

Ergonomic Optimization of the Work Environment on the Production Floor using the Ergonomic Checklist Methods

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Ergonomic Optimization of the Work Environment on the Production Floor Using the Ergonomic Checklist Methode

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Abstract

2 PT Pura Barutama Unit Engineering is a company that produces agricultural machinery. 10 Work safety is one of the factors that must be considered by the company because if an accident occurs, it will not only harm employees, but the company will also be affected either directly or indirectly. To avoid work accidents and occupational diseases, ergonomics is applied, which regulates the harmony between humans and the work environment. The purpose of this study was to determine the results of the evaluation of the working environment in terms of ergonomics with the Ergonomics Checklist method based on the International Labor Office (ILO) on the production floor. The results of observations on the production floor showed that 104 points were applied well, 11 points were applied in a bad condition and 13 points were not found on the production floor. From the checklist points that are not good, suggestions for improvements that can be made by the company are given to improve occupational health and safety in the production environment so that the resulting productivity can be more optimal.

11 **Keywords:** Occupational Health and Safety, Ergonomic Checklist

1. Introduction

The health of the workforce is an essential thing to pay attention to because they are the ones who continue to support National Development. Occupational health can be achieved optimally if the three work components (work environment, workload, and work capacity) can interact well and in a balanced manner (Suma'mur, 2009). Technological developments are growing very rapidly, thus making many companies use machine in their production processes to increase work productivity. However, it actually makes work monotonous. On the other hand, there is a lot of work that is done manually and demands greater physical stress. The demands of physical work can result in a decrease in the health of workers (Tarwaka, 2011). This decrease is often referred to as workload, which is the impact felt due to work actions carried out daily. Workers who feel their workload exceeds normal limits experience physical and psychological work stress, or what is commonly referred to as mental workload (Manuaba, 2000).

According to the International Labor Organization (ILO) in 2013, every 15 seconds a worker dies due to a work accident or work-related illness, or every year more than 2.3 million deaths.

Environmental ergonomics is one of the issues that exist in the company. This is because it is difficult to align workers with their work. Ergonomics is the science, art, and application of technology that synchronizes between humans and their activities using tools or technology to get maximum performance (Tarwaka, et al, 2004). Based on this, a checklist and handling of ergonomic risks that can interfere with health and comfort are needed in the hope that these risks can be reduced.

The Ergonomic Checklist is a collection of checklists to match the analogy between the ergonomics check and the work environment (Ahmadi, Zakerian, & Salmanzadeh, 2017). One of the places that have the potential for ergonomic risks that can cause unsafe condition incident or accident is on the production floor of PT. Pura Barutama Unit Engineering.

PT. Pura Barutama Unit Engineering which joined Pura Group is a machine industry company that produces tools and machines for agriculture, fisheries, and plantations. In the face of competition in this global era, companies will be willing to improve the quality and quantity of products made. One of the keys to meeting the needs of the target market is the implementation of an integrated production process. This is supported utilizing modern technology machines and continuous improvement of the quality of human resources. With the increase in human resources, it will create comfort when doing a job. In addition, the safety and health of workers is an important matter for the company to pay attention to. This includes identification, evaluation, and control of hazards that may occur in the work environment resulting in illness, health problems, or significant discomfort so as to reduce worker efficiency. So it is necessary to evaluate the overall working environment conditions in terms of ergonomics using an ergonomic checklist.

The Ergonomic Checklist can tell which points are good and which still need improvement. One of the causes of checklist points that have bad grades is work posture. The existence of this poor work posture if carried out continuously can result in decreased worker productivity and can cause workers to experience musculoskeletal disorders. Therefore, it is necessary to evaluate the ergonomics checklist to see which points must be improved so that it can be optimal

1.1 Objectives

Objectives of this study are:

- 1) To analyze ergonomic problems on the production floor.
- 2) Provide suggestions and suggestions for improving ergonomic facilities.

2. Literature Review

2.1 Ergonomic

Ergonomics is a science that studies the harmony of humans with their work. This science places humans as the first element, especially their abilities, abilities, and limitations. Ergonomics aims to make work, equipment, information, and the environment in balance with each other by describing the physical relationship between humans and work facilities. The benefits and purpose of this science is to minimize discomfort at work. So that ergonomics is useful as a preventive medium against work fatigue as early as possible before it is fatal (Dwi & Hery, 2014). The consequence of a non-ergonomic work atmosphere is that the body condition becomes less than optimal, inefficient, of low quality and a person can experience health issues such as low back pain, skeletal muscle disorders and others. Therefore, ergonomics is important because the ergonomics approach is to create good harmony between humans and machines or the environment (Pangaribuan. M, D, 2009).

