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Participatory Ergonomics for OHS System Design Using Job Safety Analysis and Risk Score

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ABSTRACT IN ENGLISH

PT. XYZ faces challenges with its Occupational Health and Safety (OHS) system, which is overly generic, lacks detailed risk analysis for high-risk jobs, and suffers from minimal worker involvement, leading to irrelevant control strategies. This study aims to design an effective and adaptive OHS system by integrating Participatory Ergonomics, Job Safety Analysis (JSA), and Risk Score techniques through a Participatory Action Research (PAR) design involving 50 technicians and supervisors. The results indicate a highly receptive environment for change, evidenced by high perceptions of Managerial Support (4.44) and Self-Involvement (4.11), alongside a low perception of added Workload (1.38). The collaborative JSA and Risk Score analysis successfully identified four primary high-risk jobs (high-voltage cable jointing, new distribution pole installation, switchgear maintenance, and protection equipment testing), pinpointing critical hazards such as electric shock and falls from height. Based on these findings, a structured OHS improvement program was formulated, featuring practical recommendations like semi-annual JSA updates, mandatory worker involvement in JSA reviews, and weekly safety talks. The study concludes that this integrated, participatory method is crucial for creating an effective and sustainable OHS system, as it enhances the accuracy of hazard identification and fosters a proactive safety culture owned by the entire organization.

Keywords:
OHS Management System;
Participatory Ergonomics;
Job Safety Analysis; Risk Score

1. INTRODUCTION

Occupational Safety and Health (OSH) is a fundamental aspect that must be prioritized by every company, especially those operating in the fields of engineering and electrical installation maintenance, where the risk of hazards is considerably high. According to the International Labour Organization, the implementation of an effective OSH management system has been proven to reduce workplace accidents by up to 40% [1]. Therefore, companies must design an OSH system that is not only compliant with standards but also practical and effective under real working conditions.

Nevertheless, many Occupational Health and Safety (OHS) systems currently implemented are too generic and fail to address the specific challenges encountered in the field. At PT. XYZ, the company selected as the case study for this research the existing OHS system has not yet conducted a detailed risk analysis for each type of high-risk technical task. As a result, hazard identification and control strategies are often inaccurate and less relevant to the workers. This issue is further exacerbated by the lack of active involvement from technicians and supervisors, the individuals who best understand the intricacies of the work in the design and evaluation of the OHS system. This gap between OHS policies and actual working conditions represents the core issue that this study aims to resolve.

To address this issue, this study aims to design an effective and adaptive Occupational Health and Safety (OHS) management system at PT. XYZ by integrating the participatory ergonomics approach, the Job Safety Analysis (JSA) method, and the risk scoring technique. Participatory ergonomics was chosen because it emphasizes the active involvement of workers in the design process [2], [3], thereby ensuring that the solutions developed are truly relevant and easy to implement., Job Safety Analysis (JSA) is a commonly used technique to identify potential hazards and assess the risks involved in each step of work activities [4], [5]. JSA helps companies design more accurate control strategies to reduce or eliminate work-related risks.

To support quantitative risk analysis, companies can also use a risk score to determine the priority of hazard management based on the level of risk identified [6], [7]. Risk scores provide essential insights for OSH management in allocating risk control resources optimally. By combining participatory ergonomics, the JSA technique, and risk scoring, company XYZ is expected to design an OSH management system that is not only technically effective but also tailored to the unique risk characteristics of the company.

Previous research has shown that implementing participatory ergonomics significantly improves working conditions. For instance, a study by Surya et al. (2021) was conducted a study at PT DRA Component Persada using qualitative methods involving HIRARC and fishbone diagrams to assess workplace accident risks. They identified eight hazards, with 38% categorized as medium risk, and proposed improvements using the 5W1H method [8]. Research by Ilmansyah et al. (2020) conducted a study at PT Shell Indonesia using the Job Safety Analysis (JSA) method on fuel loading and unloading activities. The results identified four medium-risk hazards caused by human error, with recommended controls including training, preventive maintenance, and routine safety inspections [9]. Sukapto et al. (2018) conducted research at PT PAI Bandung using Job Safety Analysis, Risk Score, and participatory ergonomics. They identified three high-risk workstations and recommended improvements like PPE, exhaust fans, and chemical storage solutions [10]. Krishnanmoorthy et al. (2025) conducted a systematic review involving 19 studies on nurses across various countries, using participatory ergonomic interventions to evaluate their effectiveness in reducing WMSDs, sick absenteeism, and improving work performance. Results showed multicomponent interventions, especially those including physical activities, were more effective than single interventions [11]. Similarly, Umaindra & Saptadi (2020) conducted a study at PT Ebako Nusantara using the Job Safety Analysis (JSA) method to identify risks at the Smoothmill department. The study found all nine work activities carried medium to high injury risks, especially hand injuries and eye hazards from wood chips, and recommended using PPE, 5S implementation, and operator training [12].

