

Ergonomic Assessment Using the Ergonomic Checklist Method in the Production Unit

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Abstract. PT XYZ is engaged in the garment manufacturing industry and has become a garment manufacturing company with exports to five continents with modern manufacturing facilities in Southeast Asia. In the current condition of PT XYZ, there are still vulnerable and risky areas with the potential for work accidents. This prone and risky condition can be seen in the work environment where there are still scattered items, a low level of security, insufficient lighting, insufficient air ventilation, inadequate hand tools for workers, or the way employees lift materials where employees still make bending and twisting movements that are harmful to employee's health. Based on the book "Ergonomic Checkpoints: Practical and Easy-to-Implement Solutions for Improving Safety, Health, and Working Conditions" published by the International Labour Organization and the International Energy Agency, this study uses observation and interviews to collect data, using 132 ergonomic checklist questions and provides improvement recommendations. From the research 15 points still need to be done correctly, so they are prioritized for improvement. Recommended improvements include creating two-way lanes in the production unit to facilitate worker mobility and other recommendations.

Keywords: ergonomic checklist, work environment, occupational health and safety

1 Introduction

This research was conducted because it was reviewed from the background of the problems that the industrial world is facing. According to the Ministry of Industry of the Republic of Indonesia, the industrial world's development and technology and information are increasing rapidly [1]. The development of the industry causes competition between industries to be tighter. In the face of intense competition, it is necessary to improve product

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quality and company productivity; this is undoubtedly related to human resources. One of the efforts that can be made for the quality of human resources in the company is attention to aspects of occupational health and safety. Occupational Safety and Health aspects are essential for companies, following the Labour Law Number 13 of 2003 Article 86 Paragraph 2 and the Occupational Safety Law Number 1 of 1970 Article 2 Paragraph 1 [2]. Occupational safety involves the prevention of accidents and the protection of labor from Occupational Diseases.

According to the International Labour Organization, occupational accidents and diseases are serious problems. In 2013, 1 worker died every 15 seconds, and 160 workers became ill due to work [3]. In 2012, there were 2 million death cases due to occupational accidents. In 2018, 380,000 workers, or 13.7% of the 2.78 million, died from work accidents. In Indonesia, based on data from the Employment Social Security Agency (BPJS), work accident cases increased by 5.65% to 234,270 cases in 2021. Efforts to reduce this problem include analyzing the causes of hazards and improving productivity.

One of the largest industrial companies in Indonesia is PT XYZ, a garment manufacturing company in Southeast Asia with exports to five continents, focusing on denim and casual wear. However, there is still a risk of work accidents due to an unorganized work environment, low levels of safety, poor lighting, and material lifting techniques that are hazardous to employee's health. So this research aims to identify, provide recommendations for improvement, and improve the potential causes of work accidents at PT XYZ and evaluate the completeness of the work environment using the Ergonomic Checklist, which consists of 132 questions in 9 aspects of assessment. This research is conducted to improve safety, health, and work efficiency. The results obtained in this study are in line with research on Ergonomic Analysis with *Ergonomic Checklist* at ME RU IV Cilacap Workshop [4].

2 Methods

2.1 Time, Location, and Subject

This research began with data collection, carried out on 27 December 2023 - 27 January 2023, with the data collection location at PT XYZ in Semarang City, Central Java, Indonesia. The subjects studied were workers in the production unit of PT XYZ.

2.2 Research Method

The following is the research flow of "Ergonomic Assessment Using the Ergonomic Checklist Method in the Production Unit"

