

**Individual Contracts  
and  
Workplace Relations**

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and Paul Ronfeldt**

**WORKING PAPER 50**

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This collection of articles on the 12 hour workday is a result of a half day conference held in October 1997 by the Australian Centre for Industrial Relations Research and Training (ACIRRT). The decision to hold such a forum was sparked by an awareness of the increased incidence of 12 hour shifts and 12 hour 'spans' in enterprise agreements on ACIRRT's ADAM database and a growing interest in 12 hour shifts shown by many organisations and businesses' that contact ACIRRT. In addition, related work undertaken by ACIRRT researchers on trends in hours of work had shown a significant increase in both average full-time hours and an increase in unpaid overtime in Australia. These and others indicators were pointing to the possibilities for longer working days. These factors coincided with an assessment by ACIRRT of the 12 hour shift trial at the Vickery Mine at Gunnedah which revealed the lack of research on and evidence for the impact of longer working days. While considerable research has been undertaken on the effects of shiftwork, far less evidence was available for the impact of either compressed or extended working hours, especially within an Australian context. All of these factors made us realise that we were heading into "unchartered waters" in terms of the known impact of longer working days.

The half day conference on the 12 hour workday was therefore a first attempt at focusing on this emerging phenomenon in a way which attempted to draw together practitioners and researchers who were asked to address issues associated with the longer working day, rather than shiftwork in general. This collection of papers reflects an attempt to canvass many of the general trends and issues associated with longer workdays and draw together some of the current research in the field. As all of the contributors have noted, many questions remain about the impact of these new working patterns for health and safety, productivity and for family and social life.

The papers contained within the working paper reflect the broad focus of the conference. In Chapter One, the evidence for the emergence of the 12 hour workday is examined and the case is put for the existence of two different kinds of 12 hour workdays - one structured around a formal, compressed 12 hour shift regime and the other a more informal, "flexible" 12 hour extended workday emerging under decentralised bargaining. In Chapter Two, Dr Meredith Wallace reviews some of the international studies on comparisons between 8 and 12 hour shift regimes, drawing a somewhat controversial conclusion that there is an absence of negative findings where a "well-designed" 12 hour roster is introduced. The key point she makes is that the planning, assessment and careful design of the roster is an integral part of any roster change. In Chapter Three, Allan Thomas provides an innovative look at a recent attempt to determine the productivity impact of a change from 8 hour shifts to compressed 12 hour shifts at the Vickery Mine at Gunnedah. He details how the study was undertaken and outlines how difficult (and expensive) is to isolate the productivity changes due to shift length alone. Thomas's paper is a sobering reminder to many who simplistically assert that there are clear productivity savings associated with changing shift length *alone*.

In Chapter Four Sharon Bent turns her attention to the mental and physiological effects of extended hours work, as well as the family and social impact. She finds that there are multifactorial rather than unilinear explanations associated with any likely impact and argues that the evidence of some detrimental health and social effects as well as the absence of definitive information are grounds for proceeding with caution. In Chapter 5, Lee de Milia

outlines some very current research of his which examines sleep duration associated with shift length. He concludes that there is evidence of sleep loss associated with 12 hour night shifts and that sleep duration is associated primarily with shift rotation speed. Finally in Chapter Six, Melissa Benson explores the relationship between fatigue and work performance and safety. Drawing mainly on evidence from the road transport industry she reports that shifts length is associated with increased risks of fatigue and a detrimental effect on performance. She concludes by reminding employers of their responsibilities under health and safety legislation associated with safe systems of work.

All of the contributors argue that the relationship between the duration, the distribution, the scheduling and the pace of work all have profound implications for worker health and safety, workplace productivity and family and social life. We hope that this small contribution to the current debates around working time will generate further discussion and research in this important and emerging area of working life.

Kathryn Heiler

# 1. The 12 Hour Workday: What Do We Need To Know?

*Kathryn Heiler*

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## INTRODUCTION

### **The Regulation of the Working Day in Australia: A Policy and Regulatory Vacuum?**

Unlike many Northern European countries which have pursued national legislation governing hours of work and the setting of standards for the regulation of shiftwork and overtime (Hewitt, 1993; Buchanan and Bearfield, 1997), Australia has relied overwhelmingly on state and federal awards as the primary vehicle for the regulation and standardisation of hours of work. This has included standardisation of both the length of the working week and the working day. In particular, detailed provisions in industry awards have used overtime and other 'penalties' to place limits on hours of work, effectively acting as a 'disincentive' for employers against working their existing employees excessive hours without compensation.

In particular, and unlike many Northern European countries and some provinces in Canada<sup>1</sup>, we have no statutory legislation placing limits on the length of the working day and are not signatories to any ILO conventions on night work, shift work, overtime or maximum hours. However uneven, this situation may have been adequate so long as the award system remained as the primary mechanism for regulating hours. But increased decentralisation of bargaining, the weakening and restructuring of awards (especially at a federal level), the emergence of individual bargaining (AWAs) and the acceleration of enterprise bargaining at state and federal levels, has meant that the determination of hours of work is being devolved to a workplace level. While there is nothing preventing details on hours being placed in agreements, the intention of the Federal Act is clearly to avoid 'restricting productivity or efficient work practices'<sup>2</sup> which, given the interest in hours of work in agreements to date will involve hours of work<sup>3</sup>. The push is for hours of work to be decided by and large by 'agreement' between the workplace parties, which leaves them much more open to the vicissitudes of managerial prerogative and the demands of company 'bottom lines' rather than any community or industry-wide standards governing working hours. *Arguably, hours are now firmly back in competition.*

Because we have no statutory or legally delimited working day to fall back on, there exist few ways of enforcing limits on the length of the working day, except those that can be negotiated or bargained by the workplace parties. In many respects we are heading into uncharted waters in terms of the health, safety, and productivity implications to changes to hours of work - changes which have been gathering pace over the past decade. Given that it has been fifty years<sup>4</sup> since Australia has had a sustained, widespread community debate

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<sup>1</sup> See J. Buchanan & S. Bearfield (1997), *Reforming Working Time*, Brotherhood of St Laurence, Melbourne.

<sup>2</sup> *Australian Financial Review*, October 16 1997

<sup>3</sup> Well over 75% of agreements on the ADAM database held by ACIRRT at the University of Sydney have consistently contained provisions dealing with changes to work.

<sup>4</sup> This being the 40 hour week campaign and the national test case which saw the introduction of the standard 40 hour week in Australia. See B. Healey: (1972) *Federal Arbitration in Australia*, Georgian House, Melbourne for an overview of the early hours campaign in Australia.

about the direction of hours, the apparent emergence of 12 hour workdays may be an appropriate impetus to step up the debate about the current direction of hours in this country.

We also need better information about the impact of what appears to be is the current deregulation of hours of work so that we can more effectively engage in the policy debates which *should* be taking place around working time in this country. It is all too easy to discount concerns about working hours if the empirical evidence about their impact is weak or unclear. It is also important to separate the 'faddish' nature of some of the arguments for longer and compressed workdays so as to provide employers, employees and policy makers with better information with which to make decisions.

In addition, because working time policy and practice strikes so fundamentally at the heart of the employment relationship, it has potentially profound implications for those involved:

- For *employees* in terms of health, and safety, and the quality of work, for the value of remuneration and for family and social life;
- For *employers* in terms of their health, safety and welfare responsibilities and the desire to maximise the efficiency and productivity of their organisations
- For the *community* at large because the way work is organised will impact on the way society is structured, the way paid work is distributed and the outcomes for social equity and, ultimately, for patterns of social cohesion.

### ***The Definition of 12 Hour Workdays***

Before we look briefly at some of the key trends in working hours, there are some definitional issues to canvass. We deliberately called this conference *the 12 hour workday*, rather than the 12 hour *shift* conference for good reasons. It was because we believe that there are *two* kinds of longer working days emerging in Australia that lie along a kind of 'continuum' or 'spectrum'.

- The first is a structured, more formal *12 hour shift* arrangement often introduced as part of a compressed hours regime
- The second is a less formal, less planned increased *12 hour 'span'* introduced as part of a 'flexible' extended hours working regime

Outlined below is an attempt at characterising the spectrum along which these emerging 12 hour workdays might lie. It is based on trends that have emerged under enterprise bargaining and trends detected in the AWIRS 1995 survey and should be considered as exploratory at this point. Moreover, in any one workplace we might have a mixture of these characteristics and some of the characteristics may be interchangeable. For example, there is no reason why 12 hour flexible spans cannot be predictable, or why 12 hour formal shifts may not exist alongside 12 hour spans.

**Table 1: The Forms of 12 Hour 'Workdays'**

12 Hour 'Shifts'	→	12 + Hour 'Spans'
Part of a structured roster design; eg rotating shifts, day/night shift		Part of 'flexible', open-ended working arrangements; extension of working days
Introduced to reduce costs of roster changes; reduction of overtime; move from 8 hour shifts		Introduced to cope with often short term or 'seasonal' fluctuations in demand or delivery; reduction of penalties
At workplaces with continuous operation (eg mining, all manufacturing, electricity, gas, water)		Service sector industries (agriculture, finance, personal, hospitality), but also appearing in mining, manufacturing
'Compressed' working hours rather than extended working hours		Extended or averaged hours rather than compressed
Wage-rate, paid overtime or overtime allowances absorbed into base rate		Salaried model; annualised salary or unpaid overtime
Some predictability		Less predictability
Potential for OHS planning, assessment, evaluation, monitoring		Less likely to be planned, monitored, evaluated
More likely to be unionised and have active unions		Union density likely to be lower
Male dominated industries and occupations		Males and females in the industries

With this characterisation in mind, let us now look at little more closely at some of the evidence for the emergence of the 12 hour workday in Australia.

### **What Evidence Do We Have for the Emergence of the 12 Hour Workday?**

The first point to make is that the data on the 12 hour workday is not as comprehensive as we would wish, and establishing the trends on the length of the workday is no straightforward matter. ABS and other data generally reports working time in terms of weekly hours or annual hours, and the only information we have had to date on daily hours is published and unpublished ABS data on the shiftwork population which reports the length of the shift. Data on the length of the working day for all employees has to be estimated from the length of the working week. In addition, we cannot go to one data source to establish what the definite trends are, so we have to piece the story together from available data sources and indicators. The main data sources used will be AWIRS 1995, ABS and ADAM<sup>5</sup>

<sup>5</sup> AWIRS 1995 (Australian Workplace Industrial Relations Survey), Department of Workplace Relations and Small Business, Canberra; unpublished data; ABS (*Working Arrangements Australia* 1993 and 1995 Cat no. 6342.0); ADAM (Agreements Data Base and Monitor) developed and maintained by ACIRRT at the University of Sydney with over 4000 agreements now on the database

The indicators used to assertion the prevalence of the longer workday will include:

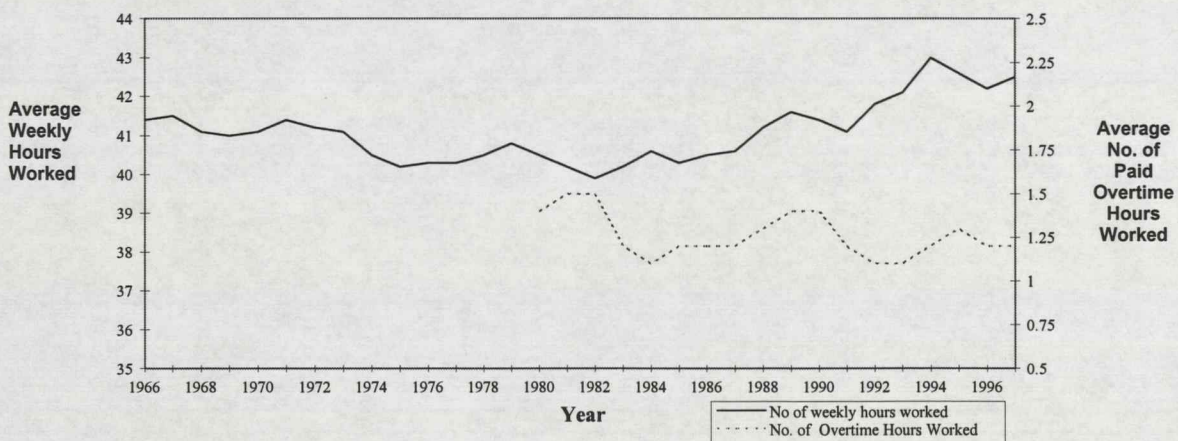
- key trends in hours worked
- operating hours
- prevalence of workplaces where shifts are worked
- incidence of 12 hour shifts
- trends in agreements

### **Key Trends in Hours of Work**

A number of trends associated with average *weekly* hours worked provided some evidence of the likely emergence of the longer workday. Obviously, if very long weekly hours are worked, these will need to be distributed across a limited number of days - the longer the weekly hours, the more likely that there will be longer workdays.

