

## THE APPLICATION OF REVERSE SHIFT PATTERN TO OPERATOR WORKERS IN THE POWERHOUSE

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### ABSTRACT

**Introduction:** Companies generally apply a shift system to keep production running. Implementing work shifts is not necessarily independent of the risks, especially for workers who carry it out. **Aims:** to analyze the impact felt by operator workers from the implementation of the shift work system that is currently being undertaken, in terms of its impact on physiological, performance, psychological, and social aspects. **Method:** This research used a qualitative approach. The research was conducted at the powerhouse and the informants in this study were management and employees of the powerhouse operator. Collecting the required data was done by interviewing and observation techniques. Meanwhile, the discussion used descriptive method. **Result:** The results showed that the backward shift pattern applied by the company did not have a break. It is known that there are several impacts felt by workers as a result of implementing backward work shifts, such as disturbed sleep patterns, experiencing digestive disorders such as bloating and diarrhea, feeling excessively depressed, and workers experiencing social interaction barriers outside of work. However, the shift pattern currently applied has no impact on the performance of the operator. **Conclusion:** The shift pattern implemented has an impact on operator workers, especially on physiological, psychological and social aspects. Therefore, there is still a need for improvement in the shift pattern applied.

**Keywords:** Operator workers, Physiological, Psychological, Reverse shift pattern

### INTRODUCTION

There are several sectors of a company that require continuous operation, because the company or job has an important impact for the wider community, in its implementation based on Decree of the Minister of Manpower and Transmigration Number 234/2003, which categorizes the work carried out continuously, namely tourism, postal, services in the field of health, transportation, telecommunications, security, and provider/power plant companies (Decree of the Minister of Manpower and Transmigration of the Republic of Indonesia Number: Kep.234/MEN/2003). Companies must implement a shift work system in order to operate sustainably so as to maintain or improve the company's services and production results. Working on a shift basis can cause various impacts for workers who

run the work system. Shifts have an impact on circadian disruptions that cause decreased alertness, physiological, psychological, and also indigestion, decreased appetite, and stress in shift workers (Syafar and Fiatno, 2018; Bazrafshan et al., 2019). According to Maurits (2008), shift work has risks to physiological aspects such as sleep disorders, indigestion, and can affect aspects of employee performance, affecting social aspects, as well as psychosocial aspects of workers.

Human activities are normally carried out during the day, but for the asset shift workers these are not only done in the day but also at night (Arifah, Andarini and Dianita, 2019). Night work also creates conditions that can interfere with the ability to adapt biologically and socially. Various diseases directly related to shift work include fatigue, sleep disorders, jet lag, and gastrointestinal symptoms (Drake and

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Wright, 2010). From the results of annual global research data, it is estimated that about 20%-50% of adults report a sleep disorder and about 17% experience a serious sleep disorder (Saftarina and Hasanah, 2014). Research into accidents in New Zealand showed that of the 134 fatal accidents, 11% of them were caused by fatigue factor and of 1703 injuries due to accidents 6% were caused by fatigue in the operator (Adi, Suwondo and Lestyanto, 2013). Working shifts done long-term can increase the risk of developing cardiovascular disease, as well as obesity (Arifah, Andarini and Dianita, 2019). Therefore, Koemer provides criteria that need to be considered in the process of preparing or implementing work shifts, including the amount of night shift work time as small as possible; each night shift must be followed by at least 24 hours for rest (Gustafsson, 2002).

Powerhouse is a type of industrial work whose operation must be carried out continuously. This requires the power plant to implement a shift work system. In practice, the power plant divides work shifts into three shift times and uses a backward shift pattern, namely the night shifts/shift I, start from 10 PM until 7 AM (9 hours), the evening shifts/shift II, start from 3 PM until 10 PM (7 hours), and the morning shifts/shift III, start from 7 AM until 3 PM (8 hours). The implementation of the work shift that is applied is the shift starting from the night shift/shift I, then it will change after doing two times each shift. After that, workers are off for two days. The applied retreat pattern requires operator workers to return to work on the same day.

