The workload analysis in welding workshop

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Abstract. This research was conducted in welding workshop which produces doors, fences, canopies, etc., according to customer's order. The symptoms of excessive workload were seen from the fact of employees complaint, requisition for additional employees, the lateness of completion time (there were 11 times of lateness from 28 orders, and 7 customers gave complaints). The top management of the workshop assumes that employees' workload was still a tolerable limit. Therefore, it was required workload analysis to determine the number of employees required. The Workload was measured by using a physiological method and workload analysis. The result of this research can be utilized by the workshop for a better workload management.

1. Introduction
The workload is a whole demand assigned tasks to an employee. Ideally, the duty that received by an employee according to his ability. The heavier workload which being received by an employee, the more energy required to complete their works. If workload that received by employees far above their abilities, so they would have difficulty to finish all the jobs that given to them. It can be effected to their health and may result in additional expenditures for the company about the health costs of the employees and overcome complaints from the consumers due to the late submission of the order [1,2,3,4].

This research is conducted in a welding workshop located in North Sumatra. Welding workshop is producing several products such as doors, fences, canopies, trellis, etc according to customer's order. There are 6 production employees, 4 peoples are in charge of forming the product and 2 persons are in the finishing department. The order fulfillment process starts from the arrival of customer orders, search/design creation, due to date agreement, and financial transactions, manufacturing process, production storage until product delivery.

There are 11 delayed of delivery products found from 28 orders received and 7 costumers complained. Therefore, the leader submits a reprimand to employees while finishing employees complain about the weight of their workload and propose the addition of 1 employee to help them. The leader of the workshop assumes that the employee's job can still be tolerated. It takes a workload analysis to know how many employees are necessary.

2. Literature Review

Ergonomics enhances human performance including the health, safety, and productivity of employees [5]. Work productivity is typically associated with production standard time. Work productivity is crucial since the process directly involve employees [6]. The workload is the amount of work that should be held by a position or organizational unit [7,8].

Workload is one of the important factors in work efficiency that impact on work productivity [9]. The amount of oxygen used by the body is one indicator of loading during work. [10]

The Minister of Labor through Decree no. 51 in 1999 set the calorie requirement to determine the light weight of work are: [11]

1. Light Work Load: 100 – 200 kcal/hour
2. Medium Work Load: 200 – 350 kcal/hour
3. Heavy Work Load: 350 – 500 kcal/hour

The excessive workload can lead to a less comfortable working atmosphere because it can lead to the emergence of work stress more quickly [12].

3. Methodology

This study is descriptive, and the object of the study is workload of production employees amounting to 6 people. The instruments used are observation worksheet of work sampling, stationery, stopwatch, and automatic blood pressure monitor to get employee pulse data. Employee pulse rate is measured before, while, and after activities through. Work sampling observation done in 6 working days to all employees from 08.00 to 17.30 WIB with the observation determined randomly. This case achieved by systematic random sampling with 5 minutes interval of time [13].

Allowance for employees is provided with consideration of fatigue, personal needs, and inevitable obstacles. Performance employees are considered use Westinghouse system of rating to obtain: rating factor = 1 + Westinghouse factor.

Data processing of pulse is done by direct assessment method to obtain the amount of energy consumption, by the formula:

$$Y = 1,80411 - 0,0229038X + 4,71711 \times 10^{-4} X^2$$

Indirect assessment is also done by calculating % CVL (Cardiovascular Load)

$$\%CVL = \frac{\text{Working Pulse} - \text{Resting Pulse}}{\text{Maximum Pulse Rate} - \text{Resting Pulse}} x \; 100\%$$

Workload analysis is done with input in the form of productive time each employee, allowance, and rating factor where

Work Load = %productive x performance rating x (1 + Allowance)

This research was conducted with 95% confidence level and 5% accuracy level.