2.2 Ergonomic Checklist Sections

The practical ergonomics manual is the result of a collaboration between the International Labor Office (ILO) and the International Ergonomic Association (IEA). In the manual, there are 10 aspects with 128 ergonomic sub-aspect points. These aspects include:

1. Storage & Material Handling
2. Hand Tools Safety
3. Aspect security Production Machines
4. Refinement design works station
5. Workplace Lighting
6. Workspace
7. Dangers Work Environment
8. Public Facilities
9. Equipment self-protection
10. Arrangements / Organization

1

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2.3 International Labor Office (ILO)

ILO (International Labor Organization) is an international body under the auspices of the United Nations, which is active³ involved in protecting the rights of indigenous peoples around the world. The ILO was founded in 1919, as part of the Treaty of Versailles that ended the First World War. The aim of the ILO is to promote rights at work, promote decent work opportunities, enhance social protection and strengthen dialogue to address problems that occur in the world of work (ILO, 1998)

2.4 Work Posture

A good work posture must be carried out by research and have knowledge in the scientific field of ergonomics, in order to be able to analyze and evaluate the wrong work posture. If the work posture used by workers is not ergonomic, workers will get tired quickly, their concentration and level of accuracy will decrease so that it can lead to work accidents. That will cause several muscle disorders such as musculoskeletal disorders (MSDs) and other disorders that can interfere with the work process (Andrian, 2013).

2.5 Work Environment

The work environment is anything that is around workers that can influence them to fulfill the tasks assigned to them (Nitisemito & Alex, 2001)

2.6 Occupational Health and Safety (12)

According to Buntarto (2015) occupational health and safety (K3: Kesehatan dan Keselamatan Kerja) aims to ensure the integrity and physical and spiritual health of the workforce as well as their work and culture. The scope of K3 includes the maintenance of a healthy work environment, prevention, and treatment of accidents caused by work while working. In occupational safety and health, the principles of ergonomics play a role in improving occupational safety and health factors. In addition, it can increase work effectiveness and the loss of health risks due to inappropriate work methods (Dwi & Hery, 2014).

3. Methods

This research was conducted using the Ergonomics Checklist method based on the International Labor Office (ILO) evaluation results from the ergonomics of the work environment production floor.

4. Data Collection

The data collection needed by the author is observation with an ergonomic checklist. Where, the results of this observation² will be used to evaluate the overall working environment conditions in terms of ergonomics on the production floor of PT. Pura Barutama Engineering unit. Data collection is done by examining the overall condition of the company PT. Pura Barutama Engineering unit on the production floor based on the ILO's ergonomic checklist
Primary Data: direct observation to obtain data by taking the necessary documentation to support research and consulting with supervisors at PT. Pura Barutama Engineering unit.
Secondary Data: data that can support information or support the completeness of primary data. Secondary data collection is done by conducting a literature study, namely studying some of the existing literature and in accordance with the subject.

5. Results and Discussion

Based on the results of observations made on the production floor of PT. Pura Barutama Engineering Unit uses an ergonomic checklist to get the results of points that need to be improved, which can be seen in Table 1

Table 1. Ergonomic checklist points that need improvement

No	Aspect	Sub Aspect
A	Storage & Material Handling	13. When moving objects manually (without tools), try to raise or lower as little movement as possible from the original height position.
		15. When working on objects, carrying, lifting and so on, avoid bending or twisting the waist.
		17. Make the movement of lifting and lowering objects slowly and avoid twisting the waist or bending the body
C	Aspect Security Production Machine	53. Use a protective fence or means of a fixed barrier to prevent body parts of the officer from coming into contact with the rotating/running parts of the machine in use
		54. Use protective devices that support each other, in such a way that dangerous parts of the machine are not touched by workers, while the machine is running
D	Refinement design works station	60. Use protective devices that support each other, in such a way that dangerous parts of the machine are not touched by workers, while the machine is running can be more free in handling small or large objects
		69. Provide facilities for eye examinations, and provide appropriate glasses for workers who use visual displays everyday
		74. Lighting must always be on where the workers are, for example in alleys, stairs, etc.
E	Workplace Lighting	77. Prepare special lighting in the workplace for the purpose of supervisory work and so that workers can carry out their work more thoroughly
F	Workspace	86. Heat and cold sources copy the use of a natural ventilation system to increase the comfort of the air in the workspace
		108. Involve all employees in planning their routine activities
J	Arrangement organization	/ 109. Perfect the types of work that are difficult and disliked, in order to increase productivity in the future Consult workers, how to improve working time arrangements

5.1 Numerical Results

5.1.1 Ergonomic Checklist Recapitulation

Based on the results of data collection obtained, and the assessment step will refer to practical ergonomic guidelines where there is the word " Good" or " Bad" if the company has implemented aspects that must be carried out according to the ergonomics checklist guidelines and the word " Not Appropriate" if the company has not implemented. The assessment that refers to the conditions in the field is divided into two categories of assessment, namely good if the aspects in the ergonomics checklist have been implemented according to the rules and not good if these aspects have not gone well or have not been implemented, the data recapitulation obtained is presented in Table 2.