Based on the initial survey and interviews, it was found that the application of the backward shift pattern in the powerhouse was used with the approval of the operator workers with management, with the consideration that the vacation time that the workers got was longer. Workers complained about the lack of rest time available when moving from the first shift to the next shift. Workers also complained

about the sleep disturbances they experienced. In addition, there was a finding of one worker who was carrying out an exchange of services so that the worker had to work 24 hours a day. Therefore, this study was conducted to analyze the impact of the application of the backward shift pattern on operator workers.

## METHOD

This research is a descriptive research with a qualitative approach with the main purpose of the study is to describe the circumstances objectively of the impact of the application of shift patterns on operator workers at PT X. Research is conducted in power generation companies. Informants in this study are operator workers who carry out shift work, which is divided into two people per group, namely in the operator supervisor, control room operator, and generator turbine operator, in addition, the management, who is the head of staffing who determines the application of shift systems at the powerhouse, is also used as research informants as well as senior supervisors of operators (**Table 1**).

**Table 1.** Informants' Characteristics

No	Occupation	Initial
1	The Head of Staffing (HS)	E
2	Senior Supervisors of Operators (SSO)	AS
3	Operator Supervisor (OS)	Y
4	Operator Supervisor (OS)	MTM
5	Operator Supervisor (OS)	MSD
6	Control Room Operator (CRO)	TH
7	Generator Turbine Operator (GTO)	R
8	Generator Turbine Operator (GTO)	T
9	Generator Turbine Operator (GTO)	S

No	Occupation	Initial
10	Generator Turbine Operator (GTO)	TR

The data collection technique in this study is to conduct in-depth observations and interviews by looking at the impact of shift work on four aspects by Maurits and Widodo (2008), namely physiological, performance, psychological, and social.

Ethics approval was obtained from The Health Research Ethics Commission of Public Health Faculty, Sriwijaya University No:269/UN9.1.10/KKE/2019), on July 30 2019.

## RESULT

The average age of informants working at the operator ranges from 24 until 31 years old, in the sense that the informant is in a productive age. The supervisor is in charge of all the work in their respective squads, the control room operator is in charge of operating the generation device through the controller on the computer, and the turbine generator operator in charge of operating and checking the generation aids. Based on the results of this study, an overview of the impact of the application of shift patterns to workers is seen from physiological, psychological, performance, and domestic and social aspects as presented by Maurits and Widodo (2008).

### The Impact of Physiological Aspects

Based on the observations and interview results with informants about the impact caused by the shift work system imposed by the powerhouse on the physiological impact of sleep disorders in operator workers the following information was obtained:

*"From the pattern of shift itself because the work is not normal where others rest while we have to work, with shifts like now where the night used to be, then to noon, then to the morning, it*

*is rather heavy when moving the second shift of each shift so lack of sleep, I feel sleepy."(R, GTO)*

*"Personally, when changing the night shift to the afternoon shift, it's very tired, we only have 8 hours of rest and it's still better if we can use it for rest, otherwise we can't usually use it to its full potential."(TH, CRO)*

*"...for me, it's ideally around 8 hours, after the afternoon shift it's about 5 hours, if after the night shift itself it's shorter, at least sleeping at 8 or 9, at 11 or 12 I'm already awake..."(T, GTO)*

*"...after coming home from the night shift, I feel sleepy but can't sleep..."(S, GTO)*

*"...overtime work makes it easier for me to get the flu, cough, that is..."(TH, CRO)*

All informants experienced circadian rhythm changes from normal bedtime. The night generally used for sleep and rest turns into morning or daytime; this change in sleep patterns occurs when workers get part of the night shift. This causes the operator workers at the powerhouse to experience sleep deprivation. Based on the results of in-depth interviews information obtained was that the majority of workers' sleep duration decreased from the previous 6-8 hours to 4-5 hours per day. As a result, workers often feel sleepy, dizzy, unwell, and two informants often have difficulty sleeping after coming home from work shifts. In addition, six of the eight informants revealed that the milk they drank caused a digestive disorder. As the informant said:

*"...sometimes i get stomachache after a day or night shift in the morning..."(MSD, OS)*

*"...after coming home from the night shift, sometimes I often feel like I'm bloated like a cold, I've also had diarrhea..."(T, GTO)*

Operator workers suffer from indigestion such as flatulence, and diarrhea generally occurs in the morning, after doing

night shift work or day shift. Based on information obtained from informants, indigestion or diarrhea arises because it is caused by food eaten during shift work, and according to observations also operator workers often bring snacks or snacks from outside, consume caffeine, and some are also active smokers.

