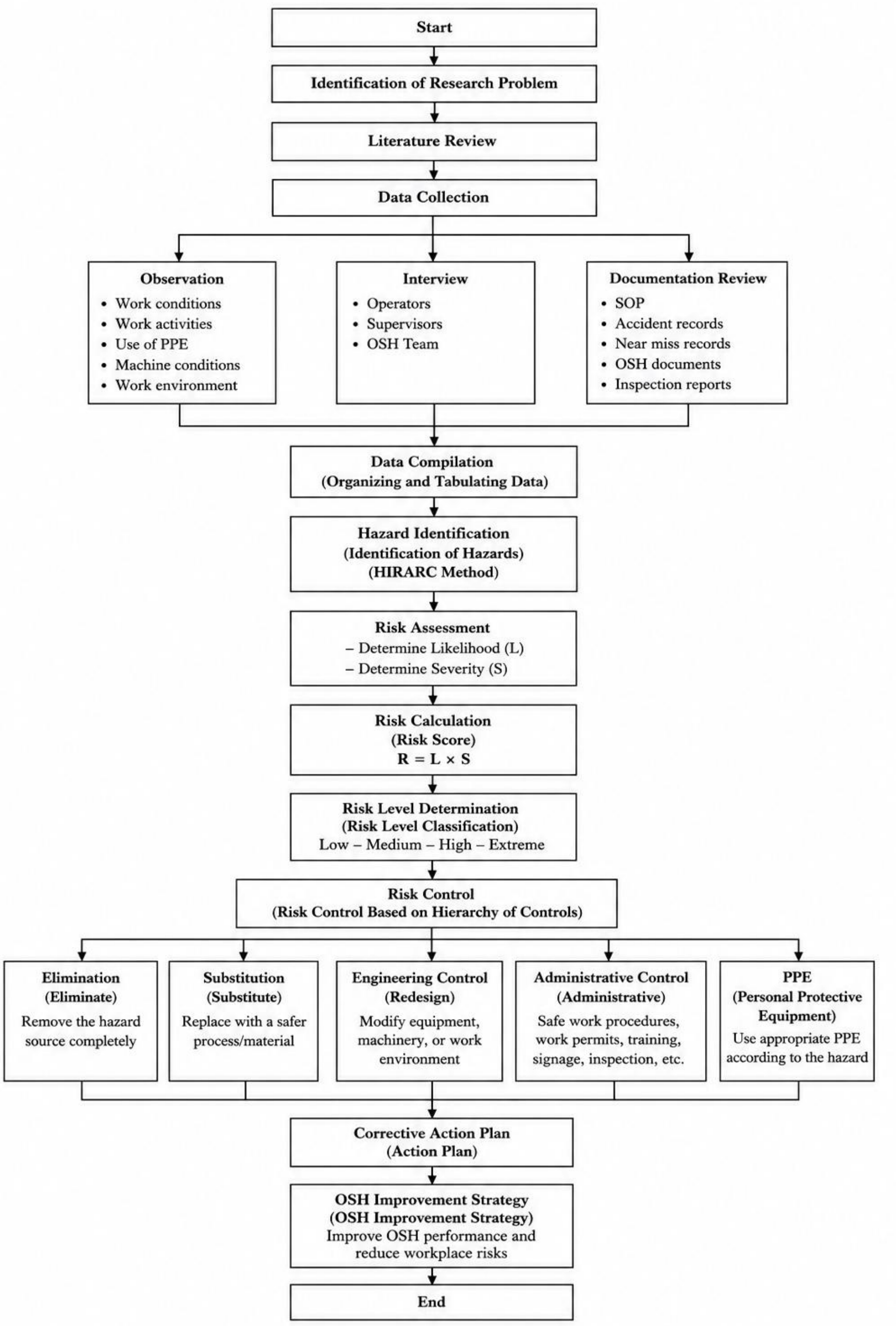

Figure 1. HIRARC Method Research Flow Chart

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2.5 Hazard Identification, Risk Assessment and Risk Control (HIRARC) Method

HIRARC is a method used to identify potential hazards, evaluate risk levels, and determine appropriate control measures (Fadilah & Herbawani, 2022). This method consists of three main stages, namely Hazard Identification, Risk Assessment, and Risk Control.