Based on this background, this study aims to implement participatory ergonomics using job safety analysis and risk scoring techniques to design an OSH system in company XYZ. The application of these methods is expected to generate accurate and effective recommendations for reducing hazards and workplace accidents. The direct involvement of workers will be a key factor in the success of the system, ultimately leading to improved productivity and overall company performance.

2. METHOD

2.1. Participatory Action Research (PAR)

This study employs a qualitative approach with a Participatory Action Research (PAR) design. PAR was selected because this study aims not only to investigate OHS issues within the company but also to provide implementable improvement recommendations based on the collaboration between the researcher and the workers [13].

In PAR, the researcher's role extends beyond merely collecting and analyzing data; it involves actively engaging in a process of change (action) alongside organizational members to improve systems or conditions currently considered sub-optimal. Workers are also fully involved in the processes of problem diagnosis, solution design, implementation of the improvement plan, and evaluation of the implemented solution's effectiveness [14].

Thus, the PAR design is highly aligned with the principles of the participatory ergonomics method in the effort to improve the OHS management system at this company. The active involvement of workers is expected to generate improvement recommendations that are more adaptive to the actual situation in the workplace.

2.2. Research Stages

This study was carried out through several main stages that were structured and interrelated. The first stage was the Problem Identification, in which the researchers conducted an initial assessment of Occupational Health and Safety (OHS) issues at PT. XYZ. This process involved initial field observations, interviews with management, and an analysis of existing workplace accident data.

The next stage was the Literature Review and Research Design. At this stage, an in-depth literature review was conducted regarding participatory ergonomics approaches, the Job Safety Analysis (JSA) method, and risk scoring techniques. The results of this review served as the basis for developing research instruments, including interview guidelines, the Employee Perceptions of Participatory Ergonomics Questionnaire (EPPEQ), and JSA worksheet formats.

Data Collection was conducted using three main methods. First, an observation at the work site was carried out to monitor technicians' activities and identify potential hazards. Second, interviews were held with technicians and supervisors to explore work processes, past encountered risks, and gather input for improving the OHS system. Third, the EPPEQ questionnaire was distributed to measure employees' perceptions of the implementation of the participatory ergonomics program within the company.

The collected data were then analyzed in three stages. First, a Participatory Ergonomics Analysis was conducted based on the EPPEQ questionnaire results to assess workers' perceptions of their involvement, managerial support, and the participatory work culture. Second, Job Safety Analysis (JSA) was performed by breaking down each work process based on observation and FGD results, then identifying potential hazards in each step. Third, a Risk Score Analysis was carried out to evaluate the level of risk for each identified hazard by considering its likelihood and severity.

The final stage of this study was the Formulation of Recommendations and Conclusions. The results of the three analytical methods were synthesized to formulate structured, practical, and applicable recommendations for improving the OHS management system. All findings were then summarized in the conclusion to illustrate the contribution of this research to the development of a more adaptive and sustainable OHS system.

