Shiftwork, sleep, fatigue and time of day: studies of a change from 8-h to 12-h shifts and single vehicle accidents

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Chapter Four

A case study investigation of absence
4.1 Introduction

The shiftwork literature has primarily regarded absence as an indicant of shiftworkers' health status (Costa, 1996). This relationship however, is far from a straightforward linkage between the stressors of shiftwork, to ill health and then absence.

The wider literature on sickness absence has identified many factors that are linked with absence. They include: motivation (Landy, 1990), accidents (Ong et al. 1987), organizational factors (Geurts, Buunk & Schaufeli, 1994; Tharenou, 1993), job characteristics (Marmot, 1994), high work loads (North et al. 1996), economic conditions (Fitzgibbons & Moch, 1980) and remuneration practices (P. Smith et al. 1998). Data from the ABS (1997) also indicates sickness is not the sole determinant for absence. Ill-health accounted for 54% of workplace absences and 22%, were attributed to 'recreational purposes.'

The findings that a number of non-health related variables may play a stronger role in governing absence behaviour, suggests that absence should not be regarded as a proxy indicator of health (Kleiven, Boggild & Jeppesen, 1998). Instead, absence may better serve as an indicator of shift system fatigue or dissatisfaction.

Within a shiftworking population, norms and expectancies regarding work attendance may be such, that absence is used strategically. For example, a number of studies have found absence was most likely at the start or end of a shift spell (Markham, Dansereau & Alutto, 1982; Nicholson, Jackson & Howe, 1978). This behaviour serves to increase the amount of time off. The timing of absence also appears to be strategic. Choosing when to be absent, tends to be associated with the least financial cost to the shiftworker (P. Smith et al. 1998).
It may also be limiting to only consider absence as a vehicle to extend time off or to avoid particularly difficult sections of a shift cycle. Absence may be a broader attempt to redesign an existing shift system to derive maximum benefits.

Absence can be augmented with overtime to redesign a shift system. It is possible to engineer a weekly rotating 8-h shift to resemble a compressed workweek by taking absence and working overtime to maintain earnings. The selective use of absence and overtime are likely to vary, according to both shift design and remuneration system characteristics.

Absence imposes a significant cost to industry. Estimating this cost involves many assumptions. Nonetheless, conservative estimates indicated a cost of $7 billion to Australian business in 1990 (Wooden, 1992). In one company, absence was calculated at approximately $50 million in 1992 (Erwin & Iverson, 1994). Therefore, well designed shiftwork systems may contribute to business competitiveness and employee satisfaction.

The use of archival data is the most common methodological approach to studying absence. These data sources offer some advantages (Drury, 1995) but may have limitations (see chapter six). Large data sets do not necessarily result in representative data (Hammer & Landau, 1981). The use of archival absence data requires consideration of both, the quantitative characteristics and the qualitative aspects. That is, the reasoning behind the behaviour.

Self report measures are also used to collect absence data. This approach has shown wide variability against company recorded statistics. Johns (1994) found correlations between 0.3 and 0.9 in nine separate studies.

The present study will explore changes in absence between the last year of 8-h shifts and the first year of 12-h shifts. The complex relationship between shiftwork
and absence, suggests an experimental or quasi-experimental design may not be overly informative. The possibility that absence and overtime can be used to redesign the shift system, suggests a case study approach is of greater value (see also Nicholson, 1993). Nonetheless, the study will combine a standard comparison of absence, with a case study methodology.

The study seeks to answer four main questions. The first two questions examine the pre and post absence behaviour and their associated reasons. The second two questions are more exploratory. They seek to determine if; (a) absence is used to redesign the shift cycle; and (b) single days and small periods of annual leave (SPAL) are used to redesign the shift cycle.

The chapter commences with a brief review of the methodological difficulties in absence research and is followed by a literature review of absence and shiftwork. Finally, the context for the present study is described, followed by the results and a discussion of these results.

4.2 Methodological difficulties

Absence data derived from archival sources are subject to a number of sources of bias. In particular, these include; (a) recording error, (b) differences in absence classification, (c) changing socio-economic factors over the span of the archive, and (d) individual and shift system differences. These error sources highlight the difficulties in using archives to examine absence and especially, when seeking to make comparisons between organisations.

Underpinning these difficulties is a reliance on cross sectional study designs (Nicholson, 1993). These designs further limit the ability to understand the role of absence in shiftwork health.
4.2.1 **Recording error**

The reliability of absence data has been questioned by a number of authors. Absence is open to being both under reported and mis-recorded (Landy, 1990). Personnel policy, custom and practice may support the non-recording of short absence periods and the reasons for the absence (Landy & Farr, 1983). These practices are by no means uniform across organisations.

The justification for absence varies by organisation. Fischer (1986) found 'sickness' was only justified if supported by medical certification despite the absence length. However, it is more common for absences of less than three to four days to be self reported (Markham et al. 1982; Nicholson et al. 1978; Taylor, 1967) and therefore, the validity of the explanation on health grounds is open to question. The difficulty in clearly linking ill health with absence, has led some to suggest that self reports may be more an index of work dissatisfaction (Harrington, 1978).

The comparison of absence between studies is also problematic due to the differences in the metric used to record absence. It is standard practice to report the number of days or shifts lost but some organisations have included days off and public holidays as inclusive of the absence spell (P. Taylor et al. 1972). Less used, is the number of hours lost (Williamson et al. 1994).

4.2.2 **Classification systems**

Landy and Farr (1983) have listed 28 separate categories that have been used to record absence. These may be grouped however, into two broad classes; absences due to sickness and absences reflecting work motivation. However, distinguishing between a health or motivational related absence is far from clear cut. This difficulty has implications for the validity of absence as a measure of occupational health or work motivation (Muchinsky, 1977).
A common method in organizations is to distinguish between *certificated* and *non-certificated* sickness absence. Some have also distinguished between *excused* absences (other than illness, eg. death in the family) and those which are *unexcused* (Fitzgibbons & Moch, 1980).

