WORKLOAD ANALYSIS ON PRODUCTION PLANNING CONTROL DIVISION PRESSURE PART USING FULL TIME EQUIVALENT METHOD AND NASA TLX AT PT ABC

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Abstract. PT ABC is a company engaged in steel manufacture technical assistance. The company produces with a make to order system. The production process for each order can take about 1-3 months. Especially for production in the pressure part can spend a long time due to the shape of the product that has a large enough volume. This causes the production planning control (PPC) employees to be able to control and make an optimal schedule so that the production process runs according to plan. Optimal performance of each employee will certainly be achieved if the workload received by each employee is evenly distributed so that workload measurement is needed to be able to find out whether the workload received by each employee is evenly distributed or not. Workload measurement can be done using the full time equivalent (FTE) and NASA-TLX methods. Workload measurements were carried out with 7 PPC employees in the pressure part. The results of workload measurements using the FTE method obtained an average FTE index value of 1.69 (overload) and the results of workload measurements using the NASA-TLX method obtained an average WWL value of 76.19 (high). Based on the results of workload measurements on PPC employees in the pressure part, it is necessary to add employees to equalize the workload of 3 employees so that the number of employees in the PPC pressure part becomes 10 employees and the average FTE index value to 1.18 (normal).

Keywords: Workload, Full Time Equivalent, NASA-TLX, Workload Measurement

1. Introduction

PT ABC is a company engaged in steel manufacture technical assistance. PT ABC produces steel construction fabrication, pressure parts, and maintenance services. The company produces with a make to order system so it is very important for PT ABC to maintain customer trust with satisfactory production results. One of the production factors that play an important and vital role is humans because humans as the most determining resource whether the production process runs smoothly and achieves goals [1]. At PT ABC, the Production Planning Control (PPC) Division has the task of planning the production process that will be carried out based on the number of incoming requests and what projects the company is working on at that time. This work is carried out by human labor who are experts in the field of PPC employees at PT ABC. The optimal work carried out by PPC Division employees will also optimize the production process carried out so that we need to know whether the workload borne by PPC employees is optimal or exceeds normal limits. Based on this problem, the workload of each employee needs to be measured in order to optimize work and increase productivity. Workload measurement can be done using the full time equivalent (FTE) and NASA-TLX methods. FTE is one of

the methods used to analyze workload on a time basis as long as it takes to complete the work and the time is entered into the FTE value [2] while the NASA-TLX method is a method used to analyze the mental workload faced by workers who must perform various activities in their work. After measuring the workload, the optimal number of employees is calculated based on the workload of each employee. The main objective is expected to know how much workload is owned by PPC employees and how many optimal employees are needed by PT ABC in the PPC Division of the pressure part.

2. Literature Review

2.1. Determination of allowance & effective working time

The determination of allowances is based on the standard allowances determined by the International Labor Organizations (ILO) and the calculation of effective working time based on KEP/75/M.PAN/7/2004, namely the number of days in the calendar minus holidays and leave [3]. Effective working days can be found using the following formula:

$$Effective\ Working\ Days = (A - (B + C + D)) \quad (2.1)$$

Description:
A = Number of days according to the calendar
B = Number of Saturdays and Sundays in a year
C = Number of holidays in a year
D = Amount of annual leave

2.2. Full Time Equivalent (FTE)

Full Time Equivalent (FTE) is one method that can be used to measure time-based workload. This is because the FTE method is done by comparing work completion time and available work time subjectively [4]. The implications of the FTE value are divided into 3 types, namely underload, normal, and overload [
2]. The FTE index range is said to be underload if the FTE index is 0-0.99, then it can be said to be normal if the FTE index is 1-1.28 and said to be overload if the FTE index is more than 1.28 [5]. In the process of calculating the FTE index value, it is carried out by means of processing time / year which has been adjusted with allowances divided by effective working time / year. To calculate the FTE value, you can use the following formula:

$$FTE = \frac{Total\ Working\ Time + Allowance}{Effective\ Working\ Time} \quad (2.2)$$

2.3. National Aeronautics Space Administration Task Load Index (NASA-TLX)

The NASA-TLX method is a method used to analyze the mental workload faced by workers who must perform various activities in their work. The NASA-TLX method is carried out by means of weights and ratings for each indicator that has been obtained will be multiplied then summed up and divided by 15 according to the number of pairwise comparisons then after the average WWL value of each employee is found then the next value grouping can be done based on workload classification [6]. There are 5 classifications of mental workload, namely low, medium, somewhat high, high, and very high [6].

