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Workload Analysis with Full Time Equivalent Method to Optimize Production Unit Performance at PT X

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Abstract

PT X is one of the companies in the manufacturing industry engaged in the automotive sector. In carrying out the production process, PT X sometimes has problems, namely there is often a mismatch in the number of spare parts sent with the number of spare parts written on the purchase order (PO). The production delay occurred due to a shortage of manpower and an uneven workload in production activities at PT X. For this reason, it is necessary to measure the workload as a basis for calculating the workforce needs. In this study, researchers used the full time equivalent (FTE) method. After calculating with this method, it is known that the workload in the coated spare parts production line is not balanced among 10 operators who work, where 3 operators with high workloads or overload, 5 operators with normal workloads, and 2 operators with low workloads or underload. The results of the calculation show that the workload has a negative effect on operator performance. The proposed improvement is by adding 2 operators and mutating horizontally, the results obtained are an optimal workforce of 12 people, with workloads in the normal and low (underload) categories.

Keywords: full time equivalent (FTE), workload measurement, labor, human resources

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1. Introduction

Manufacturing is one of Indonesia's businesses and continues to show its development from time to time. In the manufacturing industry, business activities use and require many things, including the use of machines, advanced equipment, and technology, as well as a certain amount of labor. Manufacturing is a large industry, which can be seen from a large amount of production and labor or human resources. Human resources (HR) need to be considered in a company, because Human resources are the most important factor in producing a quality product (Kurniawan, 2020). In the form of effective and efficient human resource development, human resources need to be planned and managed properly to encourage the realization of the company's vision, mission, and goals.

PT X is one of the companies in the manufacturing industry engaged in the automotive sector. This company runs its business by producing automotive components or spare parts, both motorbikes and cars. In the production process, PT X uses several stamping machines that have different pressures according to the thickness of the automotive components to be produced. The problems that exist in PT X is the frequent discrepancy between the number of spare parts sent and the number of spare parts written on the purchase order (PO). According to a statement from the Leader Production Planning Control, if this happens, the company will usually ask for negotiations so that the shortage of spare parts that are not yet available can be sent after they are finished producing. The following is data on the shortage of spare parts:

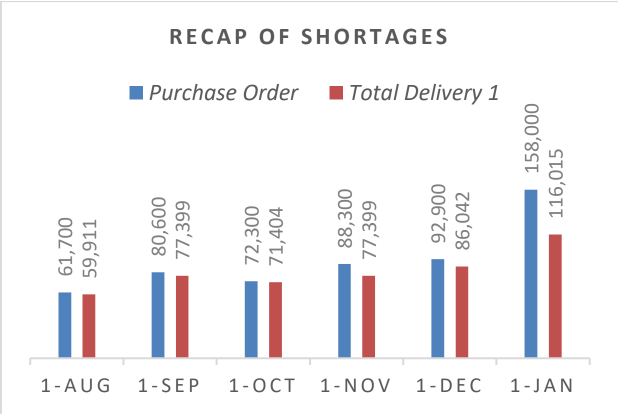

Figure 1. Recap of spare parts shortages

According to a statement from the Director of PT X, the discrepancy between the number of spare parts sent and the number of spare parts ordered due to production delays that occur in the company. Director of PT X also added that the production delay occurred due to a shortage of manpower and an uneven workload on production activities at PT X. This is in accordance with the research of Kurniawan (2020) that production delays can occur due to lack of labor and uneven workload. The impact of the delay in production made the company have to pay shipping costs to fulfil the shortage of purchase orders (PO). If the production delay continues to occur, the company will continue to experience problems considering the increase in shipping costs that must be incurred by the company. In addition, the direct impact that can be caused is to make operators have to catch up with the production delay by increasing working hours outside of working hours or commonly called overtime (Kurniawan, 2020).

