FINAL REPORT

Work Breaks and Rest Periods

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Project Manager

Carmel Bofinger
Manager, Health Projects
Minerals Industry Safety and Health Centre
The University of Queensland

Ph 07 3346 9749
Fax 07 3365 8361
Email c.bofinger@mishc.uq.edu.au

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EXECUTIVE SUMMARY

This project, funded by the New South Wales Coal Services Health and Safety Trust, was designed to develop and apply a model to examine work breaks and rest periods in mining operations that leads to ensuring the benefits associated with work breaks are optimised. It complements much of the work that has been completed in examining shift rosters.

A targeted literature review was performed based on information collected from a wide variety of sources. Despite the concerns expressed about the effect of fatigue and rest on the rate of production and safety, scientific research on this topic has generally only proposed breaks schedules for very specific, repetitive tasks or practitioners have resorted to general statements about the desirability of rest periods. As such this previous work cannot be directly applied to determine optimal rest patterns in the majority of mining tasks.

The objective of the original proposal was to ascertain how quantity of work, quality of work and subjective fatigue alter with time on task and scheduling and length of breaks and to develop guidelines for determining the most appropriate break patterns. This objective was significantly modified based on the findings of the literature review and initial data collection. The original four stages proposed for the project were refined and partially modified during the project.

The Work Effectiveness Model (WEM) was developed using information collected during the project to allow evaluation of the effectiveness and efficiencies of current work practices. The WEM involved establishing the baseline of safe operation and the NORM of operations on site ie how work is actually performed rather than what is required in procedures. The NORM of operations may comply with the baseline or be significantly different. Once this NORM was determined, the cost and likelihood of variations to the NORM was assessed and the resulting work effectiveness outlined. The project used the high fatigue risk task of haul truck driving to apply and refine the WEM.

Information from 20 mines was collected including documentation, interviews with management and operators and a questionnaire covering factors affecting work breaks. Lost time injury (LTI) and high potential incident (HPI) data were also analysed. The results from the field study were used to assess how the work breaks affect the WEM and where improvements are possible.

The factors affecting the NORM fall under physical demands, mental demands, work environment and skills base. These factors also influence the fatigue associated with work. Unfortunately fatigue is not easy to quantify and it is also not easy to quantify the costs to a site of factors affecting the NORM that may cause undue fatigue. Only outcomes leading to accidents, incidents or potential damage are generally reported and it is difficult to determine the influence of fatigue.

The results of the analysis of the LTI and HPI data showed that it was not possible to determine any pattern associated with shift length or break scheduling, however, from analysis of the human factor causes of high potential incidents it was found that approximately 20% of such incidents might be influenced by work breaks.

The results of the project indicated that current work break times and durations are generally adequate for managing the fatigue associated with haul truck driving. There was good

recognition of the need to consider the working conditions and work environment with regard to operating effectively and efficiently but there was limited formal recognition of the physical and mental demands of the tasks in the written procedures. Allowing operators some control over precise break timing would be valuable, however, breaks should not be excessively delayed.

The large number of variables that were identified that affect the effectiveness of breaks and the time suitable to work on a single task limited the potential for any definitive or prescriptive guidelines to be developed.

Perhaps due to the focus on fatigue in the mining and other industries in recent years, there was good understanding and application of processes to manage fatigue applied by individuals. This focus on fatigue management may also have led to the absence of any clearly identifiable impacts of work break patterns on quantifiable and reported outcomes. Continuing education and publicity about the effectiveness of regular breaks is strongly recommended.

Overall it was concluded that the methods and framework outlined by the WEM can be valuable to help assess the adequacy of work break patterns associated with a variety of mining tasks. It is strongly recommended that the WEM be used to assess other mining tasks and the results used to optimise break arrangements.

1 INTRODUCTION

Coal mining is an industry that has a large number of different arrangements for working hours and work breaks that vary between different mine sites and different tasks at the same site. No 'standard' pattern for hours worked or rest breaks to be taken is commonly applied across the industry in Australia.

In recent times considerable effort has been expended in establishing safe, yet productive shift rosters. Within any roster arrangement, the rest periods and work breaks that a worker takes within a shift can have a significant effect in terms of job performance, productivity and worker health. Optimisation of work breaks and rest periods has not received the same level of attention accorded to length of shift determinations.

At a mine site, there are many factors that impact on the timing, duration and conditions under which a work break is taken. The complex interaction of these factors prevents the development of any rigid, prescriptive rules for the work breaks. However, the benefits of work breaks in terms of productivity and worker well-being are well documented and the site factors should not prevent the development and implementation of effective and adaptable work break processes.

This project was designed to develop and apply a model to examine work breaks and rest periods in mining operations that leads to ensuring the benefits associated with work breaks are achieved. It was funded by the New South Wales Coal Services Health and Safety Trust.

The project personnel would like to thank the Health and Safety Trust for making the funding available. Special thanks are also given to the management and operators at the sites involved in the project for the co-operation, time and information provided to the project personnel.

1.1 Project Personnel

The following personnel from the Minerals Industry Safety and Health Centre (MISHC) at the University of Queensland and other Centres were involved in this project.

Project Leader and Manager	Carmel Bofinger	Manager, Health Projects (MISHC):
Research Officer	Sharyn Cobbin	Education/Research Officer (MISHC):
Other project personnel	David Cliff	Director of Research (MISHC):
	Tim Horberry	Monash University Accident Research Centre.

2 LITERATURE REVIEW

A targeted literature review was performed based on information collected from a wide variety of sources. This included scientific literature, personal contacts, industry reports, previous work by the project team, standards/legislation and information from relevant agencies (eg NOHSC).

2.1 History of work and rest breaks

In recent times, considerable effort has been expended in establishing safe, yet productive shift rosters. There has been less effort contributed to the determination of effective work breaks during a shift. The determination of rest break policy is usually made either through trial and error, historic preferences or negotiation.