3. Methods

- The methods used in data collection are: Observation is done to find out the actual condition of the work environment, especially the PPC division. Interviews with employees to collect data on what tasks are done, effective working time in a year, and allowance time.
- To determine the workload of each employee, a questionnaire was filled out and an interview was conducted with each employee using a predetermined method.
- Data processing for workload calculations using the FTE and NASA-TLX methods is carried out by calculating the FTE index value and calculating the average weighted work load (WWL) value.
- Identify the workload value and categorize the workload value for each employee.
- Calculate the optimal number of employees based on the FTE index to determine whether additional employees need to be added to the PPC division or not.

4. Results And Discussion

4.1.Calculating of FTE index

After determining effective working days, effective working hours are determined, namely the amount of formal work minus allowances. The following is the determination of allowances and effective working time.

Table 1. Effective Working Time

The year 2022		
Total Days	365 Days	
Annual Leave	12 Days	
National Holiday	8 Days	
Weekend (Saturday-Sunday)	105 Days	
Public Holidays	2 Days	
Total Effective Working Days	238 Days	
Calculations	Total	Unit
Effective Working Days	238	Days
Working Hours/Year	1904	Hours
Allowance	16	%
Work Effectiveness/Year	84	%
Total Effective Working Hours/Year	1599,36	Hours
Total Effective Working Hours/Month	133,28	Hours
Total Effective Working Hours/Week	33,32	Hours
Total Jam Kerja Efektif/Hari	6,664	Jam

Based on Table 1, the allowance factor is obtained at 16% so that the effectiveness of work/year becomes 84% and in Table 1 the calculation of effective working time based on the 2022 calendar is also obtained as much as 238 days of effective working time. In the process of calculating the FTE index value, the work time/year that has been adjusted with allowances is divided by the effective working time/year. The following are the results of the calculation of the FTE index value.

Table 2. FTE Index

Name	Working Time/ Year (Minutes)	Effective Working Time/ Year (Minutes)	FTE Index	Category
Suroso	171312	95961,6	1,79	Overload
Yus Indrawan	171426		1,79	Overload
Tantri Pusparini	63180		0,66	Underload
Solihin	247320		2,58	Overload
Ugi Almansyah	110250		1,15	Normal
Aditya	215910		2,25	Overload
Dean Fegy Putra	152460		1,59	Overload
Average			1,69	Overload

Source: Data processing

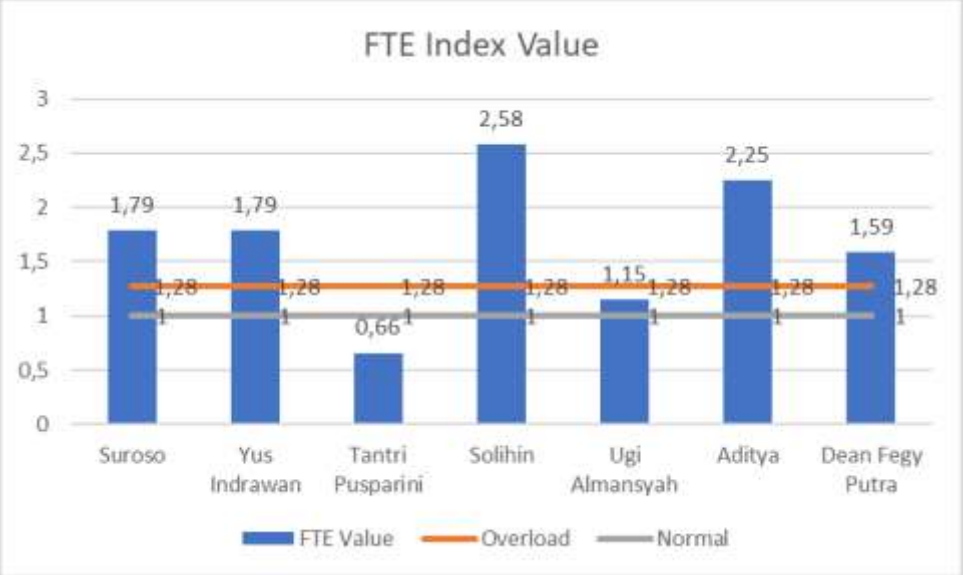


Figure 1. FTE Index

The implications of the FTE value are divided into 3 types, namely underload, normal, and overload [2]. The FTE index range is said to be underload if the FTE index is 0-0.99, then it can be said to be normal if the FTE index is 1-1.28 and said to be overloaded if the FTE index is more than 1.28 [5]. Based on Table 2 and Figure 1, it can be seen that Solihin has the largest FTE index with a value of 2.58 and Tantri has the smallest FTE index with a value of 0.66.