There has been sustained evidence for some time that full-time employees in Australia are working longer average weekly hours. The average hours worked have remained at over 40 since the mid 1980s at the same time as paid overtime hours have remained fairly stable. Figure 1 below outlines these trends:

**Figure 1: Average Weekly Hours Worked and Average Paid Overtime Hours Worked by Full-time Employees, 1966-1995**



Source: ABS *Labour Force, Australia*, (Cat no. 6203.0) 1966-1997  
*Australian Economic Indicators* (Cat. no. 1350.0)

#### **\* Longer hours**

In addition to a sustained increase in average working hours per week, there has also been an increase in persons working very long hours of over 60 per week, with the percentage working over 60 hours increasing from 3% in 1978 to 7% in 1996<sup>6</sup>. An average of 60 hours per week over a five day week would easily result in 12 hour workdays.

#### **\* Distribution of hours**

The 'hollowing out' of standard working hours, whereby some persons are working very few (or no) hours while others are working longer hours, also sets the stage for longer working days. For instance in 1984 18.4% of persons worked 49 hours and more per week, by 1994 this had increased to 27.3%

<sup>6</sup> P. Dawkins (1997) 'The Distribution of Work in Australia' in *Changing Labour Markets: Prospects for Productivity Growth, Workshop Proceedings*, Industry Commission, Melbourne

### ***Workplace Hours of Operation***

The other indicator we can examine in order to get a sense of whether the conditions for longer workdays exist is by looking at the hours of operation of workplaces and businesses. A number of factors have led to an increase in operating hours of businesses and organisations including deregulated retail trading hours, greater interface with international markets such as in the financial sector and a heightened need to maximise the use of expensive plant, equipment and technology through continuous production runs. Thus a combination of manufacturing and service sectors are operating under conditions conducive to longer hours.

This obviously has an effect on working hours of employees. Where workplaces are operating for longer than 12 hours per day and/or 24 hours per day there is likely to be scope for extended hours or additional shifts. This is especially the case where workplaces are operating for 24 hours per day. AWIRS 1995 provides some evidence on operating hours of workplaces and this presented below:

**Table 2: Workplace Hours of Operation**

- Almost a third (32.1%) of all workplaces operated for more than 12 hours per day
- Of these:
- 18.8% of workplaces operated for 12 hours or more per day (85 -167 hours per week)
  - 13.3 % of workplaces operated for 24 hours per day (168 hours per week)

Source: AWIRS 1995: Workplaces with 20 or more employees

The workplaces with longer hours of operation tend to be:

- larger (over 200 employees)
- found in the following industries:
  - mining
  - transport and storage
  - health and community services
  - personal and other services

### ***Workplaces Where Employees Work Shift Work or On-Call***

The other evidence we can look to in order to ascertain whether working days are getting longer is to look at data associated with shiftwork. Data on shiftworkers is not very comprehensive and not particularly current. In particular, it will not pick up trends which have been emerging in the past 3 or 4 years. That being said, AWIRS 1995 provides some data on the percentage of workplaces where shiftwork is performed. This is outlined below:

**Table 3: Workplaces with Shift Work and On Call**

- 62.6% of all workplaces have employees who work shifts or are on call
- These are more likely to be larger organisations (over 200)
- These are more likely to be in:
  - mining
  - electricity gas and water
  - accommodation services
  - transport and storage
  - health and community services
  - cultural and recreational services
  - personal and other services

Source: AWIRS 1995 (unpublished data)

***Workplaces With Shifts Only (No On-Call)***

If we narrow this data down to workplaces where employees work shifts only (no on-call) we get a better sense of the extent of shiftwork being performed. What we do not know is whether these shifts are being worked as part of a formal, structured shiftwork regime, or as part of a flexible, extended hours regime.

- 32.3% of all workplaces have employees who work shifts
- These workplaces are more likely to be found in:
  - mining
  - manufacturing
  - accommodation
  - transport and storage
  - recreational services

Again we can see a mix of manufacturing and service sector industries.

***Workplaces With Employees Who Work 12 Hour Shifts***

In one of the few surveys to have captured the emergence of 12 hour shifts in Australia, AWIRS 1995 tracked the prevalence of 12 hour shifts at workplaces where employees worked some kind of shift arrangement. It found that:

- 17.2 % of workplaces where employees worked shifts or were on-call had 12 hour shifts
- this represents around 10% of all workplaces
- Industries where 12 hour shifts are more likely to be found include:
  - mining
  - manufacturing
  - transport and storage

- cultural and recreational services
- personal and other services

- The workplaces that have 12 hour shifts tend to have as their largest occupational grouping:

- tradespersons
- plant and machine operators
- labourers and related workers

Table 4 below presents an overview of those industries where 12 hour shifts were more or less prevalent

**Table 4: Spread of 12 Hour Shifts Across Industries where shifts are worked**

Industries more likely to have 12 hour shifts %		Industries less likely to have 12 hour shifts %	
<i>All industries</i>	17.2	<i>All industries</i>	17.2
Mining	48.6	Education	4.4
Personal and other services	35.2	Utilities	5.4
Manufacturing - metal	30.4	Govt admin	6.8
Transport/storage	27.7	Health/community	7.3
Manufacturing -other	26.3	Communication	9.2
Manufacturing TCF	26.1	Retail	13.6
Recreation	24.4	Property/business	15.0

Source: AWIRS 1995 (unpublished data)

We can see that workplaces with 12 hour shifts predominate in, but are not confined to, the heavier industries such as mining and manufacturing and also appear in the services industries.

### ***Lengths of Shifts Worked By Shiftworkers***

While AWIRS 1995 provides some information on workplaces where shifts are worked, it does not provide us with any sense of whether or not these shifts have increased. Longitudinal data on shift length is difficult to obtain but there is some unpublished ABS data<sup>7</sup> which throws a little more light on the subject. This data does suggest that between 1993 and 1995 there was a move within the male shiftworking population away from 8 hour shifts and towards 12 hours shifts. For example:

- 10.8% of male shiftworkers worked 12 hour shifts in 1993
- 14.6% of male shiftworkers worked 12 hour shifts in 1995

<sup>7</sup> ABS Cat. no. 6342.0 *Working Arrangements Australia* (Unpublished data)

There was no other significant movement within the shiftworking population in terms of shift length throughout this period. Unfortunately this data item has been dropped from the current labour force survey so we will not be able to establish whether this has been a sustained trend.

### *Trends in Enterprise Agreements<sup>8</sup>*

The other place we can look to for the evidence of the longer workday is to enterprise agreements. The detailed hours provisions that often appear in enterprise agreements give us some indication of the trends that are emerging with respect to both 12 hour shifts and 12 hour 'spans' over time.

A key feature of enterprise agreements has been hours of work, with well over 70% of agreements being concerned with changes to working hours in some way. Through a range of provisions in agreements working time is being radically changed and diverging from what has been thought of as 'standardised' working time in Australia. Arguably, the devolution of deliberations over hours to a workplace level, combined with a weak legislative framework is leading to an effective *deregulation* of working time arrangements which have the potential for both progressive and regressive outcomes.

In particular, increased flexibility provisions in agreements are making it theoretically possible to work longer days because they *remove the disincentives for longer hours* by reducing or eliminating allowances, penalties and overtime associated with extended or irregular hours. Some of the key provisions which appear in agreements, often in combination, include:

- increasing the span of ordinary hours per day
- increasing the number of ordinary days per week
- averaging hours over period (4 weeks, 6 months, 12 months)
- annualising salaries
- absorbing allowances
- reducing, staggering, eliminating rest and meal breaks

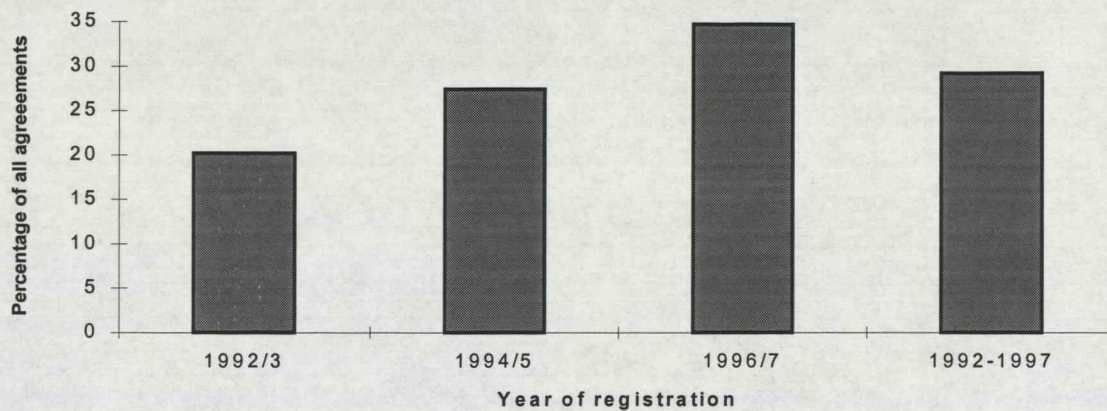
With respect to the longer workday, trends in agreements point quite clearly to the emergence of the two different types of longer workdays outlined earlier.

The *first* are those agreements where 12 hour spans are evident. These increased spans of ordinary hours specify that any hours worked within the span attract the same rate of pay, and often this provision is combined with other provisions where hours can be averaged, other penalties absorbed and so on. The increased spans are generally associated with the combining of a number of flexibility provisions in agreements. These trends are indicated below:

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<sup>8</sup> ADAM data has been used here

**Figure 2: Span of Hours 12 and More**



Source: ACIRRT (1997) *ADAM Report No. 13*

Figure 2 above shows an increase in the number of agreements which specify a span of normal hours of 12 or more, rising from around 20% in 1992/3 to over 30% of agreements in 1996/97.

Spans of *12 hours* cut across industries but are above the average in:

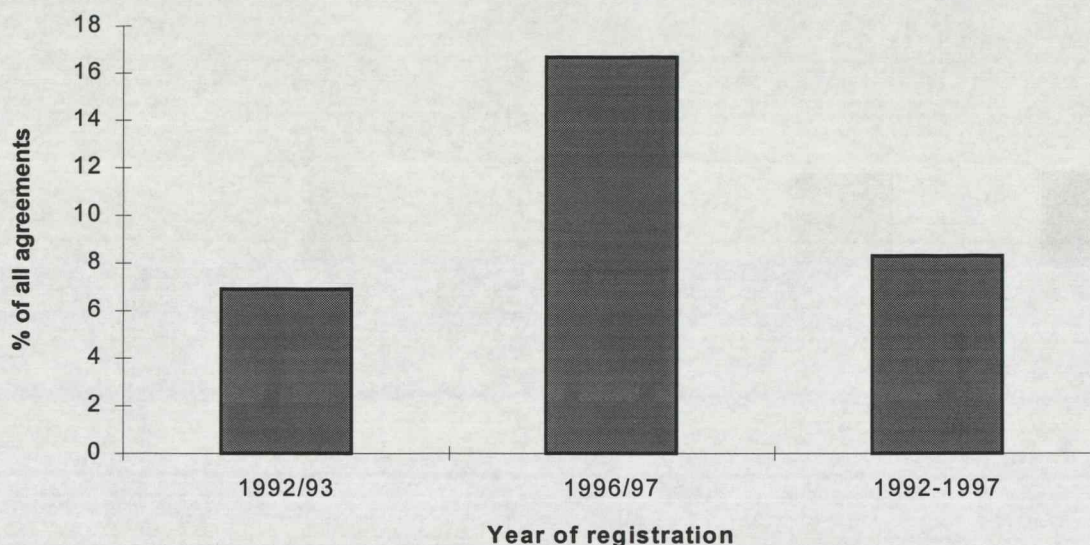
- mining/construction
- agriculture
- wholesale/retail
- communications.

