ROSTERING AND SHIFTWORK ARRANGEMENTS IN THE QUEENSLAND MINING INDUSTRY

Key Trends

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1 BACKGROUND

Working time arrangements in Australia have undergone rapid and structural change over the last decade and a half. The mining industry far and above leads the way in terms of the rapidity of the change and the seemingly unique nature of the specific arrangements that are emerging across sections of the industry. The coal and metalliferous sectors now have longer average weekly hours than any other industry, with the industry working on average almost one day longer per week than the all industry average. In addition, the emergence of compressed shift schedules and intensive shift schedules in both long distance commuting (LDC) sites and community sites has raised a raft of sensitive industrial, OHS, regulatory, social and methodological issues, many of which have generated much recent intense public debate. It is fair to state that many of these issues are still far from resolution and many gaps remain in our understanding of the impact and solutions associated with some of the following issues:

- The extent and nature of these changes
- The impact of these changes for workplace safety, health, social and family life
- The long term implications for the mining labour market in terms of the sustainability of these arrangement
- The current and future industry response to these issues
- The current and future policy and regulatory response to these issues
- The adequacy of and need for a comprehensive risk management approach at a workplace level[1].

This presentation seeks to redress just some of these gaps, focusing primarily on outlining the extent and nature of the changes. This paper will focus on:

- a presentation of some of the key results from the recent survey into shiftwork and rostering trends undertaken by ACIRRT earlier this year[2].
- Some brief speculation about what is driving these changes and the key implications are.

It will be argued that the rapidity and nature of the changes across the industry demands a more coordinated, systematic and pro-active response from all levels of the industry. Whilst support for managing this OHS issues specifically and exclusively at a workplace level has considerable support, it will be seen that clear processes and systems for doing so remain very underdeveloped. This raises some serious questions about the pace and efficacy of the current industry responses. Clearly these issues – as complex and multi-factorial as they are - can only be touched upon in this paper. This presentation is designed to "set the scene" for both the discussions to follow and for the panel discussions later in the conference.

Part 1: Summary of key trends in shiftwork and rostering

The Australian mining industry can be characterised as having shiftwork and rostering arrangements that are possibly unique within Australia.[3] The recent survey of shiftwork and rostering arrangements in the Australian mining industry[4] undertaken by ACIRRT this year revealed that compressed *and* extended shifts are now almost industry "norms" in parts of the industry and that intensive work schedules are also widespread. This is especially so in the metalliferous sector and WA, significant in Queensland and a significant and possibly expanding feature of the coal industry (although to a lesser extent in NSW). Also surprising was the emergence of these kinds of arrangements in both the underground and open-cut

[1] This issue was explored in detail at the recent NSW Minerals Council Conference where the feasibility of a risk management approach to shiftwork was presented and workshopped by the author

[2] This survey was funded principally by the ILO, with support from the Joint Coal Board (OHS Trust) and the respective NSW and Queensland mining departments. See Appendix 1 for an overview of the sample size

[3] It is possible that the extent and nature of the arrangements in Australia are unique internationally as well. The ILO does not retain detailed country figures on the mix of arrangements in mining by country and research on the shiftwork in mining settings (especially compressed and extended shifts) is very rare.

[4] This survey was of mine sites (coal and metalliferous) of more than 20 employees; we excluded the quarrying industry from this survey for cost reasons.

sectors of the industry. Some of the key trends from this survey are presented below in order to demonstrate the extent to which working time arrangements now depart from any traditional notion of a of "standard" ordinary working hours of 40 per week and 8 per day.

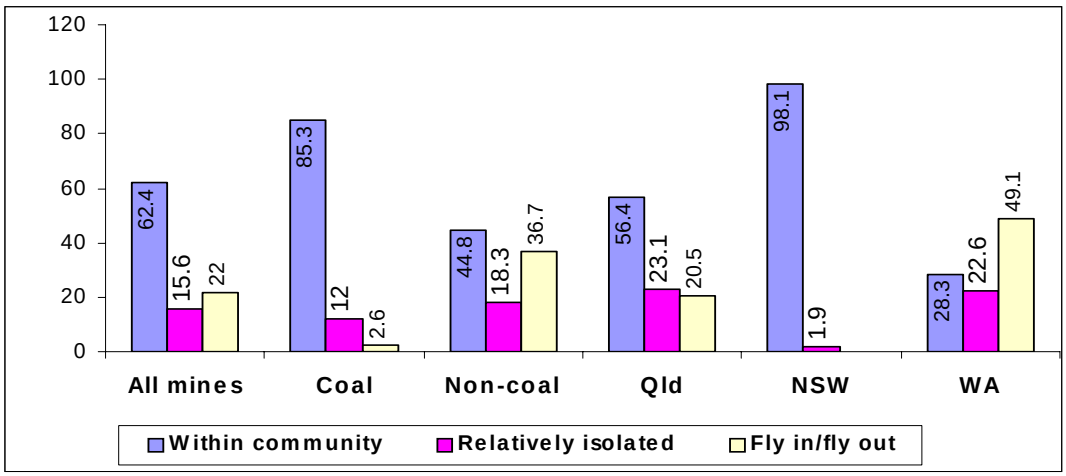
First we provide some basic demographic data of the coal and metalliferous mines we surveyed.

1.1 Mine location

The community setting of the mine was an important piece of information to know about the mine, since the specific working time arrangements will impact differently and will be more or less suited to particular mine settings. In addition, the move away from establishing local mining towns when new mines are established and the pros and cons of doing so has been subject of some public discussion and the impact of LDCs also the subject of some recent industry research (AMMA, 1998). Also, as we shall see, LDC sites are also the sites where the most intense compression of schedules takes place, raising a host of unresolved questions about lifestyle, safety and health as was highlighted in the recent QMC report of shiftwork (QMC 2000)

Our survey found that overall, 62 percent of mines are located in a settled mixed community, with 16 percent in relatively isolated mining towns and a further 22 percent using 'fly-in/fly-out' methods. Note in particular in Graph 1, the tendency for coal mines to be in a community setting, the large proportion of WA mines that are FIFO and the overwhelmingly community location of NSW mines. Queensland mines are a mixture, with the majority (56.4%) being located in a mixed community setting, 23% in isolated communities and a further 20% in LDC locations.

Graph 1: Location of all mine sites

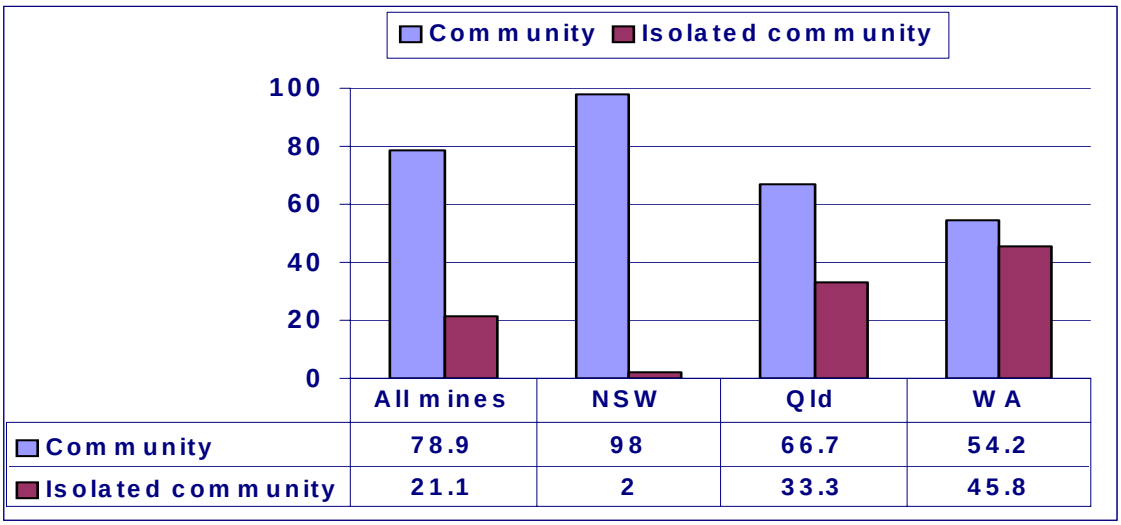


Source: Heiler, Pickersgill and Briggs 2000

The unique characteristics of LDC sites, their shiftwork arrangements, recuperative environment and living conditions means that they are arguably not as easily comparable with sites that are located in or near to settled communities. In community settings, whether isolated or not, employees travel to work on a daily basis and are required to undertake multiple functions associated with family, relationships, child care, domestic duties and social activities that can impact on their ability to prepare for and recuperate from their shifts.