Rest periods have been advocated by most time and motion study practitioners since early work by Gilbreth and Gilbreth in 1919 (Eilon, 1964). This early work concentrated on productivity and efficiency rather than the minimisation of fatigue. Work examining the structure and timing of breaks is predominantly based on studies of manual production work. The majority of these studies were done during the first half of the 20 century. During and after World War 1, the Industrial Fatigue Research Board in England carried out many investigations on the effects on performance in repetitive perceptual motor tasks resulting from the length of the work day or the work week an the scheduling of pauses. These results advocated the periodic scheduling of short rest pauses during the work day.

There has been a range of studies completed in different industry sectors, mainly focussing on the repetitive tasks in processing industries. The relevance of these to the mining sector is limited due to the type of tasks and work studied. A selection of more recent qualitative and quantitative studies is summarised in the following sections.

2.2 Qualitative studies

As reported by Penn and Bootzin (1990), it has been demonstrated in vigilance research studies that rest breaks aid the maintenance of efficiency. In general, rest breaks have been shown to produce benefits in mood and lasting increases in overall productivity.

An investigation into work and rest periods for light and semi-skilled work processes was completed by Bhatia and Murrell (1969). This investigation introduced short 10 minute breaks every hour. Some of the findings included:

- Although many of the advantages of rest pauses are to be gained even if operatives remain in their work areas, they should preferably leave it to obtain the benefit of a change of environment and a change in the type of muscular activity.
- Rest pauses were spent mainly in having refreshments. The proportion spending them entirely in relaxation was insignificant.

As reported in Dadabneh, Swanson and Shell (2001), some research has indicated that conventional rest break schedules (mid-morning, lunch and mid-afternoon) are not fully

effective in eliminating operator discomfort and performance deterioration for repetitive or processing work. This suggests that alternative work/rest schedules may be more effective in improving comfort, health and productivity.

Five to ten minute breaks every one-half to hour appear to be sufficient to sustain performance in vigilance tasks (Penn and Bootzin, 1990). The best timing of scheduled breaks may depend upon the task as breaks cannot be undertaken at certain stages of a work process. Optimal timing of breaks may also vary with the individual, especially with inexperienced/novice workers, but there is evidence that workers can pace themselves in accordance with scheduled breaks, and prefer to be otherwise uninterrupted (Penn and Bootzin, 1990).

This study also demonstrated the relationship between fatigue and worker output. In general, workers will tolerate certain levels of fatigue and will protect their output from declining by investing more resources and working harder. This behaviour will hold until fatigue reaches a level at which the workers cannot work any harder: then their output will drop significantly. This was consistent with results of a study by Meijman (1997) that showed mental fatigue will not show up as performance impairment as long as the operator is willing to compensate by investing more effort.

An overall finding of two major studies (Bhatia and Murrell, 1969; Dadabneh, Swanson and Shell, 2001) was that taking hourly or half-hourly short breaks had no adverse effect on production. Further, they both recommended that companies should be encouraged to experiment with frequent rest breaks.

Evidence from industrial settings and laboratory simulations also suggest that frequent short breaks (eg 10 minutes per hour) can improve performance at work (Tucker, 2003). Care should be taken to schedule rest breaks so that they fit in with work routine. Interventions that have the most potential for short-term alerting effects include the optimal timing of rest breaks so as to not interfere with work flow.

Other studies have suggested that care be taken to integrate the breaks with task demands because when breaks are too frequent they may disrupt the work flow. This point is particularly relevant to many mining tasks. Optimal rest break scheduling should therefore be a function of the task demands, cycle time and total duration of the task (Kopardekar and Mital, 1994).

However, Akerstedt and Landstrom (1998) reported that breaks are unlikely to have effects on sleepiness induced by circadian or homeostatic factors. As such, sleepiness recovery breaks should be reserved for sleepiness due to time on tasks, where the effects are temporary.

In some situations, the scheduling of additional rest breaks could increase risk, for example if they involve shutting down and starting-up procedures that are inherently more risky (Tucker, 2003).

2.3 Quantitative models

Although it may appear that taking a rest break is intuitive, workers will not always select an optimal rest beak schedule, and performance and productivity may be improved

by using a systematic schedule for breaks. However, a review of the relevant literature reveals that in spite of the potential productivity benefits of systematically determining work-rest cycles, the limited amount of related research based on quantitative models has been primarily focussed on specific tasks and work environments, eg hot work or shift scheduling in terms of work hours of the day and workdays of the week.

The literature associated with quantitative modelling of work and shift scheduling has demonstrated that the use of flexibility in designing employee schedules can generally result in a substantial improvement in labour use and productivity (Alfares, 2004; Brusco and Jacobs, 2000: Bechtold and Jacobs, 1990; Janaro and Bechtold, 1985; Bechtold, Janaro and Sumners, 1984; Eilon, 1964)).

The mechanistic model proposed by Eilon (1964) was dependent on the explicit statement of the characteristics of the production rate and was based on a number of assumptions that limited the validity and application of the model. While some of these assumptions have been refined, the more recent models still do not generally take into account time of day and the effects of circadian rhythms, and only limited work has been completed that considers the effect of work hours on fatigue. There has been separate mathematical modelling of circadian rhythms taking into account endogenous and exogenous factors but this remains a mathematical model of a biological process that is difficult to relate to physiological function (Minors and Waterhouse, 1992).

Work completed by Janaro (1985) and Bechtold, Janaro and Sumners (1984) focussed on maximization of productivity through selection of the optimal number, duration and arrangement of rest breaks. This work also built on the earlier mathematical models and demonstrated that the limited validity associated with previous models could be addressed by focusing on decreasing work output and recovery of work rate potential during rest breaks over a single time horizon. The models could be based on a fixed number and duration of rest breaks, or where conditions are un-restrained. The selection of the optimal number, duration and placement of rest breaks over a single time horizon becomes a complex programming problem. This work identified that further research was needed to address the maximization of work output across an entire day or shift where the shift may be conceived as two interdependent work-rest horizons with lengths influenced by the “window” within which the meal break must be inserted.