Based on the above problems, it is necessary to use workload measurement or workload analysis as an example of calculating the needs of work workers to determine the workload received by the operator and the manpower needed. Moekijat (2008) suggests that the burden of work that is not distributed equally can result in the discomfort of the work atmosphere because the employee feels that the burden of work he does is too much or increases the shortcomings. The method used in this study is the Full Time Equivalent (FTE) method. Dewi and Satrya (2012) stated that FTE is one of the methods of workload analysis based on time by reducing the length of time presentation of work later this time is converted into FTE value indexes where the implications of the FTE value are divided into 3 types, namely overload, normal, and underload. The advantage of the FTE method in increasing company productivity according to Pambudi (2017) is that it can optimize the performance of entrepreneurs who know the optimal number of employees needed by the company.

2. Study Literature

2.1 Object of study

The object of the research carried out is in the stamping & manufacturing company PT X. The company is in Pekayon, South Bekasi. This research was conducted on January 11, 2021 – March 11, 2021, which focused on the production activities of PT X. Object This study is specifically focused on productive raw time and productive working days obtained through direct calculations using a stopwatch.

2.2 Data Retrieval Procedure

The data collection methods used in this study include observation, interviews, literature studies, and documentation (Sugiyono, 2016). All procedures are carried out directly with related sources, namely production activities in PT X.

2.3 Human Resource Management (MSDM)

Human Resource Management (MSDM) is considered very important for the running of a company or organization because MSDM is part of controlling and utilizing labor. Where control and utilization aim to make labor function productively in the process to achieve the goals of a company.

2.4 Workload

Workload is one aspect that really needs to be considered by every company. Every job a person does is a workload for him, and the burden depends on the person's work style. (Munandar, 2001) posits that from the point of view of ergonomics, every workload received by a person must be adjusted and balanced both to physical abilities, cognitive abilities and the limitations of humans who receive the load.

2.5 Direct uptime measurement

Method used to measure work time directly in this study was a stopwatch time study. Stopwatch time study conducted by measuring repeated time is done by resetting the pointing needle to zero after reading and recording the work time of the workpiece being tested. In the measurement of working time directly, there are several calculations to obtain the standard time, such as:

2.5.1 Cycle time (Ws)

According to Wignjosoebroto and Zaini (2006), "cycle time is the result of direct observations listed in the stopwatch". In general, the cycle time can be formulated:

$$Ws = \frac{\sum Xi}{n} \tag{1}$$

With:
Ws = Cycle time
$\sum Xi$ = Total observation time
n = Number of observations

2.5.2 Normal time (Wn)

According to Wignjosoebroto and Zaini (2006), "normal time is the time required for an operator who is trained and has average skills to carry out an activity under normal working conditions and tempo." In general, normal times can be formulated:

$$\text{Wn} = \text{Ws x Performance Rating} \tag{2}$$

With:
Wn = Normal time
Ws = Cycle time
PR = Adjustment factors

2.5.3 Raw time (Wb)

According to Sutalaksana, Ruhana and John (2006), standard time is the time needed reasonably by a normal worker to complete a job that is carried out in the best work system. In general, the raw time can be formulated:

$$Wb = Wn \times \frac{100\%}{100\% - Allowance} \tag{3}$$

With:
Wb = Raw time
Wn = Normal time
$Allowance$ = Allowance

2.6 Data Adequacy Test

According to Sutalaksana, Ruhana and John (2006), "The data adequacy test is carried out to find out whether the data taken from the research field is sufficient to be used in solving existing problems. If N' ≤ N, then the data is sufficient. Conversely if N' > N, then the data is not enough (Purnomo, 2004). "In general, the data adequacy test can be formulated:

$$N' = \left[\frac{\frac{k}{s}\sqrt{N\sum x_i^2 - (\sum x_i)^2}}{\sum X}\right]^2 \tag{4}$$

With:
N' = Amount of data needed
N = Number of observations made
x_i = Observation Data - i
K = Confidence level
S = Degree of accuracy

2.7 Data uniformity test

Uniformity tests are also needed to cope with changes that continue to occur but still must be within the limits of reasonableness (Sutalaksana, Ruhana and Tjakraatmadja, 2006).
Measures to conduct data uniformity tests according to (Abbas, Robert and Shinta, 2008) i.e.:

2.7.1 Calculating the average ($\bar{X}$)

$$\bar{X} = \frac{\sum xi}{N} \tag{5}$$

With:
$\bar{X}$ = Average
x_i = Observation Data - i
N = Number of observations made

2.7.2 Calculating the standard deviation (∂x)

$$\partial x = \sqrt{\frac{\sum (x_i - \bar{x})^2}{N-1}} \tag{6}$$

With:
∂x = Standard deviation
x_i = Observation data - i
$\bar{X}$ = Average
N = Number of observations made

2.7.3 Find the upper control boundary (BKA) and Lower Control Limit (BKB)

$$BKA = \bar{X} + 2\partial x \tag{7}$$

$$BKB = \bar{X} - 2\partial x \tag{8}$$

With:
$\bar{X}$ = Average
∂x = Standard deviation

2.8 Allowance

Allowance is time used to anticipate time needs outside of work (Sutalaksana, Ruhana and Tjakraatmadja, 2006)

2.9 Rating Factor

One of the most frequently used methods in determining performance rating and is also the oldest method is the method developed by Westinghouse Electric Corporation. According to (Niebel and Freivalds, 1999), the Westinghouse rating system describes six classes that represent existing proficiency in the evaluation of a job.

2.10 Full Time Equivalent (FTE)

According to Dewi and Satrya (2012), "FTE is one of the time-based workload analysis methods by measuring the length of time to complete the work then the time is converted into an FTE value index where the implications of the FTE value are divided into 3 types, namely overload, normal, and under load."

Table 1. Value implications FTE

No	FTE Value	Category
1	FTE > 1,28	*Overload*
2	1 ≥ FTE ≥ 1.28	Normal
3	FTE < 1	*Underload*

The following is a calculation formula that can be used to get an FTE value from a work process (Karo and Adianto, 2017)

$$FTE = \frac{Total\ working\frac{hours}{year} + Allowance}{Effective\ Working\frac{hours}{year}} \tag{9}$$

$$Total\ Hours = \frac{freq \times process\ time \times working\ days/years}{3600} \tag{10}$$