In order to be able to better compare trends between states, we have also analysed data with LDC sites taken out. Part of the reason for doing this is so that the impact of the long periods of compressed shifts so characteristics of LDC sites, especially in WA, does not impact upon state comparisons. By controlling for LDCs we can more accurately compare the real differences between the states and better assess the significance of any differences, knowing that we are comparing like with like. Graph 2 shows the breakdown of community based sites by states.

Graph 2: Community and community isolated sites only



	All mines	NSW	Qld	WA
Community	78.9	98	66.7	54.2
Isolated community	21.1	2	33.3	45.8

Graph 2 shows that NSW stands out as having very few sites that are deemed as “isolated” communities, while Qld has around one third and WA almost half. It is important note however, that even though these sites are “isolated” they are still supported by communities of families, local businesses and other support services. They may be isolated, but they do not compare with the controlled environments of LDC sites.

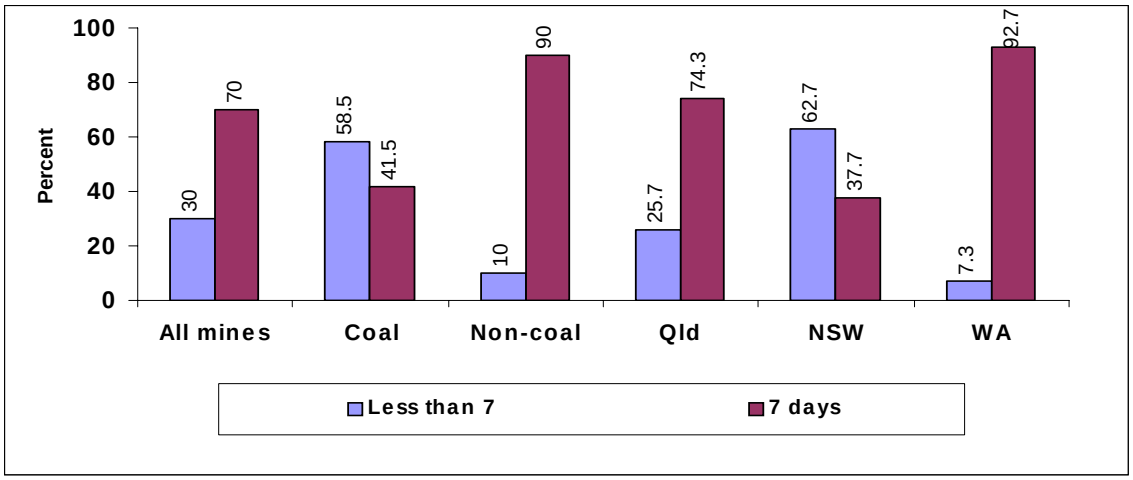
In summary, we see that the majority of sites in all states are located within communities, with around a half of WA and 20% of Qld sites being LDC sites.

1. 2 Operational days and hours of the mines

We would argue that the move towards continuous operation has been one of the drivers behind the emergence of these new rostering trends in mining. Operational times of mines also give a good indication of potential rostering arrangements. As mines move towards continuous operation of 7 days per week, so too is the incentive greater to move towards compressed arrangements (12 hour shifts), particularly (but not only) if sites are remote or isolated.

As can be seen in Graph 3, 70 percent of all Australian mines operate on a seven-day basis, with WA mines more likely to operate 7 days per week (92.7%). Queensland is just above the national average at 74.3% and NSW far less likely at 37.7%. The greater percentage of 7-day operations in WA is not purely a function of remoteness or isolation, since almost a half of WA mines are in a community setting of some kind. The non-coal sector is also far likelier to operate 7 days per week than coal.

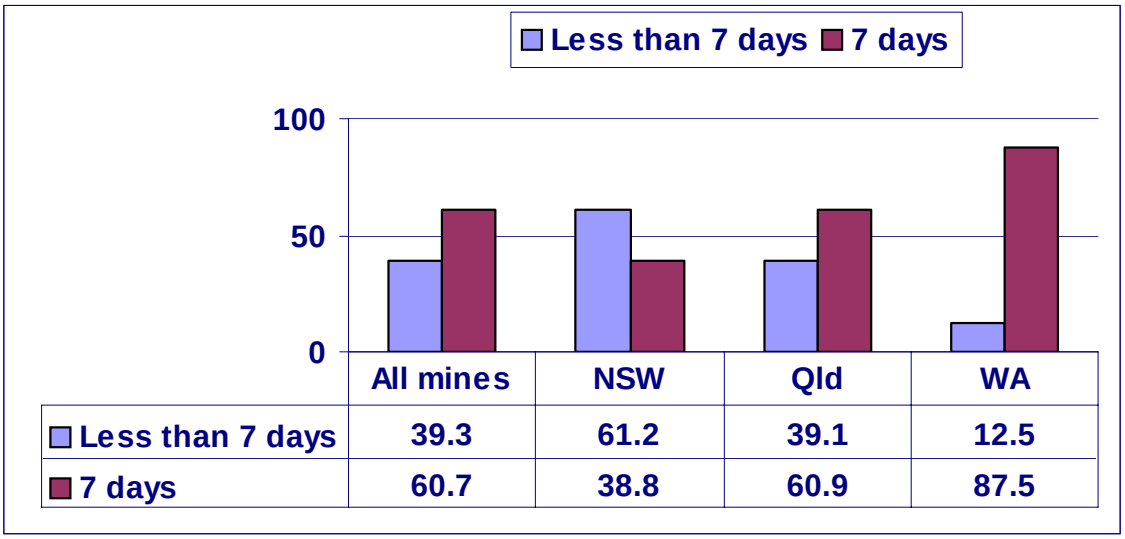
Graph 3: Days of operation: all sites



Source: Heiler, Pickersgill and Briggs 2000

If we remove the effect of the LDC sites, we see that the main state differences are maintained, but are not as stark as they were when LDC sites were included. We see that WA is still far likelier than NSW and Qld to operate 7 days per week, irrespective of the relative isolation of the mine.

Graph 4: days of operation: excluding LDC sites

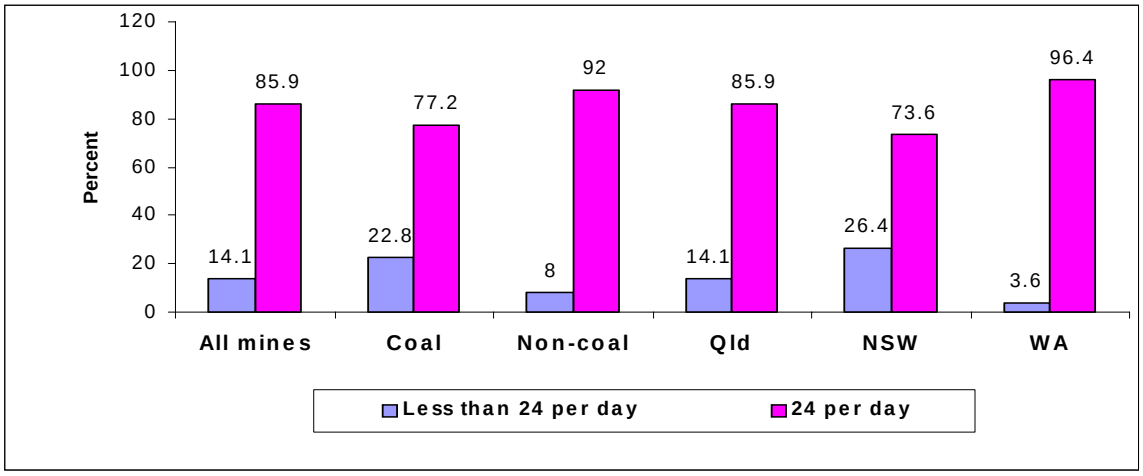


	All mines	NSW	Qld	WA
Less than 7 days	39.3	61.2	39.1	12.5
7 days	60.7	38.8	60.9	87.5

Hours of operation

The difference between the states and sectors for days of operation is sustained for daily hours of operation, although to a lesser degree. Overall, 86 percent of mines operate on a 24 hour basis. Of those mines *not working* on a 7 day/24 hour basis, the largest proportion are in the coal industry, where 53 percent of mines work less than 7 days a week and 21 percent work less than a twenty four hour day. WA again stands out as the most likely sector to operate 24 hours per day and Queensland conforms to the national average. Interestingly, while only 37.7% of NSW mines operate for 7 days per week, double this number operate 24 hours a day. This suggests that daily continuous operation does not necessarily imply 7 day per week operation, at least in NSW, whereas it appears to in WA and Queensland.