Overall, the focus of the research based on the quantitative models was on productivity – not the minimisation or management of fatigue. These models have limited applicability for the mining industry as they are based on highly repetitive tasks or for individuals working on independent tasks.

2.4 Effect of napping during breaks

The benefits of short naps in terms of improving alertness has been widely accepted in the general community, particularly in terms of long distance driving and the benefits associated with “power naps”. The effectiveness of napping in the workplace has also been considered. A study of the impact of short naps on performance of 12 hour shift workers indicated that short naps were effective under ideal conditions but that the challenge remained to effectively integrate napping strategies in to the workplace under operational settings (Purnell, Feyer and Herbison, 2002).

2.5 Effect of activity during break

With the exception of the taking of stimulants (eg coffee, illegal drugs), limited research has been conducted on the most beneficial activity during breaks. This is likely to vary with the task, time of day or night, time during shift, and individual preferences.

The results of a study (Lisper and Eriksson, 1980) showed that food intake has a positive effect on performance but that the length of the rest break has little or no impact. The effect of food intake is one of less deterioration in performance over time on task rather than an immediate effect on performance right after the break. The break is more than the food ingested and eating is certainly more stimulating than sitting and waiting for continuation of the task. From an applied point of view it is sufficient to know that a break with food improved performance more than a break without food, no matter what the length of the break. Food intake does not, however, seem to be positive to use as a general fatigue countermeasure.

Akerstedt and Landstrom (1998) also considered caffeine as a proven and efficient fatigue countermeasure. There was also indirect evidence from observations that increased physical activity (including simply standing up and walking about) is a favourite countermeasure of fatigued individuals, although the long term effectiveness was not measured.

Likewise, Horne (2004) when reviewing fatigue caused by driving argued that a variety of countermeasures were safer than continuing to drive whilst an operator was in a fatigued state. Simply stopping driving for a few minutes whilst still seated in the vehicle cab improved safety; doing exercise for a few minutes was more effective, however the most effective countermeasure during a short rest break was ingesting caffeine (eg coffee) then taking a 15-minute nap. However, most of these countermeasures only offered a relatively short-term performance improvement.

Therefore, both physical action and social interaction seem feasible fatigue countermeasures, at least in the short-term. It may be the change in activity and not rest that alleviates fatigue during breaks especially for tasks that are monotonous and boring.

2.6 Legislative requirements and guidelines from other industries

There are few legislative requirements from any industry regarding work breaks. One area where recommendations for breaks has been defined has been in the transport industry.

For example, the Victorian *Road Safety (Drivers) (Driving Hours) Regulations 2001* include:

> Section 9, 506. Minimum rest time – commercial bus drivers: and
> Section 11, 508A. Minimum rest time – heavy, truck drivers:
>
> > 1, (a) for any 5.5 hour period – 30 minutes, either as one continuous period or as two continuous periods of 15 minutes each.

Although there are limited legislative requirements, a number of industries, particularly the transport industries have developed and implemented guidelines covering the timing and duration of breaks in shifts.

2.7 Summary of literature review

Despite the concerns expressed about the effect of fatigue and rest on the rate of production and safety, it appears that practitioners have generally resorted to general statements about the desirability of rest periods rather than attempting to specify a rest policy based on analytical methods.

Similarly, scientific research on this topic has been rather piecemeal, and generally only proposed breaks schedules for very specific, repetitive tasks. In some cases these recommendations have been made based on limited studies covering very targeted operations and the results should not be generalised to another industry.

Studies completed for the long distance transport industry have limited application due the differences in work arrangements experienced by long haul transport drivers compared to mining operations.

As such, this previous work cannot be directly applied to determine optimal rest patterns in the majority of mining tasks.

3 METHODOLOGY

The original methodology for the project aimed at the staged development of a model to evaluate the effectiveness of work breaks and rest periods.

The original project proposed four stages of work.

1. *Definition of current practices*
2. *Development of work breaks framework*
3. *Development of work effectiveness model (WEM)*
4. *Review, evaluation and amendment of the model*

These stages were refined and partially modified during the project as further information became available or was identified as not being available.

The objective of the original proposal was to ascertain how quantity of work, quality of work and subjective fatigue alter with time on task, and scheduling and length of breaks and develop guidelines for determining the most appropriate break patterns.

This objective was significantly modified based on the literature review and initial data collection. The large number of variables that were identified that affect the effectiveness of breaks and the time suitable to work on a single task limited the potential for any definitive or prescriptive guidelines to be developed. This had been identified in the literature review as a limitation of the outcomes from previous research.

It was recognised that the outcomes of the project need to be:

- applicable to the mining industry;
- consistent with health and safety goals;
- able to be modified to suit the individual sites'
  - mining conditions;
  - production demands;
  - workforce characteristics.

The development of the WEM was designed to allow evaluation of the effectiveness and efficiencies of current work practices. The results from the field study were then used to assess how the work breaks affect the WEM and where improvements are possible.

To ensure the WEM was suitable for generalisation across the mining industry, a range of mines were used to collect data for this project. Table 3.1 shows the 20 mines involved in the project and the type of information that was obtained from each site. The tools developed and used to gather the information are shown in Appendix A.

3.1 Information from fatigue guidelines for the mining industry

A number of mining industry bodies and some Regulators have produced information to assist in the management of fatigue. These include:

- The Queensland Department of Mines and Energy (2001);

- The New South Wales Minerals Council (2003);
- The Minerals Council of Australia (Baker and Ferguson, 2004);
- The Tasmanian Minerals Council (2004);
- The Western Australian Department of Minerals and Energy, (2000).

Some of these guidelines talk in general terms about rest breaks within shifts and some do not mention this factor at all. There is little consideration given to the benefits of rest breaks or the most effective ways in which rest breaks can be implemented.

Company guidelines accessed during the project give greater consideration to the timing and length of rest breaks within shifts.

