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 Three

An Interview Study of Shiftworkers
3.1 Introduction

The results from chapter two suggest two very different interpretations for assessing the impact of a fast rotating 12-h shift system. The survey data found strong support from both sets of shiftworkers, in that they provided more advantages than the former slow rotating 8-h shifts. However, this same survey and sleep data, also found a number of fatigue indicants.

A limitation of a pure quantitative approach, is that they provide little insight into shiftworker cognitions. Therefore, the results from chapter two can be usefully augmented with interview data, to allow a more comprehensive understanding (Tepas et al. 1981a) of the change to a faster rotation.

Furthermore, a qualitative assessment of a change in shiftwork systems, can yield a rich source of comments that are not easily accessible in a survey methodology (Wedderburn, 1987). The change to a faster rotation may have required for example, some adjustments to family life and sleep strategies. Of course, interview data can be subject to bias. Therefore, this needs to be considered critically in the results.

The interview study was conducted with the shiftworkers from the Steel study only.

3.2 Method

3.2.1 Subjects

Fifteen male and three female shiftworkers (n = 18) from the sample described in section 2.3 participated in semi-structured interviews. All shiftworkers were married or living with a partner. Mean age was 34.7 years (SD = 6.03, range 26-47) and total shiftwork experience was 11.42 years (SD = 7.78, range 2.5-26.5). Shiftwork experience on the current 12-h system was approximately 1.5 years.
3.2.2 Interview methodology

Individual interviews were held during work time in a quiet office at the work site. Each interview lasted approximately one hour. A copy of the probe questions used in the interview, is shown in appendix three.

The interview consisted of two parts and these are shown in more detail below. The main aim of the first part was to assess the positive and negative aspects of 12-h shifts in more detail. In the second part, the aim was to understand the factors which governed sleep behaviour on a range of shift options.

3.2.2.1 Part one - satisfaction with 12-h shifts

During each interview, the following areas were probed:

- Advantages and disadvantages of 12-h shifts
- Sleep and tiredness on night shift
  - Preparatory sleep before the first night shift
  - Recovery day sleep after the last night shift
  - Recovery sleep from a spell of two and three consecutive night shifts
  - Napping and nodding off on night shift
  - Shift section in which tiredness peaked
  - Tiredness by time of day on night shift
- Sleep and tiredness on day shift
  - Napping and nodding off on day shift
  - Tiredness by time of day on day shift
- Sleep constraints
- Driving home after night shift
- The impact of increased night shift spells
• The impact of 12-h shifts on absenteeism

The responses to each question were recorded verbatim. At the end of all the interviews, the responses to each area were listed and subsequently categorised into common themes.

3.2.2.2 Part two - sleep diaries for hypothetical 12-h shifts

To understand the factors that governed sleep behaviour, shiftworkers were asked to complete a series of sleep diaries. Each diary contained a 12-h shift schedule in which the night shift 'load' was progressively increased. The majority of these shift schedules were unknown to the shiftworkers (see below). However, they were familiar with working three consecutive 12-h night shifts (present 12-h shift cycle) and seven consecutive 8-h night shifts (former shift cycle). The shift schedules were presented in the following order:

- D D N (12-h; shift changes at 07.00 and 19.00; D and N separated by 24-h)
- D N N
- D D N N
- N N N
- N N N N
- N N N N N N N (8-h night shifts started at 23.00)

To provide a context for these (mostly) hypothetical shift schedules, shiftworkers were instructed that the work periods were preceded and followed by two days off.

These hypothetical sleep diaries were scored in the same way as the diaries in chapter two. The rationale for sleep behaviour was also recorded verbatim and common themes extracted.
3.3 Results

3.3.1 Part one

Advantages and disadvantages of 12-h shifts

Improvement to social and family lives was cited by all shiftworkers as the primary advantage of 12-h shifts. These benefits were attributed to the increased number of leisure days. In particular, three factors from the shift design contributed to these benefits.

By eliminating afternoon shifts, 12-h shifts removed one-third of the unsocial hours which shiftworkers previously faced. Furthermore, whereas the 8-h shifts provided for one weekend off per month, the 12-h schedule had six free weekends in a ten week period. Time off at weekends is highly valued (Colligan & Rosa, 1990; Wedderburn, 1981).

Secondly, the fewer number of consecutive night shifts, contributed to maintaining a more diurnal pattern. This resulted in less social isolation compared to the former seven consecutive shifts

The third feature was that the shift schedule contained two long work breaks. The first block of five days off occurred mid-way through the cycle and a second block of seven days off, ended the cycle.

The two long periods of days off were described as; mini-holidays, forgetting about work and of feeling less like shiftworkers. One employee described 12-h shifts as;

"...sensational really. You work the same hours in less days and the money is great. Now I can actually enjoy the money I make. Before I used to make money but didn’t have the time to spend it with."
The specific benefits of 12-h shifts included:

- taking short family holidays during the long breaks
- pursuing personal hobbies
- socialising with friends during weekends
- fewer consecutive night shifts made them less ‘grumpy’ and more friendly, both at home and with friends
- greater involvement in child care and domestic duties at home

In all, these comments suggest a very satisfactory outcome for the faster rotation. Nonetheless, some difficulties with 12-h shifts were identified and reflected a mix of fatigue and social factors. The issues included:

- The three consecutive shifts occurred over weekends. These shifts were considered tiring per se, due to the shift length and compounded by any social activity taken over the weekend.
- Two days off after night shift were considered insufficient, particularly after three night shifts.
- Too many consecutive training days, resulting in fatigue. The five training days comprised two 12-h days, followed by three 8-h days, with each starting at 07.00.
- The two long blocks of days off followed night shift. The first day off was regarded as ‘lost’, since they needed to take some sleep after the shift. The suggestion was to end the shift cycle with day shifts, to maximise time off.
- Arranging team meetings was difficult. To allow meetings, shiftworkers estimated giving up, one-half of a day off, every six weeks.
- Difficulty in maintaining contact with other crews because handover contact was reduced (Lowden et al. 1998; P. Smith et al. 1998).
The impact of long breaks on work continuity

The concerns with communication at work were augmented by two additional difficulties. These were: lack of knowledge regarding recent furnace operations and a possible decrease in job ownership.

