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Excessive Working Days for Shift Workers

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Abstract: Along with the needs of the manufacturing industry to increase the production volume, many industries rely heavily on shift work to optimize production. Even though the industry's need to survive is unstoppable, governments in various countries are trying to protect the rights of employees by establishing several regulations regarding working hours. The purpose of this study is to evaluate alternative shift patterns and determine recommendations for shift patterns. Thus, production continuity is maintained, but also prioritizes the interests of employees. Government regulations and company regulation is the main guidance for creating alternative of shift patterns. Shift schedule was generated within one year using three types of shift pattern, based on 2017 calendar, to handle the work within 24 hours. The next step is to calculate the workdays for each shift day patterns within one year. Employee with non-shift schedule are following the national holiday and collective leave that issued by the government. Then, the next step is to calculate the workdays for non-shift employee within one year. From the advantages and disadvantages of the proposed shift patterns, alternative 2 would be chosen as the best option for scheduling shift worker because it is appropriate with government and company regulation, and also, once a month, shift employee will get 3 days off.

Keywords: working hours, overtime, shift, excessive working days, manpower

1 Introduction

Along with the needs of the manufacturing industry to increase the production volume, many industries rely heavily on shift work to optimize production. Employee work shift is a shift or determination of working hours from hours in general that occurs once in 24 hours. The application of shift times varies depending on the needs and also the type of business. Even so, companies still have to pay attention to the safety and health when implementing it.

In various countries, regulations are established regarding working hours. World Health Organization (WHO)'s standard working hours defined as working hours of 35–40 hours per week [1]. Countries around the world have a total number of hours worked between 30 and 40 hours in 1 week [2]. However, it turns out that a number



of countries in Europe such as Germany, France, the Netherlands, Norway and Denmark have working hours of less than 30 hours in 1 week [3]. There are even countries that have an average working hours of more than 40 hours in 1 week, such as Mexico and Korea [4]. Meanwhile in Indonesia, the Indonesian government sets a standard working hour of 40 hours per week [5].

The purpose of this study is to evaluate alternative shift patterns and determine recommendations for shift patterns. Thus, production continuity is maintained, but also prioritizes the interests of employees.

2 Literature Review

2.1 Duration of Work

At the workplace, the duration and timing of work are crucial to determine how long employees are exposed to other working conditions and how much time is available for recovery, leisure activities, or private obligations [6]. The combination of high job demands and low job control is assumed to result in the highest level of strain, causing fatigue, physical illness, and job dissatisfaction. In contrast, workers who have a high level of job control when facing high job demands are hypothesized to experience lower strain and, beyond that, job satisfaction and personal development [7]. As an essential work resource, working time control may help employees manage work and personal demands, promoting health and work-life balance [8]. Moreover, long working hours or overtime may lead to shortened recovery time, resulting in psychological and physical health [9]. Furthermore, shift work or night work may lead to a disruption of circadian rhythms linked to biological functions such as hormone levels and sleep [10]. To produce a quality business process, it is necessary to understand the condition of the employees which is one of the internal factors of the company's business processes [11].

2.2 Shift Work

Shift work means a work schedule in which a worker replaces another on the same job within a 24-hour period. However, this is a narrow definition, and another definition of shift work is work that extends beyond the typical “nine-to-five” workday or work outside of the hours from 06:00 a.m. to 08:00 p.m. There are many types of shift work with respect to the structure: the presence or absence of night work, the duration of the shift (6 hours, 8 hours, 12 hours, or 24 hours), the number of workers or teams (two, three, four, or more teams), the change of working time (permanent or rotating), and so on. Shift work is commonly used not only in manufacturing industry to increase productivity but also in the hospital, police stations, and fire departments for public interest [10]. Shift work is associated



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with a higher rate of sickness absence due to poorer work time control, i.e., employees being less able to control the timing, duration, and distribution of their work time. Poor work time control is prospectively associated with lower subjective health and an increased risk of sickness absence. In contrast, good work time control is associated with improved sleep quality, less depressive symptoms, and a reduced risk of long-term sickness absence [12].