Table 3.1

Mines providing information for Work Breaks Project

Mine Number	State	Involved in C10032	Shift length	M'ment questions	Personnel question	Site procedures	Operator interview	Risk ass'ment
Surface operations								
1	QLD		12	√	√	√	√	
2	NSW		10	√	√	√	√	
3	QLD		8	√				
4	NSW	√	12	√	√			√
5	QLD		12	√				√
6	QLD	√	8	√				√
7	QLD	√	12	√				√
8	QLD	√	12	√				√
9	QLD		12	√	√	√		
10	NSW		12	√	√	√	√	
11	QLD		12	√	√	√	√	
12	QLD	√	12	√				
Underground operations								
13	NSW		8	√	√			√
14	NSW		8	√	√			√
15	NSW		8	√	√			√
16	NSW		8	√	√			√
17	NSW	√	8	√				√
18	QLD	√	8	√				√
19	NSW		8	√	√			
20	QLD		12	√				

3.2 Definition of current practices

Literature on breaks within shifts was first reviewed. The applicability of appropriate models of defining break times and the application of legislation and regulations in Australia and Internationally to such work was taken into account. This process helped to define the data to be collected in the project. A number of data gathering processes were used.

i. Survey of work hours and rest break patterns

   A survey of hours worked and current rest break patterns covering a range of underground and surface coal operations in Queensland and New South Wales was completed. Detailed information on the procedures and practices used to allow breaks to be taken was collected and analysed.

ii. Operator break pattern questionnaire

   A questionnaire covering aspects that need to be considered to identify and clarify the limiting factors controlling the length and adequacy of breaks was developed by the project team . 766 questionnaires were completed by workers in a range of operations including coal surface and underground and metalliferous surface and underground operations.

   This was supported by face-to-face interviews with 59 haul truck drivers at four different sites.

iii. Other sources of data

   In addition, interviews with mine managers, OH&S staff and other stakeholders also took place to gather information relating to sites and break processes.

3.3 Development of framework

In the original project proposal, it was proposed that based on the background and research data collected, a general framework would be established that covered:

- the overall length of time for which an individual can work safely and efficiently on individual tasks;
- the length of time for which an individual should work before having a break.

This framework would take into account information from the ACARP project C10032, Development of a risk management tool for shiftwork in the coal mining industry (Bofinger at al, 2002).

This framework should be realistic in terms of economic costs and benefits of taking work breaks/ rest pauses. The framework to evaluate breaks considered the different break patterns, what is done during breaks and the control individuals have regarding timing of breaks.

3.4 Development of the WEM

The model that was developed in this project was based on the Work Crew Performance Model (WCPM) developed by Wiehagen, Lineberry and Rethi (1996). The WCPM was developed as a practical method for enhancing the performance of mining work crews. The key components of the WCPM are shown in Figure 3.1. It relies on the cost-benefit assessment of operator skill based on observing those activities under the direct control of the equipment operator. The WCPM ranks behavioural measures of efficiency relevant to the operator's task.

The original WCPM was significantly refined and modified during the project to develop the WEM. The WCPM model was refined based on the analysis of the information gathered during the project. Detailed information to allow the refinement and application of the model were collected from sites, individual operators and information reported by other relevant studies. The final WEM model is shown in Figure 4.1.

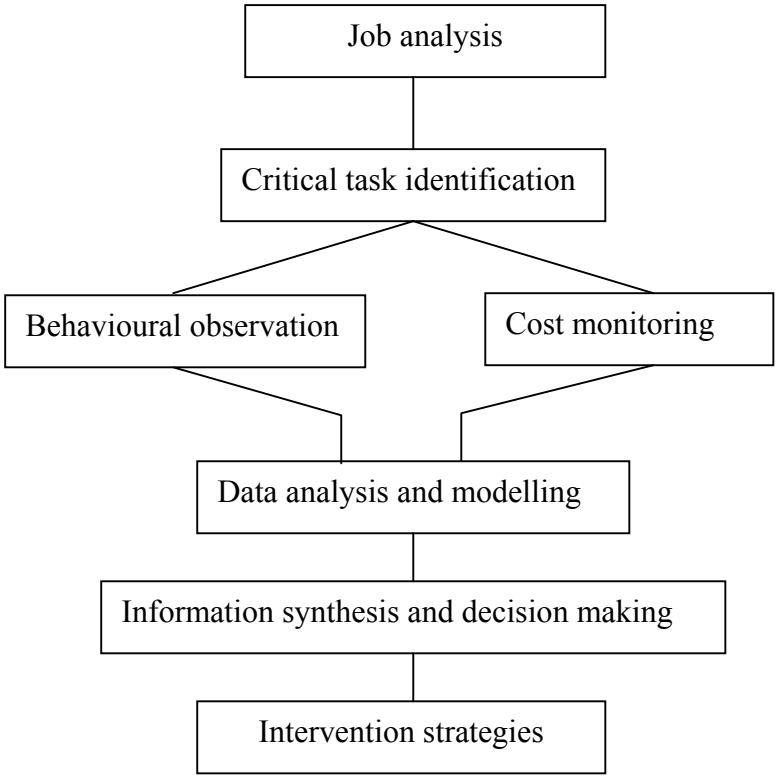


Figure 3.1
Work Crew Performance Model
Wiehagen, Lineberry and Rethi, 1996

The actual measures that were considered that may influence the WEM included:

i. Quantity of Work

A range of operating schedules was studied over a variety of roster patterns. Information collected as part of previous shiftwork research (Bofinger et al, 2002) was also utilised.

ii. Quality of Work

This was achieved through interviews with supervisors and crews as well as observation by the research team. LTI and HPI data were accessed and analysed in an attempt to identify any correlations of time of day with incidents.

In this project additional information was collected and analysed considering the costs of accidents, injuries and equipment damage, in addition to the behavioural measures of efficiency.

Productivity and efficiency are important economic measures of job performance and should be taken into account in evaluating the effectiveness of work break/ rest pauses. However, there is such a large number of variables that influence productivity that it was not possible to directly evaluate the effect of work breaks on productivity in this project.