### **The Impact of Psychological Aspects**

Based on the observations and interview results with informants about the impact caused by the shift work system imposed by the powerhouse about the psychological impact in this case work stress on shift operator workers in power houses, informants said:

*"Honestly, the shift like this makes me worry about my health because of lack of rest, yes...although the time off is a little longer, but with a little rest time this made me less comfortable,"(TH, CRO)*

*"Bored for sure with the shift pattern especially if you have rotation shift then you'll stay here for days..."(TR, GTO)*

*"...when you're often at work because of overtime, because the office is like this, you just keep on doing things like this, it's very boring..."(T, GTO)*

*"...in my opinion, the current shift is heavier. Sometimes because the house is far away, from the night shift to the afternoon shift it's lazy to go home because the time is short. So you have to stay for days here, and also if you change the second afternoon and the first morning you have to stay here too..."(TR, GTO)*

*"...every time there is a disturbance, you must be anxious because the pressure is high, it makes you anxious, tense, for example when there is a blackout incident..."(MSD, OS)*

From the interview, it can be concluded that most of the workers at the powerhouse experience work stress. Six out

of eight informants feel challenged and worried about the shift patterns that are currently applied, which makes only a short time of rest available so that workers feel worried about their health in the future. While seven out of eight informants experience boredom, some of them are due to monotonous work every day, in addition, when workers have to do overtime or exchange services, that results in workers being continuously in the company environment for days.

Workers often feel depressed and agitated at certain times such as when the generating machine is experiencing problems. This can cause work stress because the pressure experienced by workers becomes higher and they are required to take quick action in overcoming the problem.

### **The Impact of Performance Aspects**

Performance measurements in the powerhouse itself has used an application under the name IP Perform, and in the implementation of shift working hours, all informants at the powerhouse do not experience interference with their performance. Based on the results of in-depth interviews the following information was obtained:

*"We already have a special application to input and see the performance of each individual (IP Perform). The performance of shift workers here is included in good and excellent indicators."(E, HS)*

*"Their performance is on average good and very good so there is no problem with the shifts that are now with their performance because it can be seen for themselves the workload that is arguably not too much; on the other hand with six people in one squad it already felt effective and efficient to do all the tasks of the company for these operator workers."(AS, SSO)*

*"The division of tasks is quite ideal for the number of workers, so the*

*division of tasks itself is fairly even and not too burdensome for one part because the division of tasks has been adjusted to each part and is running well.*"(MTM, OS)

The results of the interview showed that the current shift pattern is not a problem for the performance of operator workers at the powerhouse. The workload provided by the company is not too much and heavy, feeling that the division of job duties on each operator worker has been going well, on the other hand some parts in the operator, namely Control Room Operator (CRO) and Generator Turbine Operator (GTO), already have partners to rotate work, and all informants reveal that they can always fulfil their tasks properly and on time.

### **The Impact of Social Domestic**

The study results stated that the operator workers do not have social interaction barriers with colleagues in the company environment. In the domestic and social aspects of operator workers at the powerhouse, it was revealed that relationships and interactions with family, friends, and social communities outside the work are not good.

*"...quite impactful, because, for example, I go in at night so in the morning at home, we rest we go at night so if there are a neighbor gatherings so we can't get together..."*(TH, CRO)

*"...it affects my relationship with the environment since I usually rest during holidays."*(TR, GTO)

*"...family, there may be times where I want to play with family but I can't since I need to go to work on big days or Eid..."*(S, GTO)

Based on the interviews, with the current shift patterns imposed at the powerhouse, seven out of eight informants complained about their disrupted social interaction relationships, such as during get-togethers with relatives and family, get-

togethers with friends, or activities at home with the community such as neighborhood gatherings or devotional work, which is not uncommon for these activities to be done during their shift schedules, and ordinary operator workers use time off to rest, which makes them rarely socialize with the outside environment; this affects their relationships and social interactions.

## **DISCUSSION**

### **Impact of Physiological Aspects**

Based on this study, it was found that the majority of workers who run shifts experience disorders in the physiological aspect, which are closely related to health problems. The physiological impact of workers can occur due to changes in circadian rhythms that occur during shift work. According to Rouch (2007), the shift system will disrupt circadian rhythms for workers who run it. Circadian rhythm is the basic nature of physiology, so if circadian rhythms are disrupted it will have a physiological impact on workers, such as disruptions in sleep patterns, digestive disorders, and other health disorders (Maurits, 2008).