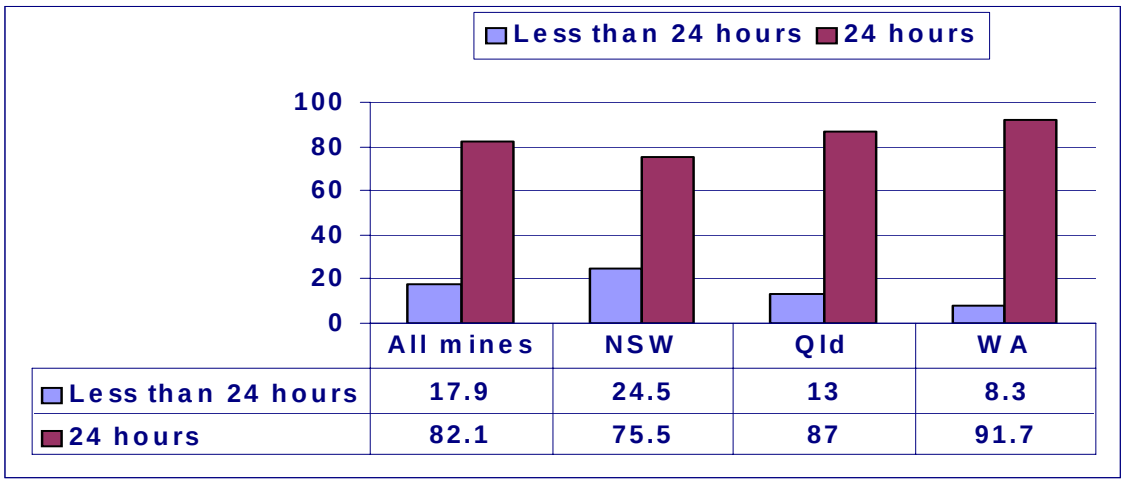
Graph 5: Operational hours: all mines



Source: Heiler, Pickersgill and Briggs 2000

Again we see that even when we remove the LDC sites from our analysis, the trends are maintained but the differences between the states not quite as stark.

Graph 6: Operational hours excluding LDC sites



	All mines	NSW	Qld	WA
Less than 24 hours	17.9	24.5	13	8.3
24 hours	82.1	75.5	87	91.7

Overall, our survey highlights the strong spread of continuous operation across the industry. Whilst the move to 24 hour/7 day per week operation is also becoming more common across other industries, mining, along health, and hospitality stands out as more likely to have continuous operation. Significant to note again is the extent to which WA departs from NSW, irrespective of the relative isolation of the sites. Queensland trends appear to be heading more towards the WA trends.

1. 3 Standard shift length and roster patterns

The complexity and multiplicity of rostering arrangements meant that we focused on collecting robust descriptive data about the main rosters at each site surveyed. We focused on collecting key descriptive data that would enable us to build up the major characteristics of rosters that we could then compare across sectors and states. We asked about standard shift length, rotation pattern number of consecutive minimum and maximum shifts, ordinary average hours of work and overtime practices. In this way, we

hoped to build up a descriptive picture of the most common rosters across a variety of mine types. We present some of this data below and, as before, we also control for relative isolation of the sites.

Standard shift length

Mines were asked to provide identical information about both production employees and maintenance employees[5]. As table 1 indicates, there is a high proportion of 12-hour shifts within mining in general, but also some differences between production employees and maintenance employees, with maintenance workers less likely to work 12 hour shifts. Overall, standard shifts of 8 or less are now nationally in the minority.

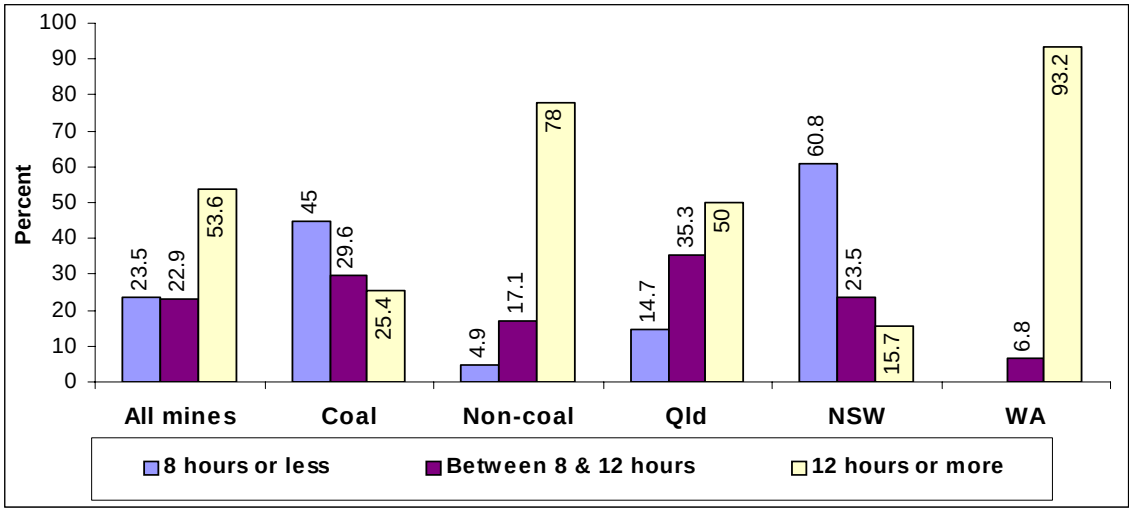
Table 1 Standard shift lengths for production and maintenance employees (in percentages – all respondents, all mines)

Standard Shift Length In Hours	Production Employees	Maintenance Employees
8hrs or less	23.5	28.9
between 8 & 10	10.5	12.1
between 10 and 12	12.4	14.1
12hrs	53.6	45.0
Totals	100%	100%

Source: Heiler, Pickersgill and Briggs 2000

However, as graphs 7 and 8 show, there are significant sectoral and state differences, which are stronger than those between production and maintenance employees.

Graph 7: Standard shift length for production areas: all mines



Source: Heiler, Pickersgill and Briggs 2000

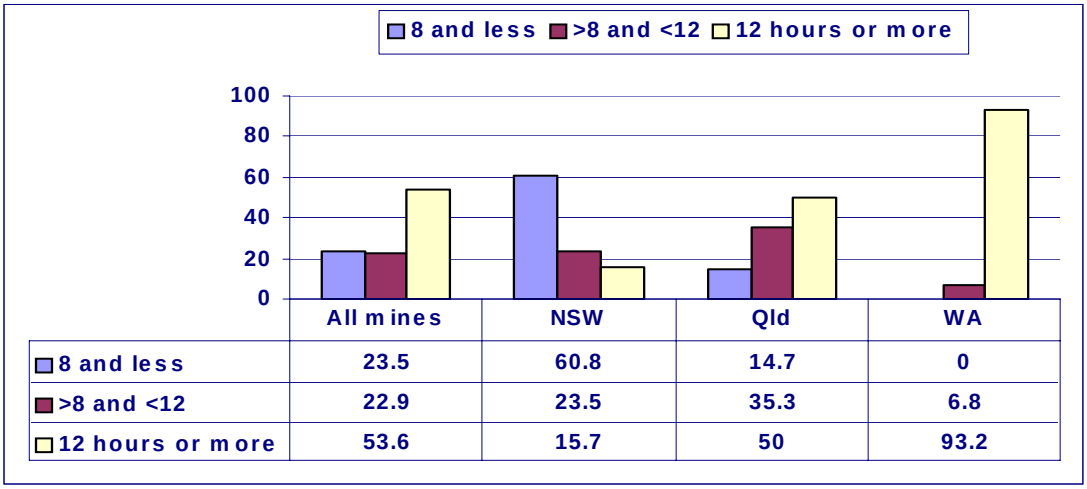
Note in particular the much higher proportion of shifts longer than 8 hours in the non-coal area and in Western Australia and Queensland. In WA we can see that some form of twelve hour shift arrangement predominates in the production area (93%), while in NSW at 15.7%, and in the coal industry as a whole (25.4%), the opposite is true. On average, Queensland (at 50%) lies between the Western Australian and New South Wales extremes, with Queensland virtually a mirror image of NSW with respect to the distribution of shift patterns. With respect to Queensland, it is important to note that 85.3% of sites have a standard shift length in excess of 8, compared to NSW where this figure is 39.3%. WA, by comparison, has no sites with 8 hour shifts as their most common shift in the production area.