The variety of classification systems limits the ability to make between study comparisons. Taylor et al. (1972) attempted to classify and compare absence between 29 companies. They reported being unable to fit three basic categories to this data set due to recording and measurement differences between the organisations. The three categories were: medically certified (absences lasting > 3 days); short spells of sickness (≤ 3 days) and, other absences (≥ 1 day) for reasons other than incapacity.

4.2.3 Socio-economic and organisational factors

Socio-economic factors refer to the availability of employment, market conditions, financial need and general social attitudes towards absence. Each of these factors may influence absence behaviour. The use of archival data needs to consider the effect of a changing social context from which the data are drawn.

Organisational factors describe the intra-organisational work factors that affect absence behaviour. These include; job differences and characteristics between workers (Marmot, 1994), incentives offered by the employer to attend work, levels of supervision (Tharenou, 1993) and the conditions at work. For example, Markham et al. (1982) reported that new supervision had an indirect effect on absence by retrenching some employees with high absence rates.

An organization's selection practice may also impact on absence. For example, Kleiven et al. (1998) recently suggested the lack of differences between dayworkers and shiftworkers may have been due to an earlier program of medical screening. Following on from work by Thiis-Evensen (1958), the company screened
potential employees for gastrointestinal and sleep disorders.

The role of organizational factors on employee well-being has been well documented in the occupational stress literature (Sauter & Murphy, 1995; Theorell & Karasek, 1996). According to a recent review of work related illness Griffiths (1998) stated,

"... the largest causes of self-reported ill-health amongst the working population of Great Britain today are strongly associated with psychosocial and organizational factors at work (p. 4)."

4.2.4 Individual factors

A range of individual characteristics such as age, gender and motivation have been shown to impact on absence rates. In a number of studies (Daniel, 1990; Taylor et al. 1972), age was positively correlated with absence rates. Older shiftworkers have been reported to have longer absence spells, while younger shiftworkers take more days off (P. Taylor, 1967).

Fitzgibbons and Moch (1980) reported females had higher absence than males. Similarly, Costa et al. (1990) reported female nurses had higher general morbidity and absence rates compared to male nurses. This was attributed to the strain of working and running a household. However, gender differences are not clear cut (Beerman, Rutenfranz & Nachreiner, 1990; Harma, Ilmarinen & Knauth, 1988).

4.2.5 Shift design

There is some evidence that absence varies by shift design, including; shift length (Daniel, 1990; Gardner & Dagnall, 1977), rotation speed (Fischer, 1986; Markham et al. 1982; Nicholson et al. 1978; Taylor et al. 1972; Wyatt & Marriott, 1953), fixed versus rotating (Fitzgibbons & Moch, 1980; Walker & de la Mare, 1971) and shift start times (Shepherd & Walker, 1956). These shift differences are discussed in section
4.3.1. Conclusions regarding the impact of different shift systems on absence, are hindered by the variety of shift systems in operation (Tepas et al. 1997). Furthermore, differences between shift systems are confounded by differences in work tasks, number of hours worked, remuneration systems, social norms and the availability of relief cover (P. Smith et al. 1998).

4.3 Interpretation of absence behaviour

Absence behaviour is generally explained from three theoretical perspectives; motivation, social exchange theory and health.

The motivational perspective is grounded in the job satisfaction and social exchange literature. Job satisfaction explanations (Steers & Rhodes, 1978) highlight the role of employee motivation in work attendance. Central to the model proposed by Steers and Rhodes (1978) is that attendance motivation is mediated by the employer's reward system, the employee's personal work ethic and organisational commitment. However, Hackett and Guion (1985) reported a low correlation (-0.09) between absence and job satisfaction.

Social exchange theory (Chadwick-Jones et al. 1982) appears able to explain the low correlation between job satisfaction and absence. While job satisfaction is important, absence behaviour is primarily governed by group norms and expectations. Social exchange theory acknowledges the conflict between work and non-work demands and that absence is one vehicle for redressing this balance.

Organizations and work groups will handle this conflict in different ways. For example, employees may consider absence due to sickness to be legitimate, but there is far less agreement when absence is taken for other reasons (eg. other family commitments, social functions or moonlighting). Absence for 'non approved' reasons
may result in sanctions within the work group. A key feature of the social exchange model is that it highlights the salience of non-work activities in determining absence behaviour.

The social exchange model also suggests that relationships between employee and supervision may be reciprocal in governing absence behaviour. Tharenou (1993) reported that employees with supportive supervisors had less uncertified absences. Similar results were obtained by Unden (1996) who concluded absenteeism was associated with less supportive work environments.

The major point arising from the social exchange model is that absence is no longer regarded as the dependent variable. Nicholson (1993) articulated a re-conceptualisation of absence; "absence is not an end point, but a behaviour which mediates between qualities of experience over time (p. 290)."

A more recent explanation for absenteeism has been offered by Geurts et al. (1994). Drawing from social psychology and equity theory, the authors demonstrated that health complaints were not directly related to absence frequency. Instead, health complaints were indirectly linked via two social comparative processes. The first process suggested that the more employees discussed problems in their work environment, the more likely they were to attribute health complaints to the work environment. The second process suggests that the more employees considered their health to be disadvantaged by the work environment, the less well off they felt compared with external referents. These unfavourable comparisons result in absence, as the employee seeks to reduce the perceived inequity.

Shiftwork health models suggest that stressors in the work environment lead to psychological and physical ill health. However, the relationship between stressors and shiftwork is complex (Costa, 1996). When absence is used as a measure of ill
health, this complexity is further extended since absence behaviour is multi-factorial (Nicholson, 1993).