Each individual has a different ability to adapt to the mismatch between circadian physiology and sleep-wake behavior. These differences can affect several aspects of physiology, such as gastrointestinal systems, cardiovascular, and sleep-wake in specific individuals. In addition, the other most common effects of working the night shift are excessive sleepiness and insomnia, which contribute to other hazards such as accidents, and are defining symptoms of Shift-Work Sleep Disorder (SWD) (Drake and Wright, 2010). SWD is diagnosed if there is a report of excessive sleepiness or insomnia for at least three months related to a repetitive work schedule that overlaps with regular sleep times (Burman, 2017).

From the theory it can be concluded that the results of this study show that workers experience physiological impacts where all informants experience changes in circadian rhythms from normal sleep time.

Night, which workers generally use for sleep and rest, turns into morning or daytime; this change in sleep patterns mainly occurs when workers get part of the night shift. This causes the operator workers at the powerhouse to experience sleep deprivation. Based on the results of in-depth interviews information was obtained that the majority of workers' sleep duration decreased from the previous 6-8 hours to 4-5 hours per day. As a result, workers often feel sleepy, dizzy, unwell, and two informants often have difficulty sleeping after coming home from work shifts.

The study results are in line with the research of Anggraeni (2015), which found that of the ten workers at PT. Admira there were eight workers who complained of experiencing physiological disorders such as sleep disorders, physical disorders, and indigestion. Similar research conducted by Sari (2020) obtained the result that doing night shift work resulted in disruption of workers' night sleep patterns. In addition, as many as 41 workers have poor sleep quality; workers who work in the night shift feel tired and sleepy, due to the night wind and this is also what makes during rest hours used by workers to sleep (Juliana, Camelia and Rahmiwati, 2018).

Cho and Duffy (2019) stated that recent research shows that disrupted sleep, insufficient sleep, and sleep disorders can affect sexual function. Individuals with Erectile Dysfunction (ED) or urological disorders may have sleep disorders that contribute to their urological or sexual dysfunction. All common sleep disorders, including Obstructive Sleep Apnea (OSA), insomnia, restless legs syndrome, and Shift-Work Sleep Disorder (SWD) are associated with ED and/or other urological disorders (Cho and Duffy, 2019).

In addition, sleep disturbances are causally linked to chronic disease although there is insufficient evidence to prove this (Briancon-Marjollet et al., 2015; Kecklund and Axelsson, 2016). However, a systematic review and meta-analysis by Kecklund and Axelsson (2016) found there

were inconsistencies between studies to prove the relationship between work shifts and accidents, type 2 diabetes mellitus, obesity (RR: 1.09-1.40), stroke (RR: 1.05), coronary heart disease (RR: 1.23), cancer (RR: 1.01-1.32), prostate, and colorectum. Laboratory studies show that cardio metabolic stress and cognitive impairment increase due to shift work, as well as sleep deprivation.

This study result also found six out of eight operator workers felt digestive disorders such as flatulence and diarrhea after working night shifts or day shifts, in addition some operator workers at the powerhouse also have a habit of bringing food from outside, morokok and drinking caffeinated beverages. Syifa et al. (2017) revealed that of 25 shift worker respondents, 72% of workers experienced indigestion that occurred when workers worked night shifts, while 28% did not experience indigestion. Other research conducted by Ihsan (2020) said the chronic fatigue experienced by night shift workers, if not balanced with healthy eating habits, can result in impaired digestion. Nea et al. (2017) also revealed that shift workers had poor and irregular diets, as well as an increase in the consumption of cigarettes and alcoholic beverages. Syafar and Fiatno (2018) stated that the level of consumption of light snacks among shift workers is higher than normal workers. In addition, the quality of the diet is lower and tends not to meet the requirements of balanced nutrition.

