ISSN No:-2456-2165

Analysis of the Effect of Work Shift and Time of Holidays on Employee Weak Levels

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Abstract:- PT. Ciliandra Perkasa is a company of oil processing industries (fresh fruit bunches). The products are CPO and palm kernel. Inside the factory there is has a lot of departments, sorting, maintenance, and laboratories. When this condition is considered work time maintenance employees are still high, then if the employee continues to work with excessive working hours will be worrying fatigue will be higher. This study aimed to investigate the effect of shift work and time off for employee fatigue levels before and after doing maintenance work shift changes. The approach used in analysis work shifts and time off by using a completely randomized experimental design to optimize the design of alloy parameters and variables that exist. After the experiment and processing the data obtained value of F value (23.5)> F (Table, α, 0.05), (4:22) for a confidence level of 95% and the 99% confidence level F value (23.5)> F (Table, α, 0.01) in (7.72) the hypothesis is rejected for the first experiment while time off work shift that is both experimental values obtained F value (15.67)> F (Table, α, 0.05), (4:22) for a confidence level of 95% and the 99% confidence level F count (15.67)> F (Table, α, 0.01) in (7.72) the hypothesis is also rejected, so these results suggest that changes in work shifts and time off gives significant effect on employee fatigue.

Keywords: *shift work, time off, fatigue, design of experiments*.

I. INTRODUCTION

Fajarwati (2011) defines working in shifts differently from working on a normal day. Working within 24 hours will cause a worker fatigue which can cause the employee's work performance to decline. The effective time to work is around 8 hours for 5 days or 6 days a week. The long working time, the management provides a shift system at work. According to Susetyo (2012) At present the shift work system has been applied extensively by various sectors both manufacturing industry and service industry. This situation in addition to providing economic and social benefits but can also have a negative impact so special attention is needed. The impact that is often associated with shift work is general fatigue which, if prolonged, can lead to chronic fatigue. Fatigue in workers is very bad, fatigue can reduce performance and is a condition that can increase the risk of disease.

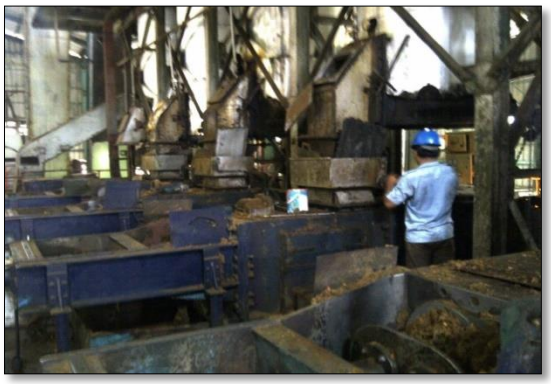

Fig 1:- Employee Maintenance Repairing Press Machine

PT. Ciliandra Perkasa Built 2001 located in the Siabu village Salo District, Bangkinang Regency with an installed capacity of 45 tons TBS / hour. Raw materials come from the nucleus garden from one location and another location. In addition to the main products in the form of CPO and palm kernel, side production is also produced in the form of waste water, fiber, shells and empty bunches. In the factory there are several departments that have important roles such as sorting department, defense department, laboratory department and process department.

In the initial survey in conducting site reviews and conducting observations directly in the maintenance department especially regarding working hours which were felt to be still high by employees because they counted their working hours for 8 hours then at night they routinely checked back to the factory with the call system by the production, because the production was still running, then problems and damage were still often found if there is a delay in the process of repairing the engine along with its components, especially during the night working hours, of course this is closely related to the performance of employees at night which is considered very apprehensive. This relates to work patterns that are not applied in shifts so that this will have a negative impact on the results of achievement. Often found employees seen as a result of working with forced energy from production to the end. With working hours provided for maintenance, their machines go to work in the morning until late afternoon, but if production runs until late at night, the employees who work this morning will be called back to meet the need for engine maintenance at night conditions until the production problems are completed .