[5] We provide data primarily on production employees

Although coal mining provides over 50 percent of the number of Queensland mines, there is no difference between the frequency of 12 hour shifts in Queensland coal or metalliferous mines. . The difference between Queensland and Western Australia is therefore *not* a function of the high proportion of coal mines in the state. The 'coal industry difference' that appears in the data really reflects the *NSW* coal industry. It is therefore not a function of differences between coal and non-coal in general, but between NSW coal and other sectors.

By controlling for LDC sites, we also assess whether the greater tendency for WA and Qld to have 12 hour shifts is also a function of a greater proportion of these sites. Graph 8 shows again that the basic trends hold and that compressed shift arrangements and the differences between the states hold irrespective of whether the sites are LDC sites or located within communities. In particular, note that WA has 93% of sites based in some form of community working 12 hour shifts as the standard shift length in production. Queensland as well has in excess of 80% of sites with shifts in excess of 8 hours

Graph 8: Standard shift length for production areas: excluding LDC sites



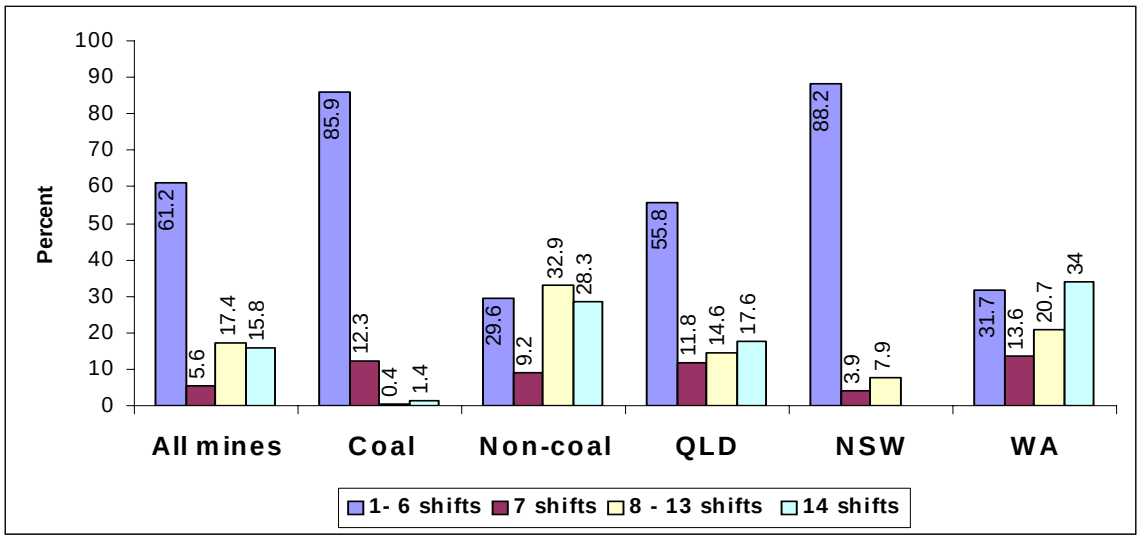
	All mines	NSW	Qld	WA
8 and less	23.5	60.8	14.7	0
>8 and <12	22.9	23.5	35.3	6.8
12 hours or more	53.6	15.7	50	93.2

Number of Consecutive Shifts

Whilst shift length is one important aspect of the roster, the way that shifts are actually worked, and the pattern of the shifts is highly significant for OHS, family and social life. The way shifts are compressed (or extended) are important components of roster design and the number of maximum consecutive shifts across a roster cycle can give us a good indication of how they are worked.

In terms of shift and roster patterns the major differences are again primarily sectoral and state. As graph 9 shows, the trend towards multiple consecutive shifts is most marked in the non-coal area and in Western Australia. In coal mining, only between 1 and 2 percent of sites work more than seven shifts in a row, with between 86 percent (production) to 94 percent (maintenance) working 5-6 days in a row.

Graph 9: Maximum number of consecutive shifts worked: production areas

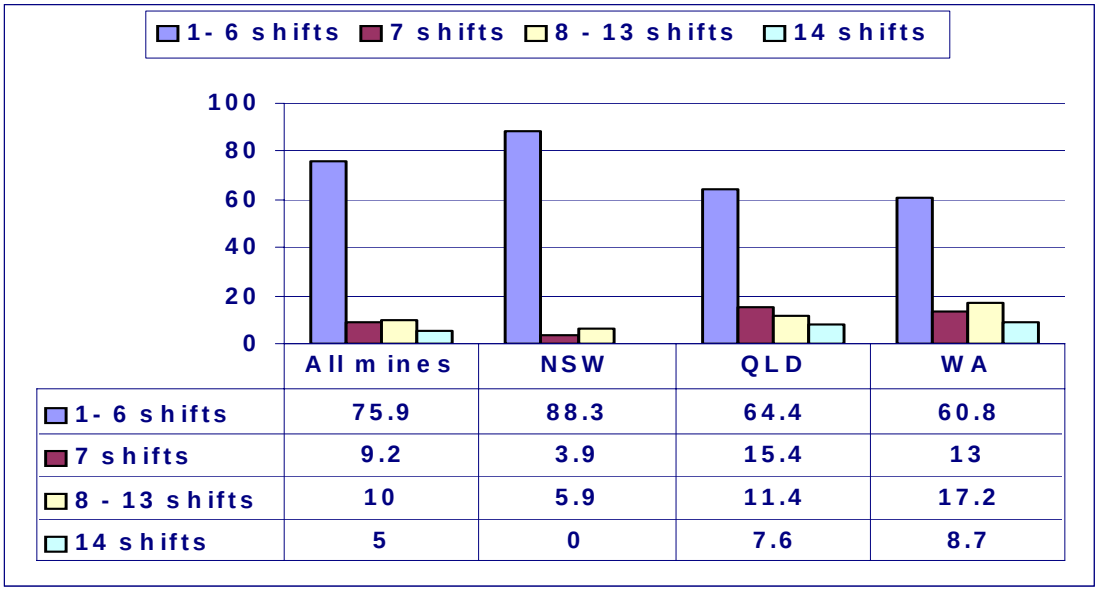


Source: Heiler, Pickersgill and Briggs 2000

In the non-coal sector, 28 percent work 14 shifts in a row and in Western Australia it rises to over a third (34%). The figure for WA is significant since we saw previously that 93% of sites in production work twelve-hour shifts. For Queensland, half of the sites reported standard 12 hour shifts. The difference between Queensland and Western Australia is not attributable to proportion of 'fly-in/fly-out' operations in WA. Even eliminating Queensland long distance commuting sites, WA has proportionally more sites operating 12 hour shifts and with a greater number of consecutive shifts, with Queensland coal mines being more likely to have least consecutive shifts (6 of 20 or 33%) operating a 3 or 4 day roster.

If we remove LDC sites from our analysis we see that whilst 12 hour shifts are not a function of the relative isolation of the mine, the long and intense periods of compression appears in part to be. Graph 10 shows that community based sites are less likely in WA and Qld to have the long periods of compression that we saw in Graph 9.

Graph 10: Maximum consecutive shifts: excluding LDC sites



	All mines	NSW	QLD	WA
1- 6 shifts	75.9	88.3	64.4	60.8
7 shifts	9.2	3.9	15.4	13
8 - 13 shifts	10	5.9	11.4	17.2
14 shifts	5	0	7.6	8.7

Nonetheless, there are still long periods of compression evident in some states, particularly surprising for community based mines. For example, in Queensland we see that one third of sites have 7 shifts or more consecutively at least once across their roster cycle. In WA this figure is 38.9% while in NSW this is only 9.8%. In WA this is especially surprising given that we know that over 90% of sites have standard shift lengths of 12.