Therefore, to reduce the impact on physiology, such as sleep and indigestion disorders, the company can rearrange the scheduling and determination of shift patterns by using advanced shift patterns. The workplace needs to provide special time for a Power Nap (short sleep), with a duration of about 30-90 minutes of rest during the day (Garbarino et al., 2002). To avoid the problem of indigestion it is recommended in shift workers to reduce the consumption of salt and fatty foods, avoid junk food, provide extra food for workers, and consume foods with balanced and good

nutrition. In addition, avoid drinks that contain caffeine, and reduce smoking habits or food ingredients that contain nicotine while working so as to prevent the increase of stomach acid (Berger, 2005).

### **Impact of Psychological Aspects**

Psychological aspects of workers are closely related to work stress. Stress due to shift work will cause fatigue which can lead to psychological disorders of workers, such as dissatisfaction (Maurits, 2010). Marchelia (2014) expresses that psychological symptoms when someone is experiencing stress are characterized by anxiety, tension, confusion, irritability, and boredom. The results of this study indicate that operator workers experience several symptoms of work stress, including experiencing dissatisfaction with the application of the current shift pattern. The lack of available rest time causes workers to worry about their health in the future. On the other hand, all operator workers felt anxious and depressed, whether there were problems with the generator equipment or machine. Then the operator workers also feel bored with the reverse shifts applied due to repetitive work activities. In addition, if operator workers have to work overtime or there are times when workers change schedules, it makes workers have to work two to three shifts at once in one day. This means workers have to be at work for days. Thus the application of the reverse shift pattern has an impact on the psychological aspects of operator workers.

The study results are supported by research conducted by Firmana (2011) in which operator workers experienced mild stress in 15 people (21.1%) and moderate stress in 16 people (22.5%). The results show that employees who experience moderate stress and mild stress amount to almost the same. One of which could be experienced by employees because there are many overtime activities on night shifts so that the rest time is little. Saleh (2018) said that workers with long shifts can cause psychological fatigue, feeling saturated.

Research conducted by Marchelia (2014) on the comparison between the levels of stress in shift workers was categorized moderate as 78.5% and 13.2% experiencing mild stress, the most stress arises when working the night shift.

Other research states shift workers often complain about the effect on mood, anxiety, and nervousness in relation to working conditions, which cause workers to experience work stress (Costa, 2010). It was found that nurses who worked in shifts had a higher risk of overcommitment compared to those who worked on day/non-night shifts (Lin et al., 2015). Overcommitment, a kind of coping, is not only critical enough to result in emotional exhaustion but also exacerbates the negative effects of the effort-reward imbalance (Lin et al., 2015).

In this case, workers define the stress they feel at work as a "sense of fatigue." Work-related stress is considered a major risk factor in the emergence of health problems such as cancer, metabolic syndrome, cardiovascular diseases, cognitive impairment, and depression (Cannizzaro et al., 2020). Sleep disturbances are thought to increase oxidative stress, which is defined as an imbalance of excess pro-oxidative factors and reactive oxygen species over anti-oxidative activity. Oxidative stress can damage cells, DNA, and proteins and ultimately can lead to various chronic diseases such as diabetes, cancer, cardiovascular disease, dementia, and Alzheimer's (Gibson, 2021).

Thus to reduce stress, some relaxation techniques are believed to lower mental burden and stress levels. The easiest relaxation techniques such as listening to soothing music, socializing with friends, or pursuing hobbies should be chosen (Syafar and Fiatno, 2018). In addition, providing time off for shift workers is also considered effective in reducing health problems, as shown by the results of Lin et al.'s research which found that nurses who have two days off after carrying out the night shift show a

reduced risk of overcommitment (Lin et al., 2015).

In addition, Kim, Park and Niu (2017) stated the importance for the company to provide a special short time of about five minutes to give workers time to do cooking and stretching, which can relieve stress and work fatigue.

### **Impact of Performance Aspects**

Based on this research, all informants have a good performance. Performance is success in completing a task or meeting a set target; the quantity and quality of work achieved by a worker in carrying out his duties following the responsibilities given to him. So the conclusion in this study is that the majority of operator workers have good performance and are affected by the shift patterns applied. This is considering that most operator workers are still in productive age, the division of tasks in each part of the operator is in accordance with the ability and skills of workers; in some parts such as the Control Room Operator (CRO), and Generator Turbine Operator (GTO) there are already partners to rotate work so as to reduce the intensity and burden of work done by shift workers.