2.11 Research Flowchart

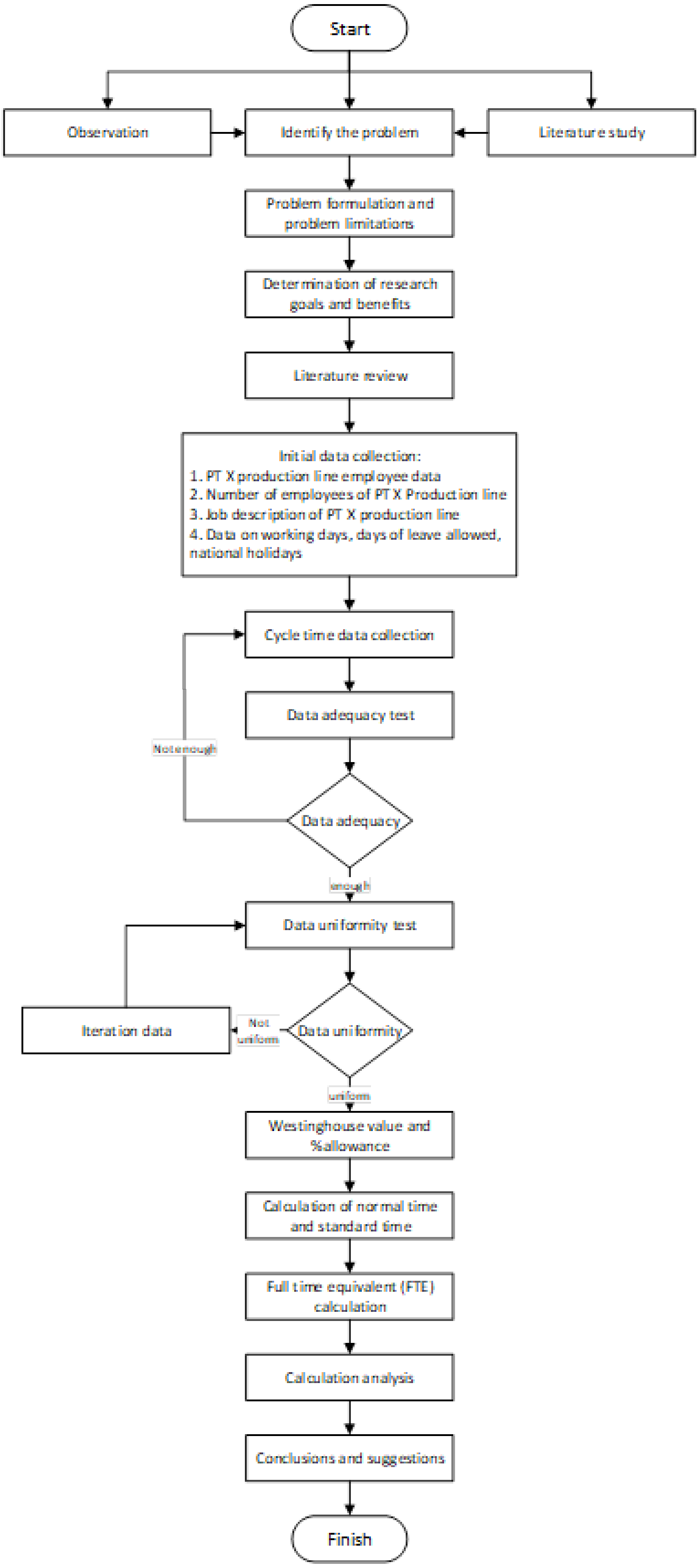

Figure 2. Research flowchart

3. Results and Discussion

3.1 Coated Spare Parts Production Workforce of PT X

In the Production of Coated Spare Parts PT X has a workforce of 10 people. Where 2 operators are on duty at SK Blank Piercing, 2 operators are on duty at SK Bending, and 6 operators are on duty at SK Coating.

3.2 Allowance

Recapitulation of allowance in Coated Spare Parts Production Line can by considering allowance factors such as energy expended, work attitude, work movement, eye fatigue, workplace temperature conditions, atmospheric conditions, environmental conditions, and personal needs can be seen in the following table:

Table 2. Allowance recapitulation

Allowance	(%)
Blank Piercing	31%
Bending	29%
Coating (Men)	30%
Coating (Women)	31%
Total	121%

(Source: Data Collection, 2021)

3.3 Amount of Time Available

In the calculation using the Full Time Equivalent (FTE) method, it is required to determine the available working time in one year, the total working hours for 1 day are 8 hours, 1 week for 5 days, 1 month for 22 days, and 1 year for 365 days. Furthermore, the calculation of holidays with a total of 133 days, consisting of a 17-day national holiday, a 104-day weekly final holiday, and the allowed annual leave is 12 days.

Working days 2021 = 232 days
Hours worked/year = 1856 Hours
Total hours worked = Effectiveness (100%All) x Hours worked/year
For example:
Total working hours blank piercing = Effectiveness (100%-Allowance%) x Hours worked/year = (100-31) % x 1856
= 1280.64 ≈ 1281 Hours
Total bending working hours = 1318 Hours
Total working hours of coating (Men) = 1299 Hours
Total working hours of coating (Female) = 1281 Hours

3.4 FTE Value of Each Operator

The FTE calculation is done by converting the working hours into the number of people needed to complete the work. This workload calculation is based on the total standard operator time for 1 year and compared to the available working time for 1 year. The processing time used is the standard time, the standard time is the time that includes the level of allowance and adjustment factors. This FTE calculation uses the following formula:

$$Total\ Hours = \frac{Frequency \times process\ time \times working \frac{days}{years}}{3600}$$

$$FTE = \frac{Total\ working\ \frac{hours}{years} + Allowance}{Effective\ Working\ \frac{hours}{year}}$$