Spans of *over 12* are above average in the service sector industries:

- wholesale/retail
- financial services
- recreational and personal services.

The *second* type of longer workday agreements where 12 hours shifts are specified are associated with the more formal, structured shiftwork arrangements and are often the result of a change from a formal 8 hour shiftwork regime to a 12 hour shiftwork regime. This arrangement is less common in agreements than are the 12hour+ spans, but also show an increase over the period. These trends are outlined below:

**Figure 3: 12 Hour Shifts**



Source: ACIRRT (1997) *ADAM Report No. 13*

12 hour shifts in enterprise agreements are more common in manufacturing, electricity gas and water, food and beverage and far less common in service sector industries.

#### ***Mechanisms For Longer Hours in Agreements: The 'New Language' of Working Time***

One of the most significant features of hours provisions in agreements is that we often see the *combining of provisions* in agreements, where the various hours provisions have to be read together to make sense of how the conditions for longer hours are made possible. In many respects there is a 'new language' of working time appearing in enterprise agreements which is another departure from the language of 'standard' time (ACIRRT, 1996). For example, the existence of increased spans of normal hours may or may not of themselves herald longer hours. However, if these longer spans are combined with other provisions for 'averaging' hours over a period, removing, absorbing penalties and allowances, increasing employer discretion to change and alter hours and increasing the normal days of the week to include Saturday and Sundays we can see that the potential for longer hours is greater. Some examples from ADAM are outlined below:

>12 hour spans combined with the removal of penalties and other allowances (9% all agreements)

- 15.0% mining/construction
- 11.4% transport and storage
- 12.9 % wholesale/retail
- 10.3% recreational and personal services

>12 hour spans combined with averaging of hours (5.9% all agreements)

- 16.1% financial services
- 15.7% wholesale/retail
- 11.2% recreational and personal
- 10.8% electricity, gas and water

>12 hour spans with normal days Mon-Sat; Mon-Sun (3% all agreements).

20.5%      wholesale/retail  
 16.4%      financial services  
 15.1        recreational and personal

***The 'Non-Union' Effect On Hours of Work***

Very recent analysis of union and non-union agreements held by ACIRRT shows that certain hours provisions were far more likely to appear in non-union than union agreements. Some examples are outlined below:

**Table 5: Hours Provisions in Agreements Union and Non-Union Comparisons**

<b>Hours Provisions</b>	<b>Non-Union % of agreements</b>	<b>Union % of agreements</b>
Any flexibility provisions	85	71
Hours > 38	7	10
Ord hours Mon-Sat	18	6
Ord hours Mon-Sun	18	6
Averaging of hours (wk/yr)	38	17
Overtime at single rate	14	1
TOIL at ordinary rate	16	9

Source: ACIRRT (1997), *ADAM Report No. 15*

**Why is the 12 hour Workday Emerging?**

The reasons why longer workdays and the potential for longer workdays are emerging are a result of a range of interrelated factors including:

- Globalisation: competition between employers and workers at a national and international level driving down costs and placing pressure on employers to maximise the utilisation of plant and equipment
- The 'cascading' effect - deregulation of trading and retail hours and increased operating hours places pressures on support and ancillary services
- Inter-industry factors - services sectors are driving the breakdown in hours regulation which flows onto other sectors
- The rhetoric of flexibility: the perception that flexibility is always progressive does not alert employees and unions to the downside of flexibility which is sometimes 'of' and not 'for' employees
- Decentralised bargaining: devolution to the enterprise level, productivity bargaining and trading away conditions is leading to a deregulation of hours
- Accommodating regulatory regime: new forms of bargaining and a new individualised focus is leaving hours 'exposed'

- Unions slow to recognise the OHS implications of longer hours

## Issues That Need to be Kept in Mind When Considering Longer Shifts or Spans

Can we afford to leave the regulation of hours up to the workplace parties - or are hours of work an issue that the community at large has a stake in and an issue that requires a stronger regulatory framework? To date, arguments about flexibility in working time - including the introduction of 12 hour shifts and extended workdays - have been primarily built around issues of enterprise productivity and efficiency using a range of outputs. But these output measures can be rather 'crude' and inadequate to capture the more complex and subtle impact of changes to hours of work on productivity, health and safety and quality of working family and social life.

There is a range of issues to keep in mind when considering longer workdays. These include:

- employer duty of care: even though federal legislation allows for considerable scope for changes to working time, employers need to be aware that workplace changes introduced under federal IR legislation are still subject to state OHS enforcement
- employers need to be aware of potential liability and responsibilities to identify and eliminate hazards associated with unsafe work *systems* (ie hours)
- there is now better scientific evidence which point to the risks associated with fatigue so it is easier to 'prove' liability

### *Key Lessons From Vickery*

The evaluation of 12 hour shift trial at the Vickery mine at Gunnedah highlighted some important issues associated with the introduction of 12 hour shifts:

- each workplace is unique and shifts cannot be introduced across the board; the working environment, labour process, family and social issues all have to be considered
- it is not easy to measure the productivity effects of shift changes
- employee and employer 'preference' should be seen for what it is and the payment of a bonus for unsafe shift arrangements can quite rightly be seen as 'danger money'
- learn about the method of 'triangulation' when assessing the impact of shift changes; different data sources are important for assessing the true impact of shift changes
- safety administration data alone (like LTIs) will *not* alert you to problems associated with extended hours. A comprehensive assessment must consider:
  - safety admin data *and*
  - impact of health and quality of working life *and*
  - impact on site safety *and*
  - social and family impact

*'Under conditions of competition standards are set by the morally least reputable agent'*  
*J. S Mill*

Thanks to: Ron Callus, John Buchanan, Shannon O'Keeffe and Mark Treffry for many creative ideas and help with data.

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## **2. The Effects of 12 Hour Shifts: Recent International and Australian Research**

*Dr Meredith Wallace*

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The research findings summarised in this paper are taken from the International Symposium on Night and Shiftwork, held in Helsinki, June 1997 and recent Australian studies conducted by Health & Work Behaviour.

### **12 HOUR AND OTHER SYSTEMS STUDIED**

Reports usually are based on a comparison between 12 hour shifts and another system.

The range of shift systems in these studies includes the following:

- Change from 8 hour shifts (slow or quick rotation) to 12 hour shifts
- The impact of starting time, 12 hour and 8 hour shifts
- Early start 12 hour permanent day shifts compared with 12 hour permanent nights
- 8 hour weekday and 12 hour weekend shifts combined
- Two weeks on, 2 weeks off - oil rig roster
- Two weeks on, 3 off; 2 weeks on, 4 off-oil rig roster
- 12 hour shifts compared with 6 hour, 8 hour and 10 hour in ICU hospital wards
- Fixed 12 hours compared with fixed 9.5 hours - coal mine

### **MEASURES TAKEN**

Studies of 12 hour shifts most commonly include measures of sleep and physical well-being. These and other measures used in the studies reported here are listed in order of frequency :

Sleep duration, sleep quality, sleepiness  
Health complaints (physical well being)  
Psychological symptoms (GHQ)  
Fatigue  
Social/family life, time for social activities  
Morning alertness  
Performance tests - cognitive tasks or reaction time  
Accidents, injuries, near misses  
Recovery after night work  
Vote to continue/satisfaction with work hours  
Melatonin rhythm  
Work/non-work conflict

### **THE OUTCOMES**

Many of the measures show no difference after a new roster system is introduced. This may be a true reflection of the roster change, or it may be that the measures are not sensitive, or

that insufficient time has elapsed for long term effects to be detected. Contradictory results between studies often arise because the 8 hour and 12 hour shift systems reported in different studies are not identical.

#### **Some Studies of 12 Hour Shifts Have Reported No Effect on the Following Variables:**

- Health
- Psychological or physiological factors
- Sleep
- Social, family factors
- Accident risk or fatigue
- Performance tasks

#### **Other Studies Report Beneficial Changes In:**

- Health problems
- Sleep after night shifts
- Family, social & work relationships
- Faster recovery after night shifts
- Alertness

### **Specific Findings**

#### *Individual Differences*

A study of the impact of change from 8 hour to 12 hour shifts revealed no differences in psychological and physical symptoms or work/non-work conflict. However, at an individual level a minority of workers (10-15%) who reported the same measures as the larger workforce on 8 hour shifts, reported significantly higher symptom levels, work/non-work conflict and fatigue on 12 hour shifts (Loudoun & Harley, 1997).

#### *Voluntary Adoption of 12 Hour Shifts*

ICU nurses who volunteered for 12 hour shifts showed improvements in sleep, social and family factors and roster satisfaction compared with those who chose to remain on 8 hour shifts (Wallace & Levens, 1996a).

#### *A Comparison Of Rapid Rotating 8 Hour and 12 Hour Shifts*

Assessment of groups who changed from slowly rotating 8 hour shifts to either rapid rotating 8 hour or 12 hour shifts showed that crews working 12 hour shifts reported a greater improvement in family, social and work relationships than did the crews working the rapid rotating 8 hour roster. Neither roster change was associated with a change in self reported health problems or with an increase in accident, injury or 'near miss' incidents in the 6 months following change (Smith et al., 1997).

#### *The Effect Of Early Starting Times*

Four groups of shift workers were compared on the impact of early and later shift start times. Two groups began the day shift at 0600 hours and worked either 8 hour or 12 hour shift systems. The other two groups started at 0700 working either 8 hour or 12 hour shift systems. Shift length did not affect the outcome. Start time had no effect on chronic fatigue. However, early starts were associated with poorer psychological health. Early shift

starts (0600/1800) were deleterious for night sleep, and beneficial for day sleep. Later starts (0700/1900) showed the reverse, but other factors favour late starts (Tucker, et al., 1997).

### ***Early Start Permanent Day and Night Shifts***

Permanent 12 hour day workers were compared with permanent 12 hour night workers. Day shift started at 0500 hours and the night shift at 1700 hours. The shift system was 3 shifts followed by 4 days off. Sleep diaries were collected for 28 days. Day workers were, contrary to expectations, significantly sleepier during work than night workers. The probable explanation is the early start of the shift (Gillberg, 1997).

### ***Recovery Time After 12 Hour Night Shifts***

A change from a backward rotating 8 hour roster to a 12 hour roster produced increased satisfaction with work hours, sleep, morning alertness and time for social activities. No effect on health, accident risk or fatigue was found. Subjective recovery time after night work was shorter for 12 hours. The increased satisfaction was associated with the opportunity to arrange meal hours, the opportunity to rest before night work and the value of having time off which coincides with social activities (Lowden et al. , 1997).

### ***Recovery Time After Extended Periods of Nights***

North Sea oil rig shift workers worked a roster made up of 2 weeks day shift (0600 - 1800 hours), 2 weeks off, 2 weeks night shift and 2 weeks off. A melatonin metabolite was used as a marker of circadian rhythm and daily sleep logs were collected giving ratings of sleep duration and quality. The time taken for the circadian rhythm to stabilise on night shift was between eight and ten days. Subjective ratings of sleep duration and quality showed a non-significant but gradual increase over the two weeks of night shift. The data suggest that these shiftworkers take over half of their entire working fortnight to adapt to night shift (Barnes et al., 1997).