Excluding the training days, shiftworkers were absent from the control room for a two week period. This required shiftworkers to spend two to three hours on the first day in the control room, reading through shift reports to familiarise themselves with furnace operations. Some achieved this task by using spare time during the training days. Only one experienced supervisor indicated the break was not problematic. He noted,

"you don't need to spend hours reading up. I know some do and they get caught with details. I take the big picture."

One shiftworker expressed a decreased level of job involvement;

". . there is less ownership of the job because we are here less. You lose that continuity of what's going on in the furnace. It's like coming back from annual leave sometimes. You just don't get that feel for what's happening. On your last shift you might have picked a problem that might need attention but the next guy may not think it's important. But when you work here for seven shifts you could monitor the issue yourself."

Trading off leisure and shiftwork scheduling

The present 12-h shift was recognised to have involved a series of trade-offs between leisure and shift design. Three consecutive shifts were not popular but this allowed for more consecutive days off elsewhere. The following comments indicated recognition of the trade-offs involved:
"Twelves ain't great but its about time off on the weekend and we get plenty of that. Six out of ten off. It's got to be better than eights."

"Twelves are a long day but lets face it, after eight hours the day is rooted anyway, so you might as well stay a few more hours."

"I feel like I'm getting less sleep but I think I'm getting a better quality sleep on twelves, so that makes up for it."

"I'm not keen on three night shifts but its got to be better than seven eights."

It was clear throughout each interview that shiftworkers did not consider 12-h shifts as equivalent to day work. However in comparison, 12-h shifts provided more leisure time and the fewer consecutive shifts reduced circadian disruption.

It is important to emphasise these shiftworkers contrasted an unpopular shift system to a new system which they had played a key role in choosing. They may therefore, be more likely to focus on the positive features (P. Smith et al. 1998).

Sleep and tiredness on 12-h night shifts

(i) Preparatory sleep before the first night shift

Preparatory sleep for the first night shift was similar, despite whether two or three consecutive shifts were worked (see table 3.1). The percentages for 'lie in late the morning before night shift' and 'nap before first night shift' are similar to those obtained by Wedderburn (1992b).

However, sleep strategies for day sleep were dependant on the number of consecutive shifts. With two night shifts, the majority indicated a willingness to take shorter sleeps. A typical comment being;

"It's only two nights - don't care - struggle - finish."

In contrast, three nights tended to be described as:
Table 3.1

Sleep Strategies in Preparation for a First Night Shift

<table>
<thead>
<tr>
<th></th>
<th>2 x 12-h NS</th>
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<th>3 x 12-h NS</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq</td>
<td>%</td>
<td>Freq</td>
<td>%</td>
</tr>
<tr>
<td>Stay up late the night before and lie in</td>
<td>2</td>
<td>11</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>Lie in late the morning before night shift</td>
<td>5</td>
<td>28</td>
<td>6</td>
<td>33</td>
</tr>
<tr>
<td>Get up at normal time in the morning</td>
<td>7</td>
<td>39</td>
<td>7</td>
<td>39</td>
</tr>
<tr>
<td>Nap before first night shift</td>
<td>7</td>
<td>39</td>
<td>8</td>
<td>44</td>
</tr>
</tbody>
</table>

Freq = frequency

(NB: Frequencies sum to more than 18 since shiftworkers were not restricted to a single response)

"I try to make sure I get more sleep to get me through."

(ii) Recovery sleep after the last night shift

In spite of the number of consecutive shifts worked, short day sleeps (2-h to 4-h) were proposed (Wedderburn & Scholarios, 1993). Sleeping in excess of these amounts was reported to; (a) waste too much of the first day off, and (b) longer sleeps interfered with subsequent sleep that night.

(iii) Recovery from a spell of night shifts

The majority (67%) of shiftworkers reported needing one full night's sleep to recover from two consecutive 12-h night shifts, with all reporting recovery after two full nights sleep (see table 3.2). In contrast, only 44% of shiftworkers indicated that a full
night sleep was sufficient following three 12-h night shifts. 33% required more than two full nights sleep.

In terms of shift design, these data indicated that a minimum of two days off after night shift may be too few (Knauth, 1997) for a spell of three 12-h night shifts. Indeed, Akerstedt (1996) has recommended a spell of three shifts should be followed by at least three rest days.

Table 3.2

**Amount of Recovery Sleep Following Two and Three 12-h Night Shifts**

<table>
<thead>
<tr>
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<th></th>
<th>3 x 12-h NS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq</td>
<td>%</td>
<td>Freq</td>
<td>%</td>
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<tr>
<td>One full night sleep</td>
<td>12</td>
<td>67</td>
<td>8</td>
<td>44</td>
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<tr>
<td>A full night sleep and the following day</td>
<td>2</td>
<td>11</td>
<td>4</td>
<td>22</td>
</tr>
<tr>
<td>Two full nights sleep</td>
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</tr>
<tr>
<td>More than two full nights sleep</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>33</td>
</tr>
</tbody>
</table>

Freq = frequency

(iv) **Napping and nodding off at work**

Thirteen shiftworkers (72%) reported napping during the night shift. Of these, most added this was ‘not the rule’. Napping was reported to be more common on the
first night shift. The most common napping time was during the second half of the shift (Torsvall et al. 1989; Wyatt & Marriott, 1953). Nap lengths were estimated between 10 to 30 minutes. Nap frequency was once or twice during the shift.