3.5 Review, evaluation and amendment of the model

In the original proposal, it was hoped that a series of trials would be undertaken at mine sites in which the efficacy of the model would be assessed.

However, the model was progressively and iteratively developed during the course of the project and reviewed and amended as an on-going process. This evolutionary process was considered to be more effective than the validation of a model only at the conclusion of the project.

4 DEVELOPMENT OF THE WEM

4.1 Critical task identification

The WCPM was based on ranking of job elements by perceived cost consequence. This cost consequence was modified in the WEM to allow ranking of tasks associated with both surface and underground operations in terms of contributing to fatigue and the consequences of working while fatigued. These tasks were given a "fatigue critical" ranking of low, moderate, significant or high. These rankings were used in the ACARP Project C10032 (Bofinger et al, 2002). The following definitions were used:

H = high risk in terms of contributing to fatigue, research and planning required at high level
S = significant risk in terms of contributing to fatigue, attention needed
M = moderate risk in terms of contributing to fatigue, responsibilities must be specified
L = low risk in terms of contributing to fatigue, manage by routine procedures

Ratings have been assigned to the level of risk associated with the factors. The following ratings were used:

High risk	= 4
Significant risks	= 3
Moderate risks	= 2
Low risks	= 1

These rating were assigned to allow consideration of the factors in both the surface and underground operations. The ratings were then summed to allow a ranking of the risk factors to allow identification of the most serious and widespread risk factors in the sector.

Tables 4.1 and 4.2 show the ranking of tasks using information from sites involved in this project and those involved in ACARP Project 10032.

Table 4.1
Fatigue Risks for Surface Operations

Task Related Risk Factor	Surface operations					
	Mine 4	Mine 5	Mine 6	Mine 7	Mine 8	Risk Rank
Repetitive, monotonous, boring tasks eg haul truck driving	S	S	H	H	S	17
Hard physical work – heavy workload	M	-	S	M	S	10
Vibration	S	M	L	S	-	9
Hot/humid work, confined space etc	S	-	-	S	L	7
Noise	S	M	L	-	-	6

Table 4.2
Fatigue Risks for Underground Operations

Task Related Risk Factor	Underground operations						
	Mine 12	Mine 13	Mine 14	Mine 15	Mine 16	Mine 17	Risk Rank
Hard physical work – heavy workload	S	M	H	S	S	S	18
Repetitive, monotonous, boring tasks	M	S	S	S	S	S	17
Noise	S	M	S	S	M	-	13
Hot/humid work, confined space etc	S	S	-	M	L	S	12
Vibration	L	M	S	-	-	-	6

There were some differences between the underground and surface operations with repetitive, monotonous tasks being major factors for both sectors and hard physical work being the most significant for the underground operations.

The risk assessments allowed the identification of high and significant risk tasks as the focus for the project. This equated to the "critical task identification" in the WCPM.

Given the experience of the research team, the ease of access to sites and operators, and the potential to generalise the results to other tasks, it was decided to investigate the potential of the WEM at the surface operations. The high risk task that was chosen as the focus of the project was the repetitive, monotonous, boring task of haul truck driving.