### ***On Shift Alertness With 8 and 12 Hour Rosters***

A study of two large groups working 8 or 12 hour shifts found that the largest differences in alertness occurred in the afternoon when the 8 hour group reported considerably higher levels of alertness. The lowest levels of alertness occurred at night, when no difference was found between the groups.

### ***Combined 8 and 12 Hour shifts***

Workers alternating between 8 hour shifts on weekdays and 12 hour shifts on weekends reported increased sleepiness on the 12 hour night shifts, but decreased sleepiness on the 12 hour day. The researchers concluded that the 12 hour shift length did not have any major impact on sleep or sleepiness (Axelsson et al., 1997).

### ***Bright Light Treatment for Night Shift Workers***

Bright light treatment was given to 7 workers on a North Sea oil rig on a roster which included 2 weeks of night shifts. The treatment was given for 30 minutes during the first 3 to 4 nights on night shift and the first 3 to 4 days at home to readjust. Time to adapt the circadian rhythm and a rating of adaptation was collected. Time to adapt to night shift was not reduced, but the night shift with bright light was rated as better than without. At home time to readapt to normal was reduced (Bjorvatn et al., 1997).

### *Night Work Outweighs the Effect of Shift Length*

Permanent colliery night workers on 9.5 hour and 12 hour shifts report more fatigue, shorter sleep and poorer sleep than dayworkers on either shift length, regardless of shift length, age and shift experience (Wallace & Levens, 1996b).

### *General Conclusions*

- 12 hour shifts frequently produce an improvement in sleep quality or sleep length. A very early start for day shift has a deleterious effect. Recovery time after night work is shorter for 12 hour shifts. The shorter sequence of shifts on the 12 hour roster may be an advantage for recovery and sleep length and quality.
- Satisfaction with social and family life usually increases.
- Physical and psychological factors tend not to change over comparatively short term studies. Accident, injury and near miss data are based on small samples over short periods and show no effect.
- The apparent contradictions in research findings can usually be accounted for by differences in roster characteristics or in research design. Most noticeable is the absence of negative findings when a well-designed 12 hour roster is introduced.

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### 3. Can We Measure the Productivity Of the 12 Hour Shifts? Problems and Possibilities

*Alan Thomas*

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#### INTRODUCTION

Increasing globalisation, falling tariffs, and increasing competition have prompted many Australian and overseas organisations to undertake radical changes to their traditional ways of working in order to improve competitiveness. Many organisations have made changes to the length of their work shifts in an attempt to increase productivity; frequently this has involved moving from traditional 8 hour shifts to those of 10 or 12 hours duration. Such moves have not always been received well by the employees affected, and several employee groups and trades unions have disputed the purported benefits of working longer shifts.

The recent dispute at the Vickery coal mine at Gunnedah, NSW is probably the foremost example of differing views on the benefits of working 12 hour shifts. The mining company wished to introduce 12 hour shifts as a means to improve productivity. The CFMEU, representing the mine workers, opposed the move, arguing that its preferred 8.5 hour shift length was more productive. This disagreement led to a major industrial relations dispute, which resulted in the mine ceasing operations for almost a year. As part of the process of resolving this dispute, the Australian Industrial Relations Commission (AIRC) decreed that trials be conducted at the mine to assess the relative merits of the two shift lengths: the mine would work the 8.5 hour shift for 3 months followed by three months working the 12 hour shift. The productivity of the different shift lengths would be audited by an independent third party.

A large firm of accountants was engaged to audit the trials, and the author led the team which undertook the audit: setting up the productivity measurement systems, auditing the data collection and preparing the final productivity results and report which would be used by the interested parties in deciding the most suitable shift length.

This paper looks at the role 12 hour shift lengths might play in improving productivity, and, using the Vickery experience as a case study, examines some of the problems of measuring the productivity of different shift lengths.

#### THE CASE FOR 12 HOUR SHIFTS

Two frequently cited reasons why 12 hour shifts are more productive than traditional 8 hour shifts are:

- **Reduction in time lost to shift changeovers** - in manufacturing and mining industries the productive time lost to shift changeovers can range from less than a minute to almost an hour; by having fewer shift changeovers in a day, 12 hour shifts reduce the productive time lost.
- **Improvement in efficiency** - in industries such as mining and maintenance where people work in teams and the exact nature of their tasks vary from day to day, it has been claimed that productivity improves over the course of a shift as the work team 'gets into a

rhythm'; the longer the team stays at work once it has found this rhythm the greater its average productivity will be.

Depending on the nature of the shift rosters and the wages structure used, a move to 12 hour shifts can also affect the cost of the labour input.

Reductions in changeover times, improvements in production and changes in labour input costs can, of themselves, be easily measured using established industrial engineering techniques. What is much harder to do, given all the various factors which can influence productivity at a workplace, is to isolate and quantify the effects these phenomena have on the overall productivity of an organisation (eg changes in value added per employee or total cost per unit of production).

### **PROBLEMS OF MEASURING PRODUCTIVITY - THE VICKERY SHIFT LENGTH TRIALS**

The Vickery shift length trials presented what was probably a unique opportunity to assess the productivity of 12 hour shifts empirically. It was an experiment conducted at a working, commercial mine to assess the differences in productivity between 8.5 and 12 hour shifts. The circumstances of the trials were highly unusual: it is only because they were ordered by the AIRC that they happened at all.

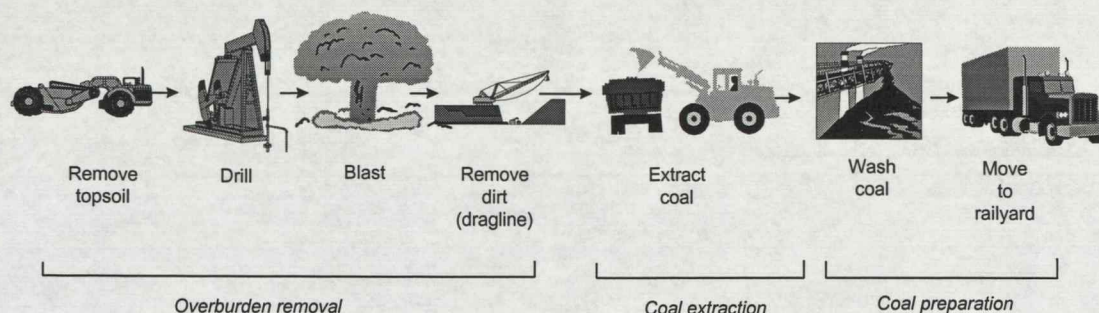
The stated objective of the trials was "to measure the effects of shift length on productivity with the only variable being shift length" and they took the form of two three month trials, the first working the 8.5 hour shift, the second working the 12 hour shift. The trials were overseen by a four man monitoring committee consisting of two company and two workforce representatives.

The first step that needed to be undertaken was to define relevant measures by which the productivity of the trials could be assessed. The committee realised it would be misleading to simply measure the overall productivity of the mine (eg cost per tonne sold) as this would not (at least in the short run) be a true reflection of the work done during a trial. Stock levels of blasted ground, exposed coal, and unwashed coal would vary, as would the amount of maintenance work performed. Consequently the productivity of all the major activities of the mine would need to be measured. This was done by identifying the major business processes performed at the mine and then selecting measures which reflected the productivity of these processes. The major processes were identified as:

<b>Overburden removal</b>	the removal of the topsoil and rock that covers the coal seam
<b>Coal extraction</b>	the removal of coal from the seam and transporting out of the pit to the input side of the coal preparation system (also known as the ROM input system)
<b>Coal preparation</b>	the process of 'washing' the coal to remove any rock or other unwanted material from the raw, run of mine (ROM) coal
<b>Maintenance</b>	the process of maintaining the mobile and fixed plant assets at the mine (dragline, trucks, bulldozers, coal preparation plant etc)

The overall mining process is summarised in Figure 1.

**Figure 1: The Overall Mining Process**



For each of the major processes, input, output, and conversion measures were selected to ensure that a balanced coverage was achieved.

- **input measures**                      assess the quantity of inputs consumed by the process  
eg. payroll cost
- **output measures**                    assess the quantity of output derived from the process  
eg. cubic metres of overburden removed per week
- **conversion measures**            assesses the efficacy by which the inputs are converted into  
outputs  
eg. the production utilisation of the coal hauling trucks.

The measures agreed are shown in Table 1.

**Table 1: Productivity Measures**

<ul style="list-style-type: none"> <li>• Topsoil removed</li> <li>• Metres drilled</li> <li>• Dozer production rate</li> </ul>	<ul style="list-style-type: none"> <li>• ROM input tonnes/week</li> <li>• ROM system rate</li> <li>• Output of saleable tonnes/week</li> </ul>	<ul style="list-style-type: none"> <li>• Man weeks worked</li> <li>• Length of defect list</li> <li>• Age of defects</li> </ul>
<ul style="list-style-type: none"> <li>• Dragline production rate</li> </ul>	<ul style="list-style-type: none"> <li>• Saleable tonnes/man week</li> </ul>	<ul style="list-style-type: none"> <li>• Scheduled maintenance compliance</li> <li>• 103 inspections compliance</li> </ul>
<ul style="list-style-type: none"> <li>• Total BCM waste moved/week</li> <li>• Prime BCM waste moved/week</li> <li>• Rehabilitation waste moved/week</li> <li>• Equipment availability</li> <li>• Production utilisation</li> </ul>	<ul style="list-style-type: none"> <li>• Total waste and coal produced/man</li> <li>• Fixed costs</li> <li>• Variable costs</li> <li>• Costs/saleable tonne</li> <li>• Costs per PBCM waste and coal moved</li> </ul>	<ul style="list-style-type: none"> <li>• Work order backlog</li> <li>• Ratio planned/unplanned work</li> <li>• Number of spills</li> </ul>
<ul style="list-style-type: none"> <li>• ROM tonnes coal extracted</li> </ul>	<ul style="list-style-type: none"> <li>• Store stock levels on site</li> </ul>	

For each of these measures, data collection and reporting procedures were drawn up which identified data sources, formulae for calculation, reporting frequency and reporting responsibility. Most of these data were reported weekly, however, some - such as production costs could only be reported monthly as the mine's existing reporting system worked on a monthly period. As part of the process of drawing up the procedures, all the relevant data

sources and reporting systems were audited, and in some instances modified, to ensure that they generated reliable data.

Once the monitoring committee had agreed upon an appropriate set of measures, the next challenge was to ensure that the results of the trials reflected only effects due to differing shift lengths. Concern was voiced by a number of people at the mine that the results of the trials could be affected by a range of extraneous issues which were wholly unrelated to the length of shift worked. For example, wet weather could close the whole of the pit; if there were more wet days in one trial than the other, then the productivity results of the trials would be misleading. The committee needed to identify all such 'influencing factors', and to find a way to adjust the productivity results to eliminate their effects. After long discussion amongst the monitoring committee and extensive consultation of the workforce, a list of twenty seven such influencing factors was agreed. Some of these factors are shown in Table 2.

### **Table 2: Influencing Factors**

- Weather
- Mine geology
- Skill levels
- Equipment breakdowns
- Stockpile movements
- Price changes
- Absenteeism
- Mining methods
- Strip ration

For each of these influencing factors procedures were drawn up for monitoring the factor and quantifying any effects on productivity it may have. It was agreed that the quantification of effects was to be done in terms of one of the productivity measures eg. if wet weather slowed down the operation of the dozer, then this loss was to be estimated in terms of bank cubic metres/direct operating hour (BCM/DOH) lost for the duration of the wet weather. The task of monitoring the influencing factors and quantifying their effects was divided amongst various mine staff members, who reported weekly to the monitoring committee. The procedures for dealing with some of the factors were quite objective: for example, the coal stockpiles were to be surveyed at the start and end of each trial by independent mine surveyors in order to determine the movement in coal stocks. However, many of these procedures were by necessity highly subjective. For example, the effects of wet weather on production output were estimated by the production superintendent using little more than personal judgment. Inevitably this high level of subjectivity would introduce errors, but the trials had neither the time nor the financial resources to measure the effects of every factor with a high degree of accuracy. Given that the results of the trials were to be used to resolve a long and bitter industrial dispute, it was essential that all the interested parties to the trials had confidence in the results. To achieve this, the monitoring committee adopted the principle of 'fair and reasonable'. This recognised the inevitable limits on accuracy and aimed to ensure that the interested parties viewed the process being followed and the judgements being exercised as being as fair as possible. To implement this principle the monitoring committee spent a great deal of time reviewing the weekly reports on the influencing factors. Once they were satisfied that the reports were a 'true and fair reflection' of the week's events, the committee approved them for use in the trial.