For example, calculation FTE for Operator 1 – Work element 1 are as follows:
Frequency of work 1 day: 3 times
Standard time: 7.46
Working days per year: 232
Total Hours (Total hours worked/year): $\frac{3 \times 7.46 \times 232}{1281}$= 1.44
Effective working hours per year: 1281
FTE operator 1 – work element 1= $\frac{1.44}{1281}$ = 0.001126

For example, the results of calculating the total FTE for the blank piercing operator 1 are shown in the following table:

Table 3. FTE Blank Piercing 1

Operator	**Work Element**	**Standard Time**	**Working Day**	**Effective Hours Worked**	**Total Working Hours**	**FTE**	**Total FTE**
Blank Piercing 1	1	7.46	232	1281	1.44	0.001126	0.45
	2	3.87	232	1281	19.95	0.015578	
	3	100.20	232	1281	516.59	0.403269	
	4	3.92	232	1281	20.20	0.015771	
	5	2.52	232	1281	12.97	0.010127	

The number of operators in the initial condition or conditions before FTE is 10 people with details such as the following table:

Table 4. FTE recapitulation

Operator	FTE Value
Blank Piercing 1	0.45
Blank Piercing 2	0.47
Bending 1	1.02
Bending 2	1.05
Coating 1	1.13
Coating 2	**1.69**
Coating 3	1.24
Coating 4	**1.95**
Coating 5	1.28
Coating 6	**1.97**

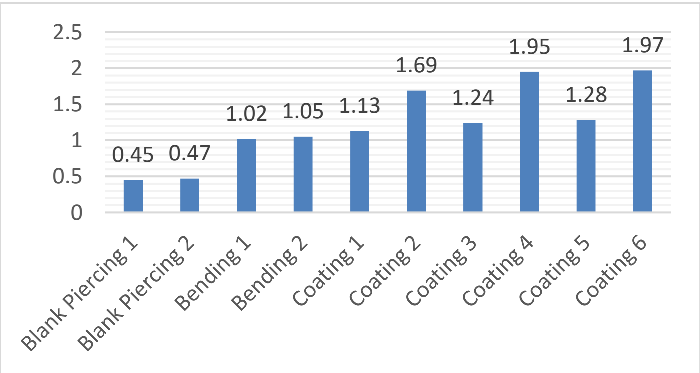

Figure 3. Initial state workload balance graph

After calculations using the FTE method, there are 2 operators with underload workloads, 5 operators with normal workloads, and 3 operators with workloads that are classified as overloaded. Operators that have overload workloads include coating operator 2, coating operator 4, and coating operator 6.

3.5 Proposed Improvements

To generalize the workload on each operator at the workstation, the researchers gave a proposal for the arrangement of operators as well as the number of operators assuming that all operators in the production unit can perform the work of other operators and the operators have the same skills or abilities so that the overhaul can be mutated horizontally.

Table 5. Proposed FTE improvements

Operator	FTE Value
Blank Piercing 1	0.9
Bending 1	1.02
Bending 2	1.05
Coating 1	1.13
Coating 2	1.08
Blank Piercing 2	0.62
Coating 3	1.24
Coating 4	1.12
New OP 1	0.83
Coating 5	1.28
Coating 6	1.05
New OP 2	0.92

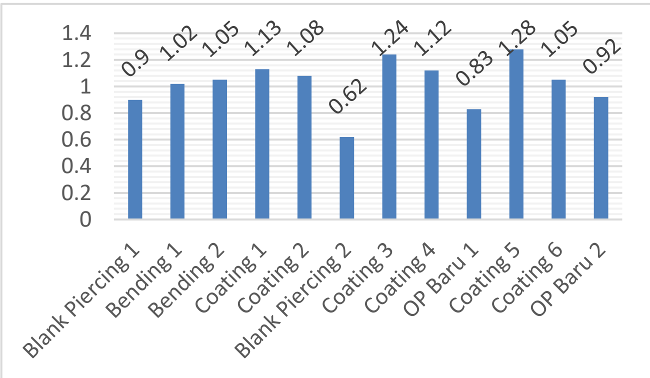

Figure 4. Proposed condition workload balance graph

The details of the proposal are as follows:

1) Reducing the operator on the blank piercing workstation from 2 people to 1 person. As a result of the reduction of operators at this blank piercing workstation, 1 operator on duty at this workstation will have an increase in the number of frequencies of work to be done and the FTE value becomes greater which is 0.9 (normal).
2) Did not make changes to the bending workstation. This is because the operator on the bending workstation already has FTE values with normal categories of 1.02 and 1.05.
3) Did not make any changes to the coating 1, coating 3, and coating 5 operators. This is because the coating operators 1, 3, and 5 already have FTE values with normal categories, namely 1.13, 1.24, and 1.28 respectively. If the addition is made, it will have an impact on the FTE value, considering that the FTE value for the operator of coating 1, coating 3, and coating 5 is close to the FTE value of the overload category.

4) Performs the transfer of the duties of the operator of blank piercing 2 to assist the operator of the coating 2. The removal of the blank piercing 2 operator is an attempt to cut the workload of the coating operator 2 which is included in the category of high workload or FTE overload by 1.62. After the transfer and calculation, a proposed FTE value with coating operator 2 of 1.08 (normal) and blank piercing operator 2 of 0.62 (underload) were obtained.
5) Adding 1 (one) operator to help the coating operator 4. The addition of this new operator is an attempt to cut the workload of coating operator 4 which is included in the category of high workload or FTE overload by 1.95. After the transfer and calculation, a proposed FTE value with coating operator 4 was obtained of 1.12 (normal) and new operator 1 of 0.83 (underload).
6) Adding 1 (one) operator to help the coating operator 6. The addition of this new operator is an attempt to cut the workload of coating operator 6 which is included in the category of high workload or FTE overload by 1.97. After changes and calculations, the FTE value proposal is obtained as follows: After the transfer and calculation, a proposed FTE value with coating operator 6 is 1.05 (normal) and a new operator 2 is 0.92 (underload).

3.6 Profit Analysis After FTE Proposal

The following is presented an analysis of the benefits of the nonprofit if the proposed improvements from the researcher are applied, including:

1) The workload of each workstation and each operator is more evenly distributed and balanced.
   Before the proposed improvements were made, it was known that the workload of some operators was too high or overloaded. Optimization of the operator performance of production units can certainly be done if the proposed improvements are implemented (Cahyani, 2020). This is supported by the proposed workload value after the FTE can be leveled and the workload becomes more balanced. Although the results of the proposed improvements are not fully balanced, the difference in workload between operators can be reduced so that the workload is more evenly distributed. In addition, a normal workload is very important for all operators to get. Because if you don't get this, work productivity will decrease so that the output produced is also not as expected.
2) Reduce production delays and minimize overtime by operators.
   With a balanced and even workload, production targets will be carried out properly and production delays can be avoided. This is because, productivity and good work motivation from the operator because the workload received is normal. As long as the production target is always met every day, it will also minimize the overtime that operators must do to catch up with the production targets that must be achieved. In addition, companies can minimize overtime costs that must be incurred.

4. Conclusions

The workload of coated spare parts operator PT X has different workloads. The operators of blank piercing 1 and blank piercing 2 each have low workload values or underloads that are in the range of 0 - 0.99. Bending operators 1, bending 2, coating 1, coating 3, and coating 5 each have normal workload values that are in the range of 1 - 1.28. Coating operator 2, coating 4, and coating operator 6 each have a high workload value or overload that is in the range of > 1.28.

Based on the results of the workload calculation carried out, the workload of the coated spare parts production operator is uneven or unbalanced. This is because there are still operators who have a high workload or overload and there are also operators who have a low workload or underload. The proposed improvements provided by the researchers are to add 2 operators and carry out operator mutations with the aim of balancing or levelling the workload. Although not completely balanced overall workload, researchers can reduce the value of high workloads or overloads to normal workload values. With the proposed improvements, the equalization effort managed to get results with details of 4 operators with low workload or underload (0 - 0.99), and 8 operators with normal workload (1 - 1.28).

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