There was some suggestion that napping was under reported in the interviews. Although not directly probed, a number of shiftworkers noted that other colleagues napped, even though the person concerned did not report napping. There is laboratory evidence suggesting nap frequency is grossly underestimated (Torsvall & Akerstedt, 1988) and field evidence indicating nap durations are also underestimated (Torsvall et al. 1989).

The increased napping on night shift (72%) was at odds with the second questionnaire survey, that reported 33% napped on night shift. Napping is not officially sanctioned at work. Thus, it is possible that shiftworkers are unlikely to ‘officially’ record napping, in case confidentiality is compromised. Assurances of confidentiality may not necessarily convince shiftworkers of their anonymity (Wedderburn & Scholarios, 1993).

Shiftworkers were also asked whether they 'nodded off at work'. Nodding off was described as 'an unintentional near loss of consciousness'. Fourteen shiftworkers reported nodding off in the control room. As with napping, there were some anomalies in these responses which may be attributed to the factors discussed earlier for napping.

There are at least two possibilities that may explain the variance in reported napping and nodding off at work. First, while shiftworkers may be aware of increasing sleepiness, sleep onset is rapid and not always detectable (Akerstedt, 1991; Horne & Reyner, 1995b). The second possibility is that shiftworkers were understating the effect of 12-h shifts to avoid fatigue being identified as an occupational, health and safety issue.
Despite doubts about the accuracy of the extent to which napping or nodding off at work occurred, these data indicated that both were established features of 12-h night shifts.

\( (v) \) Shift section in which tiredness peaked

The shiftworkers were asked to indicate which one section of the 12-h shift cycle was particularly tiring. Most tiring were the three consecutive night shifts and especially the final night (see table 3.3).

Table 3.3

Sections of the 12-h Cycle Associated with Fatigue

<table>
<thead>
<tr>
<th>Section of shift cycle</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Third night of three night sequence</td>
<td>5</td>
<td>28</td>
</tr>
<tr>
<td>The two day sequence following the three night spell</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>Third shift of either days or nights</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>Third day of the three day spell</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>The training days</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>The last roster day following the third night shift</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>The first night of the three night spell</td>
<td>1</td>
<td>6</td>
</tr>
</tbody>
</table>

Two factors may explain the tiredness associated with the third night shift. First, the longer shifts allow for less recovery time and this is further compounded, by
acute sleep loss on the first night and a cumulative sleep loss across subsequent nights. Second, this tiredness is exacerbated by the preceding work and rest periods, comprising of two day shifts followed by two days off (D D O O N N N). It may be the case that the night shifts are worked with some level of residual fatigue from the day shifts. This was also the case for the day shifts which followed the three night shifts.

Two (11%) employees reported the five training days as being most tiring. This highlights the effect that sleep truncation over five consecutive day shifts is also problematic. The training days consisted of two 12-h and three 8-h shifts commencing at 07.00.

(vi) Tiredness by time of day on night shift

Night shift tiredness for all shiftworkers was concentrated in the period between 02.00 to 06.00 and coincided with the timing for napping and nodding off. Tiredness was attributed to the lack of work stimulation during this period and this is a useful reminder to consider that fatigue is not only physiological (Konz, 1998). Alertness was reported to increase during the last hour of the shift due to activities associated with the end of shift hand over (L. Smith & Gardner, 1997).

Sleep and tiredness on 12-h day shifts

(i) Napping on day shift

Only one male shiftworker reported napping on day shift. He took a 10 minute daily nap at approximately 14.30 and was not attributed to work or social demands.

Napping on days off was also atypical. Two shiftworkers (11%) reported taking an occasional afternoon nap on the second day off after night shifts to facilitate recovery.
(ii) Tiredness by time of day on day shift

Twelve shiftworkers (67%) reported feeling tired only once during day shift. Three were most tired before 10.00, seven between 13.00 and 15.00 and two after 17.00.

The remaining six shiftworkers (33%) reported feeling tired twice during the day shift. Two employees reported tiredness before 10.00 and between 14.00 to 17.00. Two reported tiredness twice in the afternoon between 13.00 and 14.00 and at 17.00 to 18.00.

Tiredness in the morning was attributed to early waking and tiredness at the end of the shift was attributed to the shift length. Tiredness after lunch was attributed to having taken a meal.

Sleep constraints for day and night shift

Only day sleep was reported to be constrained by family and domestic demands.

The three female shiftworkers reported restricting day sleep to spend time with spouses. One delayed sleep until her husband went to work. The others terminated sleep in order to attend to domestic tasks and prepare the evening meal for their partners.

Family roles also dictated some male sleep behaviour. At their wives' insistence, two shiftworkers reported sleeping only while the children were at school. On weekends, supporting their children's sporting activities required timing and disrupting day sleep to maximise their availability.

Shiftworkers with working spouses also reported special arrangements. Two shiftworkers curtailed day sleep on weekends in order to spend time with spouses.
Providing child care while the spouse worked part-time was another factor cited by one shiftworker. His day sleep was delayed until her return at 15.00. Clearly, this does not allow for much sleep before a 19.00 start time.

**Driving Home**

Rosa and Bonnet (1993) have suggested that shiftwork fatigue is an issue both on and off the job. In particular, they noted that driving home after night shift may be hazardous. Several self-report studies have found an increased driving risk in shiftworkers (Gold et al. 1992; Richardson et al. 1990).

