

**Extended Shifts - Occupational Health and  
Safety Perspective**

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## INTRODUCTION

Not all employees work 8am to 5pm, Monday through Friday. The nature of the services performed may necessitate other schedules. Police officers, fire fighters and telephone operators provide 24-hour-a-day service. In industrial manufacturing (for example mining) some technology requires constant monitoring and operation. It is not practical or economical to shut off furnaces and process operations at 5pm just because the workers want to go home. In those cases it is advantageous to run them continually by having different shifts work around the clock. However, shift-work brings other problems. This paper briefly looks at what is shift-work, the effect of shift-work on OHS. Finally, recommendations for some of these problems are suggested with the aim of reducing the impact of shift-work

## DEFINITIONS OF SHIFT-WORK

Shift-work refers to the working of shifts that do not include only the standard eight-hour order of events. The term can encompass a wide variety of hourly arrangements. Four known arrangements are:

- a) Continuous Shift-work - the organisation operates on a twenty-four hour basis seven days a week and continues on public holidays.
- b) Semi-Continuous Shift-work - operations carried out continually for twenty-four hours but for five or six days a week rather than seven.
- c) Discontinuous Shift-work - consisting of daily work activity that is less than twenty-four hours and where work is halted at the end of the work day and also usually on weekends.
- d) Overlapping Shifts or a Combination of full-time and part-time Worker Shifts - operations used to maintain services over a larger duration than the normal working day.

The concept and practice of shift-work has existed since the days of Ancient Rome and from this time the number of worker's participating in shift-work has increased (Carpentier and Cazamian, 1977). Additionally there has been an increase in the number of problems experienced by the workers and organisations involved in shift-work (Nollen, 1982). The problems associated with shift (especially night shift-work) stem primarily from the fact that humans are not naturally nocturnal animals. Substantial adaptation is therefore necessary on the part of the worker concerned if she or he is to adapt adequately to the shift-work constraints placed upon them. If this adaptation is not achievable subsequent psychological, physiological, domestic and social problems may arise as a consequence (Monk and Tepas, 1985).

At present it is estimated that over 20% of the population currently in the workforce are involved in shift-work (Monk and Tepas, 1985). This estimation is likely to increase as a result of unemployment and other technical, organisational, social and economic factors.

It has now become necessary for organisations and associated management bodies to acknowledge the possible problems that shift-work has and will continue to pose (not only for the worker but for management, organisations and communities as a whole). An attempt to develop and maintain workable solutions in response to these problems will need to be incorporated into organisations to a much larger extent.

## **FACTORS DETERMINING RECOURSE TO SHIFT-WORK**

Four major factors that play a role in determining whether shift-work arrangements are necessary are:

- economic factors;
- technical factors;
- organisational factors;
- social factors.

With the advent of the second phase of industrialisation and more importantly with mechanisation and automation economic factors have become an important determination of shift-work patterns.

The increase of investment in human and intellectual resources and in capital equipment; the constant depreciation of equipment; and the diminishing production utilisation periods have all had an influence on economic factor recourse to shift-work. Technical factors arise from the continual use of chemical, physical and operational processes within an organisation. Such processes will be required by the organisation concerned if quality of its goods and services are to be maintained and guaranteed.

Research into organisations indicate that there is a correlation between the automation and concentration of production machines and continual shift-work. A combination of management and production and an increase in business have all assisted in this correlation (Carpentier and Cazamian, 1977). The organisational factors above and additional organisational pressures, competition and transfer of technology effects will all play a role in increasing the shift-work trend.

## **GENERAL FUTURE TRENDS ASSOCIATED WITH SHIFT-WORK**

Overseas research, and more specifically UK research, have indicated factors that may prove to be restrictive to the introduction of shift-work in the future (Rodgers, 1982).

These factors may also be applicable to the Australian situation and are:

- (a) Availability of Labour - the introduction of, or extension of, shift-work may be hampered by recruitment problems;
- (b) Technical Development - shift-work numbers may be reduced by an increase in automatic or semi-automatic production within organisations;
- (c) Management Resistance - due to shift-work creating more managerial problems management may lack enthusiasm for its introduction or extension;
- (d) Shop Floor Resistance - adherence by the worker to the traditional weekend may have the affect of reducing acceptable shift-work patterns or halting them completely.

In Australia's immediate future however, it seems that due to increasing capital costs shift-work will remain a continual aspect of the industrial scene. Changes in shift lengths, a greater acceptance of sleeping on the job at night and changes in the number of shifts worked maybe the end result.