2.5.1 Hazard Identification

Hazard Identification is the initial stage that aims to identify all sources of hazards contained in each work activity. The identification process was carried out through field observations, interviews, analysis of company documents, and discussions with the K3 team.

The hazards found are then grouped into several categories, namely:

a. Physical hazards, such as noise, dust, heat, and slippery floors (Haque et al., 2025).

b. Mechanical hazards, such as rotating machinery, moving machine parts, and the risk of being pinched (Małysa, Pawlak, Šolc, & Midor, 2026; Satria Hanafi & Sholihah, 2017).

c. Chemical hazards, such as exposure to textile dyes, acetic acid, and mineral oils.

d. Ergonomic hazards, such as bending working positions and repetitive movements (Yani et al., 2020).

This stage generates a list of hazards that will be further analyzed at the risk assessment stage.

2.5.2 Risk Assessment

Risk Assessment is a risk assessment process to determine the level of risk of each hazard that has been identified.

The assessment is carried out based on two main parameters, namely:

1. Likelihood (L), which is the possibility that a danger may occur.
2. Severity (S), which is the severity of the impact caused if the hazard occurs.

The risk value is calculated using the equation:

$$\mathbf{R = L \times S}$$

The results of the calculation were then classified into low, medium, high, and extreme risk categories based on the AS/NZS 4360:2004 risk matrix.

The determination of likelihood and severity values is carried out through discussions with the company's K3 team based on work experience, accident data, observation results, and actual conditions in the field**.**

2.5.3 Risk Control

The Risk Control stage is carried out to determine the most effective control measures against the hazards that have been assessed.

Risk management is structured based on a control hierarchy that includes:

1. Elimination, i.e. eliminating the source of the hazard.
2. Substitution, which is replacing the source of danger with a safer alternative.
3. Engineering Engineering, which is modifying equipment or the work environment.
4. Administrative Control, namely through SOPs, training, inspection, and supervision.
5. Personal Protective Equipment (PPE), which is the last protection for workers.

Control is prioritized on risks that have high and extreme levels of risk.

2.6 Risk Matrix used

Table 1. *Likelihood* On the AS/NZS 4360 standard

Level	Description	Remarks
5	*Almost certain*	There are ≥ 1 occurrence in each day

4	*Likely*	There are ≥ 1 incidents in each week
3	*Possible*	There are ≥ 1 incidents in each month
2	*Unlikely*	There are ≥ 1 incidents in each year
1	*Sweet*	There are ≥ 1 incidents in every 5 years

Table 2. Severity Scale On AS/NZS 4360 standard

Level	**Description**	**Remarks**
5	*Severe*	Fatality ≥ 1 person, very large losses, major operational disruption
4	*Major*	Serious injury, major production disruption
3	*Moderate*	Medical treatment required, significant financial loss
2	*Minor*	Minor injury, small financial loss
1	*Negligible*	No injury, negligible financial loss

Table 3. *Risk Raring* On AS/NZS 4360 standard

Likelihood	***Severity***				
	5	4	3	2	1
5	M	H	H	VH	VH
4	M	M	H	H	VH
3	L	M	H	H	H
2	L	L	M	M	H
1	L	L	M	M	H

Description:

- **L** = Low Risk
- **M** = Medium Risk
- **H** = High Risk
- **VH** = Very High Risk

2.7 Data Validation

Data validation was carried out through source triangulation techniques and group discussions with the company's K3 team. The risk assessment was carried out by five people consisting of the Head of Production, the K3 Supervisor, two senior operators, and one engineer. This method is used to reduce subjectivity in scoring likelihood and severity so that the results of risk assessments become more accurate and scientifically accountable.