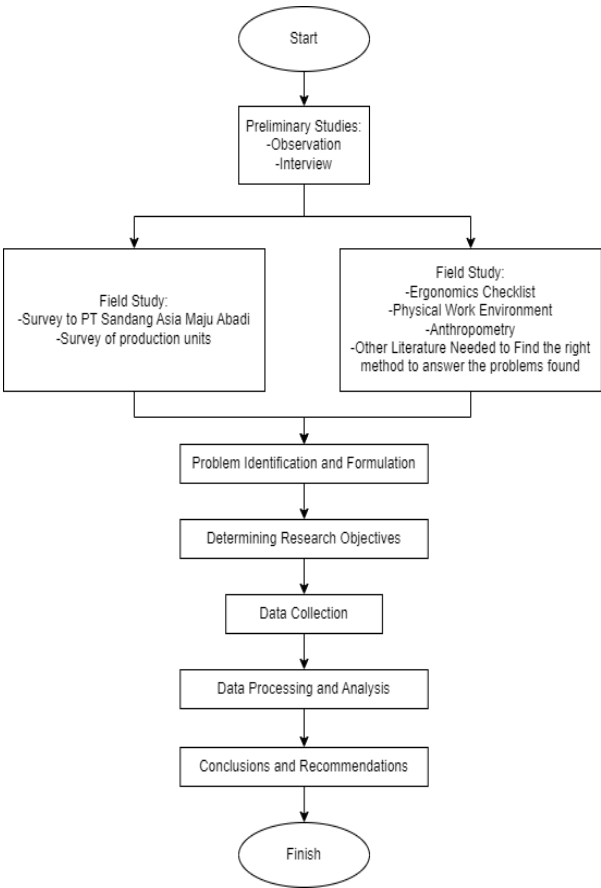


Figure 1. Research Flowchart

Starting with a preliminary study in the form of field studies and literature studies, aims to find problems that exist in the object of research. Then, the problem formulation is carried out based on the preliminary study that has been carried out. The next stage is to collect data through observations and interviews to get a direct picture of the working environment conditions in the production unit in the field. This data provides a better understanding of what factors can potentially cause occupational diseases and accidents.

Then, collect all the results of information using 132 ergonomic checklist questions and provide recommendations for improvement based on the book "Ergonomic Checkpoints: Practical and Easy-to-Implement Solutions for Improving Safety, Health, and Working Conditions" by the International Labour Organization and the International Energy Agency so that it specifically discusses the standards for implementing ergonomics and provides practical solutions that can be implemented without incurring high costs. The selection of this research method is in line with research on Ergonomic Evaluation Using Ergonomic Checklist in the Supply Department of PT Indocement [5].

3 Result and Discussion

3.1 Analysis of Ergonomic Checklist Aspects

In the ergonomic checklist observations that have been made, 15 sub-aspects are categorised as priorities for improvement. These improvement recommendations are based on the book "Ergonomic Checkpoints: Practical and Easy-to-Implement Solutions for Improving Safety, Health, and Working Conditions" by the International Labour Organization and the International Energy Agency [6].

3.2 Recapitulation of Ergonomic Checklist Results

In the *ergonomic checklist* observations that have been made, several sub-aspects of the nine aspects fall into the good and bad categories, and several sub-aspects are categorised as priorities for improvement in the production unit. The following is a recapitulation of the results of data collection with an ergonomic checklist [3]:

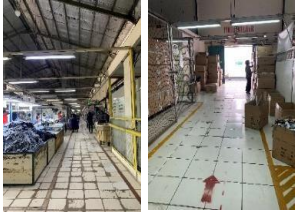
Table 1. Recapitulation of Ergonomic Checklist

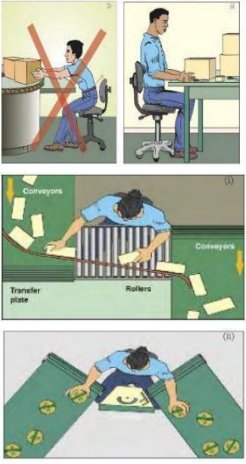
No.	Aspects	Sub-aspect	Assessment		No Found
			Good	No	
A	Material Storage & Handling	17	13	4	0
B	Tools or Hand Tools	14	11	2	1
C	Safety aspects of production machinery	19	13	4	1
D	Workstation Design Refinement	13	11	0	2
E	Workplace Lighting	9	9	0	0
F	Workspace	12	11	1	0
G	Work Environment Hazards	9	8	1	0
H	Public Facilities	12	9	3	0
I	Work/Organisation Setup	27	27	0	1
Total		132	112	15	5

3.3 Material Storage and Handling Aspects

The material storage and observation aspect discusses how the company treats materials being repaired and worked on. In this aspect, 17 sub-aspects are assessed. Thirteen sub-aspects are classified as good, and four as poor considered a priority for improvement.

Table 2. Analysis and Recommendations for Improvement of Aspect A

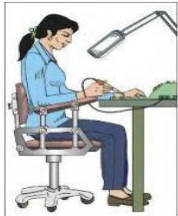
Documentation	Analysis	Recommended Improvements
Freeway transport routes with clear signage		
	The production unit is already signposted with a one-way transport route. However, the expected path can provide two-way access. This can facilitate access to worker mobility.	
Reduce manual handling of goods/materials by utilizing assistive devices		

	Material handling still uses manual labor (passed), which causes workers to get tired quickly, and there is a high risk of MSDs. So, mechanical aids such as pulleys and overhead cranes are needed.	
The existence of a special handle or place to hold the goods in the box to be lifted		
	Box handles are considered unsafe and have a high physical workload [7]. An improvement recommendation that can be applied to the box lift is to add space for finger grips to make the lift more ergonomic.	
Eliminate tasks that require bending or twisting at the waist when handling materials		
	There is work that is considered less ergonomic and has a high risk of back injury. Because workers still bend and twist their waists when checking activities. The recommendation that can be applied is to provide a chair with a design that suits the posture and arrange the appropriate work layout to avoid excessive waist twisting.	