2.3 Government Regulations

2.3.1 Working Hours

Working Hours are the time to do work, can be carried out during the day and / or at night. Working hours for workers are regulated in [5], particularly articles 77:

1. 7 hours a day and 40 hours a week for 6 working days per week, or
2. 8 hours a day and 40 hours a week for 5 working days per week

If the maximum hour exceeds (more than 40 hours), the working time is considered as Overtime Work so that the worker is entitled to overtime pay.

That provision of 40 working hours does not apply to certain business sectors or occupations. [13] regulated the types and nature of work that are constantly carried out:

1. Health services
2. Transportation services
3. Transportation equipment repair services
4. Tourism business
5. Postal and telecommunications services
6. Electricity supply
7. Clean water service network
8. Oil and gas fuel supply
9. Self-service businesses
10. Shopping centers
11. Mass media
12. Security sector
13. Conservation institutions
14. Jobs that if terminated will disrupt the production process, damage the material, and include maintenance / repair of production equipment.

However, any excess working hours performed by workers in carrying out the work as listed above must be counted as overtime that must be paid because it is a worker's right that protected by law.

2.3.2 Overtime Work

Based on Article 1 paragraph 1 of [14], overtime is working time that exceeds 7 hours a day for 6 working days and 40 hours in a week or 8 hours a day for 8 working days and 40 hours in a week or working time on weekly rest days and/or on official holidays stipulated by the Government. Overtime work can only be done a maximum of 3 hours per day and 14 hours in 1 week excluding weekly breaks or official holidays.

2.3.2.1 Overtime Work Calculation

1. Calculation of Overtime Wages on Working Days

Table 1.
Overtime Wages on Working Days

Overtime Hours	Formula	Remarks
1 st	$1,5 \times 1/173 \times \text{Monthly wages}$	100% of Wages, if the prevailing wages in the company consists of the basic wage and fixed allowances.
2 nd , 3 rd	$2 \times 1/173 \times \text{Monthly wages}$	75% of Wages, if the prevailing Wage in the company consists of the basic wage, fixed allowances and non-permanent allowances, provided that the monthly wage cannot be lower than the minimum wage

2. Calculation of Overtime Wages on Holidays/ Rest

Table 2
Overtime Wages on Holidays

Overtime Hours	Formula
6 Working Days per week (40 Hours / Week)	
1 st 7 hours	$7 \text{ hours} \times 2 \times 1/173 \times \text{Monthly wages}$
8 th	$1 \text{ hour} \times 3 \times 1/173 \times \text{Monthly wages}$
9 th – 10 th	$1 \text{ hour} \times 4 \times 1/173 \times \text{Monthly wages}$
Official Holidays Fall on the Shortest Business Day e.g. Friday	
1 st 5 hours	$5 \text{ hours} \times 2 \times 1/173 \times \text{Monthly wages}$
6 th	$1 \text{ hour} \times 3 \times 1/173 \times \text{Monthly wages}$
7 th – 8 th	$1 \text{ hour} \times 4 \times 1/173 \times \text{Monthly wages}$
5 Working Days per week (40 Hours / Week)	
1 st 8 hours	$8 \text{ hours} \times 2 \times 1/173 \times \text{Monthly wages}$
9 th	$1 \text{ hour} \times 3 \times 1/173 \times \text{Monthly wages}$
10 th – 11 th	$1 \text{ hour} \times 4 \times 1/173 \times \text{Monthly wages}$

Anyone who violates the provision of overtime wages as regulated in article 78 paragraph 2 and article 85 paragraph 3 of the Law No.13 of 2003, will be subject to a **minimum imprisonment of 1 month, a maximum of 12 months and / or a**

minimum fine Rp 10,000,000 and a maximum of Rp 100,000,000. Regarding this sanction, it is stated in the provisions of the Manpower Act article 187 paragraph 1.