3. Results and Discussions

3.1 Overview of PT Industri Majalaya's Production Process

PT Industri Majalaya operates an integrated textile production line. The company already has early-stage SMK3 documents, an active P2K3 team, and conducts monthly inspections. Based on observations, no extreme category risks were found. Of the 10 hazards identified, 2 of them were in the High category (R 10–15) and 8 were in the Medium category (R 5–9). This shows that the company has managed the inherent hazards quite well, but there is still room for improvement (Kurnianingtias, 2022; Wardini et al., 2024).

3.2 Hazard Identification

The results of hazard identification at each workstation are presented in **Table 4**

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Table 4. Hazard Identification at PT Industri Majalaya Based on Observation

Code	Stations	Activities	Types of Hazards	Source	Existing Control Conditions
H-01	Blowing & Carding	Unrolling & cleaning machine	Physical (dust)	*Beater*, *licker-in*	*Dust collector* cyclone, cloth mask, weekly cleaning schedule
H-02	Blowing & Carding	Cleaning cylinder *wire*	Mechanic (pinched)	Barbed cylinder	Fixed guard, no interlock during manual cleaning
H-03	Ring Spinning	Empty bobbin replacement	Ergonomics (bending posture)	Table height, reps	Rotation every 2 hours, without lifting aids
H-04	Ring Spinning	Fly cleaning around *the spindle*	Mechanic (stuck)	*Spindle* 12,000-15,000 rpm	Machine termination procedure (80% compliance)
H-05	Weaving (Air Jet)	Fabric inspection	Physical (noise)	65 units Loom, 88-91 dBA	Earplug (70% discharge), 3-hour area rotation
H-06	Weaving	Lubrication treatment	Chemicals (mineral oils)	Brake oil, thinner	SDS available, nitrile gloves, natural ventilation
H-07	Dyeing	Preparation of dye solution	Chemicals (irritants)	Dispersion, acetic acid	LEV portable, PPE rubber gloves, glasses
H-08	Dyeing	High temperature dyeing process	Physical (heat, steam)	Minor leaks in *the seal*	Thermal insulation, wait <60°C before opening
H-09	Finishing (Stenter)	Fabric feeding	Physical (surface temperature)	*Hot flue* 180-200°C	Guard mesh, PPE heatproof gloves
H-10	Finishing	Floor Cleaning	Physical (Slippery)	Water+Residual Finishing Agent	Slippery Warning Signs, Squeege (not always used)

3.3 Risk Assessment Results with HIRARC method

The assessment is carried out by an internal K3 team (5 people). Each member gave an L and S score, then averaged. The full results are presented in Table **5**.

Table 5. HIRARC Risk Value and Category

Code	Danger	L (average)	S (average)	R (L×S)	Categories	Brief Justification
H-01	Cotton dust 4.2 mg/m³	3 (medium)	2 (light)	6	Medium	Slightly above NAV, dust collector still works

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H-02	Cylinder wire without interlock	2 (small)	4 (weight)	8	Medium	Fatal risk, but only occurs during major cleaning
H-03	Repetitive bending posture	4 (large)	2 (light)	8	Medium	30% of operators complain of back pain
H-04	Non-stop spindle cleaning	2 (small)	5 (fatality)	10	Height	Violation of the procedure ±1x/month, potential amputation
H-05	Noise 88-91 dBA	5 (almost certainly)	2 (light)	10	Height	Constant exposure, risk of hearing loss
H-06	Mineral oil exposure	3 (medium)	2 (light)	6	Medium	Dermatitis in 15% of technicians
H-07	Acetic acid vapor (8 ppm)	3 (medium)	3 (medium)	9	Medium	Still below NAV but strong smell
H-08	Hot steam leakage	2 (small)	3 (medium)	6	Medium	Seal replaced routinely, minor leakage
H-09	Hot flue contacts	2 (small)	4 (weight)	8	Medium	Guard mesh prevents direct contact
H-10	Slippery floors	4 (large)	2 (light)	8	Medium	It happens often, but there have been no serious injuries

No risk was found with the Extreme category (R≥16). Two High category risks (H-04 and H-05) are top priorities.

3.4 Data Analysis and Risk Visualization

In this study, data analysis and risk visualization based on the results of the HIRARC assessment are presented to facilitate interpretation and risk control decision-making.