4.2. Calculation of Mental Workload Indicators and Average WWL

The calculation of each mental workload indicator is done by multiplying the rating value and the weight value of each mental workload indicator. The following are the results of the value of each mental workload indicator and as shown in Table 3:

Table 3. Mental Workload Indicator Value

No	Name	Work Duration (Year)	Indicator Value						Total
			MD	PD	TD	P	EL	FL	
1	Suroso	32	270	80	320	240	320	0	1230
2	Yus Indrawan	15	180	20	320	270	250	0	1040
3	Tantri Pusparini	5	210	0	210	240	350	50	1060
4	Solihin	14	240	140	360	80	400	0	1220
5	Ugi Almansyah	8	140	0	75	320	240	375	1150
6	Aditya	0,33	160	10	150	350	400	0	1070
7	Dean Fegy Putra	0,75	450	210	70	180	320	0	1230
	Average		235,71	65,71	215	240	325,71	60,71	
	Total		1650	460	1505	1680	2280	425	
	Ranking		3	5	4	2	1	6	

Source: Data Processing

Table 4. WWL Average

Name	WWL	WWL Average	Workload Category
Suroso	1230	82	Very High
Yus Indrawan	1040	69,33	High
Tantri Pusparini	1060	70,67	High
Solihin	1220	81,33	Very High
Ugi Almansyah	1150	76,67	High
Aditya	1070	71,33	High
Dean Fegy Putra	1230	82	Very High

Source: Data Processing

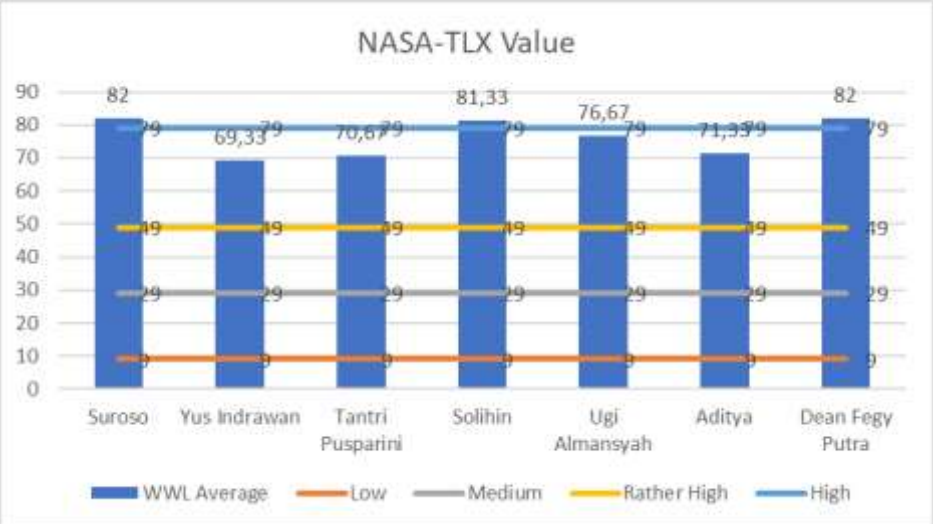


Figure 2. WWL Average

Based on Table 4 and Figure 2 above, the highest value among the 7 employees is for employees Suroso and Dean with the same value of 82 and the lowest value is for employee Yus Indrawan with a value of 69.33. It can be seen in Table 4 and Figure 2 that the largest value obtained by each indicator is in the mental workload indicator, namely the Level of Effort (TU). This is because the work done by PPC PP Division employees requires great mental effort and physical effort.