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No	Factor	Old Shift
1.	Shift Type	Permanent
2.	Length of each shift	7 working hours + 1 hour break
3.	Mechanism	7 working hours + overtime (while still in production and damage to engine components) maintenance employees are ready to be called to the location
4.	Working hours	07.00 - 12.00 Break 2 hours 14.00 - 17.0). for all employees (14 people) Then the night came back to use the On Call system, and this routine happened every day. (3-4 hours)
5.	Shift rotation	-
6.	The number of shifts per team in 1 week	-
7.	Holiday	Sunday Maintenance routine 1-3 hours

Table 1:- Characteristics of old work shifts

Seeing similar conditions, of course there are many losses from various aspects starting from the performance of employees who will experience a decline, delay in the process of engine maintenance. Then from health which will also decrease if in the long term it will have a negative impact, the risk of various diseases will come. To avoid various types of losses, it is necessary to implement shift based work, by dividing 14 employees into 2 shifts, normal working hours or the first 8 hours of shift 1 with 10 employees, then the remaining working hours until production are categorized as shift 2 with 4 employees, so that each employee has their own shift schedule. And the level of employee fatigue can be reduced, their performance can be returned optimally, of course, this can increase production capacity by running production without obstacles, based on the explanation described above, an experimental design will be carried out based on work shift and holiday time to see the effect on maintenance staff fatigue . The objectives to be achieved are to find out the influence of work shifts and time off on the level of fatigue of maintenance employees before and after changes in work shifts.

I. METHOD

The first step that must be done before conducting the research is to conduct a preliminary study. The preliminary study was carried out at PT. Ciliandra Perkasa in the area of Siabu village, Salo District, Bangkinang Regency, which was the object of research. So the formulation of the problem is How the influence of work design and holiday time design on the level of fatigue of the maintenance staff of PT. Mighty Ciliandra.

The next step taken is the data collection stage, by making a number of questionnaires which will then be tested for validity and reliability then distributed to maintenance employees as respondents with a population of 14 people. Based on primary data, namely data or information obtained directly from the company, in the form of distributing questionnaires to employees both before the application and after the application design. The data are in the form of responses and perceptions of employees regarding the characteristics of the royal shift, time off is also fatigue. For secondary data obtained based on Literature Study as well as the data from the initial working conditions and regarding the conditions of employees obtained from the company.

Processing data is the result of questionnaire dissemination data on employees in the maintenance department, using experimental design aims to compare the level of fatigue experienced by employees before and after the implementation of the new work shift and to compare the effect that occurs between the level of employee fatigue on holiday time Data elaboration using Complete Random Design Method and then ANOVA analysis will be conducted to see the effect of fatigue with 95% and 99% confidence level. The purpose of data processing is to facilitate researchers in making decisions or solutions to be given to the problem under study.

According to Sudjana (1994) Determining whether the hypothesis is accepted or rejected is done by comparing F count with F table, with the provisions as follows: If F count> F table then the hypothesis is rejected and If F count <F table then the hypothesis is accepted. If the hypothesis H0 is accepted, then the test has been completed if H0 is rejected, it will be followed by the LSD (Least Significant Difference) test.

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II. RESULTS AND DISCUSSION

The characteristics of respondents in the Maintenance department are based on the results of a survey with the distribution of several attributes using a questionnaire as attached to the following table in table 2:

Characteristic	Quantity	Percentage (%)
Age		
20-25 years	3	21.4
26-30 years	5	35.7
≥ 31 years	6	42.9
Quantity	14	100
Status		
Married	10	71.5
Single	4	28.5
Quantity	14	100
Response to the Old Shift		
Comfortable	10	71.5
Uncomfortable	4	28.5
Quantity	14	100
Response to Shift Changes		
Disagree	2	14.3
Agree	12	85.7
Quantity	14	100

Table 2:- Characteristics of Respondents Maintenance of Palm Oil Mill PT. Ciliandra Perkasa

➢ *Validity test*

This stage to test the validity is used to determine the level of accuracy of a measuring instrument in carrying out its measuring functions. The criteria used are valid or invalid if the correlation coefficient r is obtained more than or equal to the coefficient in the table of critical values r, which is at the 5% significance level.