4. Results and Discussion

4.1 Work Sampling Results

Work sampling is done by calculating the productive time for each employee. There are 3 categories of employees, as:

• Handyman, with the main task of designing and making products
• Handyman Assistant, with the task of assisting the craftsman and
• Finishing Employees with the main task of sanding and painting the product

Recapitulation of work sampling observation results is given in Table 1.

Table 1. Recapitulation of Work Sampling Observation Results

Respondent	Activity	Days						Average Productive Time
		1	2	3	4	5	6	
Handyman 1	Work	47	48	46	49	49	52	0,822
	Idle	12	11	13	10	10	7	
	Total	59	59	59	59	59	59	
Handyman 2	Work	50	53	49	52	52	53	0,873
	Idle	9	6	10	7	7	6	
	Total	59	59	59	59	59	59	
Handyman Assistant 1	Work	53	53	52	54	55	55	0,911
	Idle	6	6	7	5	4	4	
	Total	59	59	59	59	59	59	
Handyman Assistant 2	Work	53	52	49	51	49	56	0,876
	Idle	6	7	10	8	10	3	
	Total	59	59	59	59	59	59	
Finishing 1	Work	51	56	50	53	54	56	0,904
	Idle	8	3	9	6	5	3	
	Total	59	59	59	59	59	59	
Finishing 2	Work	53	53	49	55	52	55	0,895
	Idle	6	6	10	4	7	4	
	Total	59	59	59	59	59	59	

From Table 1, it can be seen that observations were made 59 times per day for each employee during the 6 working days of productive time range from 82.2% to 91.1%. Allowance given to handyman is 20%, while for finishing employees is 19%. The calculation of accuracy results of observations yields a figure of ± 3.7%, and it is qualified thoroughness set in early observation.

4.2 Category of Work Load
The employee's pulse rate before work, while working, and after resting some time, is also measured to obtain energy consumption values and % CVL of activities. The value of energy consumption for all handyman, handyman assistants, and finishing employees shows that work activities are quite heavy for them since the average energy consumption is greater than 350 kcal/hour. The energy consumption values of all employees and %CVL are listed in Table 2.

Table 2. Energy Consumption of Employees

No	Employees Category	Energy Consumption (kcal / jam)	%CVL
1	Handyman 1	381,18	45%
2	Handyman 2	483,03	52%
3	Handyman Assistant 1	362,86	44%
4	Handyman Assistant 2	351,96	38%
5	Finishing 1	363,46	42%
6	Finishing 2	356,67	39%

The value of %CVL all employees shows that the activity of making products and finishing needs an improvement category. An ideal workload according to workload analysis is 100%, which indicates employees are in normal condition (not overloaded). The amount of workload each employee is shown in Table 3.2.

Table 3. Recapitulation of Workload

No	Employees Category	Work Load Values
1	Handyman 1	104%
2	Handyman 2	110%
3	Handyman Assistant 1	112%
4	Handyman Assistant 2	107%
5	Finishing 1	110%
6	Finishing 2	109%

Table 3 shows that all employees suffer excessive workload. Excess workload all employees varies from 4% to 12%. Average employee load of 107%, auxiliary employees and finishing employees 109.5%.

5. Discussions

Total workload of the 6 workers is 6.52. This value indicates the tasks they employ require more than 6 employees. Energy consumption from all workers are having workload heavy while the cardiovascular load category to require improvement, therefore it is necessary to add 1 worker especially if considered the average percentage of productive time the six workers have used their working time well, where the average time earning is in the range of 81.2% -91.1%, while the allowance given by 19% and 20%, means that in the condition of allowance provided the worker utilized to complete the tasks. If the number of production workers changes from 6 to 7, the average workload will decrease from 108% to 93% so that no more workers will be overloaded and energy consumption will not be as big as the actual condition. An additional 1 worker is expected to assist the completion of finishing tasks and product creation so that no longer delay in product delivery.

6. Conclusion

From this study it can be concluded that the workload received by workers during this time is excessive, so that required additional 1 new worker.

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