Seven shiftworkers (39%) reported some difficulty in driving after night shift. For example:

"I haven't fallen asleep but I've come close."

"For the first time last week I struggled. I mean, I almost pulled over."

Of concern, was that five of these shiftworkers reported not recalling driving home on some occasions. One shiftworker living some 20 minutes from the plant, indicated that driving through urban areas was frustrating. On reaching the freeway he reported being relaxed but sometimes, drove on "auto-pilot."

One shiftworker (GH) who did not participate in the study, was reported by most of the shiftworkers to be at particular risk during night shift. Anecdotal accounts indicated: (a) GH had had three major vehicle accidents in the last three years while driving home after night shift, (b) frequently napped throughout the night shift, and (c) fell asleep while in conversation at night. According to peers, possible reasons for GH's difficulties included spending his free time building a home and being the sole carer of two young children.

Although it was not directly asked, it is reasonable to suggest that driving home after 8-h shift was also problematic. Indeed, the alleged vehicle accidents involving GH
had occurred during 8-h shifts.

The impact of more night shift spells

(i) Increasing the number of first night shifts on 12-h shifts

Shiftworkers were asked for their satisfaction with having to start more spells of night shift. Half the shiftworkers reported the first night shift was relatively easy. Part of this ease was attributed to the earlier starting time of 19.00. Some shiftworkers commented they felt more alert at this time compared to starting 8-h night shift at 23.00. This was especially the case in winter.

The balance did not particularly enjoy the increased number of night shift transitions but it was considered better than seven 8-h shifts. One employee said, "I hate the first night blues but its over quick and its better than facing six more."

The major difficulty posed by 12-h night shifts was the reduced opportunity for pre shift napping. Napping was difficult for two main reasons. The little time elapsed since the main sleep, made it difficult to nap before the need to start night shift at 19.00. The second factor was that the late afternoon hours carried a high family and domestic role.

(ii) Increasing the number of consecutive night shifts

One strategy to increase mean TST is to increase the number of night shifts by slowing the rotation speed. This option was rejected by all but one shiftworker. Increasing the number of shifts was considered equivalent to seven 8-h night shifts.

The shiftworkers favoured working two consecutive night shifts as a maximum, but understood that a third night shift allowed for more time off. One employee indicated occasionally taking a single day from his annual leave allowance to avoid working three consecutive night shifts.
The impact of 12-h shifts on absenteeism

Chapter four reported absenteeism dropped significantly on 12-h shifts. Shiftworkers were asked to explain this fact. Everyone indicated it was primarily due to the reduction in overtime and pay annualisation (see section 4.4.1).

As a follow up question, shiftworkers were asked if pay annualisation resulted in 'pressure' to attend work. Most shiftworkers agreed this was the case. Northrump (1989) also found considerable peer pressure to attend work on a CWW.

The rationale for attending work was that absence placed a heavier load on others to provide cover. For example,

"you come in sometimes dragging your bones around, but why should someone on a roster come in if you can make it?"

Another noted;

"management would say the salary package has taken away the decision as to whether you are sick or not. There isn't really a pressure but an understanding that we'll look after each other. You know that if someone doesn't come in, they must really be sick."

From a health perspective, some expressed the concern that attending work when sick was not in the interests of other employee's health. Some suggested, that colds and flu's seemed to last for months in the control room. Concerns regarding safety and work performance were not raised.

3.3.2 Part two

Proposed total sleep time (TST)

The proposed mean TST for the six (mostly hypothetical) shift configurations are shown in table 3.4. These means are rounded to one decimal point, to reflect they are estimates. The means need to be interpreted with caution because they reflect
Table 3.4

Proposed Mean TST on Different Shift Schedules (n = 18) (Standard Deviation Shown in Brackets)

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<td>(1.7)</td>
<td>(1.5)</td>
</tr>
</tbody>
</table>

Type; 2D1N = 12-h, two day and one night shift; 1D2N = 12-h, one day and two night shifts; 2D2N =12-h, two day and two night shifts; 3N = 12-h, three night shifts; 4N = 12-h, four night shifts; 7N = seven consecutive 8-hour night shifts; O1 = day off before work spell; O2 = day off after work spell.
In general, as the number of consecutive night shifts increased, either independently or combined with day shifts, the amount of sleep proposed for preparatory (O1) and recovery sleep (O2) also increased. The highest estimated preparatory (8.6-h) and recovery (13.5-h) sleep was recorded when working four 12-h night shifts. This indicated shiftworkers planned for the increased demand, by banking some sleep before the work spell and taking longer recovery sleep.

The second observation assumes that sleep recovery reflects some level of tiredness (Akerstedt, 1990). The greatest amount of recovery sleep was proposed after four 12-h night shifts (13.5-h), followed by three 12-h night shifts (13.1-h). In both cases these estimates were higher than those for seven 8-h night shifts (12.4-h). These results suggest that even two 12-h night shifts need more recovery time than seven 8-h night shifts. Preparatory sleep was less when day and night shifts were combined compared to just night shifts.

The combined day and night shift sequences, with the exception of the 1D2N sequence, were considered to be difficult. The difficulty stemmed from the fatigue associated with two extended shifts and then, how to prepare for night shift. The data suggested that additional sleep was planned to deal with the increasing number of combined shifts. This can be seen in two ways: (a) proposed TST increased on the second day shift compared to the first day shift; and (b) proposed TST increased to the end of the first night shift as the number of consecutive shifts increased.

The fourth observation showed mean TST increased (modestly) as the span of night shifts increased in agreement with other studies (Dahlgren, 1981a; Dirkx, 1993).
The shiftworkers had earlier provided sleep diary data (chapter two) for working three 12-h night shifts and seven 8-h night shifts. This allowed a direct comparison of the diary data with the proposed data from the interviews.