At the end of the trials the monitoring committee faced the challenging task of normalising the productivity data to eliminate the effects of the influencing factors.

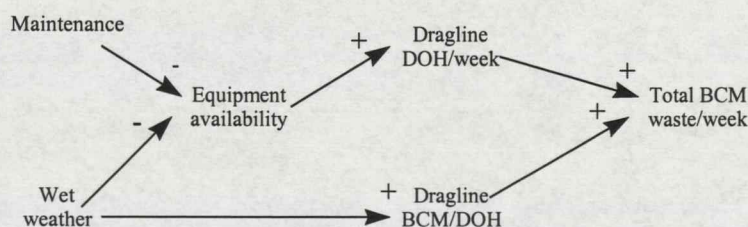
It was recognised that the influencing factors had two different effects on the productivity results:

- **direct effects:** the direct consequence of the influencing factor; for example, wet weather might disrupt the overburden removal process, causing a reduction in the cubic metres of overburden removed.
- **flow on effects:** the indirect consequences of the influencing factor; using this same wet weather example, a reduction in the cubic metres of overburden removed would also reduce the tonnes of coal which could be extracted from the pit (since this depends on the overburden being removed to expose the coal seam) and also on the tonnes of coal sold (the tonnes extracted less the tonnes of rock removed during the washing process and some other losses).

Therefore to remove the effects of influencing factors from the final productivity results, both the direct and flow-on effects would have to be eliminated.

To do this the technique of systems dynamics was used to develop a graphical model of the direct and flow on effects of the influencing factors on the various productivity measures. A greatly simplified version of this model is shown in Figure 2.

**Figure 2: Graphical Model of the Direct and Flow-On Effects**



This model was then expanded in an Excel spreadsheet which incorporated the mathematical relationships between the measures and the direct and flow-on effects of the influencing factors. The data from the trials were entered into this model which calculated and removed the effects of the influencing factors to generate the final trial results.

## CONCLUSIONS

The final results of the trials were inconclusive. There was a slight difference in results between the two trials, but this difference was well within the overall margin of error. This margin of error was estimated to be around 10-15%.

There are so many factors affecting the productivity of a commercial mine that it is very difficult to isolate productivity changes that are due to shift length alone. Assumptions and estimates have to be made about the effects of influencing factors and the numerous ways in which they can affect productivity. Inevitably errors will be introduced. This point was well recognised at Vickery where the emphasis was on a fair and reasonable result, rather than a highly accurate one. The opinion of the monitoring committee and the author is that the results obtained were the best that could be reasonably obtained given the inherent limitations of time and cost.

Attempting to measure the productivity effects of shift length on a commercial organisation is a very time consuming and expensive business. These trials, including the time required for preparation and to produce the final results, took over nine months. They cost a great deal of money and created a lot of disruption at the mine. It is only because the trials were ordered by the AIRC that they happened at all. Any business would be far better advised to spend its time and effort on improving productivity rather than trying to quantify the benefits of one single productivity improvement technique.<sup>1</sup>

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<sup>1</sup> For further information, please contact Alan Thomas, Price Waterhouse Urwick, (02) 9256 8261

## 4. The Psychological Effects of Extended Working Hours

*Sharon Bent*

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### INTRODUCTION

Whilst there has been significant and systematic research conducted into the effects of shiftwork on the individual's mental and physical health, there is a dearth of information and systematic enquiry concerning the effects of extended working hours or overtime on the individual. The term 'extended working hours', refers to the extension of the 'normal' work day - that is, when work extends beyond the traditional eight hour period usually between 8.00am - 6.00pm - to include overtime work in the evenings, at weekends, and occasionally during holiday periods (Spurgeon, Harrington & Cooper, 1997).

Throughout the world, there is considerable international variation in attitudes and practices relating to working hours, even within the developed world. In the United Kingdom, the tendency is for employees to work longer hours than comparable groups in other European states, averaging a total of 44.7 working hours per week as opposed to 39.9 hours in Germany and 39 hours in Denmark and the Netherlands. Recent data show that the United Kingdom has about twice as many employees as any other country in the European Union who work more than 48 hours per week in a normal week. In a recent survey carried out by Austin Knight (1995) which sampled employees from 22 large United Kingdom organisations, two thirds reported regularly working more than 40 hours per week and one quarter more than 50 hours per week, despite having contracted hours of between 35 and 37 hours. In the United States in 1990, the average contracted working week was 37.5 hours, although with overtime, the working week of the average male American worker was 41 hours. During the same period, the average Japanese worker worked a contracted 41 hours per week, but, in addition, averaged nearly 36 hours of overtime per month. In recent years 'Karoshi' or death from overwork has received considerable attention as a social problem in Japan.

Whilst Japan tends to be regarded as an example of the extreme in terms of long hours, some of the data collected recently in the United Kingdom suggest that conditions for at least some British workers are not so different. According to Spurgeon, Harrington & Cooper, (1997) and Kathryn Heiler of the Australian Centre for Industrial Relations Research and Training (ACIRRT), there also appears to be a growing trend which is not always reflected in official statistics, for professionals and managers to work unpaid overtime to deal with excessive workloads. In a study by ACIRRT in 1996 of managers, professionals, paraprofessionals, sales workers, trades, plant and machine operators and labourers, 28.6% were working overtime and 60.1% of those overtime hours were unpaid. Recent findings by ACIRRT showed that of 3000 new enterprise agreements, 28% now had a span of 12 hours as ordinary or standard hours and that there had been a deregulation of the days of the week on which work could be done without overtime and a move in some cases to averaging hours of work over a four-week period.

The psychological effects of shiftwork such as fatigue, problems with attention and concentration, malaise and irritability, social isolation, and family disruption have been well researched and validated. This research however is not strictly applicable to extended hours

or overtime because of the contribution to these conditions by shiftwork-specific factors such as phase shifting in circadian rhythms. Shiftwork therefore results in a more complex situation than that where stress and fatigue result from an extension of the working day. For example, when one considers the stress experienced by those who work extended hours, it remains arguable whether the long hours act both directly as a stressor, in increasing the demands on a person who attempts to maintain performance levels in the face of increasing fatigue, and indirectly by increasing the time that a worker is exposed to other sources of workplace stress. This paper will concern itself exclusively with the psychological effects of working overtime or extended hours, including such health issues as mental health disorders and maladaptive coping behaviours, fatigue and performance, diet and gastrointestinal disorders, and quality of social and family life. However there is little research in this area specifically relating to extended working hours as implications for the possible psychological effects of overtime work will be based on what we know about the effects of shiftwork.

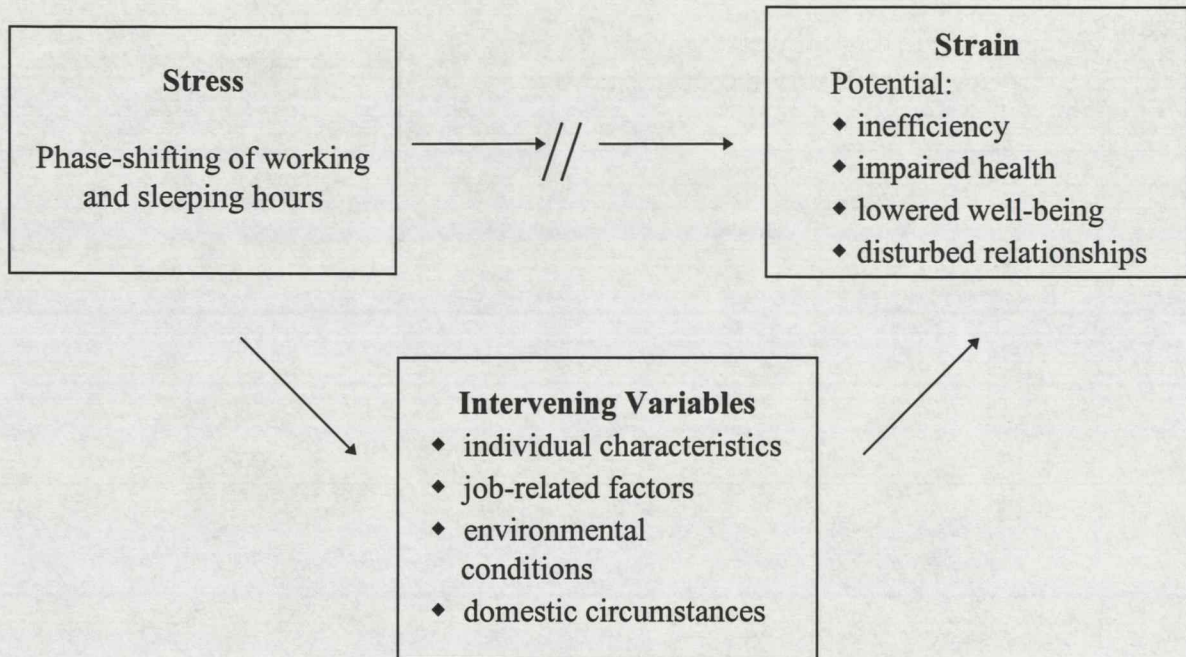
A note of caution is necessary at the outset. In the study of the health effects of shiftwork there are a range of modifying factors (eg. personality, attitude, motivation, choice and control over hours worked, social support, physical and psychological job requirements, organisational and cultural climate) which are likely to influence the level and nature of an individual's health and performance outcomes from working extended hours. These factors make it difficult to draw definitive conclusions about the direction of any causal relationship between long hours and mental health as the relative presence or absence of these moderating factors will influence the degree to which the individual is effected by working extended hours, if at all.

## **MENTAL HEALTH DISORDERS AND MALADAPTIVE COPING BEHAVIOURS**

Shiftwork has been associated with psychological effects - both cognitive and emotional. Cognitive problems include short-term problems with concentration, memory, accuracy, vigilance and code transcription. Emotional problems include depressed mood, irritability and feelings of malaise. Factors which have been shown to modify how an individual copes with, and is therefore affected by, shiftwork include individual factors such as age, 'moonlighting', 'morningness', sleep pattern history, personality type (ie. Type A, neurotic introversion), psychiatric illness, alcohol or drug use, gastrointestinal history, presence or absence of epilepsy, diabetes and heart disease (Tepas & Monk, 1987); job-related factors such as physical and psychological requirements of the job (eg. routine, monotonous, higher-order vs lower order cognitive processing), support, control and choice over working hours; environmental conditions such as lighting, temperature, noise; and domestic circumstances such as domestic work load, spouse's working hours, children and their age, accommodation, and neighbourhood.

In regard to extended working hours and their effect on the psyches of individuals, research findings have proven to be non-definitive, advocating instead a multifactorial explanation for health effects found amongst those working extended hours. Long hours have often been found however, to be an important factor, but not necessarily the only or most important factor in influencing the psychological health of these workers. These studies have emphasised the need to take such modifying factors as tenure in the job, presence of family problems, domestic work load, administrative problems, choice over hours worked, work satisfaction, personality and attitude, social support, and lifestyle factors such as exercise

and nutrition into account when examining the effects of extended working hours on the individual's health. Some mental health disorders which have been associated with working extended hours include greater prevalence of maladaptive coping behaviours such as smoking, drinking alcohol and substance misuse, higher levels of stress-related symptom reporting including anxiety and depression, musculoskeletal symptoms, headaches, sleep disturbance, and relationship problems.