Finally, it is important to note that any relationship between absenteeism and outcome measures may not be stable over time. Fitzgibbons and Moch (1980) examined the consistency of their absence findings at two time points. While some were stable, they reported a 'discomforting lack of stability' in some measures. An initial finding of higher absence on a fixed afternoon shift was not observed at time two.

4.3.1 Shiftwork and absence - literature review

Shiftworkers do not appear to have increased absence due to ill health as predicted by health models (E. Taylor, Briner & Folkard, 1997). Comparisons of different shift schedules have also produced mixed results. The many methodological differences between absence studies make it risky to form strong conclusions. It may be best however, to consider each study as meaningful in its own right. Some studies are discussed below. Health and motivational arguments have been advanced to explain the absence of a shiftwork-absence relationship.

A number of early studies reported that shiftworkers had less absence than day workers (Aanonsen, 1964; Thiis-Evensen, 1958). When day and shiftworkers were matched for age and occupation, higher absences were found in dayworkers (Daniel, 1990; Taylor, 1967, Taylor et al. 1972). Taylor and his colleagues have consistently failed to find evidence suggesting any health differences between day and shiftworkers.

Fischer et al. (1998) also matched day and shiftworkers for age and length of service. No differences were found using a self report format. They attributed their findings to a relatively 'young' and 'healthy' sample. These self report data were not validated against company records. Therefore, this raises the possibility of bias in self reports (Johns, 1994).
Costa et al. (1990) compared absence between male and female nurses working day and three-shift shiftwork over a two year period. Females recorded higher absence attributable to pregnancy and significantly higher morbidity. There were no significant absence differences between female dayworkers and female shiftworkers. Female shiftworkers also recorded significantly higher absence during the first five years than did female dayworkers. However after five years service, absence was slightly higher for female dayworkers.

Kleiven et al. (1998) also found no differences between day and shiftworkers on health grounds. Two shift workers had significantly higher absence and this was attributable to their physically demanding work. The methodological strength in their study was that they reviewed first time absences. Therefore, these data are not influenced by shiftworker effects (Kecklund & Akerstedt, 1992).

Comparisons of rotating versus fixed shifts suggest that fixed shifts have less absence. Colligan, Frockt and Tasto (1979) found mean absence was non significantly higher in rotating shiftworkers, followed by fixed night, afternoon and day shift. The nurses on rotating nurses were also significantly more likely to be absent for serious reasons (eg. acute respiratory infection and gastrointestinal symptoms).

M. Smith, Colligan and Tasto (1982) found significantly higher absences in rotating male shiftworkers, followed by fixed afternoon, night and day workers. No significant differences across fixed and rotating shifts were found for females. Females however, recorded significantly higher absences compared to males across all shift types. M. Smith et al. suggested that rotating shiftworkers and fixed night workers may have used absence as a coping strategy to deal with the effects of shiftwork. Jamal (1981) also found higher absence for nurses working rotating 8-h shifts compared with nurses on fixed shifts.
In contrast to these findings suggesting fixed shifts are associated with less absence, Fischer (1986) reported absence was highest on a fixed evening/night shift (18.00-04.15) compared to fixed three shift systems and two slow rotating shifts. The start and finish times of this particular shift are not conducive for family and social life. In addition, after taking day sleep there may be little time for other activities.

Investigations of fixed three shift systems have indicated no significant differences in absence between day, afternoon and night shift (Fitzgibbon & Moch, 1980; Markham et al. 1982). Walker and de la Mare (1971) examined absenteeism among permanent shift employees in three plants. In two of the plants, they concluded that permanent nightworkers were more absent than permanent dayworkers.

Pocock, Sergean and Taylor (1972) compared a rapidly rotating three shift system, to a weekly continuous rotating system. The authors reported rapid rotation resulted in a 36% increase in certified absence and a 29% increase for uncertified absence compared to the former shift system. These findings have been argued to be the result of some ‘special features’ in the company’s remuneration system and need replication (Wedderburn, 1992b).

Akerstedt and Torsvall (1978) compared a number of shifts which changed from fast to slow rotating 8-h shifts. These results suggested rotation speed did not affect absence in shiftworkers but absence was reduced for those employees changing to day work only. These effects were found in a five month period on both systems. Therefore, the longer term implications of the change is not known.

Wyatt and Marriott (1953) found that overall, day shift had more absence than night shift but this was clouded by an inability to distinguish permanent dayworkers and shiftworkers. Their sample also allowed a comparison of fortnightly and monthly rotating shiftwork. The results indicated for both rotations, day shift had the higher absence and
in at least half the plants, this difference was significant. Day shift absence was lower on the second week of the rotation cycle whereas on night shift, absence was highest during the second week. The authors concluded that night work 'impaired fitness or inclination to work.'

The main health argument for increased absence in dayworkers is the shiftworker effect. Comparisons between day and shiftworkers are confounded by the presence of ex-shiftworkers now on day work due to poor health (Reid, 1957, cited in Taylor, 1967). A number of studies have also reported increased absence in former shiftworkers, now on day shift (Angersbach et al. 1980) and that former shiftworkers have impaired health (Frese & Semmer, 1986; Koller et al. 1978) and greater morbidity (Taylor & Pocock, 1972).

The motivational argument proposes that shiftworkers have a greater job involvement and commitment to each other (P. Taylor, 1967). P. Taylor (1970) concluded from interviews, that shiftworkers considered themselves to be 'elite' and 'had a sense of responsibility to and identification with their work unknown to many day workers (p. 29)."

Differences between day and shiftworker absence may also be explained by the ability to access services most commonly available during the week (eg. doctors, solicitors) (Costa, 1996). While shiftworkers have free time during work days to attend to business matters, day workers do not have this flexibility. Absence may be the only strategy to attend to such matters.