Table 2. Recapitulation of ergonomic checklist

No	Aspect Reviewed	Sub Aspect	Evaluation		Not Appropriate
			Good	Bad	
1 to 21	Storage & Material Handling	21	16	3	2
22 to 36	Hand Tools Safety Aspects	15	14	0	1
37 to 56	Security production Machines	20	17	2	1
57 to 71	Refinement design works station	15	13	2	0
72 to 81	Workplace Lighting	10	7	1	2
82 to 87	Workspace	6	4	1	1
88 to 94	Dangers Work Environment	7	5	0	2
95 to 98	Public Facilities	4	4	0	0
99 to 107	Equipment self-protection	9	9	0	0
108 to 128	Arrangement/organization	21	15	2	4
Total		128	104	11	13

5.1.2 Calculation of Data Recapitulation Percentage

Table 3. Recapitulation of data percentage

No	Aspect Reviewed	Sub Aspect	Evaluation		Not Appropriate
			Good	Bad	
1 to 21	Storage & Material Handling	21	76.19%	14.29%	9.52%
22 to 36	Hand Tools Safety Aspects	15	93.33%	0.00%	6.67%
37 to 56	Security production Machines	20	85.00%	10.00%	5.00%
57 to 71	Refinement design works station	15	86.67%	13.33%	0.00%
72 to 81	Workplace Lighting	10	70.00%	10.00%	20.00%
82 to 87	Workspace	6	66.67%	16.67%	16.67%
88 to 94	Dangers Work Environment	7	71.43%	0.00%	28.57%
95 to 98	Public Facilities	4	100. %	0.00%	0.00%
99 to 107	Equipment self-protection	9	100%	0.00%	0.00%
108 to 128	Arrangement / organization	21	71.43%	9.52%	19.05%
Total		128	104	81.25%	8.59%

The highest percentage of good variables is 100% in the aspect of public facilities and personal protection equipment, for the highest bad variable is 16.67% in the workspace aspect, and for the variable that is not appropriate namely 28.57% on the aspects of the hazards of the work environment. The main priority for the bad checklist points is focused on the workspace aspect, with a percentage of 16.67%. Therefore, it is necessary to make improvements immediately to increase company productivity.

5.2 Graphical Results

From the ergonomic checklist recapitulation data at PT Pura Barutama, it can be seen that from the 128 checklist points, 104 points have been implemented well, 11 points were applied in bad condition, and 13 points were not appropriate on the production floor. However, for checklist points that are not good, special attention is given as much as possible, and repairs are made as soon as possible so that it is easier to increase comfort for workers.

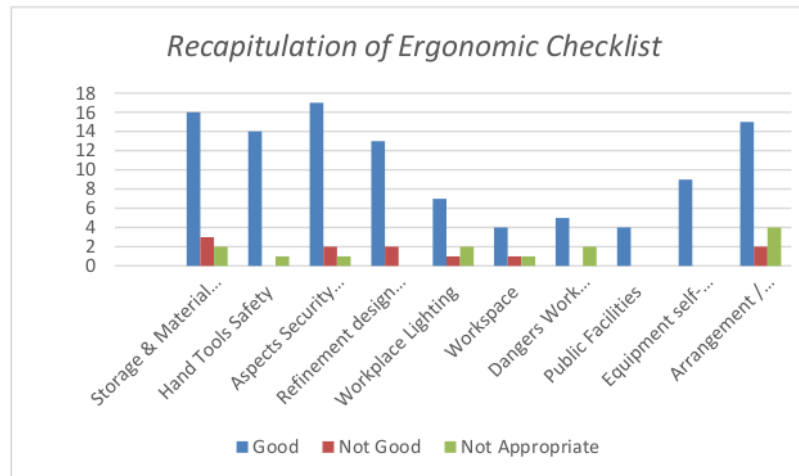


Figure 1. Recapitulation of ergonomic checklist

5.3 Proposed Improvements

After collecting data, the next step is to analyze and discussion to provide suggestions for improvement. In this report, a practical guide to ergonomics checklist issued by the ILO to determine the conditions of the work environment. The assessment using ergonomic checklist is expected to increase work productivity so that the company's targets can be met. Ergonomics checklist based on the ILO (International Labor Organization) divides 10 aspects of the checklist criteria with a total of 128 points in the list of questions. The following is an analysis and discussion of the results of the ergonomic checklist analysis that needs to be given suggestions for improvement on priority points:

A. Material Storage & handling

Point 13: When moving objects manually (without tools), try to raise or lower as little movement as possible from the original height position

Recommendations:

1. In manual transfer of goods from one job site to another, position the material at an adequate height. Like moving between two surfaces of the same workplace. By avoiding lifting and lowering movements, it can reduce the fatigue factor and the occurrence of musculoskeletal disorders.