2.3.3 Excessive Working Days

The company will release official holiday for the employee based on joint decree of 3 ministers:

1. Ministry of Religious Affairs,
2. Ministry of Manpower and Transmigration, and
3. State Minister for the Empowerment of State Apparatus

This schedule of holiday apply for non-shift employee, and for shift employee, they follow their shift schedule, including the day off. However, the calculation of overtime refers to those schedules for calculation of overtime during holiday.



Figure 1
National holiday from Indonesian government

Excessive working day is the difference between shift and non-shift workdays. The difference may occur, because the different way to determine the day off between that two work types. Therefore, if we compare the workdays between shift and non-shift worker, there will be different workdays. Usually, the amount of shift workdays more than non-shift workdays.

2.4 Company Regulations

The regulations related with working hours are stated in [15], article 17 to 20:

1. Working time is the time for all employees to do work during the day and night. Controlling the entry and return times is carried out using a time recording machine. Working time consists of non-shift, shift, and overtime.

Table 3
Shift and Non-shift working time

Type	Days	Working Hours	Rest Hours	
Non-shift	Mo – Thu	07.30 – 16.30	12.00 – 13.00	
	Friday	07.30 – 16.30	11.45 – 12.45	
Type	Shift	Working Hours Including Rest	Regular Working Hours	Excessive Working Hours
Shift	I	22.00 – 06.00 (8 hours)	7	1
	II	06.00 – 14.00 (8 hours)	8	
	III	14.00 – 22.00 (8 hours)	7	1

2. Regulation about Overtime:
 - a. A maximum of 3 hours in 1 day and / or a maximum of 14 hours in a week and / or a maximum of 56 hours in a month
 - b. A maximum of 8 hours in 1 day to perform work during the weekly rest time or official holidays set by the company

3 Method

According to [1], three types of personnel scheduling address a range of problems and solution approaches for different industries: (i) shift scheduling, (ii) day-off scheduling (involves assigning days off between workdays over a given planning horizon), and (iii) weekly tour scheduling (arises when shifts and days off are scheduled simultaneously).

Aggregate planning is concerned with developing a specific course of action for the production system to meet anticipated demand [4]. Management must first prepare a forecast of the total market over the planning horizon in aggregate terms. The objective of aggregate planning is to allocate capital and labor resources effectively to meet the anticipated demand over the planning horizon.

The stages in the heuristic method are:

1. Determine the demand for each period.
2. Define what capacity is at regular and overtime in each period.
3. Determine the cost of labor, the cost of worker layoff, and the cost of added inventory.
4. Considerations of company policies applicable to workers and levels of supply.
5. Develop alternative plans and observe the total costs.

The method for finding efficient shift work patterns conducted by literature review for shift scheduling, and also related regulations as a theoretical basis before evaluating and compiling the efficient shift pattern as the flow process below:

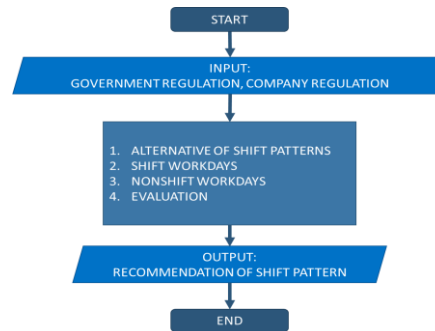


Figure 2
Flow process for getting efficient shift pattern recommendation

Shift schedule was generated within one year using three types of shift pattern. The next step is to calculate the workdays for each shift day patterns within one year. Employee with non-shift schedule are following the national holiday and collective leave that issued by the government. Then, the next step is to calculate the workdays for non-shift employee within one year. Finally, the most important thing would be giving recommendation of shift pattern based on Excessive Working Days.

4 Result

4.1 Shift Schedule

4.1.1 Shift Schedule Generation Result

Shift schedule was generated within one year using three types of shift pattern, based on 2017 calendar, to handle the work within 24 hours.