Shift factors have also been cited to explain absence differences. Wyatt and Marriott (1953) suggested day shift absence may be related to difficulty in commencing a new cycle and night shift absence was due to cumulative fatigue. Nicholson et al. (1978) discussed day and night shift absence in terms of the 'inertia' to attend work at
unsocial hours. Shepherd and Walker (1956) attributed higher day shift absence to the 06.00 start time which resulted in waking at 05.00.

**Absence distribution across shifts**

Absence does not appear to be equally distributed across workdays. Taylor (1967) found absence increased on the first work day. Markham et al. (1982) and Nicholson et al. (1978) reported absence on fixed shifts peaked at the start and end of the work period. This pattern was interpreted to ‘strategically’ lengthen the duration of time off at the weekend.

Uncertified absence on rotating shifts tends to peak on the day shift, followed by night and afternoon shifts (Nicholson et al. 1978; Wyatt & Marriott, 1953). Day shift absence is likely to be due to competing time interests, for example, appointments with doctors etc. (Costa, 1996). Furthermore, there is evidence that day shift absence involves the least financial cost and provides additional rest time (P. Smith et al. 1998).

In contrast, Pocock et al. (1972) found that absence peaked on the night shift for a rapidly rotating shift. They suggested that rapidly rotating night shifts may be associated with increased fatigue.

**4.3.2 Absence between 8-h and 12-h shifts**

Few studies have directly compared absence between 8-h and 12-h shifts. Surveys of senior company executives report impressive results but empirical data are lacking and flawed.

Campbell (1980) reported absence increased in 13 firms who adopted 12-h shifts, decreased in 30 firms and no change was found in 28 firms. Northrup et al. (1979) reported absenteeism increased in six out of 50 companies but only one was significant. Other benefits of this change included; reduced turnover and less transfers to daywork. Management attributed these improvements to increased work satisfaction,
the employee cost of a 12-h shift absence and increased time off.

Gardner and Dagnall (1977) compared the absence records for the final year of 8-h shifts against the first year of 12-h shifts. They concluded absence spells increased and the number of days off decreased on 12-h shifts, but these changes were not statistically significant (see table 4.1).

Table 4.1
Absence Frequency and Hours Lost Between 8-h and 12-h Shifts (Gardner & Dagnall, 1977)

<table>
<thead>
<tr>
<th></th>
<th>8-h Shifts</th>
<th>12-h Shifts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absences</td>
<td>100</td>
<td>120</td>
</tr>
<tr>
<td>Days Off</td>
<td>20</td>
<td>15</td>
</tr>
</tbody>
</table>

Daniel (1990) found 12-h shiftworkers had significantly more absences but only for periods of 30 days or more. These absences were attributed to "injuries and intoxications." Absences of 30 days may indicate that 12-h workers were exposed to increased work hazards. Daniel also reported a significant correlation between age and absence. Since the 12-h workers were older, it is not clear whether age, the shift roster or their interaction, best explains their findings.

A limitation of both these studies is that their data were not adjusted for the difference in the number of working days (Folkard, 1996). The fewer work days
required on 12-h shifts reduces the possibility of absence occurring. Adjusting the data from Gardner and Dagnall (1977) for this difference in work days indicated the number of shifts and hours lost was greater on 12-h shifts. In an unpublished study of 8-h and 12-h shifts, in which data were adjusted to reflect the differences in shift exposure, Rowland (1989) concluded there were no significant differences for either absence duration or spells.

More recently, Williamson et al. (1994) compared absence in terms of 'hours lost' and concluded 12-h shifts had significantly more absence and recreational leave than 8-h shifts. However, it is unclear how to interpret hours lost as a metric. Absence on a 12-h shift will always be 1.5 times greater than on 8-h shifts per day. Does missing a 12-h shift indicate greater avoidance from work than missing an 8-h shift, simply because the hours lost are greater?

Williamson et al.'s. use of 'hours lost' may be a mathematical solution to the comparisons of 8-h and 12-h shifts, because the hours worked are the same. However, this approach does not allow absence behaviour to be clearly understood. It is argued that using shifts lost, may provide a less complicated metric for comparison and interpretation.

In summary, studies of shiftwork and absence have not produced unequivocal findings. In large part, this is due to: (a) recording differences; (b) the complexity and interactions between the individual, organisational and shift design features which underlie the absence data, and (c) that within these complexities, explanations for these data may reflect a number of strategies (ie. health status, work motivation, work/social group norms and expectations) to ameliorate the demands of the particular shift design.

The inability to find a strong link between shiftwork and ill-health suggests that the timing of absence may provide more useful information. Absence, of itself and in
combination with overtime may be vehicles for redesigning existing shiftwork systems.

### 4.4 A case study investigation of absence behaviour between 8-h and 12-h shifts

This study will begin with a more conventional treatment of the comparison between 8-h and 12-h shifts. However, the methodological constraints (a relatively small sample size and short time frame) limit the ability to find robust effects. The argument that absence is better suited to explore shift redesign however, suggests the use of a case study approach.

In the following sections, the contextual background to the study is presented and this is followed by an operational definition of absence. Finally, the results of the four probe questions are presented and followed by an overall discussion.

#### 4.4.1 Contextual background

**Hours of work policy**

The organization’s occupational physician developed a set of guidelines for working hours (July, 1997). The document begins with a definition of fatigue as a ‘progressive decline in performance due to a combination of many factors’. Fatigue was attributed to; ‘inadequate rest, disturbed circadian rhythms, excessive mental or physical work, inappropriate scheduling of work and rest periods, individual susceptibility, and exposure to social and emotional factors’.