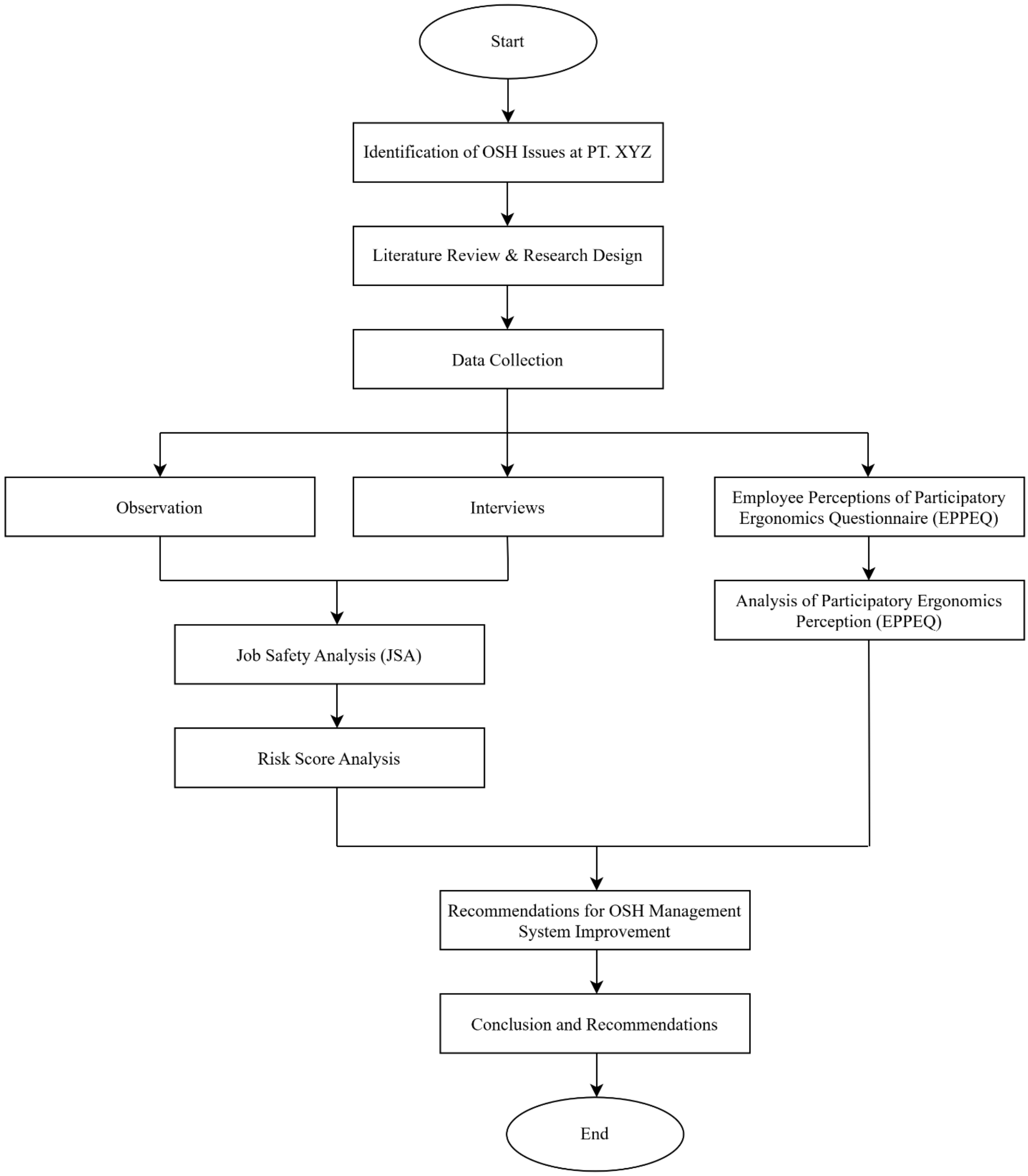

Figure 1. Research Flow in Designing an OSH Management System Based on Participatory Ergonomics, JSA, and Risk Scoring at PT. XYZ

2.3. Subjects and Research Location

The subjects of this study are technicians and supervisors from PT. XYZ, an engineering and electrical installation maintenance company. Technicians and supervisors were selected as subjects because they possess the most comprehensive understanding of the types of work, potential hazards, and the daily risks of work-related accidents. The active participation of both groups is crucial to ensure that the resulting risk control recommendations are aligned with on-site conditions.

The research was conducted at the head office and several project sites of PT. XYZ, located in the Surakarta region and its surroundings. This selection of locations was based on the company's operational coverage and its accessibility for the research team. Through direct observation and discussion at the project sites, it is expected that comprehensive feedback can be obtained from the workers regarding the primary potential hazards and the actual challenges they face in implementing the company's OHS system.

2.4. Data Collection

Three data collection methods were used in this study:

1. Observation

   Direct observation was conducted at the work sites to observe the work activities of technicians and supervisors and to identify potential hazards. The observation focused on high-risk jobs that had been previously outlined in the Job Safety Analysis (JSA). The aspects observed included unsafe work behaviors, potentially hazardous workplace conditions, and compliance with the use of Personal Protective Equipment (PPE).

2. Interviews

   Interviews were conducted with technicians and supervisors regarding their work processes, potential hazards they had encountered, and the barriers to implementing existing OHS procedures. The interviews also sought to gather worker input on recommendations for improving the company's OHS management system.