There are moves to increase individual shift lengths in some industries just as the reduced work day becomes a reality. Diversity and change will continue and will be related to the labour availability . Overall a high degree of adaptability by all will be required if such new trends are to be facilitated and accepted.

In general the shift-work situation will continue to depend largely upon the state of the economy and employment; technological developments; markets; and the management and organisational structures involved.

## **PHYSIOLOGICAL, PSYCHOLOGICAL AND MEDICAL EFFECTS OF SHIFT-WORK**

### **The Biological Circadian System and the Affect of Zeitgebers**

One of the more fundamental systems people are influenced by is that of the biological rhythm. Biological rhythms vary in frequency and will affect all parts of the body. The biological rhythms that are of most relevance to the study of shift-work are entitled "circadian" rhythms. (Latin: Circa about, Dies day; about 24 hours) and "Nyctohemeral" (alternating day (Gr. hemera) and night (G. nyr) rhythms.

Many biological variables; heart rate, body temperature, blood pressure; much visceral activity and ventilatory capacity for instance; are controlled by circadian rhythms. These rhythms are responsible for providing the psychological and physiological environment necessary for the regular cycle of sleep and wakefulness (Monk and Tepas, 1985). These regular cycles presumed that restful sleep will occur during the night hours and active wakefulness during the day hours. The biological affect experienced by the shift-worker, due to the circadian system, occur primarily when night shift is involved. With this shift, and with the alternation between day and night shifts, the biological rhythms of the body are altered and bodily habits are disturbed.

It is necessary, therefore, for the shift-worker experiencing these effects to attempt to realign to the shift rotations confronting them. Such a realignment is a slow process any may take a few days or weeks for the worker to re-adjust to alternating shifts (if at all complete re-adjustment is possible).

The circadian system is influenced by time cues or 'zeitgebers' (German: 'time giver'). These are responsible for assisting the circadian system to stay in synchronisation with pre-routinised patterns such as the 24 hour day routine (Monk and Tepas, 1985). The zeitgebers can also assist in helping the shift-workers attempt to adapt to shift changes by asserting their influence upon the circadian system and its reaction to change.

Zeitgebers can be social or physical in nature. Some social zeitgeber examples are meal times, clock time knowledge, and traffic noise. Noises of the surrounding environment, and the rising and setting of the sun are examples of physical zeitgebers (Walker, 1973). The physical zeitgebers are seemingly opposed to change or adjustment. Similarly social zeitgebers may also be opposed to change or adjustment. This, in turn, causes difficulties for the shift-worker attempting to adapt.

## **General Physiological and Psychological Effects of Shift-work**

The major physiological effects of shift-work seem more apparent in night shift and the complications associated with the alternation periods of wakefulness activity and sleepful rest. Night shift-workers have been found to experience as a consequence two forms of stress:

- (a) stress related to sleeping during a time of activation. Problems of adapting to sleep by day
- (b) stress in having to work during a period that is normally a time of slept. This type of stress may also necessitate additional bodily exertion.

Additional fatigue is an overall consequence of the decreased recuperation time available to the shift-worker. The night shift-worker will not be adequately able to benefit from the psychosomatic activation characteristic of normal work by day and sleep by night scenario. As a consequence night work will become more tiring for the worker involved.

Physiological indicators such as ventilation rate; hear rate; maximum aerobic power; body temperature and blood pressure show that the normal night time decline of these indicators are only slightly altered during night shift (Carpentier and Cazamian, 1977). In essence the body has slowed down. This in turn will have an affect on the shift-worker's performance.

General psychological effects of shift-work have been found on a range of skills. For instance, an increase in motor reactions; a decrease in spoken word tests; and a fall in body temperature. These have all been discovered as being consistent occurrences associated with regular night shift-workers (Carpentier and Cazamian, 1977). In addition faulty responses have been observed in experimental task completion. This will often occur between the hours of 4am and 6am. The detection of signal rates and response speed however tend not to be effected significantly during these hours.

## **Effects on Some Criteria of Occupational Activity**

### **EFFECTS ON OUTPUT**

Generally it is felt that output is lower by night than by day when rotating shift-work is involved (Carpentier and Cazamian, 1977). The cause of this decrease in output has been described as being due to either:

- (a) the reduced pressure upon shift-workers to produce at night; or
- (b) to over-fatigue.