Table 3.5 compares mean TST for three 12-h night shifts from three groups: (a) N7 - seven shiftworkers who provided complete sleep diary data for Time 2-5 in chapter two, (b) ALL - refers to all sleep diary data from Time 2-5, and (c) N18 - represents the proposed TST obtained from the interview study. In all cases, the proposed mean TST for N18, was well above both diary based mean TST.

Table 3.6 repeats the comparison for these three groups across seven 8-h night shifts. Again, proposed mean TST from the interviews, were higher than sleep diary means.

Relative to sleep diary TST, the proposed TST were 12.5% (3x12-h shifts) and 29% (7x8-h shifts) higher. The large difference for 8-h shifts may be due to the time elapsed since these shifts were worked.

The sleep diary TST and the proposed TST data can be used to examine sleep behaviour between 8-h and 12-h shifts. Table 3.7 shows mean TST obtained from sleep diaries for three 12-h night shifts, the first three nights on 8-h shifts and sleep at the start and end of these work spells. The table shows that preparatory sleep (O1) and sleep to the end of the first night shift were similar on both 8-h and 12-h shifts. However, the between shift sleep on 12-h shifts were shorter and sleep on the day off after work spell longer than for 8-h shifts. This suggested, 12-h shiftworkers sleep less during the work spell and repay the debt on the day off.
Table 3.5

Mean TST obtained from Sleep Diary and Interview Data for Three 12-h Night Shifts

(Standard Deviation Shown in Brackets)

<table>
<thead>
<tr>
<th>Group</th>
<th>O1</th>
<th>N1</th>
<th>N2</th>
<th>N3</th>
<th>O2</th>
</tr>
</thead>
<tbody>
<tr>
<td>N7</td>
<td>7.6</td>
<td>1.4</td>
<td>5.9</td>
<td>6.1</td>
<td>11.5</td>
</tr>
<tr>
<td></td>
<td>(1.3)</td>
<td>(0.9)</td>
<td>(1.1)</td>
<td>(0.9)</td>
<td>(2.2)</td>
</tr>
<tr>
<td>ALL</td>
<td>8.1</td>
<td>1.6</td>
<td>6.0</td>
<td>6.3</td>
<td>11.1</td>
</tr>
<tr>
<td></td>
<td>(1.5)</td>
<td>(1.1)</td>
<td>(1.5)</td>
<td>(1.4)</td>
<td>(2.6)</td>
</tr>
<tr>
<td>N18</td>
<td>8.5</td>
<td>2.3</td>
<td>7.1</td>
<td>7.0</td>
<td>13.1</td>
</tr>
<tr>
<td></td>
<td>(1.3)</td>
<td>(1.2)</td>
<td>(1.0)</td>
<td>(1.0)</td>
<td>(1.3)</td>
</tr>
</tbody>
</table>

Group: N7 = seven shiftworkers who provided complete sleep diary data from chapter two; ALL = all sleep diary data collected from chapter two; N18 = the shiftworkers in the interview study.

O1 = Day off before work spell; N1 = first night shift; N2 = second night shift etc; O2 = Day off after a work spell.
Table 3.6
Mean TST obtained from Sleep Diary and Interview Data for Seven 8-h Night Shifts
(Standard Deviation Shown in Brackets)

<table>
<thead>
<tr>
<th>Group</th>
<th>O1</th>
<th>N1</th>
<th>N2</th>
<th>N3</th>
<th>N4</th>
<th>N5</th>
<th>N6</th>
<th>N7</th>
<th>O2</th>
</tr>
</thead>
<tbody>
<tr>
<td>N7</td>
<td>7.7</td>
<td>1.4</td>
<td>6.6</td>
<td>6.6</td>
<td>4.9</td>
<td>5.9</td>
<td>5.2</td>
<td>5.5</td>
<td>8.8</td>
</tr>
<tr>
<td></td>
<td>(1.6)</td>
<td>(0.9)</td>
<td>(1.0)</td>
<td>(0.9)</td>
<td>(1.1)</td>
<td>(1.4)</td>
<td>(0.6)</td>
<td>(0.8)</td>
<td>(1.8)</td>
</tr>
<tr>
<td>ALL</td>
<td>8.3</td>
<td>1.7</td>
<td>6.8</td>
<td>6.2</td>
<td>5.6</td>
<td>5.8</td>
<td>5.9</td>
<td>6.0</td>
<td>9.4</td>
</tr>
<tr>
<td></td>
<td>(1.6)</td>
<td>(1.6)</td>
<td>(1.2)</td>
<td>(1.5)</td>
<td>(1.7)</td>
<td>(1.8)</td>
<td>(1.2)</td>
<td>(1.1)</td>
<td>(2.1)</td>
</tr>
<tr>
<td>N18</td>
<td>8.6</td>
<td>2.5</td>
<td>7.7</td>
<td>7.5</td>
<td>7.3</td>
<td>7.4</td>
<td>7.9</td>
<td>7.3</td>
<td>12.4</td>
</tr>
<tr>
<td></td>
<td>(1.0)</td>
<td>(1.3)</td>
<td>(1.2)</td>
<td>(1.1)</td>
<td>(0.9)</td>
<td>(1.0)</td>
<td>(1.4)</td>
<td>(1.7)</td>
<td>(1.5)</td>
</tr>
</tbody>
</table>

Table 3.7
Diary Mean TST for The First Three Night Shifts from a Spell of 8-h and 12-h Shifts
(n=7) (Standard Deviation Shown in Brackets)