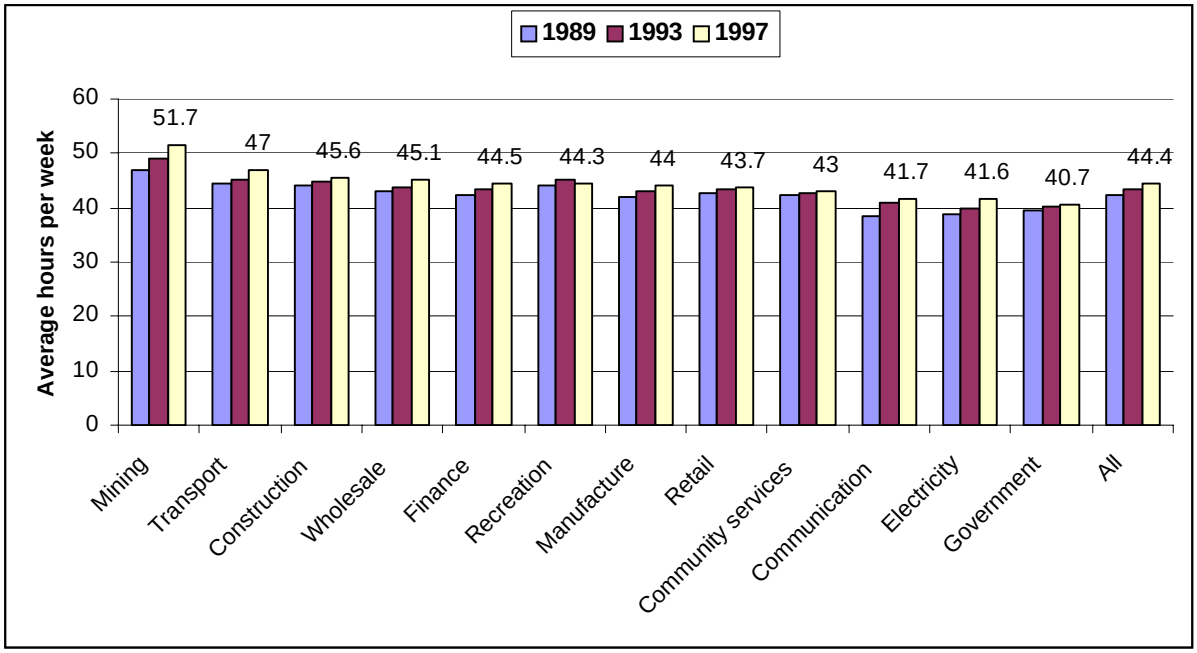
The reasons why sites are choosing to work these shifts in this manner is arguably explicable with LDC sites, but less so with respect to community based sites.

Ordinary Hours of Work

We know from other data that average hours of work have increased in Australia in the last fifteen years. Recent unpublished ABS data revealed that average weekly hours across the mining industry were 51.7 in 1997, up from around 45 hours per week in 1989; in 1997 the all industry average was 44.4. We also know that the mining industry has the longest ordinary and total hours profile of all industries with a large proportion of employees (20%) working very long average hours of in excess of 60 per week . Changes in hours of work in the mining industry are presented below using data from ABS. This is presented as a way of both contextualising the trends we found and to locate the industry against trends in other industries.

First we look at how average hours of work have increased across industries since 1989 and how mining compares. It shows that mining has experienced the greatest increase in hours compared to all other industries over this period.

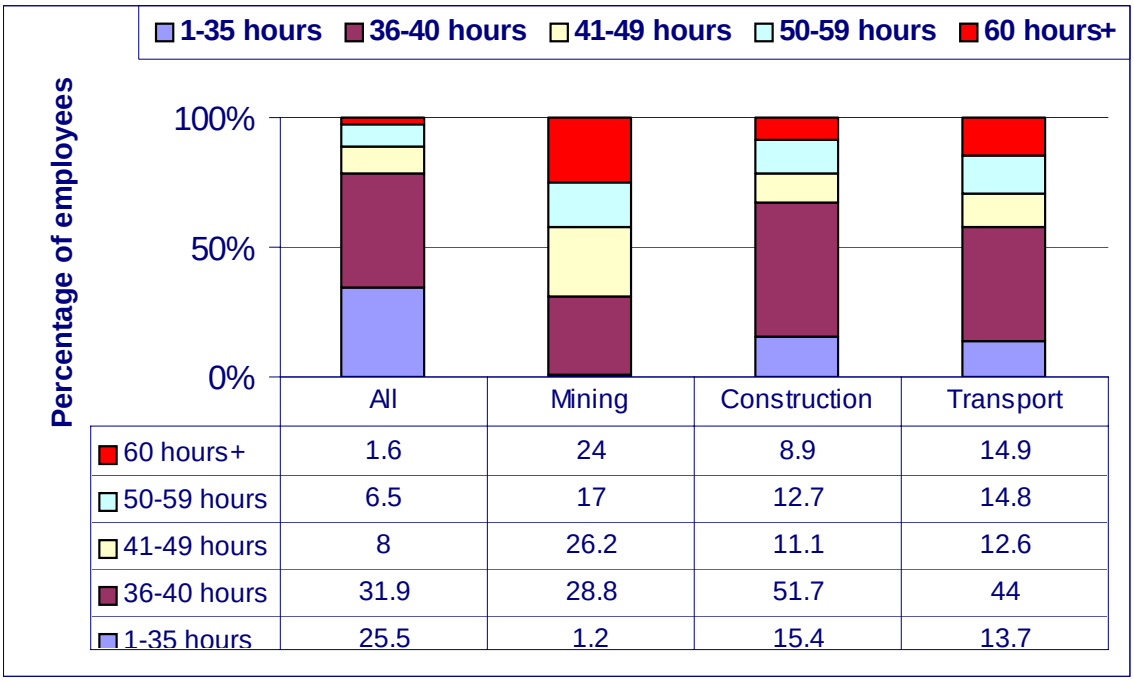
Figure 1: Average hours of work all industries, Australia 1989-1997



Source: ABS unpublished data

However, these average increases mask a more complex sectoral distributional difference within the industry. Figure 2 below shows that not only are average hours in mining longer, but the distribution of hours also sets the industry apart from others. We see that mining has a large percentage of employees (40%) clustered around very long hours of in excess of 50 per week. Even when compared to other related industries such as construction and transport, mining sits apart in terms of the concentration of employees working well in excess of 40 per week.

Figure 2: Distribution of hours: mining and selected industries 1997



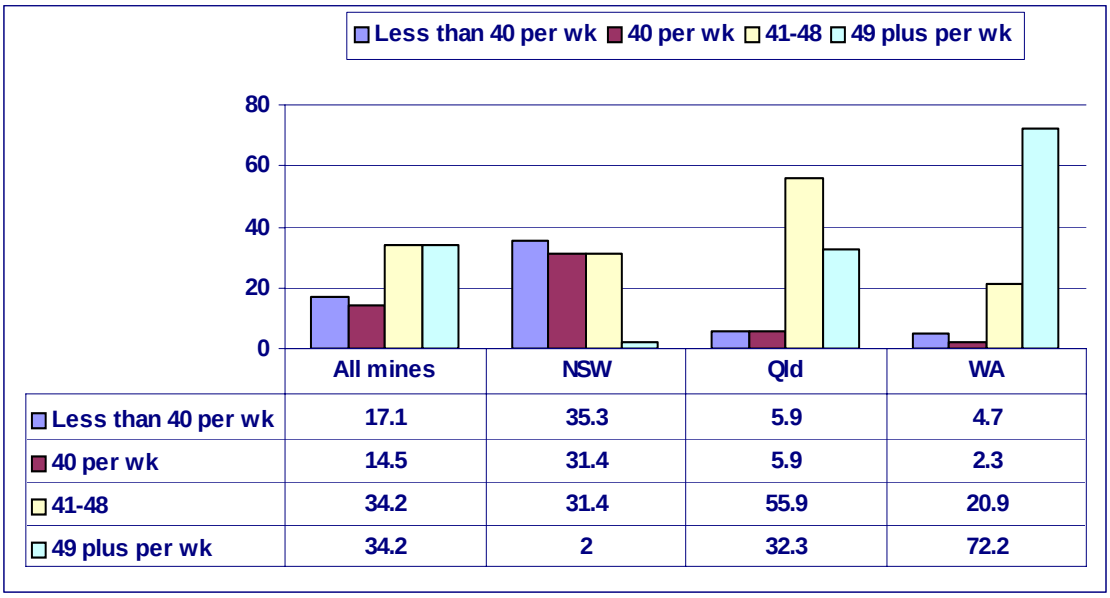
	All	Mining	Construction	Transport
60 hours+	1.6	24	8.9	14.9
50-59 hours	6.5	17	12.7	14.8
41-49 hours	8	26.2	11.1	12.6
36-40 hours	31.9	28.8	51.7	44
1-35 hours	25.5	1.2	15.4	13.7

Source: Unpublished ABS data

Our survey confirms these broad aggregate trends, showing that over 60% of all sites have average ordinary hours (excluding overtime) well in excess of forty per week and over one third working in excess of 49 per week. The average hours of work over a roster cycle is a significant feature of current compressed and extended schedules, since, at least in theory, compressed shifts should have an hours profile no longer than a shift schedule based on 8 hours shift duration. This is because over a roster cycle, hours are meant to average within a "standard" range. Thus longer days are worked, but fewer of them. Our survey shows that sectors of the mining industry is seeing the emergence of not compressed by *intensive* work schedules – long days combined with long and non-standard average hours. This is confirmed by data we presented earlier showing a long hours regime within the industry.