3. Employee Perceptions of Participatory Ergonomics Questionnaire (EPPEQ)

   Based on the Employee Perceptions of Participatory Ergonomics Questionnaire (EPPEQ), originally the Ergonomic Participatory Program Evaluation Questionnaire developed by Matthews, Gallus, & Henning (2011), five dimensions are used to evaluate a participatory ergonomics program from the workers' perspective [15], see Table 1. To determine the minimum required sample size, the "10 times rule" estimation method was used [16]. In this method, the five dimensions of the participatory ergonomics questionnaire were multiplied by 17, resulting in the following formula:
   n = 17 x number of indicators
   Where:
   n = minimum sample size

   Using this calculation, it was determined that the minimum required sample size was 50. Data was collected through random sampling, with this minimum number serving as a guideline for the observation sample. The data was then processed based on the Likert scale responses provided by the workers at PT. XYZ. The EPPEQ questionnaire, administered to 50 respondents from PT. XYZ consisted of 17 statements across 5 different dimensions. The questionnaire was scored based on the workers' selected answers, with a score from 1 to 5 assigned to each statement. Following the questionnaire distribution, scoring was performed by calculating the average score for each dimension, in accordance with the study by Matthews, Gallus, & Henning (2011) [15].

Table 1. Participatory Ergonomics Perception Questionnaire

No	Statement	SD (1)	D (2)	N (3)	A (4)	SA (5)
Dimension 1: Self-Involvement						
1	I feel actively involved in the OSH and ergonomics program in this company.	☐	☐	☐	☐	☐
2	I have sufficient opportunities to provide suggestions or input related to OSH improvements.	☐	☐	☐	☐	☐
3	My opinions and input are listened to by the OSH team or management.	☐	☐	☐	☐	☐
4	I personally participate in discussions or meetings regarding OSH.	☐	☐	☐	☐	☐
Dimension 2: Knowledge Base						
5	I have a good understanding of the ergonomic risks in my job.	☐	☐	☐	☐	☐
6	The OSH training provided has improved my knowledge about safe working procedures.	☐	☐	☐	☐	☐
7	I know who to ask if I have questions or issues related to OSH.	☐	☐	☐	☐	☐
Dimension 3: Managerial Support						
8	My immediate supervisor strongly supports the implementation of OSH and ergonomics programs.	☐	☐	☐	☐	☐
9	Management provides sufficient resources (time, budget, equipment) for OSH programs.	☐	☐	☐	☐	☐

No	Statement	SD (1)	D (2)	N (3)	A (4)	SA (5)
10	Management actively follows up on input or complaints from workers regarding OSH.	☐	☐	☐	☐	☐
11	Top management shows that occupational safety and health are a top priority.	☐	☐	☐	☐	☐
Dimension 4: Employee Support						
12	My coworkers often ignore OSH rules when unsupervised.	☐	☐	☐	☐	☐
13	My coworkers support and remind each other to work safely.	☐	☐	☐	☐	☐
14	There is good cooperation among workers in implementing the OSH program.	☐	☐	☐	☐	☐
Dimension 5: Workload or Pressure						
15	This OSH program significantly increases my workload.	☐	☐	☐	☐	☐
16	I feel pressured by the new rules introduced in this OSH program.	☐	☐	☐	☐	☐
17	Changes due to this OSH program makes my job more difficult to perform.	☐	☐	☐	☐	☐

Scale Description:
SD = Strongly Disagree
D = Disagree
N = Neutral
A = Agree
SA = Strongly Agree

2.5. Data Analysis

Data analysis is performed once data collection has been completed and the collected data is deemed sufficient. This study employs three methods for data analysis:

1. Participatory Ergonomics, used to measure the workers' perceptions of the implementation of ergonomic principles within the company.
2. Job Safety Analysis (JSA) serves to break down the stages of a work activity and identify potential hazards that may arise.
3. Risk Score, used to assess the risk level of a specific hazard and activity based on its likelihood and severity.

3. RESULT AND DISCUSSION

3.1. General Overview of the Existing OSH System at PT. XYZ

Based on observations and interviews, it was found that PT. XYZ has implemented an Occupational Safety and Health (OSH) management system for the past five years. The company's OSH policy is outlined in the Safety, Health, and Environmental (SHE) Policy, which regulates various aspects related to workplace safety. Table 2 is a general overview of the OSH system.