Seguh, Kolibu and Kawatu (2019) state that 89.1% of nurses have good performance, and only 10.9% have poor performance. So it can be concluded that there is no relationship between shift work and performance. Similar research conducted by Firmansyah et al. (2014) shows that not working shifts does not have a significant impact with performance, be it morning shifts, day shifts, or night shifts; these three shifts have no effect on the performance of nurses. Another study conducted on the performance of nurses in night shifts found that as many as twenty-three people or 76.6% have a good performance category; this is due to factors from the relationship between the workforce, working with teams, working in turns, which makes shifts that are done not have a significant impact on the performance of nurses (Ahsan, 2016).

However, research of Nurbaity, Rahmadi and Fithriani (2019) at PT Techno Indonesia shows the higher the effect of work shift impact, the decreased employee performance, or vice versa, the impact of low shifts will make employee performance rise. In addition, research by Dall'Ora et al. (2016) and De Cordova, Bradford and Stone (2016), who conducted a literature review related to the impact of work shifts on worker performance, showed that working rotating shifts was associated with poor performance outcomes and night shift workers had poor health, which can lead to errors and decreased performance.

Therefore, the thing that the company can do to maintain the performance of operator workers is maintaining supervision so that in the implementation process there is no overlap in the division of duties of operator workers, for workers are expected to maintain consistency in the division of tasks when doing shift work.

### **Impact of Domestic Social Aspects**

This research found that the operator worker complained about the pattern of shifts that workers lived, disrupting their social interaction. Shift work can cause effects in domestic and social aspects for workers and become a big problem due to disruption of family life, loss of free time, small opportunities to interact with friends, and disruption of group activities in society. Thus it can be concluded that the operator workers at the powerhouse who work with a backward shift pattern experience obstacles in interacting with social communities. This obstacle occurs when there an activity such as citizen gatherings, devotional work, gathering with friends, family, and community groups becomes very limited; in general, the time lag and holiday time is used by the operator worker for rest (sleep), thus the operator worker experiences obstacles in interacting and relating to social activities outside of work.

This research is also in line with research conducted by Supomo (2014)

There is a disruption to family life, loss of free time, lack of opportunity to interact with friends in addition to also inhibiting activities with groups in the community where the activity is generally done in the evening or evening. While for workers with night shifts, free time is often used for rest or sleep, thus they are unable to attend or participate in such activities, due to being excluded from the community environment. Maurits (2008) also says that night shifts greatly impact interaction relationships with family and social communities. Shift work makes some workers feel isolated from social activities and with interactions with family (Singh and Muninarayanappa, 2018). Work shifts or night shifts are conditions that can inhibit interaction with social life (Anggraeni et al., 2015). To overcome the impact of domestic and social aspects of workers, it is advisable for companies to hold regular programs such as family gatherings. Meanwhile, workers need to have quality time with family, or friends, such as walking, doing hobbies or sports together.

## CONCLUSION

The results of this study indicate that the application of the backward work shift pattern has an impact on workers. The impact on physiological aspects are such as workers experiencing disturbed sleep patterns, lack of sleep time, and experiencing digestive disorders such as flatulence and diarrhea. Psychological impacts are such as work stress, workers feel worried and depressed about their health, workers feel bored because of monotonous work. Finally, there is the impact of social interactions outside the work environment such as with family, friends, and the community. However, operator workers do not feel the impact of shifts on their daily performance; operator workers can always complete work tasks properly and on time. This is due to the division of labor, thus making the workload given lighter.

Recommendations are to rearrange scheduling and setting shift patterns using advanced shift patterns; the workplace needs to provide special time for a Power Nap (short sleep), with a duration of about 30-90 minutes of rest in the day. It is important for the company to provide a special short time of about 5 minutes to give workers time to do cooking, stretching, listening to music, so as to reduce fatigue in the work. They should also provide extra food for shift workers to meet the nutrition of the operator worker. In addition workers should avoid drinks containing caffeine, and reduce smoking habits or food ingredients that contain nicotine while working, to prevent the rise of gastric acid. In conducting supervision of the implementation of service exchanges to avoid workers who have excess work time in one day, so as to get enough rest time, the company can increase rewards, as well as a clear career level in workers so that workers are more motivated, which will make performance better. The company can hold a family gathering program, which can be used by workers to chat with family, and they can change the shift pattern to give a longer time lag to the operator's work.

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