The document states that actual work hours will depend on a myriad of operational and staffing issues but care must be taken to avoid excessive fatigue. Permission to exceed the guidelines must be obtained from the Manager. The document contained the following guidelines:
8-h shifts

- A maximum of 16-h should be worked in any 24-h period.
- A minimum break of 8-h shall be rostered between any two periods of work.
- A maximum of 3 x 16-h shifts can be worked in any one week.
- A maximum of 2 x 16-h shifts can be worked consecutively.
- A maximum of 5 x 16-h shifts can be worked in any two week period.
- A maximum of 8 x 16-h shifts can be worked in any four week period.
- A maximum of 12 days can be worked consecutively.
- At least 2 days where no work is undertaken in any two week period.
- There should be no overtime on the day before or after the working of two consecutive 16-h shifts.
- An individual returning to day or afternoon work after a period of 2 consecutive nights should be given a 24-h break before recommencing work.

12-h shifts

- A maximum of 16-h should be worked in any 24-hour period.
- A minimum break of 8-h shall be rostered between any two periods of work.
- A maximum of 6 x 12-h shifts can be worked in any one week.
- A maximum of 6 x 12-h shifts can be worked consecutively.
- A maximum of 10 x 12-h shifts can be worked in any two week period.
- A maximum of 18 x 12-h shifts can be worked in any four week period.
- There should be at least 2 days where no work is undertaken in any two week period.
- An individual returning to day or afternoon work after a period of 2 consecutive nights should be given a 24-h break before recommencing work.
These guidelines clearly exceed the ergonomic criteria for good shift design (Knauth, 1997). There are far too many consecutive shifts under both shift systems and too few days off. Despite these difficulties, it is far from clear how to interpret these guidelines. The overriding problem is that the level of shiftwork exposure depends on the time frame used to interpret the guidelines. Weekly interpretations result in more hours compared to a four week interpretation.

Determining mean weekly working hours is problematic because the guidelines are not mutually exclusive in terms of standard and overtime shifts. For example, 12 consecutive shifts may be worked on 8-h shifts in a fortnight. This may result in either 96-h of work for the fortnight, or 136-h with overtime (five 16-h shifts and seven 8-h shifts).

The guidelines seem to equate 8-h and 12-h shifts to impose a similar demand. It is possible to interpret the 8-h guidelines to suggest six consecutive 8-h shifts per week and this is the same amount for consecutive 12-h shifts. More importantly, it seems to consider the effect of day and night shifts to be equivalent (Tepas et al. 1997). Thus six 12-h night shifts are considered to make a similar demand on a shiftworker, as the same number of day shifts. The cumulative sleep loss across six 12-h night shifts is unlikely to be reclaimed with one recovery day.

This complicated arrangement assumes supervision has a strategy for tracking the employee's cumulative working hours, in order to assess worker availability. This is unlikely to be the case.

Remuneration policy

Under the 8-h shift arrangements, shiftworkers received a premium of approximately 8.5% (shift allowance) per shift. Shiftworkers also attracted an additional
weekend premium of 1.5 times the hourly rate for working Saturday, 2 times on Sunday and 2.5 times for public holidays. The premium is paid on the day in which most of the hours are worked. For example, Friday night shift attracts the weekend premium but not Sunday night shift.

Absent employees are paid the standard hourly shift rate minus the shift allowance and the weekend premium when applicable. Thus, there is a financial bias to be absent on a weekday.

The introduction of 12-h shifts was linked with the annualisation of remuneration. This involved two key changes: (1) each shift was paid at the same rate regardless of shift type or day of week; (2) overtime payments were abolished but not the working of overtime. In return for the removal of shift premiums and overtime payment, employees were paid an additional 21-h per fortnight. Additional payment for overtime hours was available if the combined overtime hours for the crew were above 70-h for the quarter.

In summary, the two systems provided very different motivations for attending work. The 8-h shifts had financial incentives for working the weekend period and overtime. In contrast, 12-h shifts removed financial incentives. Indeed, if the annualised pay for 12-h shifts was regarded as a de facto hourly rate index, then any additional hours worked can be construed as an erosion of income.

**Overtime arrangements**

There were three general arrangements for working overtime on 12-h shifts:

- to call in an employee on days off.
- to use a 'relief' employee to work the shift.
- to provide partial cover by having an employee stay on for the first 4-h of the next shift.
**Definitions and data source**

The absence data was obtained from the company’s database. Absence was defined as non-attendance at work for a complete shift for any reason. Employees who attended work and subsequently went home were not recorded as absent. According to company policy absences of more than three consecutive days required a medical certificate. However, in practice all absence reasons were self reported to the company and therefore, their validity could not be confirmed.

The absence records for the employees described in chapter two (n=38) were examined for the 12 months to the end of 8-h shifts and for the first 12 months of 12-h shifts. Hammer and Landau (1981) consider that 12 months of data are necessary to ensure the stability of the absence measure. From this sample, two employees were excluded for extended non-work related absence, one employee resigned and one employee returned to day work (n = 34).

For each employee, a one page report was obtained from the company. It contained the attendance pattern by shift for each of the 12 month periods as well as summary statistics of attendance. Information on the levels of overtime worked were also collected but from a separate company database.