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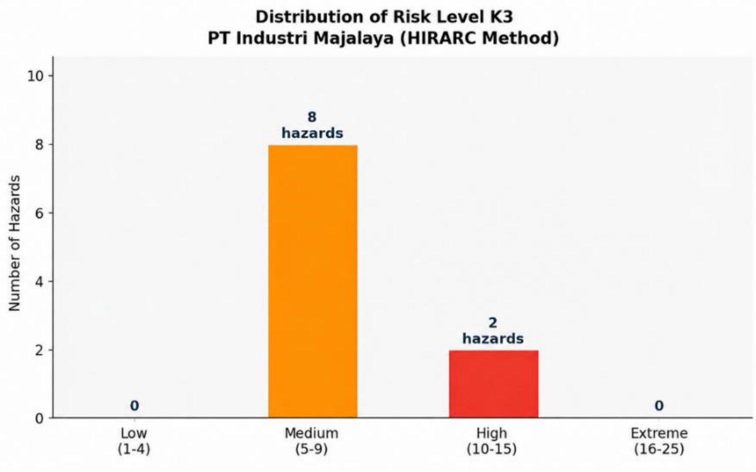

Figure 2. Distribution of K3 Risk Level of PT Industri Majalaya

Figure 2 shows the distribution of risk levels of the 10 identified hazards. As many as 80% of the hazards (8 out of 10) were in the Medium category (R 5-9), while 20% (2 out of 10) were in the High category (R 10-15). There are no Low or Extreme hazards. This distribution shows that PT Industri Majalaya has good K3 management but still needs improvement in the engineering aspect. (Anggraini, 2022; Wardini et al., 2024)

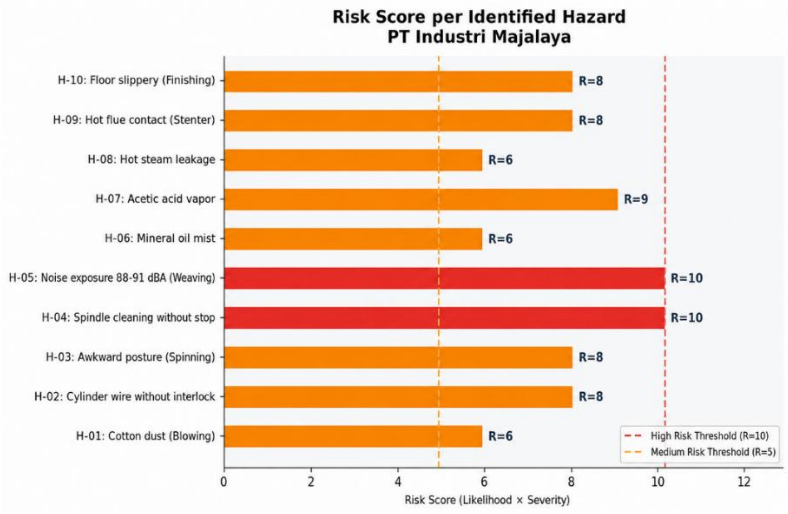

Figure 3. Risk Value per Identified Hazard

Figure 3 shows the comparison of the risk values (R) of all identified hazards. H-04 (spindle cleaning without machine stop) and H-05 (weaving area noise) have the highest risk value of R=10, exceeding the high risk limit. H-07 (acetic acid vapor) is close to the limit with R=9. Hazards H-01, H-06, and H-08 have the lowest risk values (R=6) but still require planned control.

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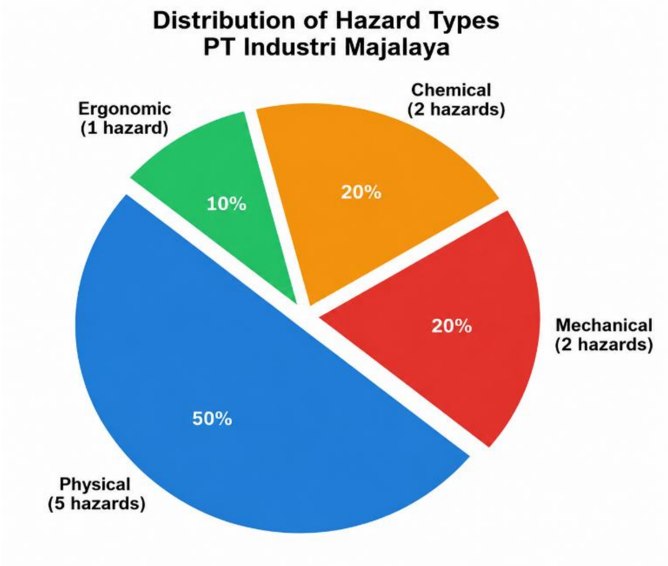