Colquhoun and Rutenfranz (1980) have proposed a 'Stress and Strain' model which highlights the important role played by such intervening variables in determining the extent to which an individual's health is effected by shiftwork.

This model proposes that if strain can be reduced (eg. by the learning of coping strategies and/or modification of intervening variables) then even if the stressor remains the same (ie. the shift system is unchanged), the level of strain may still be significantly reduced. It would appear that this model may be equally applicable in helping us to understand the relationship between the stress associated with working extended working hours and how this impacts psychologically on the individual. Research to date confirms the need to explore if and to what extent these intervening variables contribute to health and performance effects in those working of extended hours, so that conditions at the intervening variable level can be optimised for the individual and organisation to reduce unnecessary strain and derive maximal benefit from such working arrangements.

## FATIGUE AND PERFORMANCE

The onset of fatigue is perhaps the most obvious direct result of working long hours. Since the concept of fatigue is difficult to define operationally, studies have tended to measure it in terms of its effect on performance. An early experiment conducted in a large Manchester engineering works at the end of the last century provides one of the most important data sources in this field and despite being carried out over 80 years ago, has rarely been surpassed in terms of scientific method and attention to detail. After discussions with the workers, the management eliminated early morning (before breakfast) working and also overtime, effectively reducing the weekly hours from 53 to 48. Production levels remained about the same and the proportional rise in wages versus output was compensated for by a

reduction in fuel costs. There was also a considerable reduction in absenteeism. Around the same time in Germany, an optical works reduced daily hours from 9 to 8, resulting in a 3% rise in production over a year. The findings from these studies have since been replicated, with a reduction in working hours in most cases, leading to a distinct increase in output and lowered rates of absenteeism. Output has also been increased through the use of scheduled rest breaks.

Again, research has shown that there are a number of intervening variables which moderate the effect of fatigue on performance. The extent to which fatigue impairs performance has been found to be influenced by factors such as the nature of the task (ie. whether it is routine and monotonous or complex and stimulating), the motivation of the person, and the presence of other stressors.

## **DIET AND GASTROINTESTINAL DISORDERS**

Gastrointestinal disorders are more common in shiftworkers typified by changes in appetite, constipation or diarrhoea and with conditions ranging from the extreme of peptic ulcers to mild indigestion. Reasons put forward for the incidence of gastrointestinal complaints are that altered eating habits including changes in the timing of eating and the types of foods eaten. While some studies have found no increased incidence of peptic ulcers amongst shiftworkers, several have reported a high incidence of peptic ulcer amongst shiftworkers and an even higher incidence among workers who dropped out of shiftwork. Smoking habits of shiftworkers may also contribute to their higher rate of peptic ulcer disease but no consistent patterns have been demonstrated.

The role of excessive alcohol and or caffeine consumption in causing shiftworker gastrointestinal problems is unclear. While some studies have found alcohol and caffeine consumption to be higher in shiftworkers others have not. This is not surprising in that as worker population demographics vary so too do their health behaviours.

In regard to the effect of long working hours, research to date indicates that the gastrointestinal problems associated with stress may also be associated with long hours. However, this requires further investigation.

## **HEALTH EFFECTS OF EXTENDED HOURS**

### **Pregnancy Outcomes**

Some studies to date have looked at occupational fatigue, shiftwork, prematurity rates - defined as less than 37 weeks gestation - in association with number of hours worked per week. The findings indicate that there is a increased risk of preterm births if the woman is working more than 40 hours per week or shiftwork. There also in a combined effect of further increased risk if the woman is working more than 40 hours per week and subjected to occupational fatigue. The indices of occupational fatigue included standing postures, work on industrial machines, physical exertion, mental stress and environmental exposures.

The results of another study also indicated an increased rate of abortion in women working 46 or more hours a week.

Considering the findings of these studies, it appears to be prudent to consider long work hours to be added stressors on pregnancy outcomes.

### **Cardiovascular Disease**

Consideration of the evidence on cardiovascular disease and long hours suggests that the relation is not a straightforward one. As with the case of mental health disorders, working long hours appears to play an interactive or perhaps exacerbating part with other occupational stressors. The influence of sex, of individual factors (motivation, choice, and personality disposition), and of situational factors (work type, home-face interface) are all important in determining the perception of stress and its associated physical responses. Moreover, these physical responses themselves show wide individual variation, which may in turn be linked to dispositional factors. A meta-analysis on 17 studies by Sparks, Cooper, Fried and Shirom (1997) however, concluded that significant associations could be identified between hours of work and both physical and psychological health symptoms. They also concluded that given the range of factors which may moderate the relationship between working hours and health, these results are likely to underestimate the strength of the relation.

### **'Karoshi' - Death From Overwork**

In a Japanese study to evaluate the effect on the cardiovascular system of persistently long work hours the results indicated that the burden on the cardiovascular system of white collar workers increased with overtime work. It is reported that most cases of Karoshi are the result of sudden occurrences of fatal, acute cardiovascular diseases. Evidence currently available, therefore, is undoubtedly sufficient to raise concerns about a possible link between long hours and the risk of significant health outcomes, including cardiovascular disease, particularly when those hours exceed 50 a week. However, much remains to be explored in terms of the nature and interactions of the factors involved.

## **QUALITY OF SOCIAL AND FAMILY LIFE**

Shiftwork has been linked to an impoverished family and social life, and many of the mechanisms through which this develops and the health effects are applicable to those who work extended hours.

Within the family there are a number of roles that can be adversely affected by the needs of shiftwork and extended working hours. Problems arise because of the expectations regarding these roles which are carried over from the normal 'five-days-per-week; 8 hours per day' working situation. Three spouse roles may be affected by working extended hours, namely, care giver, social companion and sexual partner.

The care-giver role impinges mainly on the female worker who is often faced with societal and family expectations that she should give the same level of 'service' with regard to cooking, laundering, cleaning and housework as she should in an exclusively housewife role. Research conducted in Canada in 1992 on hospital workers calculated that female workers had an average professional working week of just over 32 hours, but also a domestic working week of 19 hours. Reports of exhaustion and insomnia were associated primarily with the duration of the domestic working week.

Research suggests that this societal role also creates many more problems for the female worker of extended hours than for men as their ability to safely access evening social activities can sometimes be impaired due to safety concerns. In regards to disruptions to the care-giver role for the male extended hours worker, these often include failure to cope satisfactorily in the home maintenance, car maintenance and other traditionally 'masculine' care giving roles that he may be expected to fulfil. Alternatively, these roles may preoccupy the extended hours worker to the detriment of high quality time spent with his or her spouse and family, resulting in possibly more family tension than would have arisen had the work been neglected.

The social companion role is crucial for many couples, particularly in cultures in which couples meet with other couples on a social basis in the evening. The absence of the extended hours worker spouse can cripple not only their own social life but also that of the spouse.

Finally, there are the problems that extended hours of work create in the sexual partner role. Fatigue, and especially cumulative fatigue is known to reduce sexual drive in favour of the need for restorative sleep. This appears to be more prevalent in females than males.

Parenting roles, especially when children are quite young, are also adversely affected by extended hours of work. For most of the year children are at school, and school is inherently 8-hour day shift oriented. Therefore, those who work extended hours may find that they spend a whole week without ever interacting with their children; the children are asleep by the time they come home from work and are not up or are only just awake and not ready for enjoyable social interaction before the worker leaves for work in the morning.

Importantly, negative impacts on spouse and parenting roles not only occur because of the times of day that the individual is required to work but also due to the days of the week that the individual must work. Society functions under the expectation of a 5-day week, day working, schedule. Very often the parent who works extended hours and/or whose working days have been deregulated is not there on a Saturday morning for the football game or netball and this can play a major role in creating problems for the child involved.

## CONCLUSION

This review has attempted to highlight the fact that there is very little definitive information available on the psychological and health effects of working extended hours, despite the increasing trend towards such working arrangements. Through reviewing what research is available, including that available on shiftwork, we can conclude that there certainly appear to be grounds for concern over the impact of extended working hours on the physical and psychological health of employees and that further research is needed in this area to explore the nature and level of risk posed by extended working hours. Research is also needed to explore the complex interaction between the individual worker and extended working hours, and in particular, the role played by intervening variables - such as characteristics and attitudes of the person, job requirements, environmental conditions and domestic circumstances - in determining the nature and intensity of health and performance effects on those who work extended hours. By knowing the mechanisms which pre-dispose a person to experiencing poor outcomes when working extended hours, we can hopefully modify these mechanisms (eg. through education programs, job redesign, targeted selection and recruitment, domestic/family support initiatives) to maximise their coping and productivity -

both at work and in their personal life. Given the increasing trend towards extended working hours, such research is now urgently required.

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## 5. The Compressed Workweek: Comparing Sleep Duration on an 8 Hour System to a 12 Hour System

*Lee Di Milia*

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Shiftworkers report a range of physical, psychological and social impairments which can be attributed to the disruption of circadian and social rhythms (Waterhouse et al., 1992). Arguably, the main preoccupation for shiftworkers is gaining sufficient sleep (Åkerstedt, 1990). Sleep duration is important for maintaining positive mood, performance and alertness. Therefore, sleep length has implications for safety at work. To ameliorate these effects, a range of interventions is available at the individual and organisational level. At the organisational level, the design of innovative shift schedules under the banner of the compressed work week (CWW) is being increasingly investigated (Duchon & Smith, 1993) and may offer greater scope for improving the potential problems of shiftwork.

A number of survey studies have indicated 'normal' sleep length to be approximately 7.5 hours (Tune, 1968). While Horne (1988) indicates 'core' sleep needs to be some 4.5 hours others have suggested that these values reflect chronic sleep deprivation and have proposed sleep durations of 9 to 10 hours to be more appropriate (Bonnet & Arand, 1995). The mean sleep durations of rotating shiftworkers are typically shorter than for day workers. These reduced sleeps are further compounded by reports which have suggested some 60 to 70% of shiftworkers complain of sleep disruption (Rutenfranz et al. 1985) which are more common for day sleep. The reduced day sleep durations and sleep disruptions are more likely explained by the circadian rhythm for alertness than by the environmental and noise factors (Åkerstedt, 1996) often cited by shiftworkers. Day sleep in 'ideal' laboratory conditions has also been reported to be lower than night sleep (Åkerstedt & Gillberg, 1981).

Studies typically show shiftworkers sleep most on their days off, followed by afternoon shift, day shift and night shift (Tepas & Carvalhais, 1990). Perhaps then, the amount of sleep taken after the night shift is critical for shift adjustment (Wedderburn, 1975). Wilkinson's (1992) review of the literature has provided the following mean values of day sleep associated with various 8 hour shift systems: (1) Permanent night work allowed some 6.55 hours of sleep; (2) weekly rotating resulted in 6.12 hours and (3) rapid rotating systems reported 5.79 hours. These values are well below the 'average' for the population.

The CWW is being investigated as a way to improve the potential negative consequences of shiftwork. The CWW can be broadly defined as a system of extending the work day beyond 8 hours but reducing the number of consecutive days worked in the work week to less than five (Tepas, 1985). Essentially the CWW is concerned with increasing the speed of the shift rotation and this is seen as beneficial for shiftworkers. Potential benefits include, minimising any circadian changes, preventing the accumulation of sleep loss across successive night shifts (Knauth, 1995) and providing greater social opportunities (Di Milia, 1997; Rosa et al., 1989).

Few longitudinal studies are available to suggest the impact of the CWW on sleep duration. Rosa et al. (1989) reported initial increases of approximately 0.20 hours for sleep after 12 hour day and night shifts. At a 7-month follow up, sleep was 7.63 hours following night shift and 6.96 hours after day shift. After 3.5 years on 12 hour shifts, sleep after day shifts was

similar but sleep after night shift was reduced by 2.50 hours (Rosa, 1991). Duchon and Smith (1993) reported 12 hour shifts improved sleep quality with no decrease in sleep length compared to the previous 8 hour schedule. These shift systems involved working 3-4 consecutive day and night shifts. Williamson et al. (1994) compared 8 hour to 12 hour shiftwork after a 12 month interval. Sleep after day shifts increased from 6.6 hours to 7.8 hours, sleep during rostered days off increased from 7.8 hours to 8.6 hours, and sleep after night shift decreased from 6.8 hours to 6.0 hours. In this study, two consecutive nights were worked. In summary, these studies reported longer sleep durations after 12 hour day shifts and rostered days, and mixed findings for sleep durations following 12 hour night shifts.