4.5 Results

4.5.1 **Probe 1: Changes in absence frequency between 8-h and 12-h shifts**

Table 4.2 shows the number of absences, absent spells and overtime hours worked per fortnight for 8-h and 12-h shifts. The number of shifts lost to absence on 8-h shifts were highest on day (45), followed by afternoon shift (42) and night shift (39). A total of 24 shifts were lost on 12-h shifts and these were evenly split between day and night shift.
Table 4.2

Descriptive Statistics for Absence Duration, Absence Spells and Overtime Between 8-h and 12-h Shifts

<table>
<thead>
<tr>
<th></th>
<th>8-h</th>
<th>8-h*</th>
<th>12-h</th>
</tr>
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<tbody>
<tr>
<td>Number of shifts lost</td>
<td>126</td>
<td>84</td>
<td>24</td>
</tr>
<tr>
<td>Mean number of shifts lost</td>
<td>3.71</td>
<td>2.47</td>
<td>0.71</td>
</tr>
<tr>
<td>Range - shifts lost</td>
<td>0-12</td>
<td>0-8</td>
<td>0-4</td>
</tr>
<tr>
<td>Number of hours lost</td>
<td>1008</td>
<td>672</td>
<td>288</td>
</tr>
<tr>
<td>Mean number of hours lost</td>
<td>29.64</td>
<td>19.76</td>
<td>8.47</td>
</tr>
<tr>
<td>Range - hours lost</td>
<td>0-96</td>
<td>0-64</td>
<td>0-48</td>
</tr>
<tr>
<td>Number of absent spells</td>
<td>81</td>
<td>54</td>
<td>17</td>
</tr>
<tr>
<td>Mean number of absent spells</td>
<td>2.47</td>
<td>1.59</td>
<td>0.50</td>
</tr>
<tr>
<td>Mean overtime (h/fortnight)</td>
<td>13.81</td>
<td>9.21</td>
<td>1.12</td>
</tr>
<tr>
<td>Range - overtime</td>
<td>0-28.9</td>
<td>0-19.3</td>
<td>0-3.3</td>
</tr>
</tbody>
</table>

* adjusted

The number of absence days ($t = 4.95; p = <0.0001$) and overtime hours worked ($t = 10.67, p = 0.0001$) were significantly lower on 12-h shifts (the comparison was adjusted for the difference in the number of work days). A significant correlation was found between absence and overtime ($r = 0.45, p = 0.007$) during 8-h but not for 12-h shifts ($r = 0.26, p = 0.13$).
Nicholson (1993) has argued short absence spells are characteristic of an ‘absence culture’ rather than illness. The positive correlation between absence and overtime for 8-h shifts lends support to the argument of an absence culture with some trading off between missed shifts and overtime shifts.

The large majority of absence spells on both shift systems were primarily of one day duration (see figure 4.1). However, the relative rate of two-day absences was higher on 12-h shifts (41%) compared to 8-h shifts (33%).

4.5.2 Probe 2: Changes to reported causes of absence

The self reported reasons for absence between 8-h and 12-h shifts are shown in tables 4.3 and 4.4.

The main factors for absence on 8-h shifts were; ‘unexplained’ (56%) and ‘flu’ (13%). The number of reasons for absence was markedly reduced on 12-h shifts. The two most common reasons were; ‘unexplained’ (66.6%) and ‘personal’ (12.5%). There may be no practical difference in the use of these categories (see table 4.4).

Table 4.5 compares the explanations common to both shift systems by shift type. In general, the relative distribution across common categories was similar for 8-h and 12-h shifts. The finding that absences were largely unexplained and of short durations, supports the argument that absences on both shift systems were not strongly health related (Nicholson, 1993).
Figure 4.1: Duration of absence spells for 8-h and 12-h shifts.
Table 4.3

Absence Explanations During 8-h Shifts (Frequencies Shown are the Number of Shifts Lost)

<table>
<thead>
<tr>
<th>Explanation</th>
<th>Day</th>
<th>Afternoon</th>
<th>Night</th>
<th>Total %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unexplained</td>
<td>27</td>
<td>23</td>
<td>21</td>
<td>56.3</td>
</tr>
<tr>
<td>Flu</td>
<td>2</td>
<td>8</td>
<td>6</td>
<td>12.7</td>
</tr>
<tr>
<td>Virus</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>3.2</td>
</tr>
<tr>
<td>Eye Infection</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>4.8</td>
</tr>
<tr>
<td>Blood pressure</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1.6</td>
</tr>
<tr>
<td>Personal</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>2.4</td>
</tr>
<tr>
<td>Gastric</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>4.8</td>
</tr>
<tr>
<td>Headache</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1.6</td>
</tr>
<tr>
<td>Food poisoning</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1.6</td>
</tr>
<tr>
<td>Hand injury</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1.6</td>
</tr>
<tr>
<td>Stomach pain</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>3.2</td>
</tr>
<tr>
<td>Ear infection</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1.6</td>
</tr>
<tr>
<td>Compassionate</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1.6</td>
</tr>
<tr>
<td>Facial injury</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>2.4</td>
</tr>
<tr>
<td>Tonsillitis</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>45</td>
<td>42</td>
<td>39</td>
<td>100</td>
</tr>
<tr>
<td>Explanation</td>
<td>Day</td>
<td>Night</td>
<td>Total %</td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td>-----</td>
<td>-------</td>
<td>---------</td>
<td></td>
</tr>
<tr>
<td>Unexplained</td>
<td>7</td>
<td>9</td>
<td>66.6</td>
<td></td>
</tr>
<tr>
<td>Flu</td>
<td>1</td>
<td>1</td>
<td>8.3</td>
<td></td>
</tr>
<tr>
<td>Virus</td>
<td>2</td>
<td>0</td>
<td>8.3</td>
<td></td>
</tr>
<tr>
<td>Eye Infection</td>
<td>0</td>
<td>1</td>
<td>4.2</td>
<td></td>
</tr>
<tr>
<td>Personal</td>
<td>2</td>
<td>1</td>
<td>12.5</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>12</strong></td>
<td><strong>12</strong></td>
<td><strong>100</strong></td>
<td></td>
</tr>
</tbody>
</table>
Table 4.5

Absence Explanations Common to 8-h and 12-h Shifts (Percentages Shown)

<table>
<thead>
<tr>
<th></th>
<th>8-h</th>
<th></th>
<th>12-h</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Day (n=45)</td>
<td>Night (n=39)</td>
<td>Day (n=12)</td>
<td>Night (n=12)</td>
</tr>
<tr>
<td>Unexplained</td>
<td>60</td>
<td>54</td>
<td>58</td>
<td>76</td>
</tr>
<tr>
<td>Flu</td>
<td>4</td>
<td>15</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Virus</td>
<td>--</td>
<td>5</td>
<td>17</td>
<td>--</td>
</tr>
<tr>
<td>Eye infection</td>
<td>13</td>
<td>--</td>
<td>--</td>
<td>8</td>
</tr>
<tr>
<td>Personal</td>
<td>7</td>
<td>5</td>
<td>17</td>
<td>8</td>
</tr>
<tr>
<td>Other</td>
<td>16</td>
<td>21</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

n = number of absence explanations.