Table 2. General Overview of the Existing OSH System at PT. XYZ

No	Component	Description
1	OSH Policy	A SHE Policy is in place as the umbrella for the company's OSH regulations.
2	Hazard Identification and Risk Assessment	Risk analysis is conducted in general, but not yet detailed and specific for each type of technician's task.
3	OSH Training	All new workers are required to attend basic OSH induction training.
4	Safety Inspection	Not yet regularly involving field operators/technicians.
5	Personal Protective Equipment	Standard equipment provided: helmet, coveralls, and gloves.
6	Safety Talk	Conducted before starting daily work activities.
7	Incident Investigation	A reporting and investigation mechanism for workplace accidents is in place.

However, some workers expressed concerns about the lack of regular reviews for risks associated with each specific job task. Workplace conditions were also perceived as having room for improvement, particularly regarding more comprehensive hazard identification. It is expected that this study will provide recommendations for an OHS management system that is more adaptive to actual on-site conditions.

3.2. Measurement of Participatory Ergonomics Perception

Based on the questionnaire results, the data was analyzed by calculating the average score for each statement. For positive statements, the response was considered favorable if the average score was greater than 2.5. Conversely, it was considered unfavorable if the average score was less than 2.5. For negative statements, the response was considered favorable if the average score was below 2.5. Table 3 presents a summary of the average scores for each dimension of the questionnaire.

Table 3. Recapitulation of Participatory Ergonomics Questionnaire Averages

No	Dimension	Average Values	Overall Average
1	Self-Involvement	3.88 4.18 4.24 4.12	4.11
2	Knowledge Base	3.47 3.68 4.64	3.93
3	Managerial Support	3.72 4.54 4.68 4.83	4.44
4	Employee Support	2.36 4.25 4.17	3.59
5	Workload or Pressure	1.41 1.19 1.53	1.38

Based on the analysis of the questionnaire data, it can be concluded that all dimensions with positive statements have an average score above 2.5. Conversely, the dimension with negative statements, specifically the workload or pressure dimension, has an average score below 2.5. The self-involvement dimension shows an average score of 4.11, indicating that every worker at PT. XYZ actively participates in efforts to improve occupational health and safety. The second dimension, knowledge base, has an average score of 3.93, signifying the existence of cooperation and information exchange related to work safety improvement efforts.

Meanwhile, the managerial support dimension, with an average score of 4.44, demonstrates that top-level management has provided adequate support for occupational health and safety issues at PT. XYZ. The employee support dimension, with an average score of 3.59, illustrates good cooperation in the effort to improve work safety at PT. XYZ. Finally, the workload or pressure dimension, with an average score of 1.38, reflects that the changes implemented to enhance occupational health and safety have a positive impact on worker performance at the company.

3.3. Identification of OSH Issues with the Highest Severity

Based on Focus Group Discussions with workers and direct observation, five primary job types with a high potential for occupational accidents at PT. XYZ were identified, as follows:

1. High-voltage cable jointing
2. Repair of underground cable lines
3. Installation of new distribution poles
4. Maintenance of electrical substation switchgear
5. Testing of protection equipment

The severity scores for the main potential hazards of each primary job type at PT. XYZ is presented in Table 4 below. These scores were determined through discussions with operators and direct observation of work procedures and have been validated by OHS and electrical installation safety experts at PT. XYZ.

Table 4. Severity Score

No.	Job Type	Main Potential Hazard	Severity
1	High-voltage cable Splicing	High-voltage electric shock	4 (Fatal)
2	Underground cable line repair	Buried by soil / Trench collapse	3 (Permanent disability)
3	New distribution pole installation	Struck by a falling pole	4 (Fatal)
4	Substation switchgear maintenance	High-voltage electric shock	4 (Fatal)
5	Protection equipment testing	High-voltage electric shock	4 (Fatal)

The severity score above shows that four job types have a severity rating of 4 (Fatal). Therefore, these four job types are a top priority for OHS risk mitigation to prevent accidents that could result in fatalities.

3.4. Job Safety Analysis and Risk Score

3.4.1. High-voltage Cable Splicing

Table 5 presents the Job Safety Analysis (JSA) for high-voltage cable splicing, breaking the process down into six main work steps. For each stage, from preparing Personal Protective Equipment (PPE) and installing grounding to cutting the cable and joining the conductor, the table identifies specific potential hazards. The identified hazards range from physical risks, such as cuts from sharp objects, tripping, and punctures to the fatal electrical risk of a short circuit caused by an improper connection. To mitigate these risks, a series of control measures is recommended. These focus on safe work procedures, including double-checking tasks against the SOP, using complete and appropriate PPE (helmet, insulating gloves), and exercising greater caution. The process culminates with a final voltage test before the cable is re-energized to ensure maximum safety.