Graph 11 shows the strong state differences in ordinary hours of work, with WA and to a lesser extent Queensland being far likelier than NSW to have large proportions of their sites working long average ordinary hours. Indeed, WA has over 70% of sites where hours in excess of 49 are worked on average. Further analysis reveals that in WA 17% work in excess of 57 hours per week while in Queensland this figure is 7%.

Graph 11: Ordinary hours of work in production: all sites

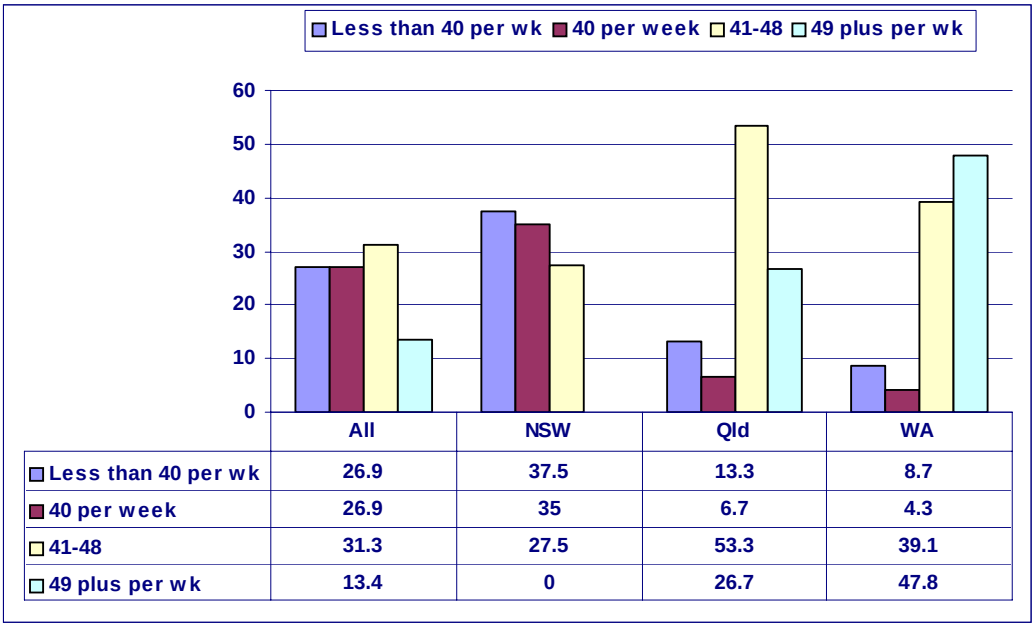


	All mines	NSW	Qld	WA
Less than 40 per wk	17.1	35.3	5.9	4.7
40 per wk	14.5	31.4	5.9	2.3
41-48	34.2	31.4	55.9	20.9
49 plus per wk	34.2	2	32.3	72.2

We can tease out the extent to which long hours are more or less associated with the isolation of the mine by controlling for LDC sites. This is important since some commentators argue that long hours are primarily associated with isolated sites where employees work these hours rather than spend time away from families.

Graph 12 shows that in WA in particular, this appears to be partly the case, where the large proportion working in excess of 49 hours per week falls from over 70% to less than 50% of sites.

Graph 12: Ordinary hours of work excluding LDC sites



	All	NSW	Qld	WA
Less than 40 per wk	26.9	37.5	13.3	8.7
40 per week	26.9	35	6.7	4.3
41-48	31.3	27.5	53.3	39.1
49 plus per wk	13.4	0	26.7	47.8

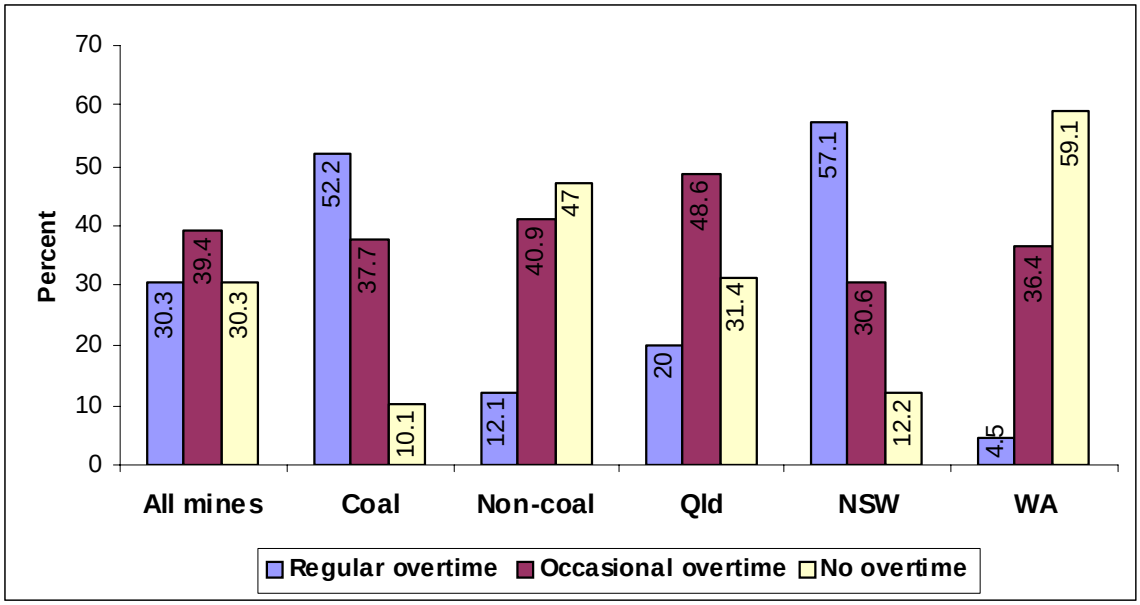
In summary we have seen that an understanding of rostering practices has to be based not just on an understanding of shift length alone, but shift length *combined with* knowing how many days consecutively they are being worked *combined with* average and total hours. This information is vital for an adequate assessment of OHS issues including the effects of fatigue

1.4: Overtime arrangements

However, merely assessing ordinary *average* hours does not provide us with the complete picture, since overtime is routinely worked across most sector of the industry. We see that not only are average ordinary hours long, but that overtime is also widespread.

Overall, approximately 70% of both production and maintenance employees worked overtime on either a regular or occasional basis. (Table 5.1). This overtime *is in addition to any mandatory overtime* already absorbed into standard hours as a result of an industrial award, agreement or individual contract. The inclusion of mandatory overtime is also a common feature of twelve hour shift arrangements, although is more common where 8 hour shifts prevail. This may explain why WA sites are less likely to be working *additional* overtime. Figure 5.1 also shows that coal mines are much more likely to work regular overtime than the non-coal sector. This is because their ordinary average hours are lower and these employees are compensated separately for overtime worked.

Graph 13: Overtime worked: production areas only – all sites



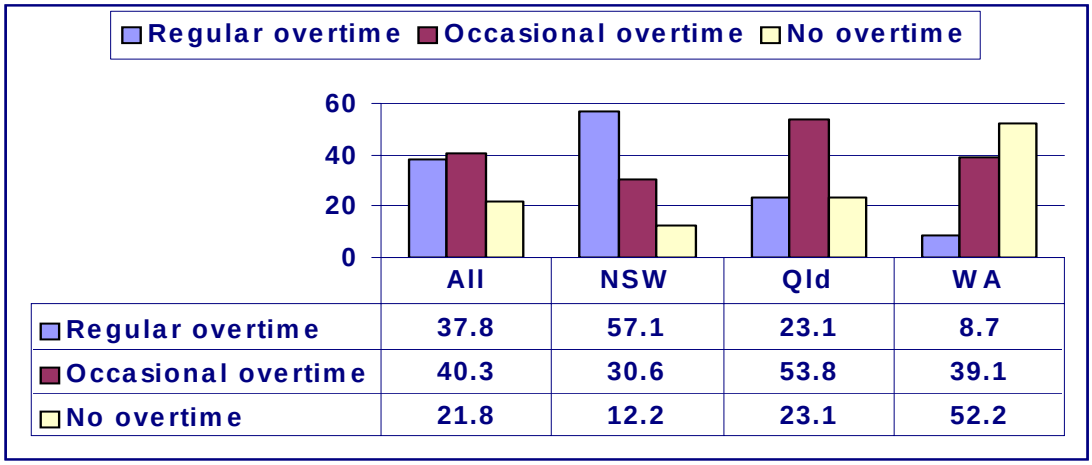
Source: Heiler, Pickersgill and Briggs 2000

Graph 13 shows that regular overtime is far more common in NSW and in coal than in WA, whilst occasional overtime is common across most sectors and states. The working of additional overtime is likely to be more prevalent in 8 hours sites, since the transition to compressed work schedules usually collapses overtime into the standard shift and it is not paid or recorded separately.