4.5.3 Probe 3: The timing of absence on 8-h and 12-h shifts

For 8-h shifts absence peaks were found at the start and end of work periods (see figure 4.2). While this can be interpreted as increasing the span of days off, additional evidence suggests this was a strategy to redesign the 8-h shift system. Insert figure 4.2

One interpretation of the evidence is that while absence at either end of the work period 'compressed' the workweek, the level of overtime maintained or increased earnings. By combining absence and overtime, they were able to increase time off and not be financially disadvantaged.
Figure 4.2. Distribution of absence days by shift type and day of the week on 8-h shifts.
Figure 4.2 also shows that absence occurred at the least financial cost to the shiftworker. Absence was generally lower during the weekends compared to weekdays. A closer inspection of the weekend absence pattern supported this argument.

Absence frequency for all three shifts peaked on the weekend day that incurred the least financial loss. For day and afternoon shift, this was on Saturday which is also high in social value (Hornberger & Knauth, 1993; Wedderburn, 1981). Absence for night shift peaked on Sunday resulting in the loss of the shift allowance only. Absence on Sunday night may be due to shiftworkers foregoing sleep after Saturday night shift, in order to spend Sunday with the family (Monk & Wagner, 1989). Afternoon shift absence was also high on Friday. This finding is also consistent with the argument of absence being concomitant with least cost but high social gain (Hornberger & Knauth, 1993).

Absence on 12-h shifts showed three main characteristics (see figure 4.3). The predominant absence peak can be seen either side of the block of five days off in the middle of the 12-h shift cycle. Absence peaked on the last night shift before the break and the first day shift after the break. This resulted in at least seven days off.

There are at least three possibilities that may explain why some shiftworkers extended the span of days off: illness, fatigue and social.

Illness is an unlikely factor. The earlier results demonstrated absences were typically single days and furthermore, the major absence reasons were unexplained and personal. This combination of factors does not indicate illness, as the primary cause of absence (Nicholson, 1993).
Figure 4.3. Distribution of absence days during 12-h shifts.
There is the possibility of cumulative fatigue leading up to the five days off. If this were the case however, one would expect absence to be higher before the days off and not after. This indicates that fatigue does not adequately explain this absence pattern.

The finding that absence increased either side of the five days off may best be explained as a strategy to extend the time off for social reasons. There is good agreement that five days off are ample for recovery (Totterdell et al. 1995). However, it is possible that cumulative fatigue was an issue. If this was the case, it could be argued that the first days off are taken up for recovery, leaving fewer days for personal use (Iskra-Golec et al. 1996).

The second characteristic in figure 4.3 is the absence pattern for the last three night shifts at the end of the cycle. Absence peaked on the first night shift and this seems to best suggest a strategy to reduce exposure to three consecutive night shifts (Pocock et al. 1972). The previous work spells indicate adequate rest time. Indeed, a fatigue argument would have been stronger if absence was highest on the third night shift.

The third characteristic was that absence increased after a demanding work spell. Two examples can be seen in the first half of the shift cycle: (a) after the five training days, and (b) after the block of three night shifts. Since both these work spells are followed by two days off, this may suggest that these provided insufficient recovery time from such work spells.

4.5.4 Probe 4: The timing of single and ‘small’ periods of annual leave (SPAL) during 12-h shifts

The exploration of absence by shift sequence during 8-h shifts allowed some insight into when shiftworkers ‘chose’ to be absent. This strategy could not be used on
12-h shifts. The faster rotation prevented the clear identification of patterns. Therefore, an alternative approach was explored.

The literature supports an argument that even a single day away from work can have ameliorative benefits. Frankenhaeuser et al. (1989) reported heart rate, blood pressure, and epinephrine excretion were reduced, and psychological mood improved following a day off compared to work days. Williamson et al. (1994) reported a non significant increase in recreational leave (1-2 days) on 12-h shifts.

The shiftworkers were free to take annual leave at their discretion subject to operational requirements. This allowed shiftworkers some control over when they scheduled annual leave. The possibility exists that if 12-h shifts were problematic, one solution would be to use annual leave as a strategy to reduce exposure to some sections of the shift cycle.

This proposal was investigated in two ways: (a) single days of annual leave were plotted by the shift cycle. To be considered, a single day of annual leave was not to be followed or preceded by more blocks of annual leave; and (b) short periods of annual leave (SPAL) were also plotted by the shift cycle. SPAL was defined as taking annual leave over one or two work spells only. Annual leave in excess of two work spells was considered to be taking a 'longer' holiday, rather than reducing shiftwork exposure.

A total of nine single annual leave days were taken and these are shown in figure 4.4. There are two main conclusions from figure 4.4. The first was that in seven of the nine cases (78%), the taking of a single annual leave day occurred during work spells adjacent to blocks of two days off. In effect, this served to increase the spell of rest days to three, suggesting that two days off were insufficient for recovery.
Figure 4.4. The occurrence of single days of annual leave across the 12-h shift cycle.
The second finding was that in six of the nine cases (67%), the single annual leave day was taken at the start or end of three consecutive shifts. Of these six occasions, four involved the three night shifts, and two involved the three day shifts. This finding suggested that three 12-h shifts, particularly the night shifts were not popular. The interview data from chapter three provided additional support for this conclusion.

