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Analysis of the Effect of Ergonomics on Increasing Work Productivity in Welding Operators at PT. TRSS uses Rapid Body Entire Assessment (REBA) Method

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ABSTRACT

The welding process on the AM65511000 type radiator product at PT TRSS in the Curug area is a heavy job that is still done manually. Improper posture and repeated acceptance of static loads for a long period can result in operator fatigue, thereby reducing productivity. The analysis was carried out using Pareto diagrams and fishbone diagrams. Ergonomics analysis with the REBA method is one method to evaluate the overall posture and work attitude of workers. In this study, an analysis of the REBA method was carried out on workers in the welding process section on the AM65511000 type radiator product to determine the risks faced by workers and the improvements that could be proposed. The research was conducted referring to the REBA worksheet by Hignett and McAtamney. From the studies that have been carried out, it was found that workers have a moderate risk with a value of 5 which means that an immediate investigation and implementation is needed in the form of changes in work posture or work environment. The highest risk value was obtained in assessing the bent body posture when moving the radiator. Suggestions that can be made include lowering the level of the holder, optimizing the position of the torso and weight point, and making a table that can be adjusted in height and tilted angle.

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INTRODUCTION

In a business process carried out by a company, there are generally many ineffectiveness and inefficiencies carried out by the company. One of the ineffectiveness and inefficiencies is regarding achieving production targets, production targets are directly proportional to production capacity, the higher the production target, the greater the production capacity. If setting a high target is not commensurate with production capacity, it is the same as forcing oneself, whereas if setting a target that is too low does not correspond to production capacity, it is the same as inefficiency.

PT TRSS is a manufacturing company that produces automotive radiators for Astra Group customers. The production capacity that PT TRSS can produce is 773 units in one month. However, in reality, the product output does not reach the production target for one of the product types depicted in Table 1. below.

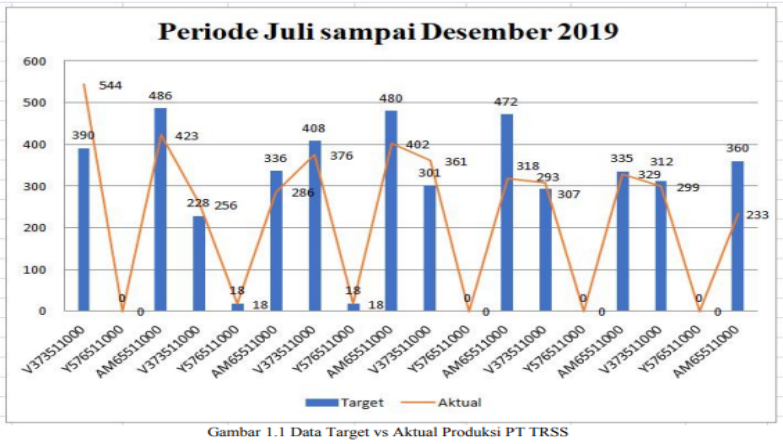
Table 1. Data Target vs Actual Output Production

Tabel 1.1 data target vs *actual output* produksi

Periode	Produk	Target	Aktual
Juli	V373511000	390	544
	Y576511000	0	0
	AM65511000	486	423
Agustus	V373511000	228	256
	Y576511000	18	18
	AM65511000	336	286
September	V373511000	408	376
	Y576511000	18	18
	AM65511000	480	402
Oktober	V373511000	301	361
	Y576511000	0	0
	AM65511000	472	318
November	V373511000	293	307
	Y576511000	0	0
	AM65511000	335	329
Desember	V373511000	312	299
	Y576511000	0	0
	AM65511000	360	233

Sumber : Dokumen PT TRSS

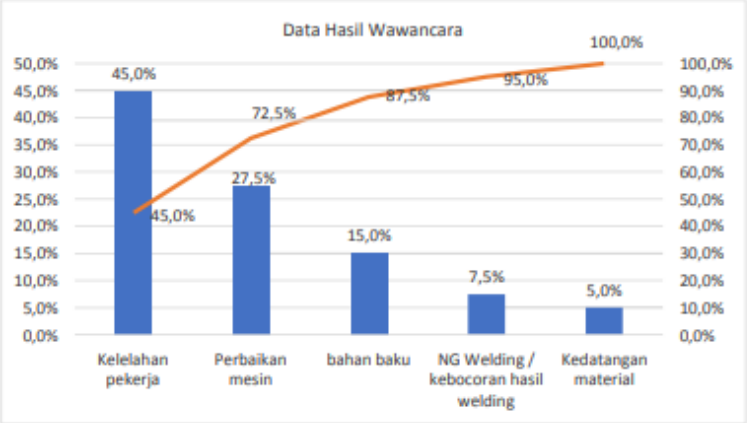
From Table 1, it can be seen that PT TRSS produces products with production quantities that often do not reach the target, only for type AM65511000 in the period July to December. Below is the production output diagram which depicts output statistics with set targets.