Point 15: When working on objects, carrying, lifting and so on, avoid bending or twisting the waist.

Recommendations:

1. Improve the workspace, so workers can adjust to a stable standing position, without having to bend over or turn around.

Point 17: Move to lifting and lowering objects slowly and avoid twisting the waist or bending the body

Recommendations:

1. Reduce the difference in the position of the material being worked on before and after the goods are lifted
2. Use a standard table or shelf that can be placed at a height suitable for lifting
3. Provide information dissemination to workers regarding the correct technique for lifting and lowering materials
4. Use tools in the form of Hydraulic Hand Trucks that can reduce the frequency of bending over

B. Aspect Security Production Machine

Point 53: Use a protective fence or means of a fixed barrier to prevent body parts of the officer from coming into contact with the rotating/running parts of the machine in use

Recommendations:

1. When workers are in proximity to moving parts of the machine, the worker faces a risk that accidents may occur. By installing additional tools or machine guards, workers can minimize work accidents when operating machines
2. Designing a permanent protector mounted around the machine to protect workers against the machine itself and objects in direct contact.

Point 54: Use protective devices that support each other, in such a way that dangerous parts of the machine are not touched by workers, while the machine is running

Recommendations:

1. Install a guard on the machine so that workers do not come into direct contact with dangerous parts of the machine when operating
2. Use complete Personal Protective Equipment on every worker

C. Refinement design works station

Point 60: Place used materials, work tools, control buttons within reach of workers

Recommendation:

1. The company from should provide shelf facilities that can accommodate used materials and work tools temporarily. Don't waste time to return to the maintenance room.

Point 69: Provide facilities for eye examinations, and provide appropriate glasses for workers who use visual displays every day.

Recommendation:

1. The company should provide facilities for eye examinations and provide appropriate glasses for workers to increase work productivity.

D. Lighting at Workplace

Point 74: Lights must always be turned on where workers are, for example in alleys, stairs, etc.

Recommendation:

1. Lighting must be adequate in any location of the company even though it has used natural lighting that comes in from between the transparent roofs So that additional lights are needed to be installed. Lack of lighting can cause workers to less be aware of surrounding materials and equipment

Point 77: Provide special lighting in the workplace for the purpose of supervisory and work so that workers can carry out their work more thoroughly.

Recommendation:

1. The company should provide additional lighting facilities on the production floor.
2. Add a flashlight to the safety helmet in use of which worker.

E. Workspace

Points Increase 86 the use of natural ventilation systems to increase the comfort of the air in the workspace.

Recommendation:

1. Lack of ventilation on the production floor This causes workers to experience overheating, resulting in reduced concentration of workers in doing their work. The company should add exhausted fan or turbine ventilator.

F. Arrangement Work/organization.

Point 108: Involve all employees in planning their activities.

Recommendation:

1. Conduct an assessment of the assignments whether they have been done well in accordance with the published worksheets.
2. Hold discussions to discuss how workers can be more actively involved in routine planning processes.

Point 109: Consult workers, how to improve working arrangements.

Recommendation:

1. Consultation activities with workers should be implemented regarding work arrangements, in the future, it can run more productively

5.4 Validation

Because good values are much more dominant than bad values and are not appropriate, the company can be said to be in good working environment conditions.

6. Conclusion

Based on data processing, concluded that:

- 1) Of the 128 checklist points, used to evaluate ergonomics on the production floor of PT. Pura Barutama Engineering Unit, it was found that 104 points were applied well (81.25%), 11 points were applied in bad condition (8.59%), and 13 points were not appropriate (10.16%). Overall, the working environment conditions observed can be categorized as good. However, for points that are not in good condition and cannot be found, recommendations are given that can be applied in the company to increase company productivity
- 2) From the bad points, several priorities need to be repaired immediately because they are not too complicated to be applied to the production floor PT. Pura Barutama Engineering Unit:
 - a. Provide chair facilities for workers to use so that they can rest for a while
 - b. Make shelves that can accommodate used materials and work tools temporarily. So as not to waste time returning to the maintenance room
 - c. Taking care of the lighting source
 - d. Provide additional facilities such as exhausted fan because the ventilation on the production floor is lacking. So that the entry and exit of air are also not sufficient
 - e. Ensure workers use Personal Protective Equipment completely and regularly.

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