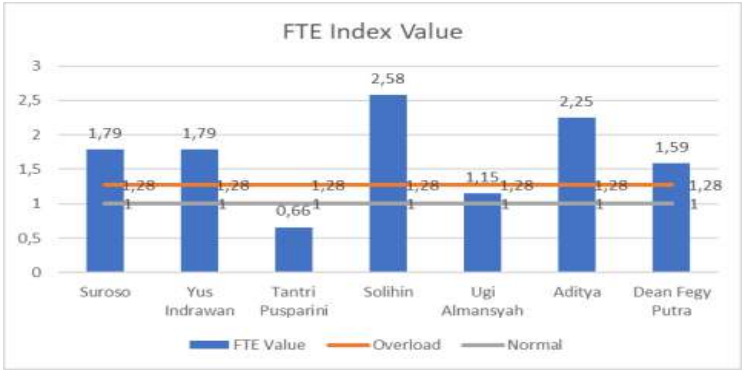
4.3. Comparison of FTE Index and NASA-TLX Value

The results of measuring workload using the FTE and NASA-TLX methods are very likely to get opposite results. This is because looking at the subjects measured by the two methods is different, of course, it can produce different results as well. The comparison of the FTE and WWL indices can be seen in Table 5 and Figure 3 as follows:

Table 5. Comparison of FTE Index and NASA-TLX Value

Name	FTE Index	FTE Category	NASA-TLX Value	NASA-TLX Category
Suroso	1,79	Overload	82	Very High
Yus Indrawan	1,79	Overload	69,33	High
Tantri Pusparini	0,66	Underload	70,67	High
Solihin	2,58	Overload	81,33	Very High
Ugi Almansyah	1,15	Normal	76,67	High
Aditya	2,25	Overload	71,33	High
Dean Fegy Putra	1,59	Overload	82	Very High

Source: Data Processing



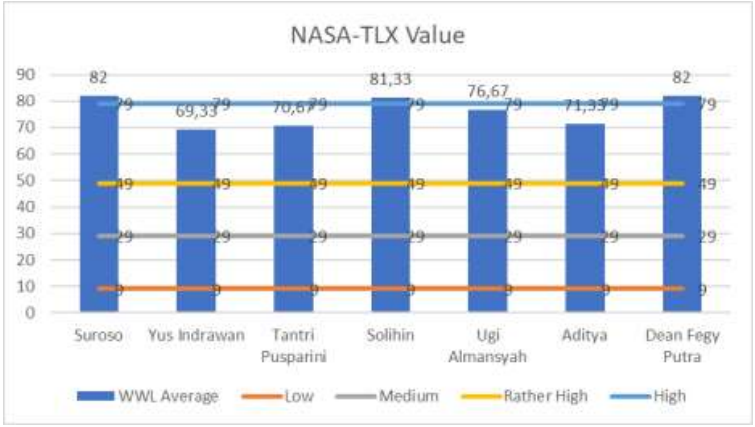


Figure 3. Comparison of FTE Index and NASA-TLX Value

Based on Table 5 and Figure 3 above, employee Tantri on measuring workload using the FTE method has a value of 0.66 which is included in the underload category (FTE < 1) while using the NASA-TLX method the value obtained is 70.67 which is included in the high category. It can be seen that the results of measuring workload on Tantri employees have different results, this is because the tasks received by Tantri may have not too much intensity but have high complexity and have little deadline time so that the mental workload is higher even though the results of measuring workload using FTE have a low value or underload (FTE < 1). This is the same as for employee Ugi where the FTE index obtained is 1.15 or normal while the mental workload obtained by Ugi is 76.67 where this value is in the high category. This difference in value can be due to the level of difficulty of the work which is quite high and has high complexity and has a small deadline so that the mental workload is higher.

4.4. Calculation of Optimal Employee Number Based on FTE Index

After obtaining the FTE index value for each employee, the optimal number of employees is calculated based on the FTE index. as shown in Table 6 below:

Table 6. Calculation of Optimal Number of Employees

	Actual Employee	Optimal Employee
	7	10
Total FTE	11,8	11,8
FTE Average	1,69	1,18
Category	Overload	Normal

Source: Data Processing

The calculation of the optimal number of employees can be obtained by dividing the total FTE index by the number of employees. Based on Table 8, the optimal number of employees based on the FTE index is 10 employees with an average FTE index value of 1.18 where the FTE index value of 1.18 is in the normal category.