1. 3 Shifts, 3 Groups, with 5 days work, 2 days off

This pattern divides the division into **three** groups with five days of work in a week and with **two** days of rest in the weekend.

Group	January																																				
	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31						
I	OFF	1	1	1	1	1	OFF	OFF	2	2	2	2	2	OFF	OFF	3	3	3	3	3	OFF	OFF	1	1	1	1	1	OFF	OFF	2	2						
II	OFF	2	2	2	2	2	OFF	OFF	3	3	3	3	3	OFF	OFF	1	1	1	1	1	OFF	OFF	2	2	2	2	2	OFF	OFF	3	3						
III	OFF	3	3	3	3	3	OFF	OFF	1	1	1	1	1	OFF	OFF	2	2	2	2	2	OFF	OFF	3	3	3	3	3	OFF	OFF	1	1						

Figure 3
Shift schedule pattern with 5 days work 2 days off

2. 3 Shifts, 4 Groups, with 7 days work, 3 days off

This pattern divides the division into **four** groups with a rotation of each group to work in shift 1,2, 3, and OFF. It gives **three** days OFF for changing from shift 3 to shift 1, if the day is OFF on Saturday.

Group	January																																						
	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	
I	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31								
II	3	3	OFF	OFF	1	1	2	2	2	3	3	OFF	OFF	1	1	1	2	2	3	3	OFF	OFF	OFF	1	1	2	2	3	3	3	OFF	OFF	1	1	2	2	3	3	OFF
III	1	1	2	2	3	3	OFF	OFF	1	1	2	2	3	3	OFF	OFF	1	1	2	2	3	3	OFF	OFF	1	1	2	2	3	3	OFF	OFF	1	1	2	2	3	3	OFF
IV	OFF	OFF	1	1	2	2	3	3	3	OFF	OFF	1	1	2	2	2	3	3	OFF	OFF	1	1	2	2	3	3	OFF	OFF	1	1	2	2	3	3	OFF	OFF	1	1	2

Figure 4
Shift schedule pattern with 7 days work 3 days off

3. 3 Shift 4 Group with 6 days work, 2 days off

This pattern divides the division into **four** groups with a rotation of each group to work in shift 1,2, 3, and OFF. It gives **two** days OFF for changing from shift 3 to shift 1.

Group	January																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue	wed	thu	fri	sat	sun	mon	tue

Figure 5
Shift schedule pattern with 6 days work 2 days off

Then, for every shift workers, HR Department will make a personal shift schedule.

		Pancasila Day															Eid Al-Fitr Collective Leave															
		Jun-17																														
No	Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
		T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	
Center																																
1	SUBAHRI	off	2	off	0	2	2	2	2	off	3	3	3	3	3	3	3	3	3	3	1	1	1	1	off	off	2	2	2	2	2	2
2	MUHAMMAD IQBAL REZA	off	2	off	0	1	1	off	off	2	2	2	2	2	2	1	3	3	3	3	off	off	1	1	1	off	off	off	off	off	off	off
3	ARIF SULISTYO	off	2	off	0	off	off	1	1	1	1	1	off	off	2	2	2	2	2	off	3	3	3	3	3	3	off	off	1	1	1	1
4	JASPER ISWANDI	off	1	off	0	3	3	3	3	3	off	off	1	1	1	1	1	1	off	off	2	2	2	2	2	off	off	off	3	3	3	off
Delivery																																
1	RAFA BASCARA PUTRA	off	2	off	0	2	2	2	2	off	3	3	3	3	3	3	3	3	3	1	1	1	1	off	off	2	off	off	2	off	off	off
2	PRISTIO PRADILAH	off	2	off	0	1	1	off	off	2	2	2	2	2	off	3	3	3	3	off	off	1	1	1	off	off	off	off	off	off	off	off
3	JACHAAGAZAL LOVIC	off	1	off	0	off	off	1	1	1	1	1	off	off	2	2	2	2	off	3	3	3	3	3	3	off	off	off	1	1	1	1
4	ABIMU MASTARI	off	1	off	0	3	3	3	3	3	off	off	1	1	1	1	1	1	off	off	2	2	2	2	2	off	off	off	3	3	3	off
Shift work in rest day (Saturday & Sunday) and/or official public holiday. Rest day.																																