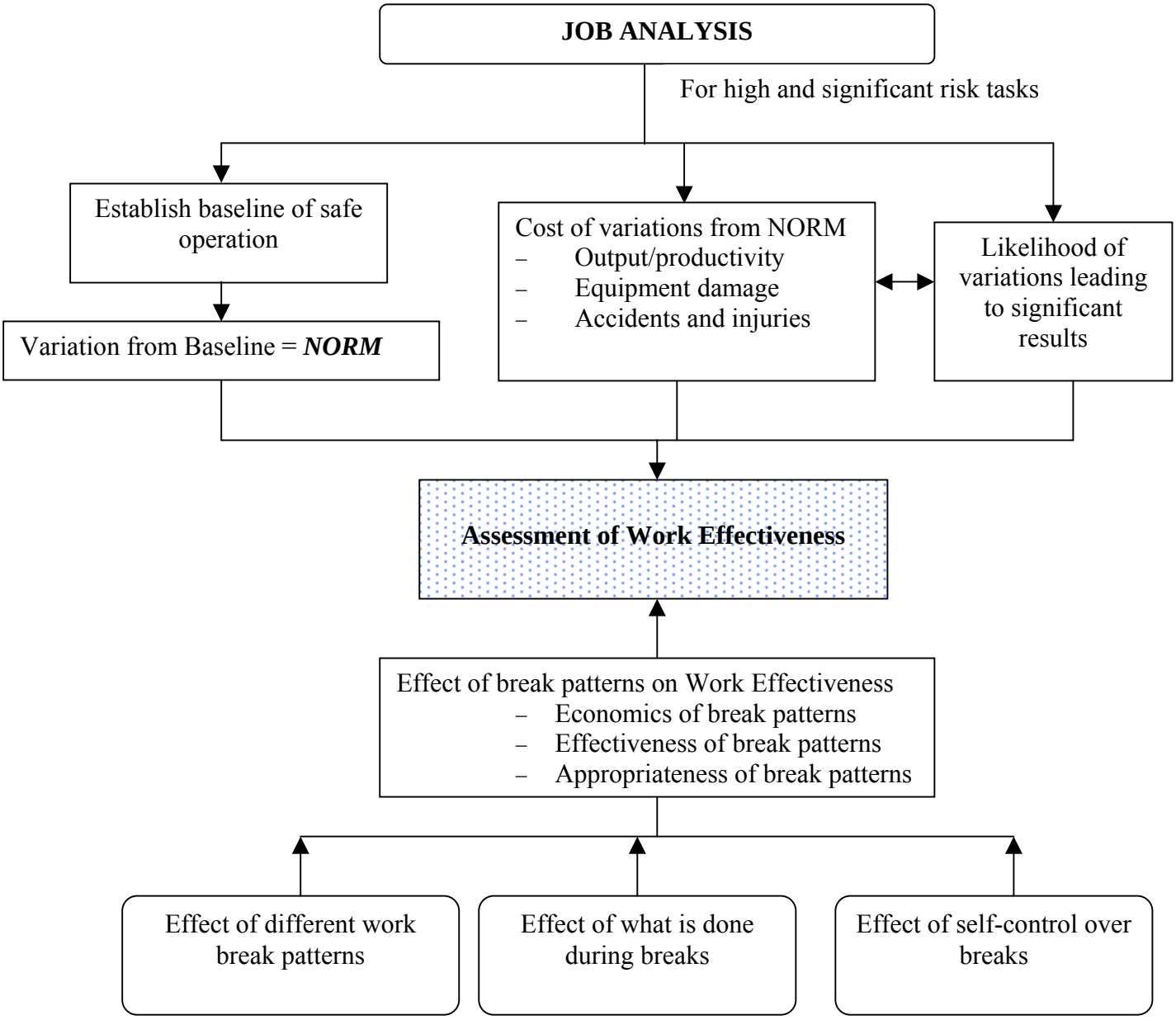


Figure 4.1
Work Effectiveness Model WEM

4.2 Identification of the NORM

There were two major inputs identified in establishing a baseline of safe operation:

- Training;
- Procedures.

There are competency requirements covered by the National Coal Training Package MNC04. The specific competency is MNCO1014A Conduct haul truck operations.

Sites have in place procedures covering the authorisation and competency required for haul truck drivers. Formal procedures were provided by a range of operations involved in the project. These procedures also cover the specific site safety instructions including:

- Start-up procedures;
- Traffic rules;
- Driving under adverse conditions.

The next step in the WEM related to the identification of the NORM. The NORM is the routine, day-to-day completion of tasks or work as it is done by the operators (ie what actually is done, as opposed to what should be done). It was recognised that this may be different to the written, formal procedure for that task.

The research team spent time interviewing and observing operators to establish where there were variations to the written procedures ie establishing the NORM. This step is similar to the "behavioural observation" step in the WCPM.

The information from the analysis of procedures and the interviews with operators and management is summarised below. Examples of details collected are shown in Appendix C.

i. Summary of procedures

Procedures were collected from four sites. Procedures covering driving and fatigue management are generally in place but the quality and coverage of the written procedures varied.

All site had implemented procedures covering driving. One site had in place comprehensive procedures covering fatigue and driving requirements. One site visited was still in the process of developing the fatigue management procedures. This was a new site.

The driving procedures outlined the competencies and authorisations needed to drive haul trucks on site and the site rules and requirements. These assisted in establishing the baseline requirements.

Generally, there was good recognition of the need to consider the working conditions and work environment with regard to operating effectively and efficiently but there was limited recognition of the physical and mental demands of the tasks.

ii. **Summary of management interviews**

Management personnel at sites were asked questions relating to the general management of hours of work and fatigue and the extent and control of formal and informal breaks. The results were consistent with the requirements outlined in the procedures and the results of the questionnaires and the interviews. The different control mechanisms governing the formal and informal breaks were well recognised.

iii. Summary of operator interviews

As part of the information gathering process, interviews were completed with 59 haul truck drivers during their work shift. The intent of the interviews was to identify the individual coping strategies that drivers have in place and also to gather information on the effect and appropriateness of the formal and informal breaks that occur during a shift.

The interview was completed in the haul trucks during normal work processes. These were completed on both day and night shift. The structured interview covered the following areas:

1. General work history and experience relating to mining and shiftwork;
2. Personal coping strategies for managing shiftwork and fatigue;
3. The effect of task rotation;
4. The effect of the formal breaks scheduled into the shift – including timing and length of breaks;
5. The effect of the breaks that occur throughout a shift for different reasons.

The analysis of the operator interviews supported the information from the answers to the questionnaires.

- There was good understanding of how to prepare for shiftwork
- There was an understanding of the need to maintain a reasonable diet and exercise levels to assist in the management of shiftwork.
- Individuals had in place strategies to assist in the management of fatigue while on site.
- There were some individuals who struggle with first night shift.
- There remained a reluctance to formally report fatigue.
- Rostered breaks were considered to be adequate
- Informal breaks were used to assist in the management of fatigue.

4.3 Establishing the NORM

From the results of the analysis of procedures, interviews and observations taken during the interviews, the NORM in place across the sites involved in the project was established to be consistent with the baseline of operation outlined in the procedures ie the situation reflected Figure 4.9(a).

The variations to formal procedures in place at the sites involved in this project that lead to the development of the NORM tended to be minor rather than major variations. The issues that were identified from the operator interviews as being most important in establishing the NORM for sites were:

- The relationship with and respect for supervisors;
- The workplace culture – eg management support for reporting difficulties. This related to more than just fatigue issues.

4.4 Factors affecting the NORM

There was a range of factors identified from the operator and management interviews that affect the NORM once it has been established.

Physical variations

- Time of day effects
- Road conditions
- Weather conditions
- Seasonal changes
- Equipment conditions – seating, radio

Mental demands

- Weather conditions
- Changes to work routes
- Changes to different types of equipment
- Fatigue from outside activities eg second job
- Family commitments

Work environments

- Supervisory arrangements
- Management response to fatigue
- Management response to non-work issues such as family commitments
- Length of travel for employees

Skills base

- Changes over time
- Depends on expertise of workforce
- Depends on preferences of workforce for task rotation

All these factors can influence the NORM in both positive or negative ways. Therefore, the WEM will vary from site to site based on the physical conditions, mental demands, environmental conditions and skills factors affecting the NORM. The recognition and management of these site factors is an important step in ensuring continuing work effectiveness.

4.5 Costs of variations to NORM

In the development of the WEM, it was anticipated that is would be possible to establish or estimate the costs associated with variations to the NORM that result in injury or equipment damage. It was not, however, possible to estimate costs associated with productivity losses due to the large number of factors directly and indirectly affecting production.