Variable	Number	r Count	r Table	Remark
Job Shift Criteria	1	0.973	0.497	Valid
	2	0.620	0.497	Valid
	3	0.922	0.497	Valid
	4	0.973	0.497	Valid
	5	0.886	0.497	Valid
	6	0.791	0.497	Valid
	7	0.891	0.497	Valid
	8	0.535	0.497	Valid
	9	0.567	0.497	Valid
	10	0.804	0.497	Valid

Table 3:- Characteristics of Respondents

Variable	Number	r Count	r Table	Remark
Exhaustion of Employees	1	0.614	0.497	Valid
	2	0.606	0.497	Valid
	3	0.526	0.497	Valid
	4	0.679	0.497	Valid
	5	0.822	0.497	Valid
	6	0.531	0.497	Valid
	7	0.858	0.497	Valid
	8	0.587	0.497	Valid
	9	0.550	0.497	Valid
	10	0.528	0.497	Valid

Table 4:- Results of Test Validity About employee fatigue

Variable	Number	r Count	r Table	Remark
Employee Holiday Time	1	0.744	0.497	Valid
	2	0.641	0.497	Valid
	3	0.638	0.497	Valid
	4	0.687	0.497	Valid
	5	0.638	0.497	Valid
	6	0.823	0.497	Valid
	7	0.846	0.497	Valid
	8	0.724	0.497	Valid
	9	0.651	0.497	Valid
	10	0.651	0.497	Valid

Table 5:- Validity Test Results About Holiday Time

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These results indicate that the questionnaire items in this study are valid, this is indicated by the value of r calculated on each item is greater than r table (0.497), meaning that all questions can be used as research instruments.

➢ *Reliability Test*

Reliability test is carried out to determine the extent to which the measurement results remain consistent if twice or more measurements are taken of the same object with the same measuring instrument. Furthermore, to find out the reliability of the questions in the questionnaire, Cronbach's Alpha technique is used. An instrument is considered reliable, if the alpha coefficient is above 0.60. The calculation of reliability test is done by statistical program. The results of the reliability test can be seen in the following table:

Variable	Cronbach Alpha	Remark
Job Shift Criteria	0.780	Reliabel
Exhaustion	0.756	Reliabel
Holiday Time	0,769	Reliabel

Table 6:- Reliability Test Results

The results of reliability testing on all items of questions obtained Cronbach Alph value greater than 0.60 so that it can be concluded that all items of this research question have met the reliability requirements or in other words that this questionnaire is reliable as a research instrument.

➢ *Experimental Design to examine the effect of employee fatigue on old work shifts and new work shifts*

TREATMENT (SHIFT)	OBSERVATION														TOTAL	%
	RES 1	RES 2	RES 3	RES 4	RES 5	RES 6	RES 7	RES 8	RES 9	RES 10	RES 11	RES 12	RES 13	RES 14		
Old Work Shift	0.64	0.64	0.71	0.71	0.29	0.36	0.36	0.71	0.21	0.71	0.43	0.71	0.71	0.29	7.48	0.53
New Job Shift	0.29	0.14	0.36	0.36	0.14	0.21	0.29	0.36	0.14	0.36	0.29	0.36	0.36	0.14	3.8	0.27
Total															11.28	0.81
Average															**5.64**	**0.4**

Table 7:- Calculation of Variable Analysis

The part used as treatment (a: old work shift, new work shift and repetition (reaponsen 1 to 14). Then determine the value of N where this value can be determined by multiplying the number of repetitions and treatments. This is intended to simplify the value F table.