Gambar 1.1 Data Target vs Aktual Produksi PT TRSS

Figure 1. Data Target vs Actual Production PT. TRSS

From the data presented above, it was found that there was a decrease in productivity in the production process at PT TRSS. This is reinforced by the results of interviews and discussions with related operators which are depicted in figure 2 below.



Gambar 1.2 *Score* Hasil Wawancara Operator Periode 2019

Figure 2. Score Result Interview of the Operator Periode 2019

Table 2. Score Result Interview of the Operator Welding

Tabel 1.2 *Score* Hasil Wawancara Operator *welding Welding*

Nara Sumber	Pertanyaan	Jawaban	*Score*		Rata-Rata	Akumulasi
			OP1	OP2		
Operator welding *welding*	Apa saja yang menyebabkan sering tidak tercapai planing produksi pada *welding type* AM65511000	Kedatangan material	5%	5%	5,0%	5,0%
		Perbaikan mesin	25%	30%	27,5%	32,5%
		bahan baku	10%	20%	15,0%	47,5%
		Kelelahan pekerja	50%	40%	45,0%	92,5%
		NG *Welding* / kebocoran hasil *welding*	10%	5%	7,5%	100,0%

Sumber : Dokumen pribadi

From the results of the interviews and discussions, the researchers concluded that there were problems faced by welding operators causing fatigue when working. This can occur due to excessive physical workload which affects welding operators who experience operator fatigue.

Based on the problems above, improvements are needed to help welding operators remain comfortable and safe when carrying out the welding process on product type AM65511000. In this study, researchers used an ergonomics approach to measure the workload received by welding operators so that they were expected to overcome the decrease in productivity caused by fatigue factors.

Several problems in this company can be used as a reference for this research:

1. What is the effect of work fatigue on the productivity of welding operators so that there is a decrease in productivity using the ergonomics approach at PT TRSS?

2. What are the proposed improvements to overcome work fatigue among welding operators in producing AM65511000-type products based on the ergonomics approach at PT? TRSS?

LITERATURE REVIEW

Definition of Fatigue

Fatigue is a common complaint in the general public and the working population. Of workers, around 20% have symptoms of work fatigue. Work fatigue can be characterized by decreased work performance or all conditions that affect all organism processes, including several factors such as subjective feelings of fatigue, decreased motivation, and decreased mental and physical activity (Setyowati et al 2014).

Factors That Influence Work Fatigue

The causes of work fatigue are generally caused by workload, both in the form of workload, external factors, the task itself, the organization (work time, rest, shift work, night work, etc.), and the work environment (physical, chemical, biological, ergonomic and psychological).) while the workload is internal factors originating from within the body itself in the form of somatic factors (age, gender, body size, condition, nutritional status) and psychological factors (motivation, job satisfaction, desires, etc.) (S Russeng, 2011).

Workload

The workload is the difference between the capacity or ability of workers and the job demands that must be faced (Tarwaka, 2014). Workload is one of the elements that must be considered for a worker to obtain harmony and high work productivity in addition to the element of additional burden due to the work environment and work capacity. The definition of workload can be seen from two points of view, namely subjectively and objectively. Workload objectively is the total time used or the number of activities carried out. Subjective workload is a measure used by someone to ask questions about workload, feelings of excess working hours, size and pressure of work, and job satisfaction (Minarsih, 2011).

Factors that Influence Workload

According to Nurmianto in Utami (2012), factors that influence workload are:

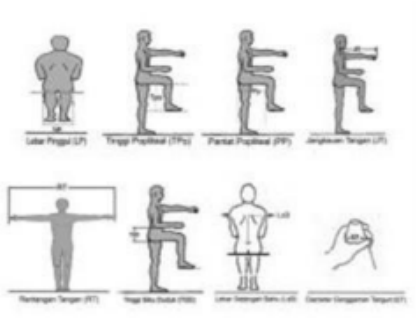
1. Allowable load
2. Transport distance and loading intensity
3. Frequency of lifting, namely the number of lifting activities
4. Ease of access for workers
5. Working environment conditions
6. Work skills
7. Uncoordinated workgroups
8. Work equipment and safety

Ergonomic

According to (Kinasih & Purnomo, 2012) in designing a tool design that uses an ergonomics approach, is a plan or design based on the tool's point of view that will be able to overcome the problems faced by the user so that it can be utilized optimally. Ergonomics is applied to create product designs, increase productivity, and improve occupational health and safety so that accidents or work incidents do not occur (Susanti, 2009)...