Work completed by Esson (1992), estimated the indirect or uninsured costs associated with an accident or injury for the open-cut coal mining industry to be 9 times the insured costs. This is considerably higher than estimates for other industries that vary between 1 and 4 times and takes in to account lost productivity.

The Occupational Safety and Health Administration (OSHA) in the United States reports that the ratio of indirect to direct costs varies from a high of 20:1 to a low of 1:1. The lower the direct costs of an accident, the higher the ratio of indirect to direct costs. OSHA generally uses a ratio of 4.5 (OSHA, 2002).

Given the range of these estimates, the OSHA 4.5 value for indirect costs is used in this project.

(i) Injury costs

A single lost time injury was allocated a direct insured cost of $3500. This is an average cost based on the data supplied in the Queensland Mines and Quarries Safety Performance and Health Report, 2003 - 2004 (Department of Natural Resources and Mines, 2001) and the costings estimated for Queensland and New South Wales by Culvenor et al (2000).

Using the OSHA ratio, this would equate to a total cost of $19 250 for the total direct and indirect costs to be assigned to an injury.

(ii) Equipment Costs

Direct costs associated with equipment damage to haul trucks at surface coal mines was provided by a large mining company. Three years of information were provided and a total of 68 reported incidents of equipment damage involving haul trucks at six different coal mines in New South Wales and Queensland.

Average cost	$5 030
Minimum cost	$85
Maximum cost	$225 995

Using the OSHA ratio, this would equate to an average cost for equipment damage of $27 665.

Using these figures, the estimate of the cost of variations to the NORM that result in an injury or equipment damage range from $19 250 to $27 5665. For the purposes of this model the costs are averaged to $23 500.

4.6 Likelihood of variations leading to significant results.

In order to assess the likelihood of variations to the NORM leading to significant results in terms of equipment damage or injury, an analysis of lost time injuries (LTI) and high potential incidents (HPI) from 2002 to 2004 was undertaken. HPI are defined as an event that causes or has the potential to cause a significant adverse effect on a person's

safety or health. This analysis used data from the Queensland Department of Natural Resources and Mines Lost Time Injury database for surface and underground coal mines. The limitations of LTIs as a measure of safety or efficiency are well documented, however, LTIs remain one of the few consistently reported metrics.

An analysis of 290 LTIs and 1154 HPIs was undertaken in order to see if there was any time dependence of LTI or HPI with time of day.

The LTI records not only specify when the accident occurred but also the shift start time, and also the number of days into the roster. It was not possible to analyse the data for shifts less than 10 hours long in any real detail due to the small number of incidents for these shift rosters.

Figure 4.2 illustrates the percent of LTI for a shift length type compared to hours into shift for three different shift length groups, less than 10 hours, 10 to less than 12 hours, and 12 hours and greater. This figure includes both underground and surface operations. The majority of shifts worked were 10 hours or longer.

There was a general trend in the <10 hour shifts of an increase in incidents at 4-5 hours into the shift. There was an increase at 8 hours for the shifts of 10 –12 hour duration and there was no clear trend in the longer shift results.

Figure 4.2 Lost time injuries based on shift length

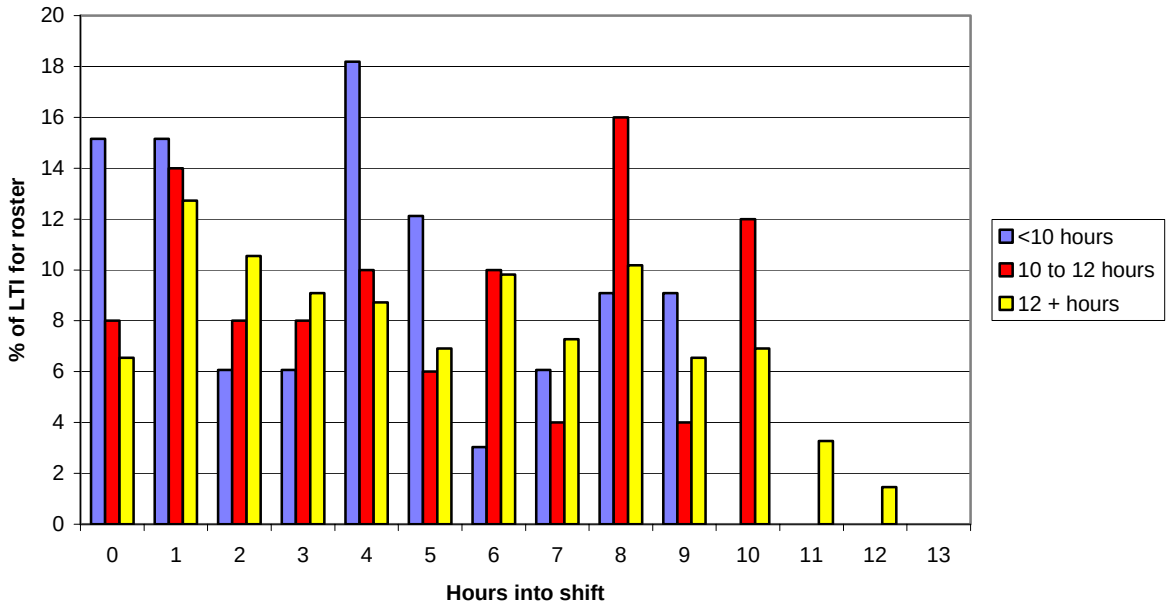
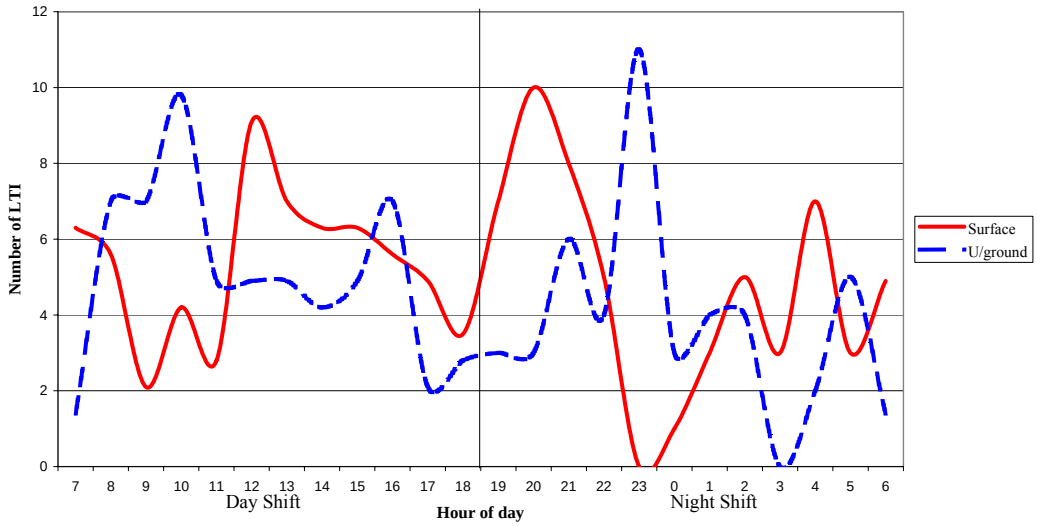