<table>
<thead>
<tr>
<th>Shift Type</th>
<th>O1</th>
<th>N1</th>
<th>N2</th>
<th>N3</th>
<th>O2</th>
</tr>
</thead>
<tbody>
<tr>
<td>8-h</td>
<td>7.7</td>
<td>1.4</td>
<td>6.6</td>
<td>6.6</td>
<td>8.8</td>
</tr>
<tr>
<td></td>
<td>(1.6)</td>
<td>(0.9)</td>
<td>(1.0)</td>
<td>(0.9)</td>
<td>(1.8)</td>
</tr>
<tr>
<td>12-h</td>
<td>7.6</td>
<td>1.4</td>
<td>5.9</td>
<td>6.1</td>
<td>11.5</td>
</tr>
<tr>
<td></td>
<td>(1.3)</td>
<td>(1.0)</td>
<td>(1.1)</td>
<td>(0.9)</td>
<td>(2.2)</td>
</tr>
</tbody>
</table>
Table 3.8 shows proposed mean TST for the first three nights of 8-h and 12-h shifts. The proposed data replicated the pattern described in table 3.7. However, the proposed values were again higher than those obtained from the sleep diaries.

Table 3.8

Proposed Mean TST for The First Three Night Shifts from a Spell of 8-h and 12-h Shifts (n=18) (Standard Deviation Shown in Brackets)

<table>
<thead>
<tr>
<th>Shift type</th>
<th>O1</th>
<th>N1</th>
<th>N2</th>
<th>N3</th>
<th>O2</th>
</tr>
</thead>
<tbody>
<tr>
<td>8-h</td>
<td>8.6</td>
<td>2.5</td>
<td>7.7</td>
<td>7.5</td>
<td>12.4</td>
</tr>
<tr>
<td></td>
<td>(1.0)</td>
<td>(1.3)</td>
<td>(1.2)</td>
<td>(1.1)</td>
<td>(1.5)</td>
</tr>
<tr>
<td>12-h</td>
<td>8.5</td>
<td>2.3</td>
<td>7.1</td>
<td>7.0</td>
<td>13.1</td>
</tr>
<tr>
<td></td>
<td>(1.3)</td>
<td>(1.2)</td>
<td>(1.0)</td>
<td>(1.0)</td>
<td>(1.3)</td>
</tr>
</tbody>
</table>

Sleep strategies on hypothetical shiftwork schedules

In general, the combining day and night shifts were not popular. The shiftworkers considered these shift patterns undesirable. The major concern was how to best prepare for the first night shift. The fact that they did not consider this first night in the same way as a spell of night shifts only, indicated they were considering the effect of the previously completed day shifts.

Sleep strategies for day shift on each of the shift configurations was similar for all shiftworkers. Variations occurred in time to bed but few before 22.00. Alarms were
used by all to wake about one hour before the shift commenced. However, there were some differences in night shift sleep strategies and these are discussed below.

(i) 2D1N, 1D2N, 2D2N, 3N

Preparation for the first night shift on the 2D1N sequence, reflected seven sleep strategies (see table 3.9). The common feature of these strategies was an attempt to reduce the amount of wakefulness before the start of night shift start by either; (a) delaying sleep the night before and sleeping in, or (b) by napping before the first night shift. Reducing the amount of wakefulness prior to the first night shift, was also the rationale for the other configurations (1D2N, 2D2N, 3N). There was however, an increased emphasis given to ensuring adequate rest as the number of night shifts or total shifts increased (eg. 2D2N).

Insert table 3.9

When two or more night shifts were worked, sleep after the last night shift was estimated to range between 3-h to 4-h. However, about one-half of the shiftworkers said they would be tired enough to sleep longer.

(ii) 4x12-h and 7x8-h night shifts

The majority (72%) of shiftworkers considered working four 12-h night shifts to be similar to seven 8-h night shifts. Despite acknowledging this difficulty, proposed preparatory sleep before the first 12-h night was unchanged. As in table 3.4, the shiftworkers indicated they would attempt good sleep lengths between the night shifts as a method of coping with the expected fatigue. After the last night shift, they proposed taking a little longer day sleep than normal and going to bed a little earlier if possible that evening.
Table 3.9

Sleep Strategies Before the First 12-h Night Shift

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Freq</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Go to bed late and sleep in</td>
<td>5</td>
<td>28</td>
</tr>
<tr>
<td>Lying in later the morning before night shift</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>Get up at normal time and nap before night shift</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>Sleep in and nap before night shift</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>Take a long sleep after the second night shift</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>Go to bed early and nap before the night shift</td>
<td>1</td>
<td>6</td>
</tr>
</tbody>
</table>

Freq = Frequency

Nine strategies were documented in preparation for seven 8-h night shifts. The strategies were grouped into those involving napping and no napping (see table 3.10).

Sleep strategies between 8-h and 12-h night shifts showed a number of differences. As the number of 12-h night shifts increased, longer day sleeps were proposed. This trend was not found on 8-h night shifts. Indeed, a few shiftworkers proposed their day sleeps decreased as the number of 8-h night shifts increased. This difference may reflect increased fatigue associated with 12-h shifts.