Known :

n = 14, a = 2

Then:

a – 1 = 28 - 2 = 26 N – a = 2 – 1 = 1 N – 1 = 28 - 1 = 27

Sum of Square Treatment (SS Treatment) is determined to reduce the average of each row with the average of the total average which is then squared and multiplied by repetition (n), it will be obtained as follows:

$$SSTreatment = \sum_{j=1}^{b} k(\bar{x}_j - \bar{\bar{x}})^2$$

$$= 14\ (0.53 - 0.40)^2 + (0.27 - 0.40)^2$$

$$= 0.47$$

Sum of Square Total (SS Total) can be determined by subtracting all data in the table with the average of the total average then squared as follows:

$$SSTotal = (Yij - Y..)^2$$

$$= (0.64 - 0.40)^2 + \ldots\ldots\ldots + (0.14 - 0.40)^2$$

$$= 1.11$$

Sum of Square Error (SS Error) is determined by subtracting the value from Sum of Square Total (SS Total) with Sum of Square Treatment (SS Treatment).

$$SSEror = SSTotal - SSTreatment$$

$$= 1.11 - 0.47$$

$$= 0.64$$

The Mean Square Treatment (MSTreatment) is determined by dividing the value of Sum of Square Treatment (SS Treatment) with the a-1 above, and the following values will be obtained:

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$$\text{MS Treatment} = \frac{SSTreatment}{a-1} = \frac{0.47}{1} = 0.47$$

The Mean Square Error (MSEror) value is obtained by dividing the value of the Sum of Square Error (SS Error) with the above N-a, and the following values will be obtained:

$$\text{MSEror} = \frac{SSEror}{N-a} = \frac{0.64}{26} = 0.02$$

The distribution of F count can be determined by dividing the Mean Square Treatment value (MS Treatment) with the Mean Square Error (MSEror) value, namely:

$$\text{F Count} = \frac{MSTreatment}{MSEror} = \frac{0.47}{0.02} = 23.5$$

The value of F table is determined by looking at the percentile value of distribution F with a level of confidence P: 0.05 for α = 95% and α = 99% for P: 0.01 with values V1: 1 and V2: 12 the values will be as follows:

F Table (α = 95%) = 0.05, 1, 26
= 4.22

F Table (α = 99%) = 0.01, 1, 26
= 7.72

Source of Variance	SS	MS	DF	F Count	F tab	
					0.05	0.01
Treatment	0.47	0.47	1			
Error	0.64	0.02	26	23.5	4.22	7.72
Total	1.11		27			

Table 8:- Results of Analysis Variance of influence of employee fatigue on old work shifts and new work shifts

Based on Table 8, it can be seen that the calculated F value (23.5)> F (Table α 0.05) (4.22) so that the proposed hypothesis is rejected. It is that fatigue has a significant effect on the old work shift after the changes from the new work shift are made. Or it can be concluded that the new work shift has an effect on decreasing the level of fatigue experienced by maintenance department employees.

Whereas for testing the confidence level of 99% Statistical test results indicate that F Calculate (23.5)> F (Table α 0.01) (7.72) at a confidence level of 99%. It is that fatigue has a significant influence on the old work shift after the changes from the new work shift are made.

➢ *Least Significant Difference (LSD) Test*

Test the least significant difference or the smallest significant difference test is intended to compare the value of each pair of mean (pairs of mean) which aims to determine the parts that are significantly different or not significantly different from the level of α 5% and α 1% of a series of tests.

$$\bar{Y}_1 - \bar{Y}_2 = 0.53 - 0.27 = 0.26$$

The least significant difference (LSD) test value can be determined by referring to the F distribution table with a value of α: 95% or P: 0.05 and a value of V: 12 and multiplied by the Mean Square Error (MS Error) root multiplied by 2 / n. as follows:

$$\text{LSD} = \text{LSD}t\alpha/2, \text{N-a}\sqrt{MSE \times \frac{2}{n}}$$

LSD = 0.05, 26 (0.053)

= 2.06 (0.053)

= 0.10918

$\bar{Y}_1 - \bar{Y}_2 \mid 0.26 \mid$ >LSD(0.10918) : So it is significantly different at the level of 5%

➢ *Experimental Design to examine the effect of employee fatigue on the time of long work shift holidays and new work shift holidays*