3.4 Aspects of Tools or Hand Tools

The aspect of tools or hand tools discusses the company's handling of tools and hand tools that are owned and used at work. In this aspect, 14 sub-aspects are assessed. Eleven sub-aspects are classified as good, two sub- aspects are classified as poor, and one sub-aspect should have been found in the survey.

Table 3. Analysis and Recommendations for Improvement of Aspect B

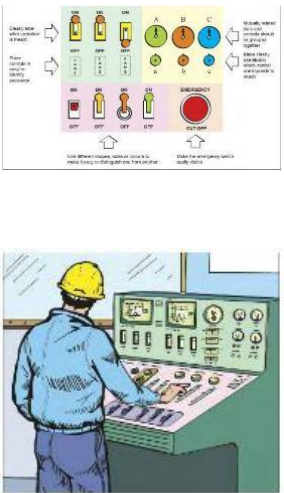
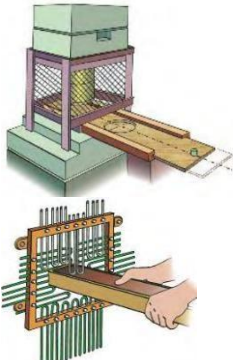
Documentation	Analysis	Recommended Improvements
Use hand supports when using work tools that require accuracy		
	Cutting fabric patterns using work tools certainly requires high accuracy and a long time, but a suitable workplace design needs to be done. A balance between workload and facilities is needed not to stress workers [3]. So, an additional design is needed in the form of a hand support on the work table.	 
Provide a fixed storage area for each tool		
	No work tool storage rack exists, so the tools are still scattered on the work table. Suggested improvement recommendations include a tool holder on each work table in each division, which aims to store tools properly and neatly.	 

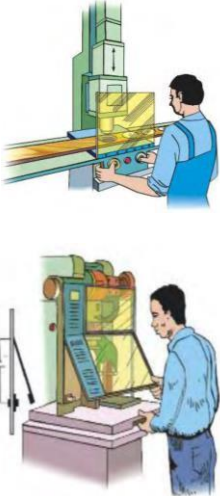
3.5 Safety Aspects of Production Machinery

The safety aspect of production machinery discusses the company's treatment of the safety of pumping machines for fuel distribution so that distribution activities run smoothly without any danger to workers. In this aspect, 19 sub-aspects are assessed. Fifteen sub-aspects are classified as good, and four are classified as poor.

Table 4. Analysis and Recommendations for Improvement of Aspect C

Documentation	Analysis	Recommended Improvements
Install protective aids or barriers to prevent workers' hands from coming into contact with hazardous machine parts		

	In a reasonably risky job (hands exposed to the machine) in a textile company, one of which is in the sewing division. A barrier/protective device is needed to prevent workers' hands from directly contacting the machine.	
Make each <i>panel/display</i> and sign different from each other and easy to read		
	Panels/displays for production work machines should be placed appropriately, and existing signs should be clearly stated and more evident. Therefore, an improvement recommendation that can be implemented is to provide different characters/labels with clear and easy-to-read information. Also, providing the required information as clearly and simply as possible so that signs can be added to indicate points or ranges where actions need to be taken.	
Using fixed guards or barriers to prevent worker's body parts from coming into contact with moving parts of the machine		
	Workers are directly involved in cutting work, so they come into contact with the tools used. This activity is risky, so protective equipment or barriers are installed to prevent hazards.	

Using a means of barrier that is bound / <i>interlocked</i> so that workers cannot reach the dangerous point of the machine in operation		
	The machine in the <i>cutting</i> division does not have a barrier so that workers can easily reach dangerous points on the machine. Barriers fastened to machinery are necessary to minimize the risk of workers being exposed to machinery in operation.	

3.6 Aspects of Improving Workstation Design

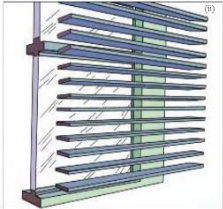
Improving workstation design discusses the workstation design prepared by the company. In this aspect, 13 sub-aspects are assessed and classified as good, so no sub-aspects need to be improved.

3.7 Aspects of Workplace Lighting

The lighting aspect of the workplace discusses the lighting provided by the company. In this aspect, nine sub-aspects are assessed and classified as good, so there are no sub-aspects that need to be improved.