Anthropometry

The human body measurements that will be used for design as shown in Figure 2.1 are Hip Width (LP), Popiliteal Height (Tpo), Popilliteal Buttocks (PP), Hand Reach (JT), Hand Span (RT), Sitting Elbow Height (TSD).), Half Shoulder Width (LSB), Hand Grip Diameter (GT). Because human body sizes vary, a principle is needed in the application of anthropometry that must be established so that it can make data processing easier. Figure 2.1 Anthropometric Measures in Design. Facility design based on extreme individuals2. Customizable facility design. Facility design is based on average size (Nofirza & Dedi, 2012).



Gambar 2.1 Ukuran Antropometri Dalan Rancangan

(Sumber: Sritomo Wignjosoebroto, 2008)

Figure 3. Anthropometric Measurements in Design

Rapid Entire Body Assessment **(REBA)**

Rapid Entire Body Assessment was developed by Dr. Sue Hignett and Dr. Lynn McAtamney an ergonomist from the University of Nottingham (University of Nottingham's Institute of Occupational Ergonomics). Finger measurements were developed in the field of ergonomics and can be used quickly to assess the working position or posture of an operator's neck, back, arms, wrists, and legs. Apart from that, this method is also influenced by coupling factors, external loads supported by the body, and worker activities. Assessment using REBA does not require a long time to complete and carry out general scoring on a list of activities that indicate the need to reduce risks caused by the operator's work posture (Setyaningsih, 2015)

METHODOLOGY

Provide clear and concise versions of your methods of conducting research, population and samples, and data analysis tools.

This research was conducted at PT TRSS is one of the manufacturing companies that produces automotive spare parts namely radiators. The study lasted six months from July 2019 to December 2019.

Data collection methods

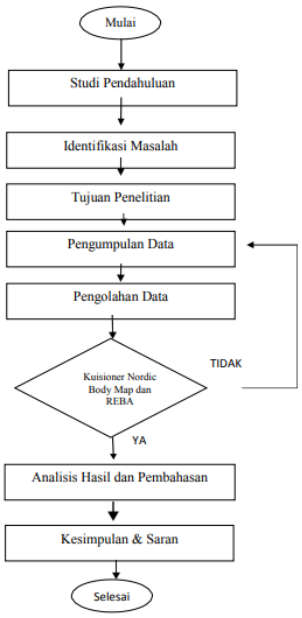
In the data collection method describes data collection techniques that contain observations, interviews and types of data containing primary and secondary data, data collection processes used in this research process are:

1. Primary data Primary Data, Data collected by means of direct observation in the field, that is, directly reviewing the product in field at the time of the verification process and conducting interviews to the parties involved.
2. Secondary Data Secondary data. Data collected by doing a literary study.

Data Collection Technic

1. The method of interview is the collection of data in the form of qualitative data obtained by interacting directly with the parties that are continuous in this research among them:
    a. QC Inspector production process of product type AM65511000. These employees are tasked with checking the quality or quality of the products produced according to engineering standards as well as ensuring that the production process is in accordance with the provisions of SOP and WI. The researcher will ask in person about the work instructions of the process of product quality verification, product specifications and experience related to the product type AM65511000.
    b. These employees are responsible for creating products and ensuring that the production process runs according to planning, both in terms of quantity, quality, and ontime delivery.
3. The method of observation or observation is the collection of anthropometric measurement data directly against the object of research, i.e. the welding operator in the production process of the product type AM65511000.