Based on the calculation of the optimal number of employees in Table 6, the addition of 3 employees in the PPC Division of the Pressure Part can be done by adding additional employees to employees who have the largest FTE index value until the next as shown in Table 7.

Table 7. Distribution of Employee Additions

No	Name	FTE Index	Category
1	Suroso	1,79	Overload
2	Yus Indrawan	0,89	Underload
3	Additional 1 Employee	0,89	Underload
4	Tantri Pusparini	0,66	Underload
5	Solihin	1,29	Overload
6	Additional 1 Employee	1,29	Overload
7	Ugi Almansyah	1,15	Normal
8	Aditya	1,12	Normal
9	Additional 1 Employee	1,12	Normal
10	Dean Fegy Putra	1,59	Overload
FTE Average		1,18	Normal
Total FTE		11,80	

Source: Data Processing

The addition of 3 employees in the PPC Division of the Pressure Part is done by adding one employee to help the work of Mr. Yus, Mr. Solihin, and Mr. Aditya. This is because the three employees have a large FTE index value.

5. Conclusion

Based on the results obtained, the following conclusions can be drawn:

- The FTE index value with the underload category was obtained by Tantri (0.66).
- The FTE index value with the normal category is obtained by Ugi, (1.15).
- The FTE index value with the overload category was obtained by Solihin (2.58), Suroso (1.79), Yus (1.79), Aditya (2.25), and Dean (1.59).
- The optimal number of employees based on the FTE index for the Production Planning Control Division of the Pressure Part is 10 employees with an average FTE index value of 1.18 (normal) which was originally 7 employees with an average FTE index value of 1.69 (overload).
- The distribution of additional employees with a lot of 3 employees is given to Yus, Solihin, and Aditya, where these three employees have the largest FTE index value.
- The largest mental workload value was generated by Suroso and Dean with the same value of 82 (very high) and the lowest value was generated by Yus with a value of 69.33 (high).
- The mental workload indicator that has the largest value is the Level of Effort (TU) indicator with a total value of 2280 and an average of 325.71.
- The difference in the comparison of the results of the NASA-TLX value and the FTE index occurs in Tantri where the FTE index obtained is in the underload category (0.66) while the NASA-TLX value is in the high category (70.67). This is because the tasks received by Tantri may not have too much intensity but have high complexity and have little deadline time so that the mental workload is higher.

References

[1]. Andriani DN. Pengaruh modal, tenaga kerja, dan bahan baku terhadap hasil produksi (studi kasus pabrik sepatu PT. Kharisma Baru Indonesia). EQUILIBRIUM: Jurnal Ilmiah Ekonomi dan Pembelajarannya. 2017 Aug 14;5(2):151-62

[2]. Dewi U, Satrya A. Analisis kebutuhan tenaga kerja berdasarkan beban kerja karyawan pada PT PLN (Persero) distribusi Jakarta Raya dan Tangerang bidang sumber daya manusia dan organisasi. Jurusan Manajemen SDM Fakultas Ekonomi Universitas Indonesia, Depok. 2012

[3]. Kementrian Pendayagunaan Aparatur Negara Republik Indonesia. 2004. Pedoman Perhitungan Kebutuhan Pegawai Berdasarkan Beban Kerja dalam Rangka Penyusunan Formasi Pegawai Negeri Sipil (Kep. Men.PAN Nomor: KEP/75/M.PAN/2004). Jakarta: Kementrian Pendayagunaan Aparatur Negara Republik Indonesia

[4]. Wardanis DT. Analisis beban kerja tenaga rekam medis rumah sakit bedah Surabaya menggunakan metode FTE. Jurnal Administrasi kesehatan indonesia. 2018;6(1):53-60

[5]. Handoko MS, Sunardi S. Perencanaan Pegawai Berbasis Beban Kerja dengan Metode Full Time Equivalent di Badan Pengelolaan Keuangan dan Pajak Daerah Kota Surabaya. JUMINTEN. 2020 Mar 30;1(2):130-9

[6]. Rachmuddin Y. Analisa Beban Kerja dengan Modified Full Time Equivalent (M-FTE) dan NASA-TLX untuk Mengoptimalkan Jumlah Engineer di Bagian Electrical/Instrument Engineering (Doctoral dissertation, Institut Teknologi Sepuluh November)