Various studies have been conducted examining the effect of different shift upon output (Walker, 1973). Wyatt and Marriot conducted two experiments during and just after World War 2. Both studies, which were carried out fortnightly and monthly, indicated that in the first week of alternating to night shift from day shift output was high. Output subsequently declined over the following weeks. This was suggested by Wyatt and Marriot to be due to an accumulation of fatigue over the shift period. Upon changing to day shift the participants output was observed to be low for the first week and than began to increase over the following weeks. A gradual dissipation of night work

fatigue was attributed to these lower observations. Studies involving rotating shift pattern have also supported the over-fatigue theory (Monk and Tepas, 1985).

### Effects on Safety

Various studies have been carried out in an attempt to identify any relationship exists between the number of accidents or injuries occurring at the workplace and shift-work (Walker, 1973). The following table acknowledges a few of these studies and states the conclusions reached.

REVIEWER(S)	TOPIC OF STUDY	CONCLUSIONS DRAWN BY REVIEWER(S)
Menzel (1962)	Accidents in relation to shift work.	Results not in agreement. A number of investigations show no association between night work and the number of accidents recorded including one where more accidents proportionately occurred on afternoon shift (Walker, 1973)
Kubler, J. (1967)	Accidents occurring in a group of metallurgical and mining industries.	Rate of serious accidents occurring during night shift is higher than rate over entire 24 hours. Accident rate lower in average during night shift and higher than average during morning shift (Carpentier and Cazamian, 1977).
Kohegyi and Bedi (1962)	Accident investigations in three pits of Pecs-Mecsek coal basin Hungary.	Majority of accidents occurred during afternoon shift (generally held to be less fatiguing) (Carpentier and Cazamian, 1977).
Andlaver and Fourre (1962)	Accidents studied in two mines and three steel works.	In all five industries the accident rate on night shift were less than on other two shifts. When very serious accidents separated those involving a loss of work greater than 15 days or partial/total incapacity found to occur more at night (Carpentier and Cazamian, 1977).
Wyatt and Marriot (1953)	Analysis of accident records in five factories.	In each factory accidents were slightly higher on night shift but differences not significant. No trends in hourly variation (Walker, 1985).

Due to human error being a feature of many accidents it may be expected that the factory accident rate would be higher half way through night shift than during other shifts. This may however not be the case (Walker, 1973). Fatigue seems to be greatest in the early hours and metabolism is stated as being also at its lowest but there is no evidence of an increase in accidents (Walker, 1973). 25 years ago Wyatt and Marriot stated that:

"... In the present state of our knowledge any attempt to explain the causes of the hourly and daily variations in accident frequency would be largely guesswork..."

(Walker, 1973, p.62)

The situation is similar today.

### **Medical or Pathological Effects**

The health consequences associated with shift-work are an important consideration and as a consequence there are many good literature reviews pertaining to this area (Monk and Tepas, 1985). It will, however, always be difficult to experimentally determine the origins of health disorders and its effects upon shift-workers. The causes of such difficulty may be in:

- the nature and condition of the job;
- the living conditions of the worker;
- the rotation of schedules.

Individual reactions; the interplay of various other factors; the complexity of harmful factors; and the time it takes for intolerance signs to appear in shift-workers also need to be considered when studying the health of shift-workers (International Labour Office, 1978).

Pathological effects are also quite often indirect. For instance troubled and insufficient sleep are the main instigators of nervous and digestive disorders (International Labour Office, 1978). Timing of sleep, work, family and social activities also play a part in poor sleep quality. Consequently such disorders are linked to both work conditions and the shift-workers life congruently (rather than due to shift-work alone). Many diseases are associated directly or indirectly with such a disruption of sleep (Monk and Tepas, 1985).

Research has identified harmful aspects of shift-work and I will address this now. Some of the diseases that shift-work may aggravate are Epileptic seizures (which are prevalent when there is a deprivation in sleep); gastrointestinal distress; ulcers; interference with diabetes and other regularly required medications due to changes in shift-work and schedules (Monk and Tepas, 1985).

Experiments show that night work which has equal output to other shifts results in physical problems. The demands result in an increase in nervous and physical energy (especially in relation to mental activities) which can in turn produce over tiredness (International Labour Office, 1978). Daytime sleep appears to be less revitalising and the residual fatigue factor that results will interfere with the workers level of tiredness in subsequent tasks.