If we examine overtime trends in community settings we see that the basic trends are maintained, with WA still less likely to undertake regular paid overtime than any other state. Another possible explanation for the trends in WA is that there is a far greater tendency for employees in WA to work under contracts of employment where overtime is not paid, or where an agreed amount of overtime is collapsed into an annualised salary package.

What is perhaps surprising is the number of 12 hour sites in both WA and Queensland where overtime is worked. What is surprising about this is that one of the design principles associated with compressed shift schedules is that they should not routinely be extended by overtime (Wallace, 1998).

Graph 14: Overtime worked: production areas only – excluding LDC sites

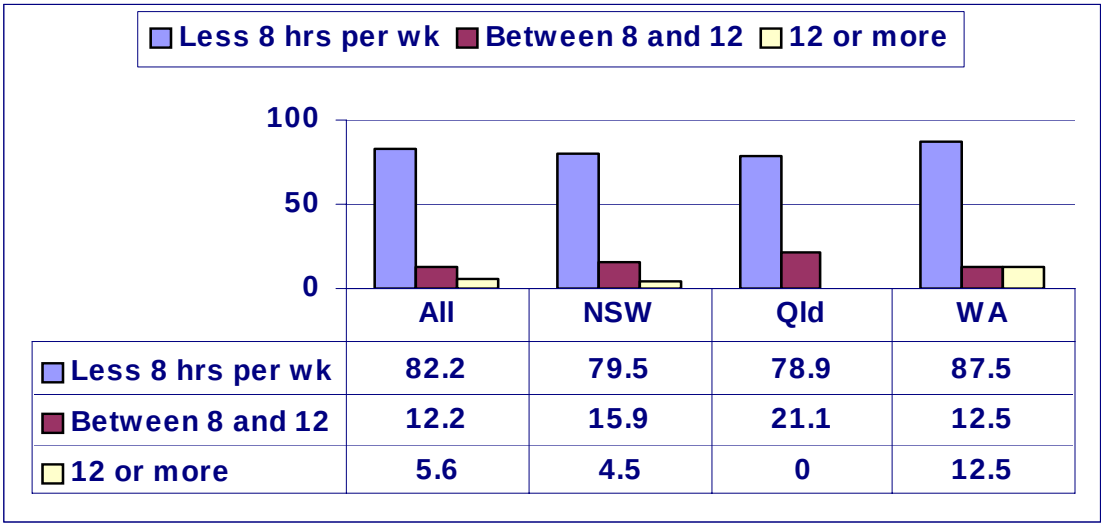


	All	NSW	Qld	WA
Regular overtime	37.8	57.1	23.1	8.7
Occasional overtime	40.3	30.6	53.8	39.1
No overtime	21.8	12.2	23.1	52.2

How much overtime is worked and how is it worked?

The majority of sites regularly work less than 8 hours per week, with around 20% of sites working more then 8 per week.

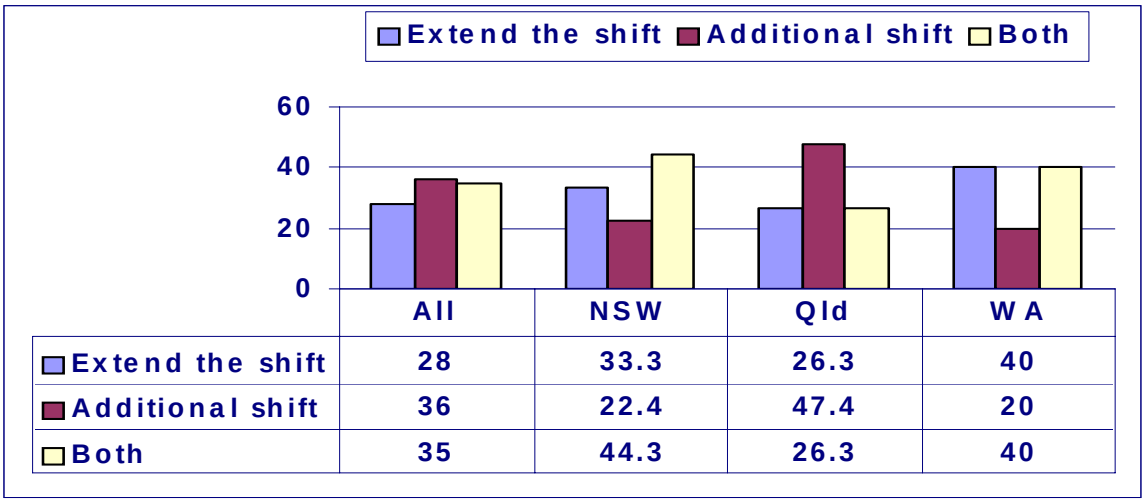
Graph 15 Amount of overtime usually worked in production: excluding LDC sites



	All	NSW	Qld	WA
Less 8 hrs per wk	82.2	79.5	78.9	87.5
Between 8 and 12	12.2	15.9	21.1	12.5
12 or more	5.6	4.5	0	12.5

However, what is perhaps surprising is the *way* such overtime is worked. Graph 16 below outlines that overtime is worked both by working additional shifts and by extending the shift. We must keep in mind that the mining industry is already a long hours regime industry; overtime levels therefore require close and careful monitoring.

Graph 16: How overtime is worked



	All	NSW	Qld	WA
Extend the shift	28	33.3	26.3	40
Additional shift	36	22.4	47.4	20
Both	35	44.3	26.3	40

In this section we have seen that the results from our survey with respect to patterns in hours worked conforms to other sectoral data from the ABS. These trends show that the emergence of compressed and extended shifts is occurring against the backdrop of long and increasing hours in the industry. The key concern that this raises is that the emerging norm in some parts of the industry is not for just compressed schedules, but for long, intensive schedules. The combination of long days and long average hours raises a raft of OHS and social issues and concerns.

Part 2: Key Implications

The implications associated with these changes and trends are potentially highly significant and encompass issues associated with: occupational health and safety, the effects of shiftwork related fatigue (organisational and non-work-related fatigue), the impact on the mining labour market, the effects on family and community life and efficiency and productivity issues. Obviously these cannot all be canvassed here and we note just a few of them.

However, there is an acknowledged need to move beyond what can be simplistic arguments about the merits of standard shift length (Heiler, 2000). In particular, the 8 vs 12 debate is now a largely unhelpful one and analyses that focus primarily on trying to "prove" the inferiority or superiority of one shift system over another will contribute little to our understanding of the real hazards associated with shiftwork. Whilst there will be specific hazards associated with compressed schedules, there will also be problems associated with extended work schedules, irrespective of whether they are worked under an 8 hour or 12 hour shift regime. ***However, this does not make the issue of shift length irrelevant.***

There are some commentators who continue to either characterise the debate in terms of 8s vs 12s or who try to assert that shift length is irrelevant since it is only one of a range of factors to be assessed and therefore not of primary concern. This is misleading. Simply because we acknowledge shift length as not the *only* factor involved with whether or not rosters are risk free, this does not mean that shift length is not a highly significant, if not critical factor. Indeed, the combination of extended days and extended weekly hours is very much "uncharted waters" in terms of the fatigue and safety effects, especially within a mining environment. For example the extra preparation and recuperation required under compressed shifts is now becoming widely

understood and this will of course have implications for the shift design and for ensuring that both shift length and total hours of work are managed very carefully. Similarly, a roster that does not allow time for biological and social preparation and recuperation due to extended work days, or which have long periods of compression in arduous or difficult environments (like hot, humid underground environments) is potentially problematic.

Indeed, the unknown effects of extended and intensive work schedules in mining was an issue recognised by the recent report into shiftwork prepared by the QMC (QMC, 2000) which was otherwise strongly supportive of the safety record of 12 hour shifts. Whilst this report made strong claims about 12 hour shifts being associated with "an improvement in safety standards in the industry" (p28), this claim is somewhat premature. The risks associated with shiftwork and rosters are multi-factorial and complex and cannot be dismissed (or confirmed) on the basis of limited and inadequate data. Far greater caution is required at this point in time.