Shift work in rest day (Saturday & Sunday) and/or official public holiday.
Rest day.

Figure 6
Example of shift schedule

4.1.2 Workdays Calculation for Shift Workers Result

The next step is to calculate the workdays for each shift day patterns within one year. From the schedule, the result can be obtained as below:

Month	Shift Day pattern 5 2	Shift Day pattern 7 2	Shift Day pattern 6 2
January	22	23	24
February	20	21	21
March	23	23	23
April	20	23	22
May	23	24	24
June	22	21	23
July	21	24	23
August	23	24	23
September	21	22	22
October	22	22	23
November	22	23	24
December	21	24	23
Total	260	274	275
Average	21,7	22,8	22,9

Figure 7
Workdays within one year for 3 types of shift pattern

4.2 Workdays Calculation for Non-Shift Workers Result

Employee with non-shift schedule are following the national holiday and collective leave that issued by the government.

NO	DATE	WEEK DAY	HOLIDAY
1.	1 January	Sunday	New Year's Day
2.	28 January	Saturday	Chinese New Year
3.	28 March	Tuesday	Day of Silence
4.	14 April	Friday	Good Friday
5.	24 April	Monday	Ascension of Prophet Muhammad
6.	1 May	Monday	Labour Day
7.	11 May	Thursday	Buddha's Birthday
8.	25 May	Thursday	Ascension Day
9.	1 June	Thursday	Pancasila Day
10.	25-26 June	Sunday-Monday	Eid Al-Fitr
11.	17 August	Thursday	Independence Day
12.	1 September	Friday	Feast of the Sacrifice
13.	21 September	Thursday	Islamic New Year
14.	1 December	Friday	Birth of the Prophet Muhammad
15.	25 December	Monday	Christmas

Figure 8
National holiday

NO	DATE	WEEK DAY	HOLIDAY
1.	2 January	Monday	New Year's Day
2.	27, 28, 29, and 30 June	Tuesday, Wednesday, Thursday, and Friday	Eid Al-Fitr
3.	26 December	Tuesday	Christmas

Figure 9
Collective Leave

Then, the next step is to calculate the workdays for non-shift employee within one year. From the schedule, the result can be obtained as below:

Month	Workdays Calendar (A)	National Holiday (B)	Collective Leave (C)	Non Shift Day (D)
January	21			21
February	20			20
March	23	1		22
April	20	2		18
May	23	3		20
June	22	1	4	21
July	21			21
August	23	1		22
September	21	2		19
October	22			22
November	22			22
December	21	1	1	20
Total	259	11	5	248
Average	22	2	3	21

Figure 10
Workdays within one year for non-shift employee

4.3 Shift and Non-Shift Workers Comparison

The comparison of shift and non-shift employee related with their working days can be obtained as below:

Table 4
Shift and Non-Shift Workers Comparison

MONTH	WORKING DAYS				EXCESSIVE WORKING DAYS					
	(1) CALENDAR WORKING DAYS	(2) NATIONAL HOLIDAY	COLLECTIVE LEAVE	(3) NON-SHIFT = (1) - (2)	(4) 3S 3G 5-2	(5) 3S 4G 7-3	(6) 3S 4G 6-2	(7) 3S 3G 5-2 = (4) - (3)	(8) 3S 4G 7-3 = (5) - (3)	(9) 3S 4G 6-2 = (6) - (3)
JANUARY	21			21	22	23	24	1	2	3
FEBRUARY	20			20	20	21	21	0	1	1
MARCH	23	1		22	23	23	23	1	1	1
APRIL	20	2		18	20	23	22	2	5	4
MAY	23	3		20	23	24	24	3	4	4
JUNE	22	1	4	21	22	21	23	1	0	2
JULY	21			21	21	24	23	0	3	2
AUGUST	23	1		22	23	24	23	1	2	1
SEPTEMBER	21	2		19	21	22	22	2	3	3
OCTOBER	22			22	22	22	23	0	0	1
NOVEMBER	22			22	22	23	24	0	1	2
DECEMBER	21	1	1	20	21	24	23	1	4	3
Total	259	11	5	248	260	274	275	12	26	27