The question regarding why we sleep is still under debate (Horne, 1988) but it is clear that sleep loss is associated with decreased alertness (Tucker et al., 1996) and decreased performance in both field (Bjerner et al., 1955) and laboratory studies. A recent meta-analytic study of laboratory studies involving sleep loss has reported psychological mood is more affected than either cognitive or motor performance (Pilcher & Huffcutt, 1996). In particular, they also found partial sleep deprivation (<5-h in a 24-h period) to have a more profound effect on mood and performance than short term (<45-h) and long term (>45-h) total sleep deprivation .

Sleep loss has implications for safety on the night shift. Demonstrating the link between working at night and safety is problematic. It could be argued that conditions at night are different to the day. For example, work demands, supervision, maintenance and ambient lighting may be different at night (Folkard, 1996). In a study of 4000 rotating shiftworkers where work load was constant, Smith et al. (1994) reported the risk of injury to be 20% higher at nights. A key finding was a large increase in 'severe' injuries for self-paced work compared to machine-paced work during night shift.

The cost of sleep related accidents (including shiftwork) was recently reported in human and financial costs. Leger (1994) estimated the cost of sleep related accidents for 1988 in the United States to be some 23,000 fatalities, between 1.9 and 2.4 million disabling injuries and costs between \$43-56 billion.

In light of the potential performance decrease associated with sleep loss and the lack of longitudinal studies of the CWW, the present studies monitored the introduction of a CWW defined as a change from 8-hour to 12-hour shiftwork. Two studies will be briefly discussed concerning the impact on total sleep time due to changes in shiftwork systems.

## **METHOD**

Both studies employed a longitudinal design in which data was collected over 5 time points over a one year period. The first time point collected sleep data for a complete cycle of the 8 hour shift and the four remaining time points collected sleep duration data on 12 hour shifts. This approach allows for any incremental changes in sleep duration to be observed.

Subjects completed daily sleep diaries and answered self estimated need for sleep regardless of which they are working. Full details can be found elsewhere (Di Milia, 1998; 1997). Sleep was recorded for the 24-h period from 07.00 to 07.00. For the first night shift, sleep duration is the amount of sleep taken to the end of this shift. Therefore, it records the preparatory sleep. Sleep to the end of the second night shift captures sleep between the first and second night shift.

Data analysis was conducted using repeated measures analysis of variance using planned contrasts between Time 1 (8 hour shift) and subsequent Times 2-5 (12 hour shifts).

## STUDY 1

The structure of the 8-hour and 12-hour shift systems are shown in Figure 1.

### Figure 1: Eight and Twelve Hour Shiftwork Schedule

#### 8-hour Schedule

7D 2R 7N 4R 7A 1R

Hours of work were; 0700 to 1500; 1500 to 2300; 2300 to 0700.

#### 12-hour Schedule

2D 2N 2R 1D 2N 2R 2D 1N 2R 2D 2N 8R

Notes: D=day shift; N=night shift; R=rostered day off  
Hours of work were; 0700 to 1900; 1900 to 0700.

## RESULTS

### 1. Sleep diary data

Repeated measures ANOVA showed no differences between Times 1-5. However, within shift differences were obtained. The mean sleep values for each shift type are shown in Table 1.

**Table 1: Mean Sleep Durations By Time Periods and Shift Type**

Time	Day mean	SD	Night mean	SD	Rostered off mean	SD	Total mean	SD
1	6.80	0.91	5.60	2.43	7.56	1.43	6.65	1.87
2	7.12	1.19	4.01*	2.56	8.91*	1.76	6.68	2.78
3	7.31	0.92	4.05*	2.70	8.81*	1.91	6.72	2.80
4	6.95	0.58	4.19*	2.97	8.29	2.40	6.48	2.79
5	6.76	1.33	4.20*	2.46	8.18	1.79	6.38	2.51

Notes: \* significant at 0.05 compared to Time 1.

Time 1 = 8 hour shift; Time 2 = second 12 hour shift; Time 3 = third 12 hour shift;

Time 4 = fourth 12 hour shift; Time 5 = fifth 12 hour shift.

## 2. Self Reported Need for Sleep

Subjects were asked to indicate their sleep need irrespective of the shift being worked including rostered days off. The modal response to this question was 7 hours under the 8-hour system. This value increased to 8 hours for the 12-hour system. Subjects also voted to change the structure of the shift system to shorten the long roster period and to increase the number of shorter roster breaks.

## STUDY 2:

The structure of the 8-hour shift system was the same as in Study 1. The structure of the 12-hour shift system in this study is shown in Figure 2.

**Figure 2: Twelve Hour Shiftwork Schedule**

### 12 hour Schedule

2D 2R 3N 2R 2D 3R 2N 2R 3D 2R 2N

Hours of work were; 0700 to 1900; 1900 to 0700.

## RESULTS:

### 1. Sleep Diary Data

Repeated measures ANOVA again showed no differences between Times 1-5. However, within shift differences were obtained. The mean sleep values for each shift type are shown in Table 2.

**Table 2: Mean Sleep Durations By Time Periods and Shift Type**

Time	Day mean	SD	Night mean	SD	Rostered off mean	SD	Total mean	SD
1	7.11	0.96	5.14	1.91	7.87	1.37	6.89	1.84
2	7.53*	0.72	3.88*	2.65	8.41	2.05	6.89	2.76
3	7.26	0.98	4.08*	2.56	8.57*	1.84	6.94	2.66
4	7.04	1.03	4.35	2.85	8.28	2.00	6.83	2.64
5	7.35	1.04	4.29	2.39	8.69*	2.21	7.08	2.71

Note: \* significant at 0.05 compared to Time 1.

## 2. Self Reported Need for Sleep

Subjects were asked to indicate their sleep need irrespective of the shift being worked including rostered days off. The mean sleep duration showed a significant increase from 7.21 hours to 7.53 hours ( $p < 0.05$ ).

## DISCUSSION

The data in both studies showed that on changing from 8 hour to 12 hour shiftwork, the amount of total sleep time across the time periods was not significantly altered. However, the overall result masks the nature of the within shift changes for sleep duration. The data showed the following trend in both studies relative to the 8 hour benchmark; sleep after 12 hour day shifts increased, sleep on rostered days off for the 12 hour system increased and sleep after 12 hour night shifts decreased. It is important to keep in mind that these results apply to these particular forms of the CWW. The CWW may differ by a number of criteria (Di Milia, 1997; Tepas, 1985).

Of concern in both studies was sleep loss associated with 12 hour night shifts. Total sleep duration decreased significantly (especially in Study 1) and showed little recovery by the end of both studies. Of note also is that the mean sleep hides the large variations in day sleep as suggested by the standard deviations in Table 1 and 2. Sleep durations of 4 hours have been associated with performance decrements (Pilcher & Huffcutt, 1996). The longitudinal design of this study implied a sustained reduction in sleep duration and not a short term adaptation response to the CWW.

There is some evidence in the 8 hour shift literature that shiftwork involving fast rotations is associated with shorter sleep durations (Wilkinson, 1992). Therefore, one potential explanation for the reductions in sleep duration is the speed of shift rotation. Faster rotations require the commencement of more work blocks with fewer consecutive work shifts. Slower rotations result in less work blocks with more consecutive work shifts. The data from these two studies suggested the greatest sleep loss was associated with the number of times blocks of night shift were required to be worked. That is, the faster the rotation, the greater the sleep loss. Study 1 involved four night shift starts every 28 days and can be considered as the faster rotating system compared to the 12 hour system in Study 2. Each night shift period contained a maximum of two nights. Study 2 required three night shift starts every 26 days and contained one block of three night shifts with the balance being blocks of two nights.

The mean sleep durations for each night in Study 1 and 2 are shown in Figure 3 and 4 respectively. Figure 3 showed at Time 1 the first night shift was associated with the lowest amount of sleep which subsequently increased across the remaining days. For Times 2-5 a 'spiked' effect was observed for each block of two 12-hour night shifts worked. Each of the first nights was associated with the lowest sleep duration including the single night shift worked in the 12 hour roster described in Figure 1. It is evident little sleep is taken by the end of the first night shift and this finding is consistent with other reports that sleep before the first night shift is minimal (Smith, 1979).

**Figure 3: Mean Sleep Duration to the End of Night Shift Per Day (n=3)**

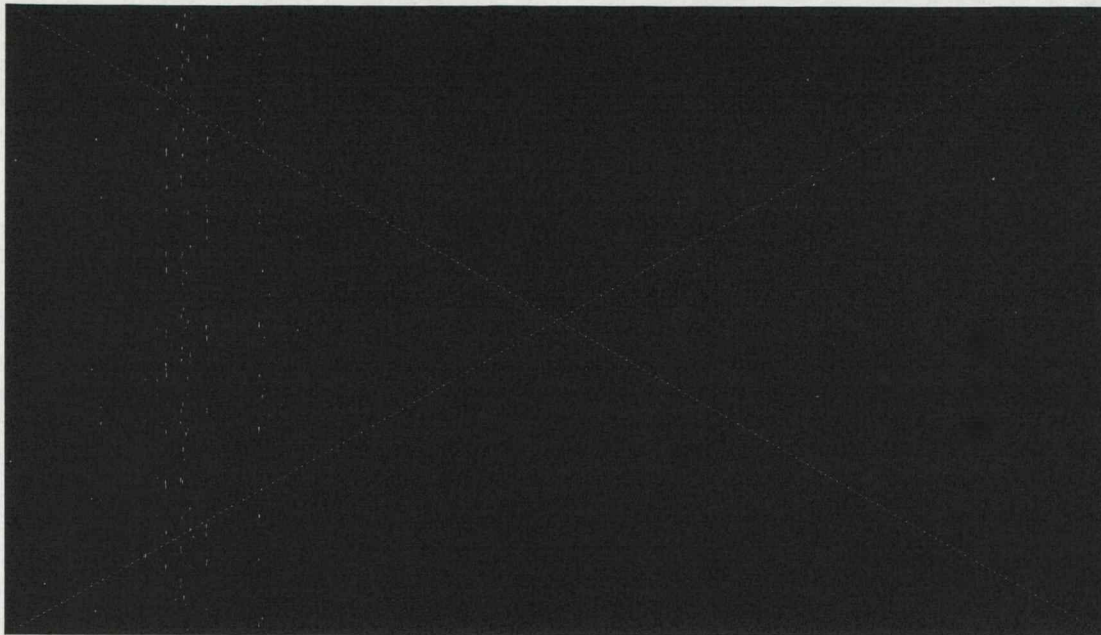


Figure 4 showed a similar pattern of results for Time 1. Sleep durations for Times 2-5 also showed the spiked effect of low sleep by the end of the first night and an increase by the end of the second night. However, a key difference in Figure 4 was the effect of working a third night. This 'extra' shift served to slow the rotation speed thereby reduced the need to undergo another start of a night shift block. Working a third night also served to increase sleep duration.

**Figure 4: Mean Sleep Duration to the End of Nightshift (n=7)**



Faster rotations clearly require more transitions back to a night sequence. Under the 8 hour system, workers underwent one 'first night effect' every 28 days. In the 12 hour system shown in Study 1, four first night effects were encountered in 28 days and the 12 hour system in Study 2 required three first night effects every 26 days. These data demonstrate the following pattern; the faster the rotation, the more first night effects must be encountered and the more associated sleep loss. The sleep values on night shifts were highest on 8 hour

shifts, lower when three nights were worked in Study 2 and lowest in Study 1 when two nights were worked.