Data Collection Techniques



RESEARCH RESULT

Calculation of Rapid Entire Body Assessment (REBA) for Welding Operators

Rapid Entire Body Assessment (REBA) is a method used to assess the work posture and movement of workers. This method is relatively easy to use because to determine the value of a body part you do not need a specific angle, only a range of angles. In the end, the final value of REBA indicates the risk level of a job and the actions that must be carried out/taken. In this case, REBA is used to analyze the working posture and movement of the welding operator. The following is a picture of a radiator welding operator at work:

Figure 4. Welding Operator Work Position

After measuring the angles of body parts, input the data into the Rapid Entire Body Assessment (REBA) worksheet. At the identification stage, the REBA worksheet is divided into body parts A and B. Body part A consists of the legs, neck, and trunk. Meanwhile, group B consists of the forearm, wrist, and upper arm. The following is a picture of the welding operator REBA worksheet:

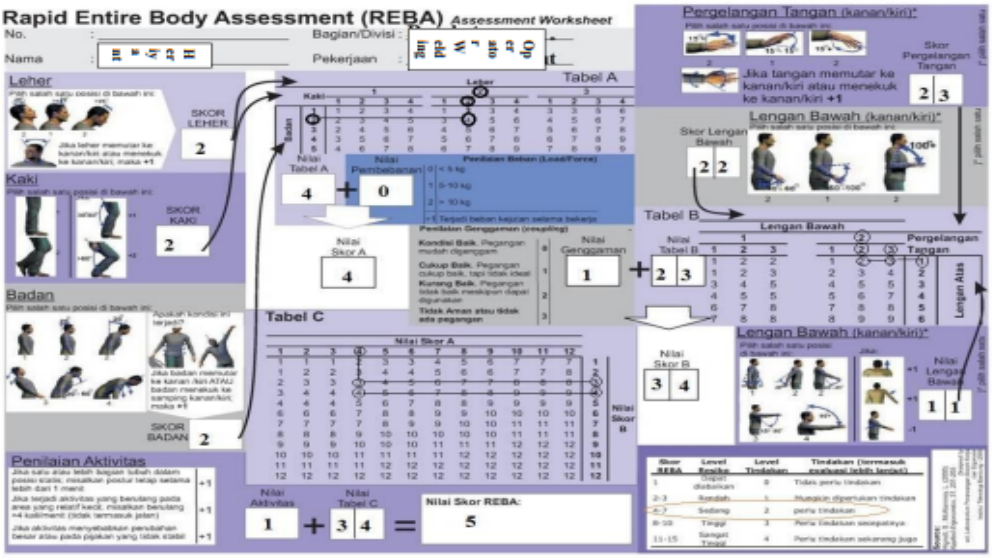


Figure 5. ***Form Rapid Entire Body Assessment*** **(REBA) Operator Welding**

Data Processing Recapitulation

Table 3. Recapitulation of Problems for Welding Radiator Operators

No	Tools	Bagian Tubuh	Skor/Nilai	Keterangan
1.	*Nordic Body Map*	Leher,Lengan dan Bahu,Punggung, Pinggang, Bokong	67-68	Bagian tubuh yang memiliki nilai keluhan tertinggi
2.	REBA *Survey*	Leher, badan, kaki, pergelangan tangan dan lengan	5	Nilai 5 mengidentifikasikan bahwa diperlukan tindakan secepatnya terhadap perbaikan postur kerja operator dan masuk kedalam resiko level yang cukup tinggi

The Relationship between Work Fatigue and Productivity

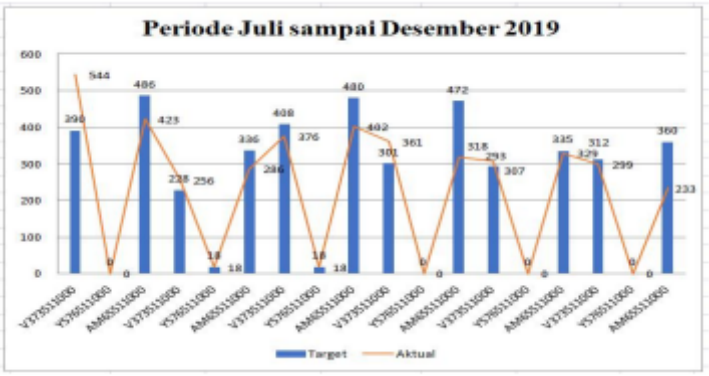


Figure 6. Target VS Actual Production Data in the Welding Division

From the picture above, it can be seen that the output of the AM655 product never reached the target, while the other 2 products with lighter weight and more compact dimensions were able to reach the specified output target. Of course, the output of this AM655 product needs to be increased again.