Figure 4.5 shows the placement of SPAL across 12-h shifts. Clearly taking SPAL increased at the end of the shift cycle (ie. the three night shifts). The two day spell preceding the three night spell was also popular for taking SPAL. This latter strategy would result in seven days off prior to the three night spell and may have been a preparatory strategy for this work spell.

The work spells adjacent to the five days off in the middle of the 12-h cycle, were also popular for taking SPAL. Taking SPAL for both work spells would result in 14 days away from work.

Finally, figure 4.6 shows the impact of combining single days of annual leave and SPAL (non-attendance) on 12-h shifts. This figure clearly illustrates: (a) avoidance of the final three night shifts, (b) an increase in non-attendance for the middle of the cycle, and (c) attempts to reduce exposure to the spell of three nights in the first half of the shift cycle.

4.6 Discussion

Shiftwork-health models (Folkard, 1996) suggest impaired health is one possibility from the phase shifting of circadian, sleep and social rhythms. The shiftwork literature in turn, has treated absence as the dependent variable in the shiftwork-health
relationship. The theoretical argument in this linkage is sound, but demonstrating this link is problematic. There are a myriad of methodological difficulties in the data sources but the underlying problem is that absence may have little to do with health. Colligan (1981) succinctly surmised that absence may equally be a function of motivation, competing time interests and health impairment.

The analysis of the company absence records found 12-h shifts were associated with a significant decrease in days lost, absence spells and overtime hours worked. However, these changes were not directly attributable to 12-h shifts. The most likely explanation, was the effect of the remuneration policy that was introduced concomitant with 12-h shifts. The policy removed financial incentive for working overtime. As a result, social pressures within the group (see chapter three) were such that the norm was to take absence only when absolutely necessary (Northrup, 1989).

There were no obvious changes in the absence reasons between 8-h and 12-h shifts and absences remained mostly of one or two day durations. These findings suggested absences on both shift systems were not clearly health related. This finding is in agreement with the wider literature (Geurts et al. 1994; Nicholson, 1993).

The use of absence as an indicator of ill health may be of little, if any value. Kleiven et al. (1998) were more candid and concluded absence should not be used as an indicator of health. It has been argued that a better use of absence (or non-attendance) is to understand the way it is used by shiftworkers to redesign their shift systems. The results from this study provided some support for this position.

Harrington (1978) noted that absence may be more indicative of worker dissatisfaction (eg. the make-up of the shift system). Dissatisfaction with the shift system, may result in shiftworkers seeking to redesign their shift to minimise exposure to difficult aspects of the system. The findings from this study provide additional support
for this position.

Absence distribution on 8-h shifts showed increases at the start and end of a shift cycle, consistent with other findings (Markham et al. 1982; Nicholson et al. 1978). The 8-h shifts were positively correlated with a high level of overtime, suggesting that absence and overtime were used to compress the 8-h shift cycle. The benefits of this compression resulted in more leisure time without a loss of earnings. Indeed, working overtime and being absent on a weekday results in increased earnings. An overtime shift worked on a weekday results in 15-h pay, compared to a loss of the shift premium (8.5%) for being absent on a weekday.

The importance of remuneration in determining absence from work was illustrated by the absence pattern over the weekend (see also P. Smith et al. 1998) for 8-h shifts. In all cases, absence reflected a balance between minimising income loss and maximising social opportunities. Absence did not appear to be random and underlines a strategic intent to redesign 8-h shifts to maximum effect.

Evidence that 12-h shiftworkers were also seeking to redesign the shift cycle was found when absence was combined with single days of annual leave and SPAL. Non-attendance was used in two main ways.

Firstly, non-attendance appeared to be primarily a means for avoiding the spell of three night shifts at the end of the cycle. This may be interpreted to indicate that three 12-h night shifts are fatiguing. Interestingly, Pocock et al. (1972) also reported high absence during a three night shift spell of a fast rotating 8-h shift system.

Secondly, non-attendance seemed to be used as a strategy to reduce the maximum number of shifts to two. This allowed shiftworkers to reduce their exposure to difficult parts of the shift cycle and thereby, reducing the level of cumulative fatigue. In turn, this increased the number of days off by an extra day. This finding may be
interpreted to indicate that two days off were insufficient for recovery (Totterdell et al. 1995) especially after three night shifts. Support for this conclusion can be found in chapter three.

A major feature of 12-h shifts is they provide increased leisure time (Tepas, 1985) over weekly rotating 8-h systems. However, in order to provide long blocks of days off, work spells may be overly compressed resulting in fewer remaining leisure days to provide recovery. Thus a less publicised feature of 12-h shifts is they can be overly compressed leading to fatigue. Two recent studies have indicated that in effect, 12-h shift nurses had no more useful time than 8-h nurses (Iskra-Golec et al. 1996; Kundi et al. 1995).

This study concluded that non-attendance on both shift systems was strategically used by the shiftworkers to redesign aspects of both shift systems. This conclusion should be treated as indicative rather than confirmatory given the small sample and short time period of investigation. The study also reported a significant decrease in absence for 12-h shifts. However, post-hoc analysis suggested the study had insufficient power (29%) to accurately reject the null hypothesis.

The study demonstrated the utility of a case study approach to understanding the many variables that impact upon absence. In particular, it allowed the data to be related to contextual factors such as the remuneration and overtime policy and the taking of holidays across the shift schedule. It is recommended other studies utilise a case study methodology to replicate these data. Shiftworkers appear to be quite resourceful in developing strategies that minimise exposure to negative impacts of a shift system.