The results obtained are not necessarily an argument against these forms of the CWW. They do suggest workers need to be educated regarding their choices in shiftwork systems. The Achilles heel in rapidly rotating CWW appears to be the first night effect. This finding is widespread (Smith, 1979; Åkerstedt, 1990). Some explanations for the lack of sleep by the end of the first night shift are: (a) difficulty in sleeping before the first night due to social and family commitments; and (b) forgoing sleep prior to the first night may well be an effective strategy to ensure sleep during the day after the night shift (Wedderburn, 1991).

The argument that rotation speed leads to more first night effects and therefore, decreased sleep durations on 12 hour night shifts are supported by the data. However, it needs to be kept in mind that the two studies involved two different sets of shiftworkers. The study did not show these effects using the same employees.

The increase in sleep after day shift and rostered days off, coupled with a significant decrease in night shift sleep, may suggest that these versions of the CWW may be too demanding for workers and is in line with other findings regarding fatigue (Tepas, 1985; Rosa et al., 1989; Rosa, 1991). This hypothesis is supported in both studies were workers subjectively estimated an increased sleep need on 12 hour shifts. Study 1 also recorded an interest in changing the CWW to allow more rest and Study 2 recorded a small rise in chronic fatigue.

In summary, total sleep length was not significantly altered by the introduction of the CWW but the distribution of sleep changed markedly for night shift and rostered days off. The data suggested that sleep duration is a function of rotation speed, the faster the rotation the more first night effects must be encountered which consequently decrease sleep duration. A balance must be achieved between the benefits of fast rotations for physiological and social reasons and the need for sleep and its implications for performance and safety.

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## 6. The Implications of 12 Hour Workdays for Workplace Safety: 'Driver Safety and Machine Operation'

*Melissa Benson*

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### INTRODUCTION

Increasingly workplaces are under constant demand to consider alternate working arrangements to remain competitive in today's market. Extended working hours are being considered by many Australian enterprises. But the question still being asked is - do extended working hours result in reduced performance? Does reduced performance have serious ramifications on safety for employees at work and what are the subsequent occupational health and safety implications for employers? Literature in these areas is limited and contradictory. A recent review indicated that there was sufficient evidence about the risks to health and safety of long working hours to warrant further investigation (Spurgeon, Harrington & Cooper, 1997).

Particular reference will be made to driver safety which has become an issue of national importance. In NSW alone, WorkCover statistics show work related road crashes in 1994/95 cost business \$31.7m (*Occupational Health Newsletter*, No.389, 1997, p.2).

### PERFORMANCE OVER EXTENDED WORKING HOURS

Studies have shown that working for extended durations on tasks that require maintenance of constant attention, prolonged inactivity, conducted in a monotonous or repetitive environment, demand more effort from a worker. (Krueger, 1989 cited in Williamson et al., 1992). Jobs, like driving, that require performance over long periods of sustained alertness, are known to be prone to increase in error with an increase in time.

If these tasks are completed at times of the day where arousal is known to be low, a worker's performance is also reduced. This can be directly related to a person's circadian rhythms or bodily functions which fluctuate in a 24 hour cycle. Heart rate and body temperature are examples of bodily functions which decrease by night. As a result, driving can therefore become more difficult to continue due to reduced levels of alertness and fatigue at night.

The NSW Department of Industrial Relations and Employment in its *Occupational Health and Safety Bulletin*, (1987), stated that there were; 'increases in the number of accidents during the night shift particularly between 2 am and 5 am. Jobs that require concentration and alertness are most affected by night work.' A number of studies have shown that in jobs such as train and truck drivers, switchboard operators and meter readers, the number of errors increase and the speed at which the job is performed decreases when performed in the early hours of the morning.

Literature specifically indicating that extended working hours can result in reduced performance at work include; operators at nuclear generating plants - doubling error rates (Kelly, Schneider, 1982), and industrial workers on 12 hour rotating shifts reported mistakes as a result of low alertness. In fact 84% of workers reported falling asleep at work at least once in the previous year (Budnick et al., 1994 cited in Church, 1995).

Alternatively;

Rosa (1991, cited in Church, 1995), in a sample study found that control room operators working on 12 hour shifts had a reduction of one to three hours in total sleep time when compared to workers on 8 hour shifts. However little deterioration in performance or alertness was observed.

An American study into commercial motor vehicle driver fatigue and alertness published in January 1997 stated the number of hours of driving (time on task; 10 v 13 hrs) and cumulative number of days were not strong or consistent predictors of observed fatigue.

## **WORKING HOURS IN THE TRANSPORT INDUSTRY**

If we examine typical working hours in the transport industry it is apparent that there are similar trends around the world.

A survey conducted by the United Road Transport Union of the hours and conditions of 640 lorry drivers in the United Kingdom found that the average working week was 62 hours. (Higinbottom, 1995 as cited in Spurgeon et al., 1997)

Similarly in Australia, a study conducted by the Federal Office of Road Safety (Williamson, Feyer, Coumarelos and Jenkins, 1992) involving 960 drivers indicated that the average mean length of the last trip they had completed was 1259.8 km with 21% of the time taken being spent in breaks. The mean number of hours worked in the previous week was 62.6 hours. However over 30% of the group had worked longer than 72 hours in the last week.

The maximum daily driving hours regulations in the United States are presently set at 10 hours/day and in Canada at 13 hours/day (Williamson et al., 1992).

Due to the nature of the work and the duration of working hours, the transport industry has become a focus for a number of studies relating to driver fatigue. Of all fatalities involving long distance truck drivers, half of them could be attributed to fatigue (Hopkins, 1992).

## **DRIVER FATIGUE**

The onset of fatigue is one of the most obvious result of working long hours and can potentially lead to reduced safety at work. Actually it should be noted that the largest incidence of driver fatigue related accidents are work related (36%). (RTA, 1995). Research estimates that fatigue causes up to 40% of all crashes (Pearson, 1994).

In NSW in 1994 there were 3,365 fatigue related crashes. In these crashes 128 people were killed, 887 seriously injured.

According to the Road Safety Bureau (1990) fatigue is;

- 1... related to the level of arousal
- 2... a progressive decrease in performance which -if not arrested - will end in sleep

Fatigue leads to a change in on road performance as it results in the reduced ability to process sensory information accurately. A driver can experience changes in visual, auditory,

tactile, proprioception and kinaesthesia sensations. Consequently a driver may not be able to perform rapidly in emergency or unpredictable situations.

Williamson et al., (1992), indicated that drivers do believe that driver fatigue is a major problem for the industry. 75% of drivers reported that their driving was worse when fatigued. Common effects of fatigue on driving were;

- slower to react
- poorer gear changes
- driving too slowly
- poorer steering

In the same study the drivers believed that the following factors contributed to their fatigue;

- dawn driving
- poor roads
- long driving hours
- un/loading
- poor weather

Brown (1994), indicated that prolonged and irregular working hours were a significant factor in causing fatigue related accidents. Studies also show that the risk of accidents increases when the duration of driving hours exceeded greater than 8 hours ie. almost double that of drivers who had driven less hours. (Haworth,1995)

In the Australian Chamber of Commerce and Industry (ACCI, 1991), information paper on extended shift arrangements it was stated that, 'extended driving hours leads to increased driver fatigue and thus reduced performance' (ACCI, 1991:6).

A study looking at driver fatigue in refinery operators found that 33.5% claimed to have fallen asleep at the wheel when driving to/from work. (Church, 1995). These incidents were noted to have occurred coming home from a standard 8 hour night shift and a 12 hour night shift. This indicates that employees driving home from night shift may be more at risk of falling asleep and/or having an accident. 67% of recent accidents or near accidents had occurred following an hour night shift and 12 hour night shift. From these results it is difficult to differentiate if the increase in driver fatigue was related to the number of hours worked or the fact that the operators were driving home at night.

Studies overseas have shown that there is a strong association between excessive hours of service and drug use for fatally injured truck drivers. Perhaps indicating that due to the extended working hours drivers are looking for mechanisms to assist them to maintain those hours.

## **WORK SITE**

Fatigue is not just an isolated problem experienced by truck drivers. A recent study conducted by the Australian Centre for Industrial Relations Research and Training (ACIRRT), 1997, at a Hunter Valley mine identified serious safety risks.

They concluded that 12 hour shifts increased workers' reports of;

- nodding off
- lapses in concentration

- tiredness
- frustration

Drivers of loaders, 'dozer' and truck drivers at the mine were more likely to report 'nodding off' and 'tiredness'

They also noted that the effects of shift duration and roster patterns were linked. (*Occupational Health Newsletter*, No.400, 1997. *OHM*, No. 109, 1997)

Most studies tend to support the view that safety is more likely to be compromised during night shift, particularly where night working is coupled with extended hours. Little information however is available on the likelihood of increased frequency of accidents occurring eg. during evening hours after an extended day.

At this stage, information from studies of 12 hour shifts does not tend to exclusively support the view that an extended day alone results in higher accident rates

## **OCCUPATIONAL HEALTH & SAFETY IMPLICATIONS**

The *Occupational Health & Safety Act 1983* states that employers must ensure the health, safety and welfare of their employees. To do this employers must;

'provide such information, instruction, training and supervision as may be necessary to ensure the health and safety at work of the employees' (OH&S Act, 1983, No.20)

Court cases throughout Australia have shown that employers can be held legally responsible for failing to exercise duty of care by not providing safe working systems. The following example illustrates fines that have been awarded against organisations for breaching this act in relation to driver fatigue accidents. A\$120,000 fine and manslaughter charges were sustained against a Victorian earth moving company. The case highlighted employer responsibility for unrealistic schedules and extended driving times (RTA, 1995).

With the introduction of 12 hour shifts employers must consider safety implications and exposure levels of employees to workplace hazards to ensure they are meeting their duty of care under the Occupational Health and Safety Act, 1983.

### **Safety Implications**

ACCI suggests that the critical occupational health & safety concern of increased working hours is a possible increase in worker fatigue and subsequent impairment of judgement resulting in increased accidents. All tasks need to be individually assessed to determine their suitability to be performed over prolonged periods

Most studies support the view that safety is likely to be compromised during the night shift, particularly where night shift is coupled with extended hours. (Spurgeon et al., 1997).

A study of data on work-related injuries among drivers in Brisbane found that an

"increased burden of injury for self-employed workers can be explained by the longer hours of exposure" (James, Papajcsik & Wyatt, 1993 cited in McFarlane, 1996)

However there is little information on whether the frequency of accidents is increased following an extended day. Data on employees working extended hours is not directly comparable to working 12 hour shifts as the expectation of an extended rest period is present. Data on accident rates associated specifically with long hours, excluding shift work are scarce (Spurgeon et al., 1997)

In terms of 12 hour work days and workplace safety there are a number of influencing factors that need further exploration; relevance of the time of day, importance of rest breaks, influence of the type of work on the nature of errors, the duration of the task and the shift rotation. These factors all need to be taken into consideration if we are to fully understand the implications of 12 hour work days.

### **Exposure Levels**

The implications of 12 hour working days on exposure to workplace hazards has been similarly overlooked. Occupational exposure levels eg chemical, physical agents, noise, vibration are designed to limit exposure levels below those likely to cause harm. These levels are based on an eight hour day, 40 hour week. Extended hours will result in greater exposure time and, therefore, it is essential that these exposure levels reflect a longer working day.

## **CONCLUSION**

From the literature reviewed above it could be concluded that fatigue does impact on driver performance and accounts for escalating organisational costs associated with accidents every year. Not to mention the high individual costs as well. However there is a lack of specific information available on whether fatigue is a direct result of extended working hours or a cumulation of other factors such as; time of day/night that driving is performed in, number of rest breaks, shift rotations etc.

Under the OH&S Act employers can be held responsible for failing to ensure the health and safety of their employees. As a result, additional research is required into workplace safety to conclusively determine the impact of 12 hour workdays on workplace safety. In particular, exposure to chemicals, vibration etc is urgently required considering the increasing trend toward extended working hours.

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