Cause and Effect Analysis

The next step is to find the cause of complaints in the operator's body parts, using a tool, namely the Ishikawa diagram. The Ishikawa diagram is a tool for identifying the cause of a problem that occurs. The process of making an Ishikawa diagram is carried out by direct observation and conducting interviews with operators to find out the problems experienced by operators. The results of the Shishikawa diagram for the rear bar bracket bolt installation operator can be seen in Figure 7. below:

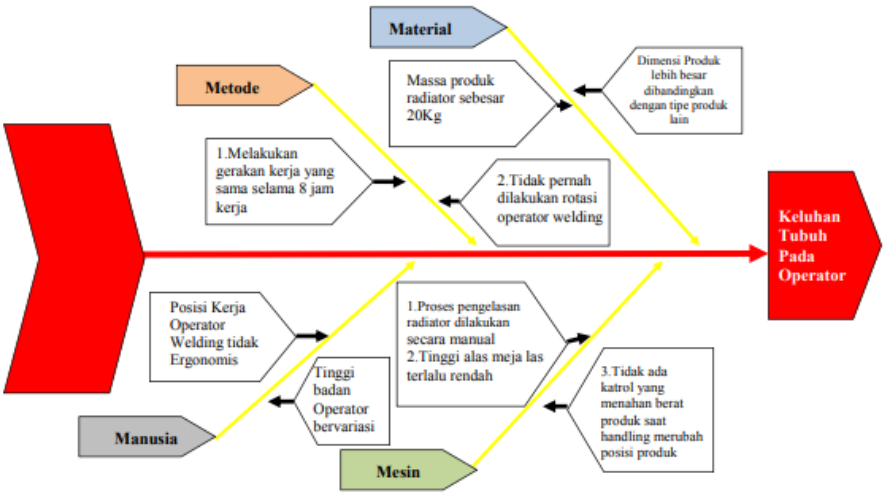


Figure 7. Ishikawa Diagram of Body Complaints in Operators

Improvement Plan

After analyzing the possible factors that cause welding operators to experience complaints after carrying out work as described above, the researcher proposed improvements to the company to reduce the impact of

complaints felt by welding operators based on the analysis carried out above. The following table 4. is a proposal for improvements that the researcher recommends for the company.

Tabel 4. Improvement Proposal Plan

No	The root of the problem	Description	Proposed Improvements
1.	The position of the welding operator when working is not ergonomic	The position of the welding operator's body forms a certain angle which has an impact on the appearance of complaints on the operator's body after work	Welding table bases are made that can be adjusted to suit the operator's height and body position. So operators no longer need to force their bodies to assume unergonomic positions.
2.	Never rotate the welding operator	This causes boredom among operators in the welding section because they have to carry out the same routine for years.	An operator rotation schedule has been created every 6 months, this is to avoid operator boredom. Apart from that, it can also have a positive impact on increasing employee competency
3.	Repeating the same work movements for 8 hours of work	Repetition of the same movement can cause the operator's body to become sore	Give the operator 5 minutes every 2 hours to stretch the muscles

The following are details of the proposed welding table base design that can be adjusted to suit the operator's height and body position as shown in Figure 7. below.

1. The design of the height of the welding table base can be adjusted to the body height of the welding operator

Figure 7. Welding Table Base Design

2. The tilt angle of the base can be adjusted according to the operator's needs

Figure 8. Welding table base tilt angle setting design

DISCUSSION

The following is the conclusion of the research that has been carried out in answering the problem formulation that has been set in the Welding division, including the following:

Work fatigue arises due to complaints about the welding operator's body, due to the welding operator's body position being unergonomic and affecting the amount of product output produced. This is because when the operator feels complaints in his body parts, the operator will reduce his movement speed, this is a common form of response as an action to reduce the discomfort felt by his body. The data presented in the graphic image shows that the output of AM 655 products has decreased to the point that it never reaches the target set by the company. This is inversely proportional to the results of NordicBody Map data processing which shows the number of complaints felt by operators.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the analysis carried out by researchers, suggestions that can be given to reduce work fatigue in operators are:

a. To get to the root of the problem, the position of the welding operator's body forms a certain angular position which has an impact on the appearance of complaints on the operator's body after work

(not ergonomic). This can be overcome by making a welding table base that can be adjusted or adapted to the height and position of the operator's body. So operators no longer need to force their bodies to assume unergonomic positions.

b. Meanwhile, the root of the problem is that welding operators have never rotated, which causes boredom among operators in the welding section, because they have to carry out the same routine for 56 years. This can be overcome by creating an operator rotation schedule every 6 months, this is to avoid operator boredom. Apart from that, it can also have a positive impact on increasing employee competency.
c. The factor that is the root of the problem is that operators have to repeat the same work movements for 8 hours of work, which can cause the operator's body to become sore, this can be overcome by giving the operator 5 minutes every 2 hours to stretch the muscles.

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