Figure 4. Hazard Type Distribution

Figure 4 shows the distribution of hazard types. Physical hazards dominate with 50% (5 out of 10 hazards), including dust, noise, heat, steam, and slippery floors. Mechanical and chemical hazards are 20% (2 hazards) each, while ergonomic hazards are 10% (1 hazard). The predominance of physical hazards is typical for the textile industry with high-speed machinery and intensive production environments.

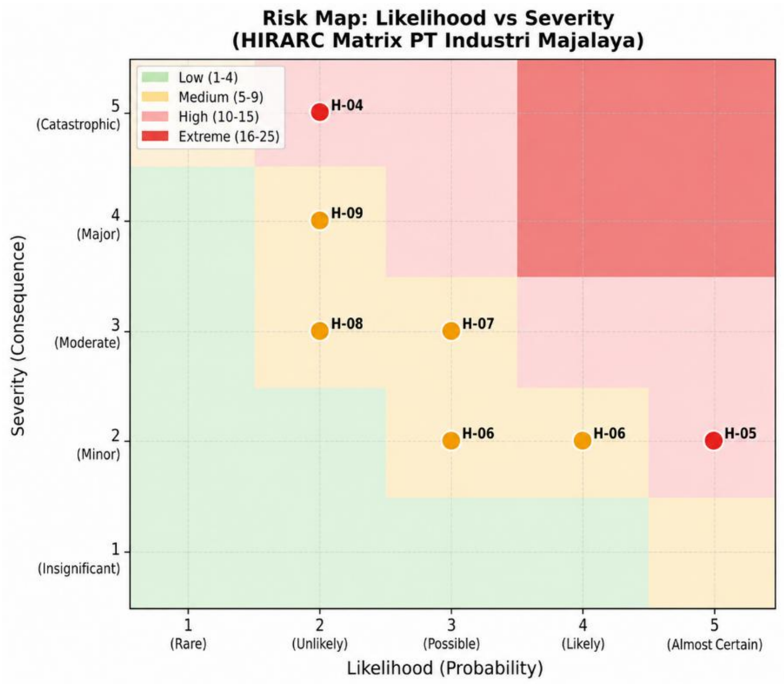

Figure 5 Risk Map: Likelihood vs Severity (HIRARC Matrix)

Figure 5. displays a mapping of the position of each hazard on the risk matrix based on Likelihood (L) and Severity (S) values. H-04 occupies a unique position in the upper right-hand corner (L=2, S=5) indicating very high severity despite its low frequency. H-05 is in position (L=5, S=2) indicating very frequent exposure. Hazards in the red zone (H-04, H-05) require immediate priority action.