Table 5. JSA Worksheet for High-Voltage Cable Splicing

No	Sequence of Work Steps	Potential Hazards	Control Recommendations
1	Preparation of equipment and PPE	a. Incomplete work tool b. Inappropriate PPE	a. Double-check the equipment list according to the SOP b. Use complete PPE (helmet, harness, electrical insulating gloves, safety shoes)
2	Installation of grounding	a. Incorrect body position and posture b. Bumping into objects / Tripping	a. Stretch before work b. Stay focused while working c. The work area must be kept tidy
3	Cutting the cable end	a. Cut by a sharp object b. Struck by flying cable pieces	a. Use a safety cutter b. Ensure no one is in the cutting area
4	Stripping cable insulation	a. Struck by sharp conductor piece b. Cut by a sharp object	a. Be careful when stripping insulation b. Use PPE gloves
5	Installation of terminals	Scratched/punctured by sharp terminals	a. Be careful when installing terminals b. Pay attention to hand position
6	Conductor jointing	Short circuit due to incorrect connection	a. Double-check the connection b. Test the voltage before re-energizing

Table 6 show the risk score for high-voltage cable splicing.

Table 6. Risk Score for High-Voltage Cable Splicing

No	Risk Type	Likelihood	Severity	Risk Score	Risk Level
1	High-voltage electric shock	3	4	12	High
2	Fall from height	2	3	6	Medium
3	Struck by / Punctured by sharp objects	2	2	4	Low
4	Fire	1	4	4	Low
5	Muscle injury	2	1	2	Low

Explanation:
Likelihood:
1 = Rare (less than 5%)
2 = Occasional (5–50%)
3 = Frequent (more than 50%)

Severity:
1 = Minor (minor injuries)
2 = Moderate (serious injuries)
3 = Major (permanent disability)
4 = Fatal

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The main risk in high-voltage cable splicing activities is electric shock, with a high-risk level. Key controls include ensuring that equipment and PPE are in good condition, maintaining a safe distance from the voltage source, and performing voltage testing before re-energizing.

3.4.2. New Distribution Pole Installation

Table 7 details the Job Safety Analysis (JSA) for the new distribution pole installation process, breaking the job down into five main stages, from the site survey to cable connection. The analysis highlights several serious potential hazards, such as electric shock during the survey, being struck by the pole during lifting, back injuries, and the fatal risk of a fall from height. As a solution, critical control measures are recommended. These include identifying surrounding electrical networks, maintaining a safe distance from equipment, using appropriate lifting equipment, ensuring effective communication among workers, and the mandatory use of Personal Protective Equipment (PPE), such as a full-body harness, when working at height.

Table 7. JSA Worksheet for New Distribution Pole Installation

No	Sequence of Work Steps	Potential Hazards	Control Recommendations
1	Site survey	Medium-voltage electric shock	Identify electrical cable networks or poles around the site
2	Drilling the pole hole	Struck by the earth auger	The operator must be in a safe position away from the auger's rotation area
3	Lifting and lowering the pole	Struck by the pole	a. Use lifting equipment according to its capacity b. Maintain clear communication between workers c. Stay in an area clear of the pole's drop zone
4	Screwing the pole foundation	Back strain/soreness	Use lifting aids to avoid repetitive bending movements
5	Connecting cables to the pole	Fall from height	a. Use a full-body harness and tie off properly to the pole b. Do not climb the pole if it is wet or slippery

Risk Score for new distribution pole installation is presented in Table 8 below.

Table 8. Risk Score for new distribution pole installation

No	Risk Type	Likelihood	Severity	Risk Score	Risk Level
1	Struck by a pole	2	4	8	High
2	Fall from height	3	3	9	High
3	Struck by an earth auger	1	3	3	Low
4	Electric shock	2	4	8	High
5	Back injury	3	1	3	Low

Explanation:
Likelihood:
1 = Rare (less than 5%)
2 = Occasional (5–50%)
3 = Frequent (more than 50%)

Severity:
1 = Minor (minor injuries)
2 = Moderate (serious injuries)
3 = Major (permanent disability)
4 = Fatal

The main risks in installing a new distribution pole are being struck by the pole, falling from height, and electric shock, all of which carry fatal potential. Key controls include effective communication among workers, the use of proper lifting equipment and safety harnesses, and maintaining a clear zone around the erected pole.