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TREATMENT (HOLIDAY TIME)	OBSERVATION														TOTAL	%
	RES 1	RES 2	RES 3	RES 4	RES 5	RES 6	RES 7	RES 8	RES 9	RES 10	RES 11	RES 12	RES 13	RES 14		
Old Holiday Time	0.21	0.64	0.71	0.43	0.5	0.21	0.43	0.71	0	0.71	0.64	0.64	0.71	0.5	7.04	0.5
New Holiday Time	0.07	0.36	0.43	0.21	0.29	0.14	0.07	0.43	0.14	0.5	0.21	0.21	0.14	0.14	3.34	0.24
Total															10.38	0.74
Average															**5.19**	**0.37**

Table 9:- Calculation of Variable Analysis

Before carrying out further calculations, it is better to first determine the part used as treatment (a: Long vacation time, new holiday time and repetition (reaponsen 1 to 14). Then determine the value of N where this value can be determined by multiplying the number of repetitions and This treatment is intended to make it easier to determine the value of F table.

Known:

n = 14, a = 2

Then:

N - a = 28 - 2 a - 1 = 2 - 1 N - 1 = 28 - 1

= 16 = 1 = 27

The Least Significant Difference test conducted shows that the submission is significantly different at the 5% level, it can be concluded that fatigue has an influence on the old work shift or the new work shift influences the decrease in employee fatigue.

Sum of Square Treatment (SS Treatment) will be obtained as follows:

$$SSTreatment = \sum_{j=1}^{b} k(\bar{x}_j - \bar{\bar{x}})^2$$

$$= 14\,(0.50 - 0.37)^2 + (0.24 - 0.37)^2$$

$$= 0.47$$

Sum of Square Total (SS Total) can be determined by subtracting all data in the table with the average of the total average then squared as follows:

$$SSTotal = (Yij - Y..)^2$$

$$= (0.21 - 0.28)^2 + \ldots\ldots\ldots + (0.14 - 0.28)^2$$

$$= 1.36$$

Sum of Square Error (SS Error) is determined by subtracting the value from Sum of Square Total (SS Total) with Sum of Square Treatment (SS Treatment).

$$SSError = SSTotal - SSTreatment$$

$$= 1.36 - 0.47$$

$$= 0.89$$

The Mean Square Treatment (MSTreatment) is determined by dividing the value of Sum of Square Treatment (SS Treatment) with the a-1 above, and the following values will be obtained:

$$MSTreatment = \frac{SSTreatment}{a-1}$$

$$= \frac{0.47}{1}$$

$$= 0.47$$

The Mean Square Error (MSEror) value is obtained by dividing the value of the Sum of Square Error (SS Error) with the above N-a, and the following values will be obtained:

$$MSError = \frac{SSEror}{N-a}$$

$$= \frac{0.89}{26}$$

$$= 0.03$$

The distribution of F count can be determined by dividing the Mean Square Treatment value (MSTreatment) with the Mean Square Error (MSEror) value, namely:

$$F\ Count = \frac{MSTreatment}{MSEror}$$

$$= \frac{0.47}{0.03}$$

$$= 15.67$$

The value of F table is determined by looking at the percentile value of distribution F with a level of confidence P: 0.05 for α = 95% and α = 99% for P: 0.01 with values V1: 1 and V2: 12 the values will be as follows:

F Table (α = 95%) = 0.05, 1, 12

= 4.22

F Table (α = 99%) = 0.01, 1.12

= 7.72

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Source of Variance	SS	MS	DF	F Count	F tab	
					0.05	0.01
Treatment	0.47	0.47	1			
Error	0.89	0.03	26	15.67	4.22	7.72
Total	1.36		27			

Table 10:- Results of Analysis Variances in the influence of employee fatigue on long holiday times and new holiday times

Based on Table 10. The above shows that the influence of employee fatigue on the time of the long holiday and the time of the new holiday with the obtained value of F Count (15.67)> F (Table α 0.05) (4.22) so that the proposed hypothesis is rejected. It is that fatigue has a real effect on the length of time off for a new holiday.