Whilst there will continue to be debates about the extent to which particular rosters and their design exacerbate or moderate the impact of shift work and night work in particular, these debates do exist to some extent on the margins. There is widespread acceptance that shiftwork is a profound biological and social disruptor that creates hazards and problems associated with the following:

- Individual health and psycho-social well-being
- Work and non-work-related fatigue
- Workplace safety
- Family, social and community disruption

The principle cause for concern associated with shiftwork is that associated with fatigue. As Fletcher (1999) pointed out, a useful way of understanding fatigue is to see it as both work-related and non-work related. In this way we can differentiate and see the relationship between fatigue generated primarily through the roster and its design, and that generated by non-work related activities, sleep disorders and poor individual coping strategies. Within a mining environment the reason why fatigue poses such a hazard is due to its potential to impair performance in a one or a number of ways, including the following (Heiler et al, 2000):

- shown to have a similar performance impairment effect as alcohol (Dawson and Reid, 1997)
- reduced and variable levels of alertness/concentration
- slower response times and reduced physiological arousal
- impaired hand-eye co-ordination
- reduced cognitive function and decision-making
- loss of situational awareness
- higher error rate, reduced margins for error
- accuracy can be sacrificed for speed
- failure to recognise existence of a problem
- performance impairment more likely where work is repetitive, mundane and/or requiring sustained vigilance
- reduced attention to subsidiary task requirement
- shift to less demanding information processing
- increased stress, frustration, irritability.
- more control = less performance decrement

However, what we are yet to establish is exactly how these generic risks actually translate in a mining environment and how they affect performance on tasks and processes specific to different mining processes.

Whilst we will not examine the other hazards here, suffice to state that there are concerns about the possible relationship between performance impairment and increased risks of errors, incidents and accidents. In addition, the relationship between non-work factors such as the

adequacy of the domestic "recuperative" environment, domestic and marital pressures, family dysfunction and ability to prepare for and recuperate from shiftwork are all considered important.

A preferred workplace framework for understanding responsibilities associated with shiftwork[6]

This insertion of fatigue as part of "fitness for duty" in both Queensland and NSW requires some brief comment. Increasingly, the issue of fatigue management is being characterised or contained with the broader issue of individual "fitness for duty". Fitness for duty contains factors such as drugs and alcohol, stress, mental health, physical health and, increasingly fatigue. There is much support for this approach among peak employer and union bodies who advocate the management of shiftwork and fatigue within a risk assessment approach, but locate fatigue primarily as an individual fitness for duty issue.

It is arguable that characterising fatigue as primarily an issue associated with individual employee fitness for duty (in terms mainly of preparation for and recuperation from shiftwork) is problematic in a number of ways. First, as we have outlined, and will outline in more detail, the hazards associated with shiftwork are multi-factorial and shaped by both organisational *and* individual factors. Whilst fitness for work (in terms of preparation for and recuperation from shiftwork) is certainly an important responsibility of employees, it may not necessarily be completely within their control (unlike the decision to use drugs and alcohol). Indeed, it is just as important to ensure that the roster is designed well so that fitness for work is actually possible. For example, an extended, intensive schedule, combined with long commuting times may not allow for the preparation and recuperation required for the employee to be fit for duty. Second, to focus primarily on employee fitness for duty is to incorrectly locate the primary responsibility for managing fatigue and other health and social problems primarily within this individual framework. Such an approach carries the risk of subsuming shift design and work design factors beneath individual strategies, an approach that would effectively ignore or fail to manage many of the key components of work design and shift design that generate fatigue.

Instead, we can more effectively locate the management of fatigue in its organisational setting, as a *shared responsibility* where employers, primary contractors, contractors and employees all have responsibilities, some of which overlap, but some of which do not.

By seeing fatigue in both organisational/work design and non work/lifestyle-related terms we have a better opportunity to tease out what these responsibilities are and where they predominantly lie.

Drawing on some of the information collected during both our previous site assessment work in Queensland, WA and NSW and the site visits undertaken in a recent project supported by the NSW Minerals Council, we have tried to identify what and where these responsibilities lie. Obviously there are areas of overlap as there are areas where the responsibilities are unclear. However, it shows that the management of fatigue and other aspects of shiftwork are more complex than characterising them primarily in terms of individual "fitness for duty". Fitness for duty requires individual responsibility but also the development and maintenance of a work environment and system which actually makes it possible and practicable for employees to prepare themselves adequately. *This is overwhelmingly an employer responsibil*ity

By way of conclusion the following framework is presented as a way of locating and delineating the various responsibilities that the workplace parties. One way of beginning to think about how to assess what the implications are and where the principle responsibilities lie is to accept that, irrespective of shift length, there is a **shared responsibility** to safety and equitably manage shiftwork arrangements at mining workplaces.

[6] This section of the paper draws heavily on a paper presented by the author at the recent NSW Minerals Council OHS Conference Terrigal in July 2000.

The following characterises one way of thinking about the shared responsibilities

Table 7: Shiftwork and fatigue: an example of principle areas of responsibility

Work design factors (principle responsibility employer)	**Non-work factors (principle responsibility employee)**
Risk management ➢ Work systems ➢ Fatigue ➢ Fitness for duty	**Shiftwork information and education** ➢ Apply information and education to management of own fatigue and improved personal management
Shift work information and education ➢ Ensure delivery of current, appropriate shiftwork, fatigue, safety and lifestyle education, sleep disorders	
Shift design: ➢ shift length, start time, number of consecutive shifts, actual hours, commuting time, work breaks, rest breaks, meal breaks etc	**Preparation/recuperation for the shifts** ➢ ensure that there is appropriate preparation for and recuperation for the shift ➢ improve lifestyle adjustment (diet, exercise sleeping strategies) ➢ ensure non-work activities (leisure or additional work) does not interfere with recuperation ➢ management of any sleep disorder
Shift implementation: ➢ total hours, amount of overtime and scheduling of overtime ➢ scheduling of rest breaks, meal breaks	
Recuperative environment (on site) ➢ LDC sites ensure optimum environment ➢ Isolated sites (?) ➢ Be aware of any obstacles to recuperation in domestic situation	**Recuperative environment (at home)** ➢ Ensure optimum recuperative environment
Work design and tasks ➢ Assessment of appropriateness of and risks associated with work tasks (especially in underground settings) ➢ Scheduling of tasks ➢ Strategies to minimise fatigue at work	➢ Be involved in monitoring and minimise fatigue at work ➢ Be involved in assessing risks associated with particular work tasks
Workplace environment ➢ Assessment of workplace environment (eg visibility, heat, humidity, dust, noise) ➢ Adjustment of exposure standards	Be aware of risks associated with workplace environment
Contractor hours ➢ Monitor contractor ➢ Ensure fitness for duty of contractors	
Commuting to and from work	Commuting from own place of residence after work (eg for leisure)

Design of roster that allows for carer/family responsibilities	
Key legislation for NSW ➢ OHS Act 1987 (general duties) ➢ Mines Inspection General Rule 2000 (fitness for duty and management of fatigue) ➢ Anti-discrimination Act 1984 (recent amendment related to carers responsibilities) WRA 1996 (workers with family responsibilities	

Source: Heiler, 2000 (unpublished working paper, ACIRRT)

Conclusions

This presentation has aimed to "set the scene" for more detailed discussions of the implications associated with changes in rostering arrangements in the mining industry in Queensland. Our data has demonstrated that changes across the industry have been both widespread and structural, changing profoundly the way that hours of work are structured and implemented. The totality of these arrangements and the combination of both long days and long average hours is creating a convergence of factors at workplace level that demands a pro-active response from the industry. The paper also calls for the location of any solution and initiatives within a framework that strongly acknowledges the management of OHS hazards and risks associated with these arrangements as a shared one.

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Appendix 1

Survey population

The population for the survey was all operational coal and metalliferous mines of more than 20 employees. The primary unit of analysis was the *mine site*, rather than employees. We collected information on the roster that *most employees* at that site, in production and maintenance areas, usually worked. This meant that we could draw conclusions about the most common arrangement for the majority of employees across all mine sites. This gives us a better overview than focusing, for example, on describing all rosters, since only a small number of employees may work a particular roster.

Reluctantly, we excluded quarrying operations and operations such as minerals sand mining. The survey frame was drawn from the 1999 *Australian General Mining Year Book* and the 1999 *Australian Coal Year Book*. All mines classed as operational in these Yearbooks were included. An initial telephone screening was conducted to eliminate non-operational mines and to confirm contact details. Using a commercial survey company, we contacted 217 mines nationally and secured 180 completed and useable surveys. There were 13 refusals, 7 confirmed as closed, and a further 14 that could not be contacted. Excluding the closures this represents an 85.7% response rate. Of those we were able to contact (196 mines) we secured a 93% response. In either case, this is an extremely robust response from an industry, which publicly at least, finds the issue of shift arrangements a sensitive one.