Findings have also indicated that current shift-workers and those who have recently done shiftwork, have a higher than average sickness rate (particularly in connections to nervous complaints, digestive disorders and sleep disturbances). This rate increases proportionally with the amount of time spent on shiftwork (International Labour Office, 1978).

Circumstances under which the worker operates can have either a negative or positive affect upon the acuteness of the disorders. Spouses and family attitudes can also influence the bodily and psychological reactions and overall attitude of the shift-worker to his work (International Labour Office, 1978).

In conclusion it may be summarised that:

- (a) the frequency and seriousness of disorders will be influenced by working and living conditions;
- (b) one social affect of shift-work only is represented by health;
- (c) an increase in more serious health problems has been identified among shift-workers;
- (d) the toleration by some workers (both physically and psychologically) towards shift-work is not expected to ensure for long when there are changes continually within their personal and social environment.

(International Labour Office, 1978).

### **The Effects of Shift-work Upon Domestic and Social Aspects**

It can be argued that due to humans being social creatures the social and domestic aspects of shiftwork are just as important as the biological ones. Both are strongly interrelated and it is therefore not surprising to see conflicts arising (Monk and Tepas, 1985).

Some of the negative aspects of shiftwork upon domestic and social factors are:

- a disruption of the shift-worker's role as spouse and parent;
- social isolation from friends who work during the day and community organisations that assume that those who want to attend are available during evenings or weekends;
- the overall inconvenience that shift-work presents for their respective families and of which strong objections have arisen;
- The disruption of day-to-day domestic life organisation due to discordance between the work and family schedule.

Overall, for most workers the impact of shift-work upon social and domestic factors are negative (others though seem able to cope adequately) and it must be continually recognised that a large amount of the society in which the shift-worker lives is day orientated. The worker is, therefore, prevented from living a 'normal' life with respect to this social orientation.



### Some Desirable Rearrangements in Relation to Shift-work

Solutions to the problems of shift-work have been studied in various countries. Such studies have centred around three aspects:

1. Improving certain conditions of the life and work of shift-workers.
2. Lightening the burden and constraints inherent in shift-work (especially in the area of night shift).
3. Systematically reducing the number of workers on night shift

(International Labour Office, 1978, p.31).

The following table briefly described the solutions proposed with relations to each factor mentioned above. This information is from the International Labour Office (1978).

**FACTOR: Improving certain conditions of life and work.**

*POSSIBLE SOLUTIONS:*

- (a) Improvement of eating facilities.
- (b) Allowing workers to have normal meals close to the work place.
- (c) Ensuring that meal composition is adequately balanced.
- (d) Provision of suitable dietetic advice and facilities to enhance the above improvements.

**FACTOR: Improving Housing Conditions**

*POSSIBLE SOLUTIONS:*

- (a) Measures aimed at making it less difficult for worker to sleep (eg. air conditioning in the bedroom).
- (b) Measures aimed at allowing an increased opportunity to have meals with families (reduction of working and travelling time).

**FACTOR: Reducing the Secondary Constraints of Work**

*POSSIBLE SOLUTIONS:*

- (a) Work flexibility through flexible working hours.
- (b) Adoption of rotating system able to be adjusted or altered where called for.

**FACTOR: Improving Medical Supervision***POSSIBLE SOLUTIONS:*

- (a) Employee assistance programs to enable early detection of health problems associated with prolonged shift-work.
- (b) Education about coping strategies for the shift-worker (eg. the danger of using alcohol to help induce sleep).
- (c) Education of supervisors so that early detection of work related problems (eg. increase in wastage) associated with shift-work can take place.

**FACTOR: Reducing Burden and Constraints of Shift-work**

## Arrangements of Rest Periods and Time Off.

*POSSIBLE SOLUTIONS:*

- (a) Time-off organised so can that some weekends can be spent with family and friends.
- (b) Rest periods allowing for a normal night after each two or three night shift sequence.
- (c) Ban on double jobbing.

## Ergonomic Arrangement of Workplaces

Proposed measure concerned with mental and physical discomfort of the workplace; work schedule chosen that complement biological rhythms; employing standards that relate to harmful factors (keeping in mind any relationship between vulnerability and the time of day and night).

In conclusion it can be seen that the issue of shift-work is complex. Most solutions have an effect on other areas of the operation. This means that decisions to take on new rostering etc. should not be taken lightly. The long term impact of shift-work should not be underestimated. The implications for Occupational Health and Safety are great especially with the introduction of recent legislation.

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