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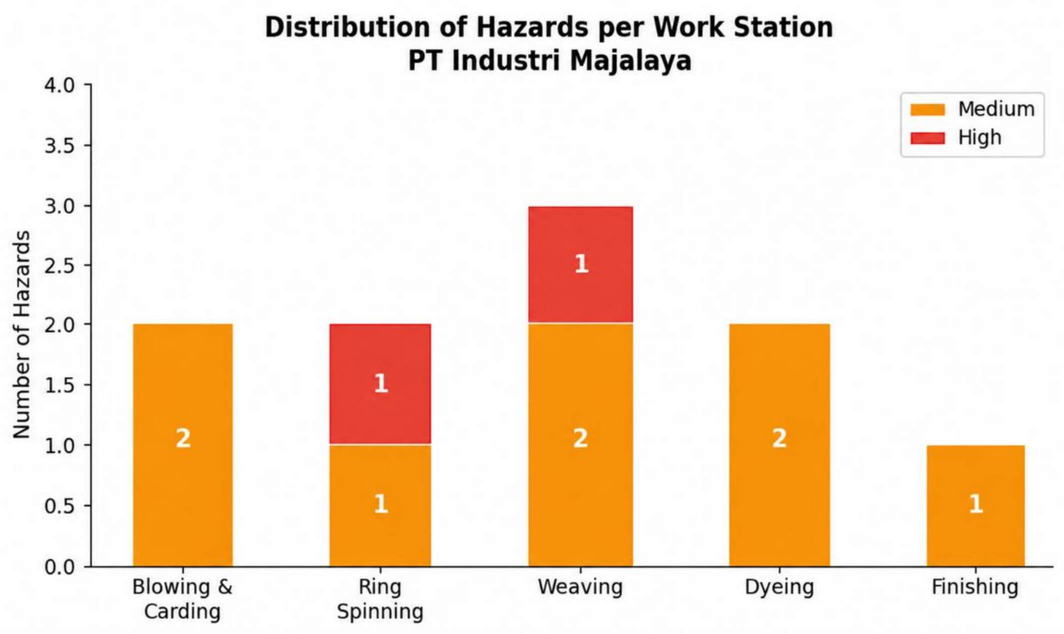

Figure 6. Hazard Distribution per Workstation

Figure 6 Displays hazard distribution by workstation. Blowing & Carding, Weaving, and Dyeing stations each have 2 documented hazards. Ring Spinning is the only station with a high hazard category (H-04), followed by Weaving (H-05). The Finishing Station has 1 hazard in the Medium category. This distribution shows that all workstations require equal K3 attention. (Gracia, Guzman, & Forst, 2022)

3.5 High-Risk Discussion

3.5.1 H-04 (Spindle cleaning without engine stop)

PT Industri Majalaya's K3 procedure requires the machine to be in a total stop before cleaning the cotton fibers on the spindle. However, observations and interviews show that about 20% of operators (3 out of 15) sometimes clean while the spindle is still coasting (spinning slows down) to save time. Spindles spinning at 12,000–15,000 rpm have the potential to cause finger amputation injuries. The R=10 value (L=2, S=5) reflects very high severity despite the relatively low frequency of violations.

Control recommendations: (1) Install a zero-speed switch that locks access up to 0 rpm revolutions; (2) Providing incentives for teams with zero procedural violations; (3) Refreshment training for the LOTO procedure every 3 months.

3.5.2 H-05 (Noise of weaving area)

Noise value of 88-91 dBA exceeds NAV 85 dBA for 8 working hours(Haque et al., 2025). With 65 units of Air Jet Loom engines operating simultaneously, noise exposure occurs almost certainly every day (L=5). Although severity is classified as mild (S=2) because the effects of hearing loss are cumulative and gradual, the risk of permanent Noise-Induced Hearing Loss (NIHL) is very real in the long term. PT Industri Majalaya has provided earplugs with an NRR of 25 dB, but the usage rate is only 70%. (Hasim & Mushidah, 2023)

Recommendations:

1. Install acoustic panels on the ceiling above the 10 noisiest engine units;
2. Perform proper earplug fitting training;
3. Consider earmuff for low-tolerance operators;
4. Perform 6 monthly audiometry for weaving operators.

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3.6 Significant Moderate Risk Discussion

3.6.1 H-01 (Cotton dust 4.2 mg/m³)

This value is only 5% above NAV (4.0 mg/m³) and is still within the limits of the engineering tolerance. Companies can upgrade from cyclone to bag filters to improve dust capture efficiency(Nafees, Matteis, Burney, & Cullinan, 2022). Positive note: based on the medical records of the last 3 years, no cases of byssinosis have been reported. (Setyaningsih et al., 2023)

3.6.2 H-03 (Bending ergonomics)

Complaints of low back pain were found in 30% of spinning ring operators. Short-term solution: 5-minute stretches every hour(Yirdaw, Kinfe, Belay, Bezie, & Natnael, 2025). Long-term: adjustable elbow-height bobbin table modification.