3.4.3. Substation Switchgear Maintenance

Table 9 presents the Job Safety Analysis (JSA) for substation switchgear maintenance, outlining six crucial work steps. The analysis clearly identifies the primary hazards: high-voltage electric shock and the risk of an arc flash when the panel is opened or cables are being worked on. Therefore, the most emphasized control measure is ensuring the substation is completely de-energized and properly grounded before any work begins. Other recommendations focus on the use of specialized PPE, such as insulating gloves, periodic equipment calibration, and good team communication to prevent physical hazards like pinched fingers when the panel is re-closed.

Table 9. JSA Worksheet for Substation Switchgear Maintenance

No	Sequence of Work Steps	Potential Hazards	Control Recommendations
1	Preparation of equipment and PPE	a. Insufficient availability of work tools b. Inadequate PPE	a. Cross-check the work equipment list b. Use standard PPE (helmet, safety shoes, rubber gloves, harness)
2	Installation of grounding	a. Electric shock while installing clamps b. Incorrect body posture	a. Ensure the substation is de-energized before entry b. Use complete PPE c. Stretch before installing grounding
3	Opening the switchgear panel (PHB)	Exposure to high voltage inside the panel	a. Ensure the substation is completely de-energized and properly grounded b. Consult with electrical personnel before opening the panel
4	Cable terminal dressing/termination	Short circuit / Arc flash	a. Use high voltage insulating rubber gloves b. Remove jewelry that can conduct electricity
5	Functional testing of equipment	Faulty measuring equipment leading to inaccurate results	Calibrate and test measuring equipment periodically
6	Re-closing the panel	Hand/finger pinch points	a. Be careful when closing the panel b. Ask coworkers if their position is clear before closing

Table 10 show the risk score for substation switchgear maintenance.

Table 10. Risk Score for substation switchgear maintenance

No	Risk Type	Likelihood	Severity	Risk Score	Risk Level
1	High-voltage electric shock	3	4	12	High
2	Fall from height	2	3	6	Medium
3	Struck by a heavy object	1	3	3	Low
4	Arc flash	2	2	4	Low
5	Fire	1	4	4	Low
6	Slips/trips	2	1	2	Low

Explanation:
Likelihood:
1 = Rare (less than 5%)
2 = Occasional (5–50%)
3 = Frequent (more than 50%)

Severity:
1 = Minor (minor injuries)
2 = Moderate (serious injuries)
3 = Major (permanent disability)
4 = Fatal

Using the risk score, the primary risk of high-voltage electric shock becomes a top priority for control, as it is classified at a high-risk level.

3.4.4. Protection Equipment Testing

Table 11 presents the Job Safety Analysis (JSA) for protection equipment testing, breaking the process into seven stages from preparation to results evaluation. The analysis highlights the primary risks, electric shock and arc flash, especially when applying the test voltage, along with other hazards like oil spills, physical injuries from dropped equipment, and misinterpretation of data. Therefore, the emphasized control measures include procedures for de-energizing the power source, using appropriate PPE, calibrating measurement tools, and ensuring solid team coordination to conduct the entire process safely and accurately.

Table 11. JSA Worksheet for protection equipment testing

No	Sequence of Work Steps	Potential Hazards	Control Recommendations
1	Preparation of test equipment and PPE	Incomplete equipment, Inappropriate PPE	a. Checklist for completeness of test equipment b. Use standard PPE (coveralls, insulating gloves, safety shoes)
2	Installation of grounding	Electric shock from incorrect grounding installation	a. Ensure the power source is de-energized b. Use insulated gloves c. Test the continuity of the grounding
3	Transformer oil sampling	Transformer oil spills/leaks	a. Use safe and leak-proof containers b. Prepare spill absorbent materials
4	Installation of the test transformer	Dropped/pinched by the transformer	a. Use appropriate lifting equipment b. Team communication is essential for coordination
5	Energizing the test voltage	Electric shock / Arc flash	a. Ensure there are no frayed cables b. Maintain a safe distance from the voltage source
6	Test data collection	Inaccurate data reading	a. Calibrate measuring equipment periodically b. Compare results from multiple measuring devices
7	Evaluation of test results	Misinterpretation of results	a. Training on test data interpretation b. Team discussion to review results

Risk score for protection equipment testing is presented in Table 12 below.