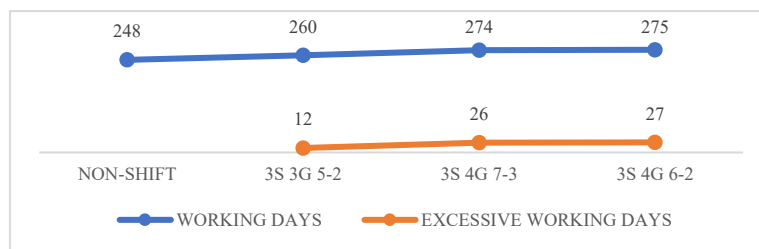


Figure 11
Comparison of Working Days and Excessive Working Days

From the above comparison, one alternative should be chosen with consideration of company and government regulation, and also the human factor itself (worker).

1. 3 Shifts, 3 Groups, with 5 days work 2 days off
Pro: appropriate with government regulation, low cost
Contra: cannot be implemented due to company regulation, need more time to calculate the payment
2. 3 Shifts, 4 Groups, with pattern A (7 days work 3 days off)
Pro: appropriate with government and company regulation, once a month, shift employee gets 3 days off
Contra: company must fill more position which resulted to the increasing of employee costs, need more time to calculate the payment
3. 3 Shift 4 Group with pattern B (6 days work 2 days off)
Pro: appropriate with government and company regulation,
Contra: company must fill more position which resulted to the increasing of employee costs, need more time to calculate the payment, once a month, shift employee gets only 2 days off

From the advantages and disadvantages, alternative 2 would be chosen as the best option for scheduling shift worker, with optimum Excessive Working Days (26 days), so it would bring the most benefit for the company (optimum cost) and the workers (more OFF days).

Conclusions

Along with the manufacturing industry's need to increase the production volume, many industries rely heavily on shift work to optimize production. At the workplace, the duration and timing of work are crucial to determine how long employees are exposed to other working conditions and how much time is available for recovery, leisure activities, or private obligations. Shift work means a work schedule in which a worker replaces another on the same job within 24 hours. Shift work is commonly used in the manufacturing industry to increase productivity and in the hospital, police stations, and fire departments for the public interest. The aggregate planning is used to allocate capital and labor resources effectively to meet the anticipated demand over the planning horizon. A specific method for aggregate planning is the heuristic method, by determining the need for each period, defining what capacity is at regular and overtime in each period, determining the cost of labor, the cost of worker layoff, and the cost of added inventory, using considerations of company policies applicable to workers and levels of supply, and developing alternative plans and observe the total costs.

Government regulations and company regulation is the main guidance for creating alternative of shift patterns. Shift schedule was generated within one year using three types of shift pattern, based on 2017 calendar, to handle the work within 24 hours. The next step is to calculate the workdays for each shift day patterns within one year. Employee with non-shift schedule are following the national holiday and collective leave that issued by the government. Then, the next step is to calculate the workdays for non-shift employee within one year.

From the advantages and disadvantages of the proposed shift patterns, alternative 2 would be chosen as the best option for scheduling shift worker because it is appropriate with government and company regulation, and also, once a month, shift employee will get 3 days off.

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© Bashirudin, I. Purnandari, P.S. (2020): Excessive Working Days for Shift Workers. In Kelemen-Erdos, A., Feher-Polgar, P., & Popovics A. (eds.): Proceedings of FIKUSZ 2020, Obuda University, Keleti Faculty of Business and Management, pp 322-334 <http://kgk.uni-obuda.hu/fikusz>

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