3.6.3 H-07 (Exposure to acetic acid vapor)

The results of personal sampling of 8 ppm are still below the Industrial Threshold Value (NABIH) of 10 ppm. However, the pungent smell signals the need for increased local ventilation. Permanent installation of a LEV with a capture velocity of 0.4 m/s is proposed.

3.7 Control Recommendations

Based on priorities, recommendations are prepared as in Table 6

Table 6. Risk Control Recommendations

Priorities	Code	Recommendations	Control Type	Estimated Cost	Target Time
1	H-04	Install *zero-speed switch* + cleaning door interlock	Engineering	IDR 45 million	2 months
2	H-05	*Acoustic panel* on 10 machine units + *earmuff* optional	Engineering + PPE	IDR 120 million	4 months
3	H-01	Upgrade *filter bag* on 2 dust *collector units*	Engineering	IDR 150 million	6 months
4	H-03	Adjustable table + structured stretching program	Administration + engineering	IDR 30 million	3 months
5	H-07	Permanent LEV over 4 dyeing machines	Engineering	IDR 200 million	8 months

4. Conclusion

4.1 Conclusions

Based on the results of hazard identification and risk analysis using the HIRARC method in the production process of PT Industri Majalaya, it can be concluded that:

1. Hazard identification successfully identified 10 potential hazards spread across five main workstations, namely Blowing & Carding, Ring Spinning, Weaving, Dyeing, and Finishing. The hazards found consisted of 5 physical hazards, 2 mechanical hazards, 2 chemical hazards, and 1 ergonomic hazard. Physical hazards are the most dominant type of hazard with a percentage of 50% of the total hazards identified.
2. The results of the risk assessment using the HIRARC method showed that there was no extreme category risk. Of the 10 hazards identified, 8 hazards were in the moderate category with a risk value of 6–9 and 2 hazards were in the high category with a risk value of 10. High category risks were found in spindle cleaning activities without engine shutdown (H-04) and noise exposure in the weaving area (H-05).
3. Physical hazards are the most dominant source of risk in the production process of PT Industri Majalaya. This shows that exposure to dust, noise, heat, and working environment conditions is still the main factor that has the potential to affect the safety and health of workers if not optimally controlled.

4. The implementation of the K3 program at PT Industri Majalaya has gone quite well, which is shown by the absence of extreme category risks and the implementation of various controls such as the use of PPE, the implementation of routine inspections, K3 training programs, and the implementation of safe work procedures at each workstation.
5. The risk control recommendations are focused on five main priorities with an estimated cost of IDR 545 million and an implementation target of 2 to 8 months. The proposed controls include the installation of *zero-speed switches*, *acoustic panels*, improvements to *the bag filter system*, the installation of *Local Exhaust Ventilation* (LEV), as well as improvements in administrative aspects and increased compliance with the use of PPE.
6. The HIRARC method has proven to be effective in identifying potential hazards, assessing risk levels, and determining risk control priorities in PT Industri Majalaya's production process. The results of this research can be used as a basis for increasing the effectiveness of the implementation of the Occupational Safety and Health Management System (SMK3) and supporting the creation of a safer, healthier, and more productive work environment.

4.2 Suggestions

Based on the above conclusions, some suggestions can be given:
For the Management of PT Industri Majalaya:
1. Immediately form a recommendation implementation team with a clear project charter and measurable KPIs;
2. Allocate a minimum of 10-15% of the K3 budget
3. Redo HIRARC every 6 months or in case of significant process changes;

For Employees:
1. Improve adherence to machine shutdown procedures before cleaning
2. Use PPE (earplugs, masks) disciplined and ask for replacement if damaged;
3. Report any new potential hazards to the K3 supervisor.

For future researchers:
1. Conduct a cost-benefit analysis of the recommended intervention
2. Expand the study on psychosocial aspects (work stress, night shifts) and mental health of textile workers;
3. Compare the effectiveness of HIRARC with the HAZOP or FMEA method in similar industries.

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