Table 12. Risk Score for protection equipment testing

No	Risk Type	Likelihood	Severity	Risk Score	Risk Level
1	Electric shock / Arc flash	3	3	9	High
2	Transformer oil spill	2	2	4	Medium
3	Dropped the test transformer	1	3	3	Medium
4	Test transformer explosion	1	3	3	Medium
5	Data misinterpretation	2	3	6	Medium

Explanation:

Likelihood:
1 = Rare (less than 5%)
2 = Occasional (5–50%)
3 = Frequent (more than 50%)

Severity:
1 = Minor (minor injuries)
2 = Moderate (serious injuries)
3 = Major (permanent disability)
4 = Fatal

The main risk during protection equipment testing is electric shock from an arc flash during test circuit ignition. Engineering controls are required to insulate the test equipment and minimize the potential for electric shock. Operators are also required to wear full personal protective equipment (PPE) to anticipate the worst-case scenarios.

3.5. Recommendations for OSH Management System Improvement

Improvement recommendations for the OSH management system at PT. XYZ is using a participatory ergonomics approach, based on the results of Job Safety Analysis (JSA) and risk score as in Table 13 below.

Table 13. OSH Management System Improvement Recommendations

No.	Recommendation	Objective	PIC (Person in Charge)	Frequency
1	Review and update JSA	To ensure the JSA reflects current conditions	Safety Officer	Semi-annually
2	Involve workers in the JSA review	To obtain input on hazards and controls from workers	Safety Officer	During each review
3	Hazard identification training	To improve workers' ability to recognize potential hazards	Safety Trainer	Annually
4	Enhance visual displays in the work area	To remind workers of key risks and their controls	Safety Officer	Quarterly
5	Conduct routine safety talks	To share information regarding new hazards and their solutions	Field Supervisor	Weekly
6	Involve workers in safety inspections	To identify unsafe conditions in the work area	Supervisor & Workers	Monthly

The improvement recommendations outlined in the table emphasize the importance of proactive and participatory approaches in enhancing the Occupational Health and Safety (OHS) management system at PT. XYZ. The key strategies proposed include regularly reviewing and updating the Job Safety Analysis (JSA), actively involving workers in hazard identification and safety inspections, and strengthening safety communication through training and routine safety talks. This approach aligns with findings from previous studies, such as those by Sukapto et al. (2018), which demonstrated that worker participation in the risk identification process can significantly improve the accuracy of hazard control and encourage compliance with safety procedures [10].

In addition, research by Ilmansyah et al. (2020) highlights the critical role of managerial support in providing adequate resources and safety training as a cornerstone of successful and sustainable OHS implementation [9]. Based on these findings, the recommendations in this study carry significant managerial implications—specifically, the need for management to integrate OHS programs into the company's operational policies, allocate sufficient budget and time for safety activities, and embed worker involvement as a core element of workplace culture. These efforts not only enhance the effectiveness of hazard control measures but also foster a stronger and more sustainable safety culture through continuous engagement and shared awareness.

4. CONCLUSION

This study successfully demonstrates that the integration of the Participatory Ergonomics method, Job Safety Analysis (JSA), and Risk Score constitutes a highly effective approach for designing a comprehensive Occupational Health and Safety (OHS) management system at PT. XYZ. The results of the employee perception questionnaire (EPPEQ) indicate a strong foundation for implementing a participatory approach, with notably high average scores in Managerial Support (4.44) and Self-Involvement (4.11). This suggests that workers are not only willing to be actively involved but also feel supported by management, while the exceptionally low score for the Workload or Pressure dimension (1.38) confirms that the OHS program is not perceived as a hindrance to productivity. This supportive environment is a key enabling factor, ensuring that the recommendations generated by this study can be well-received and effectively implemented by all elements of the company.

Through the collaborative application of JSA and Risk Score analysis, this study successfully identified four specific job types with a fatal risk level: high-voltage cable jointing, new distribution pole installation, substation switchgear maintenance, and protection equipment testing. In-depth analysis of each work step successfully mapped the main potential hazards, such as high-voltage electric shock, falls from height, and being struck by poles, which consistently emerged as the highest-scoring risks (High Risk). The direct involvement of technicians and supervisors in this process was proven to enhance the accuracy of hazard identification and generate control recommendations that are significantly more practical and relevant to actual field conditions compared to the pre-existing, more general system.

As a final output, this study produced a structured, proactive, and sustainable OHS management system improvement program. The proposed recommendations—such as periodic JSA reviews (semi-annually), the mandatory involvement of workers in JSA reviews and monthly safety inspections, and strengthening communication through weekly safety talks—are designed to create a cycle of continuous improvement. Thus, it can be concluded that the combination of systematic technical risk analysis and the practical wisdom of the workforce is the key to building an OHS culture that is adaptive, effective, and has genuine ownership across the entire organization, which will ultimately and significantly reduce the rate of work-related accidents.

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