Napping before an 8-h night shift was more frequently recorded than napping before a 12-h night shift. This suggested there was less opportunity to nap before 12-h night shifts. This may reflect the earlier start time of the 12-h night shift and pressure
Table 3.10

Sleep Strategies for The First 8-h Night Shift

<table>
<thead>
<tr>
<th>Strategy:</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. Napping</td>
<td></td>
</tr>
<tr>
<td>Nap for first night only</td>
<td>3</td>
</tr>
<tr>
<td>Nap before all night shifts</td>
<td>2</td>
</tr>
<tr>
<td>Nap from the second to last night shift</td>
<td>1</td>
</tr>
<tr>
<td>Sleep in before first night and take a nap</td>
<td>1</td>
</tr>
<tr>
<td>ii. No napping</td>
<td></td>
</tr>
<tr>
<td>Sleep more first few days and then reduce sleep</td>
<td>3</td>
</tr>
<tr>
<td>Sleep in before the first night</td>
<td>3</td>
</tr>
<tr>
<td>Regular sleep with no naps</td>
<td>2</td>
</tr>
<tr>
<td>Sleep 3-hours before shift and 4-hours after shift</td>
<td>2</td>
</tr>
<tr>
<td>Take two split sleeps during day</td>
<td>1</td>
</tr>
</tbody>
</table>

from domestic commitments in the afternoon/evening.

The shiftworker who reported being a split sleeper on 8-h shifts, found the change to 12-h shifts, particularly difficult. His sleep strategy for 8-h night shifts was to sleep for 3-h before the shift and 4-h after the shift. This strategy was developed to counter his difficulties in gaining sufficient day sleep duration. On 12-h shifts, this pre shift sleep was discarded in favour of spending this time with family. Day sleep was
reported to now consist of 2-3-h of natural sleep, followed by a prescribed sleeping pill (Normison) on waking. The pill was reported to allow a further two to three hours of sleep.

The most common strategy proposed for the first 12-h night shift was to go to bed later on the night before the first night shift and to sleep in late during the morning and/or to lie in bed longer. The rationale behind both these strategies was to decrease wakefulness before the start of night shift. This may have been a response to the greater restriction on pre shift napping before 12-h night shifts.

3.4 Discussion

Overall, the interviews indicated that in their evaluation of the change in rotation speed, these shiftworkers had a primary focus on social and family considerations, over fatigue. This supports the large number of studies that have reported these same benefits (Cunningham, 1989; Frese & Semmer, 1986; Wedderburn, 1967). The main difficulty here, is that whilst shiftworkers raised concerns about fatigue in certain sections of the 12-h shift cycle, they seemed prepared to accept this level of fatigue for the social gains. The longer term effect of this practice is not known.

There are three factors that resulted in this form of 12-h shift being able to deliver increased social and family benefits. The common feature in these factors is that they reduce cumulative exposure to shiftwork stressors.

In terms of shift design, 12-h shifts eliminate the 'unsocial' afternoon shift. These hours are then reallocated to the day and night shift. Thus a 12-h shift increases by one-third the free time available.

The second feature is that the faster rotation, helps to maintain the shiftworker on a more diurnal routine. There are two benefits from this outcome: (a) less isolation when working night shift, and (b) less circadian disruption.
The third feature, was that this 12-h shift system provided six free weekends over the ten week cycle, compared to one in four on 8-h shifts. This greatly increases the ability to participate in social functions compared to the former 8-h shifts.

A common theme during the interviews was to adjust the 12-h shifts to provide better social opportunities. When asked for shift improvements, two main suggestions were made. The first was to move the spell of three consecutive shifts from the weekend. The younger shiftworkers considered this period to be tiring, due to the shift length, combined with social activity.

The second suggested improvement was to commence the two long breaks from work after day shift, not night shift. Since the first day off began with the end of the night shift, this first day off was considered wasted.

It is important to note that despite these suggestions, there were no serious complaints raised against the 12-h shift. Of concern, is that this emphasis on maximising time off, may obscure the longer term implications of these choices (Laundry & Lees, 1991. Rosa et al. 1989).

In terms of fatigue, the shiftworkers confirmed that three consecutive 12-h shifts, particularly night shifts were tiring. Work periods that followed these night shifts were also problematic. While three shifts were considered to be tiring per se, they were compounded by the balance of work and rest days. For example, the two days shifts that followed the night shifts were also reported to be difficult (N N O O D D). These day shifts were reported to be tiring due to the sleep loss from the night shifts and the insufficient number of days off to adequately recover. This residual tiredness is subsequently carried into the day shifts with an 07.00 start time. One-third of these shiftworkers reported more than two night sleeps were required for full recovery from three 12-h night shifts.
Chapter two attributed the mean reduction for night shift TST to the acute sleep loss associated with the increased number of transitions to night shift. The results from the interview provided two additional factors that contributed to the sleep loss. The first factor was a change in sleep strategy on 12-h shifts, to minimise sleep when fewer shifts were required. The second, was that 12-h shifts reduce the amount of time available for sleep between shifts.

Common to both 8-h and 12-h shift was that little, if any additional day sleep was taken prior to the first night shift (Akerstedt, 1991). The underlying rationale is that these strategies increase the availability of free time and assist in the transition from night to day sleep. However for subsequent shifts, one key difference in sleep strategy was noted. When two consecutive night shifts were worked, there was an attempt to get by with as little sleep as possible. In contrast, the shiftworkers reported longer spells would require more sleep. This behaviour was reflected in the sleep diaries in chapter two and in the completion of the hypothetical sleep diaries completed in this chapter.

This strategy appears to reflect a judgement about their capacity to sustain fatigue across the total number of night shifts. That is, acute fatigue can be managed with less sleep for two night shifts, but as the number increases, more sleep is necessary despite the shift length. The underlying rationale for this sleep strategy is to balance the competing social and sleep needs whilst on shift (Monk, 1988). A supporting explanation is that when only two night shifts are required, shiftworkers are striving to maintain their diurnal orientation.

The second factor contributing to sleep loss was the reduced time available between shifts for sleep. There is little time for napping before a 12-h night shift, given the relatively short period since waking from the main day sleep. Furthermore, the
afternoon period is also a time of increased domestic activity (eg. children returning from school, meal preparation), that restricts sleep opportunity. In contrast, the later start time on 8-h shifts allows more possibility for pre-shift napping or simply day-to-day recovery.