As for testing with a 99% confidence level in accordance with table 10 above, the results of the F statistic test indicate that Fcount (15.67)> F (Table α 0.01) (7.72) at a confidence level of 99%. It can be concluded that fatigue has a significant effect on the length of time off for a new work shift.

➢ *Least Significant Difference (LSD) Test*

This comparison is determined by subtracting the average value of the first row with the average of the second row as below:

$$\bar{Y}_1 - \bar{Y}_2 = 0.50 - 0.24 = 0.26$$

The least significant difference (LSD) test value can be determined by referring to the distribution table F (attachment 4) with a value of α: 95% or P: 0.05 and a value of V: 12 and multiplied by the root value of Mean Square Error (MSEror) multiplied by 2 / n then the following values will be obtained:

LSD= LSDα : 0.05, N-a $\sqrt{MSE \times \frac{2}{n}}$

LSD = 2.06 (0.065)

= 0.1339

$\bar{Y}_1 - \bar{Y}_2 \mid 0.26 \mid$ >LSD(0.1339) : So it is significantly different at the level of 5%

The Least Significant Difference test conducted above shows that the submission is significantly different at the 5% level, it can be concluded that fatigue has an effect on holiday times where there is a long work shift or holiday time in the new work shift proven to have a significant effect on the decrease in employee fatigue.

➢ *New shift work results*

Some differences between the old work shift and the new work shift design can be seen in the table below:

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No	Factor	Old Shift	New Shift
1.	Shift Type	Permanent	Rotate
2.	Length of each shift	7 working hours + 1 hour break	7 working hours + 1 hour break
3.	Mechanism	7 working hours + overtime (while still in production and damage to engine components) maintenance employees are ready to be called to the location	Divided into 2 shifts: in normal working conditions of 10 people with 7 working hours + 1 rest hour, and 4 people a night until production is finished +1 hour of rest, if more than 8 hours of work it will be counted overtime work.
4.	Working hours	07.00 - 12.00 Break 2 hours 14.00 - 17.0). for all employees (14 people) Later that night Come back to use the On Call system, and this routine happens every day. (3-4 hours)	07.00 – 12.00 Istirahat 2 jam 14.00 – 17.00. tidak untuk keseluruan karyawan (10 orang) Kemudian malam Datang kembali tidak menggunakan sistem On Call, namun sudah ditentukan 4 orang dari 10 secara bergiliran karyawan maintenance untuk selalu berada di lokasi produksi.
5.	Shift rotation	-	Shift 2-2-2 + 1 day off
6.	The number of shifts per team in 1 week	-	Morning Shift: 2 days: 10 people Night shift: 2 days: 4 people Morning Shift: 2 days: 10 people Off: 1 day Total: 1 week
7.	Holiday Time	Sunday Regular maintenance 1-3 hours	Sunday Off

Table 11:- Comparison of old shifts with a new shift design

III. CONCLUSION

Based on the results of data processing, two tests can be produced which are the first on the effect of fatigue on the provision of work shifts, then the second is there is the effect of fatigue on holiday time given before and after the work shift, the information seen in both Tables 8 and 10 can be seen the first for experimental design of work shifts that obtained F_{count} (23.5)> F ($_{Table\ \alpha\ 0.05}$) (4.22). while for the holiday time the value of F_{count} (15.67)> F ($_{Table\ \alpha\ 0.05}$) (4.22) with a confidence level of 95% (attachment), so that the proposed hypothesis is rejected. The same thing also happens at the 99% confidence level for work shift F_{Count} (23.5)> F ($_{Table\ \alpha\ 0.01}$) (4.22). While for the holiday time obtained $F_{Calculate}$ (15.67)> F ($_{Table\ \alpha\ 0.01}$) (7.72) then the proposed hypothesis is also rejected so that this result states fatigue has a significant influence on work shifts and time off on the old shift system after the changes from new work shifts, new work shifts and the implementation of holiday time have an influence on the decrease in the level of fatigue experienced by maintenance department employees.

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