3.8 Workspace Aspect

Table 5. Analysis and Recommendations for Improvement of Aspect F

Documentation	Analysis	Recommended Improvements
Improve the function and maintenance of the ventilation system to ensure clean air is available in the workspace		
	Ventilation is not fully maintained, and the number available needs to be improved. Increasing the number of vents in each division, especially those with high temperatures, such as the turning division, is necessary to maintain clean air.	

3.9 Aspects of Occupational Hazards

The work environment hazards aspect discusses environmental hazard triggers that may occur. In this aspect, nine sub-aspects are assessed. Eight sub-aspects are classified as good, and one is classified as poor.

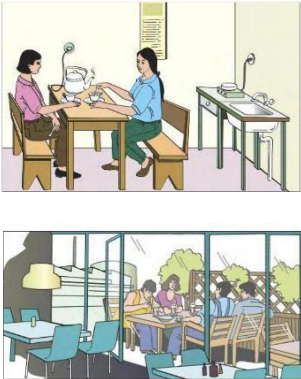
Table 6. Analysis and Recommendations for Improvement of Aspect G

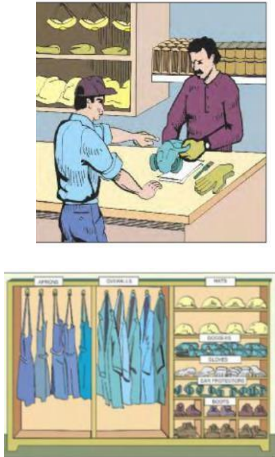
Documentation	Analysis	Recommended Improvements
Isolate or cover machines or machine parts that have high noise levels		
	Machines with high noise levels do not have sound enclosures. A sound enclosure or soundproofing is needed to reduce the noise level and maintain the health and comfort of workers.	

3.10 Aspects of Public Facilities

The public facilities aspect discusses the facilities provided by the Company. In this aspect, 12 sub-aspects are assessed. Nine sub-aspects are classified as good, and three are classified as poor.

Table 7. Analysis and Recommendations for Improvement of Aspect H

Documentation	Analysis	Recommended Improvements
Provide rest facilities for recovery from work fatigue		
	Resting facilities are provided only as a public mosque, so workers who want to recover from work fatigue cannot freely rest. A space with adequate facilities for workers to rest is needed, such as tables and other supporting facilities. Provide enough space for at least 1/3 of the workers as a place to rest.	

Provide a place/room for workers to hold meetings and training programs		
	There is no room/place for workers to hold meetings. For now, meetings are held in the company lobby with makeshift equipment. Other supporting tools are needed in holding meetings or training.	
Provide an adequate place to store personal protective equipment		
	There is no adequate place to store personal protective equipment. A shelf or cupboard is needed as a storage area, and one worker coordinates the place and sets a rule that workers must use and put it back in its original place.	

3.11 Aspects of Work Arangement/Organization

The work/organization aspect discusses work or organization arrangements for the Company. In this aspect, 27 sub-aspects are assessed and classified as good, so there are no sub-aspects that need to be improved.

4 Conclusion and Recommendation

4.1 Conclusion

Based on the book "Ergonomic Checkpoints: Practical and Easy-to-Implement Solutions for Improving Safety, Health, and Working Conditions," published by the International Labour Organization and the International Energy Agency, there are 112 points that the company is doing well by the ergonomic checklist standards. Fifteen points have not been done correctly, so they are prioritized for improvement, and five points are not found.

4.2 Recommendation

Recommendations that can be suggested as improvements include making a two-way path in the production unit to facilitate worker mobility, providing storage shelves, providing a comfortable place for workers to rest, adding barriers to each machine that has a high risk, and other improvements that have been described in the results and discussion section. Apart from the ergonomic checklist book, recommendations such as providing signs or evacuation routes, positioning a light fire extinguisher in the corner of the room, and regular tidiness reviews may also be advised.

5 Citation and References

The basis of this research is the science of Ergonomics. Ergonomics is the science, art, and technology used to adapt the facilities used in daily activities and rest to human physical and mental abilities and limitations to improve the overall quality of human life [8]. The primary function of ergonomics is to fulfill human needs for work design that provides safety and work efficiency for humans who work in it. There are six categories of relationships between humans, machines, and the environment, including human-machine, human-environment, human-machine, machine-environment relationships, etc. [9].

Occupational safety is a preventive measure to prevent accidents and protect workers from the hazards of machinery and equipment, while occupational health involves prevention efforts and the collaboration of health teams in the context of occupational medicine [10]. It can be concluded that almost 90% of workplace accidents occur due to human error. Human error includes individual actions that do not conform to predetermined patterns or violate existing procedures. Human error happens because humans have internal weaknesses such as lack of concentration, carelessness, and others [11].

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