The results from the interviews indicated that shiftworkers recognised they were trading some negative features of the 12-h shift, for other benefits. This decision is well signalled in choosing to change to 12-h shifts. In effect, they are trading the unsocial afternoon shift for more time off. Whilst the afternoon shift restricts social and family life, it is associated with longer sleep durations (Tepas & Carvalhais, 1990).

The distribution of work and non-work days was reported to have some difficulty in this 12-h shift system. Earlier in the discussion, the insufficient time off between the three night shifts and the following day shifts was made. In addition however, too many day shifts were also reported to be tiring (eg. the five training days - see table 3.3). At least three factors may assist to explain day time fatigue: (a) the sleep truncation from early rising (Folkard & Barton, 1993; Kecklund et al. 1997); (b) the shift length; and (c) the preceding period of rest and work. The implication for shift design, is to provide time off but not at the expense of leaving too little recovery time between work blocks.

Colligan and Rosa (1990) have raised the useful point that the efficacy of days off is reduced by the carry-over effects of the work schedule. Two recent studies of 12-h shift nurses, concluded while they potentially had more rest days, this may not necessarily translate into more useable time (Iskra-Golec et al. 1996; Kundi et al. 1995). Dahlgren (1981b) and Patkai and Dahlgren (1981) both reported increased satisfaction with a rotation system, that offered 3-5 rest days compared to an equivalent work system, offering two rest days per week but an increased number of holidays.
elsewhere. A number of interpolated performance studies also indicated two days off may be insufficient (Meijman, van der Meer & van Dormolen, 1993; Totterdell et al. 1995). The self-report data in the present study indicated that rest days after night shifts, should be increased to three days.

3.4.1 A note on method

The shiftworkers were interviewed on site during work time. This raises the possibility of some biased responses. It may be the case that being interviewed at work may result in positive responses to the shift schedule due to the general support enjoyed for 12-h shifts. Smith (1993) indicated there may be some distortion when interviewing people at work about work but not when regarding family and social issues.

Concerns over the validity of interview responses cannot be dismissed. However, the overall study design allowed for some responses to be validated. Each of the interviewees had participated in the survey and or sleep studies in chapter two. Therefore it was possible to refer to other data sources.

In general terms, the results from the interview study are in keeping with the survey data in chapter two regarding family and social issues. This would suggest consistency in responses.

The only major anomaly that was identified concerned the responses to the question of napping at work. The results from the interviews suggested 72% reported napping during the night shift. Anecdotal evidence suggested this may be under estimate since some of those that reported not napping, were reported to nap by their colleagues. Despite the accuracy of the estimate provided in the interviews, it was well above the 33% that reported napping in the second questionnaire survey. It was suggested that anonymity of a questionnaire may not be sufficient to record a practice that is not officially sanctioned at work.
The completion of the ‘as-if’ diaries provided a pragmatic approach to checking the results in chapter two and with which to explore changes in sleep strategies. Clearly, the shiftworkers routinely noted they were giving ‘ideal’ estimates for sleep in completing the hypothetical shift patterns in the interview study. Therefore, this supports Paley et al.’s. (1998) conclusion that shiftworkers report best guess scenarios.

This finding emphasises that sleep diaries completed over long periods are best able to capture the daily variations in sleep, subject to the changing milieu in shiftworkers lives. Estimating sleep need in the absence of a context, disregards the importance of situational events.

Nonetheless, the proposed sleep estimates mirrored the data obtained from the diaries across a run of night shifts. Therefore, while they may be overestimates, the trend reflected sleep behaviour.

### 3.4.2 Sleep diaries as an educational tool

Shiftworker education whilst offering good face validity, has been criticised for essentially imparting information (Tepas, 1993). Shiftworkers tend to be passive recipients in this process. Educational psychology has long suggested that education is a process of engagement, in which the student actively constructs knowledge (Pressley & McCormick, 1995). One method to engage shiftworkers, is having shiftworkers complete sleep diaries for alternative shift designs.

Diary completion is a variation of the time budget approach. Presenting diaries in which the work schedule is fixed, requires shiftworkers to think through how their unique circumstances may be affected by adjusting shift parameters. This technique satisfies the principles of being practical and relevant in designing educational shiftwork programs (Tepas, 1993). The strength of this device needs to be considered in light of
the possibility that shiftworkers overestimate sleep duration.

In support of this suggestion, some shiftworkers volunteered comments that completing diaries in the main study, provided them with valuable feedback regarding their sleep patterns and duration. Most expressed surprise, to discover sleeping much less than expected.

3.4.3 Summary

The interview study was designed to augment the results from chapter two, for the shiftworkers in the Steel study. The information from the interviews allowed a more comprehensive understanding of the effect of 12-h shifts.

Overall, the interviews indicated 12-h shifts were highly valued. Significant improvements to social and family life was reported. These benefits were achieved at the expense of increased fatigue during some sections of the shift cycle. This seemed a trade-off, that they were more than willing to accept. The longer term implications of this trade-off is not known (Rosa et al. 1989).

The interviews suggested that reductions in mean TST on night shift were also due to other factors. The first factor was a change in sleep strategy to take as little sleep as possible when only two night shifts were worked. This was interpreted as a judgement by shiftworkers to sustain acute fatigue. The second factor was a reduction in time available for sleep on night shift.

In terms of shift design, these results support the following recommendations: (a) a maximum of three consecutive shifts - this may be a reasonable compromise between reducing cumulative sleep loss, whilst not overly increasing acute sleep loss, and (b) the provision of two full days off following night shift - this is in contrast to the more common 1.5 days off.