Figure 4.3 shows the trend of LTIs for both underground and surface operations over the 24 hour period. This figure shows the results weighted for the number of workers on site for day and night and covers the operations with both day and night shifts. It does not include any operations with three shifts per day. The majority of the shifts start between 6 and 7 o'clock. Based on information supplied by the sites, there is approximately 40% less workers on site during night shift compared to day shift.

Using the weighed information, there is no significant difference between the number of LTIs reported on day or night shift. Although the night shift has the highest peak for

both underground (~ 11pm) and surface (~8pm), the total number of LTIs in each shift is similar. It is difficult to establish any clear pattern. The lows at the start of the shifts are

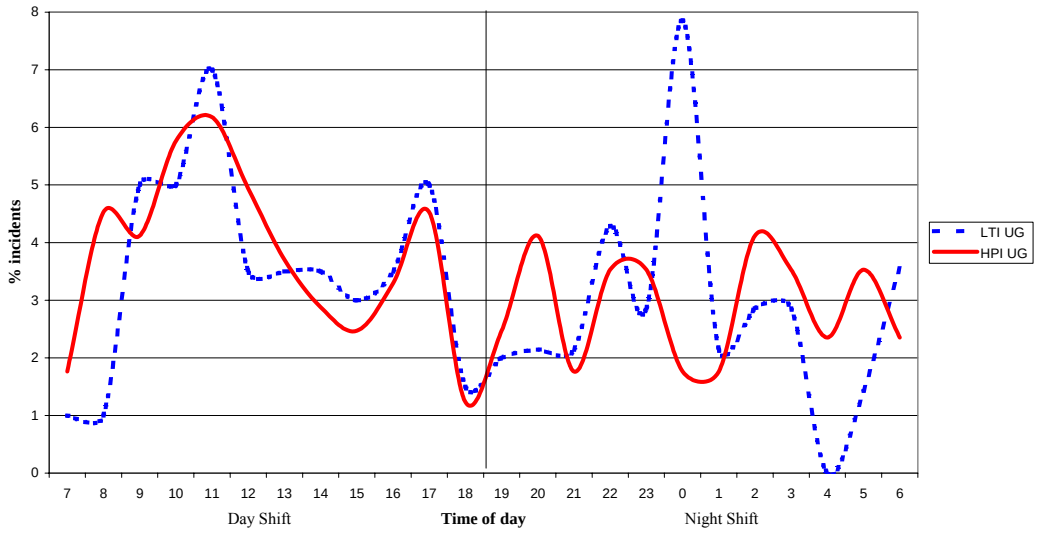
Figure 4.3 LTIs weighted for number on shift



expected due to the limited activity taking place at shift change.

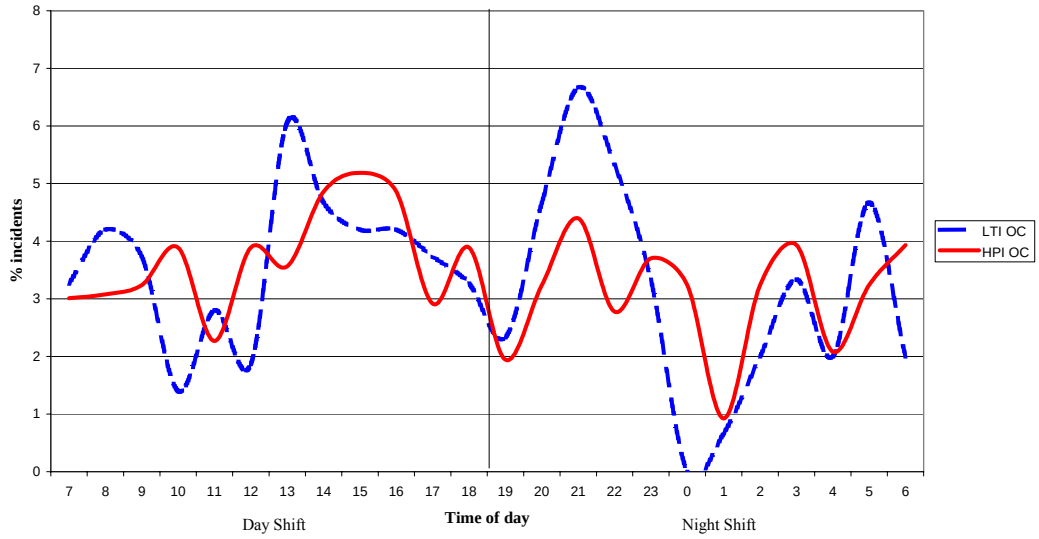
HPIs were also analysed and compared to LTIs (Figure 4.4 and 4.5). HPIs may be an indication of an error occurring that does not lead to an injury. These are weighted for the number of persons on shift.

Figure 4.4 Weighted undergound results



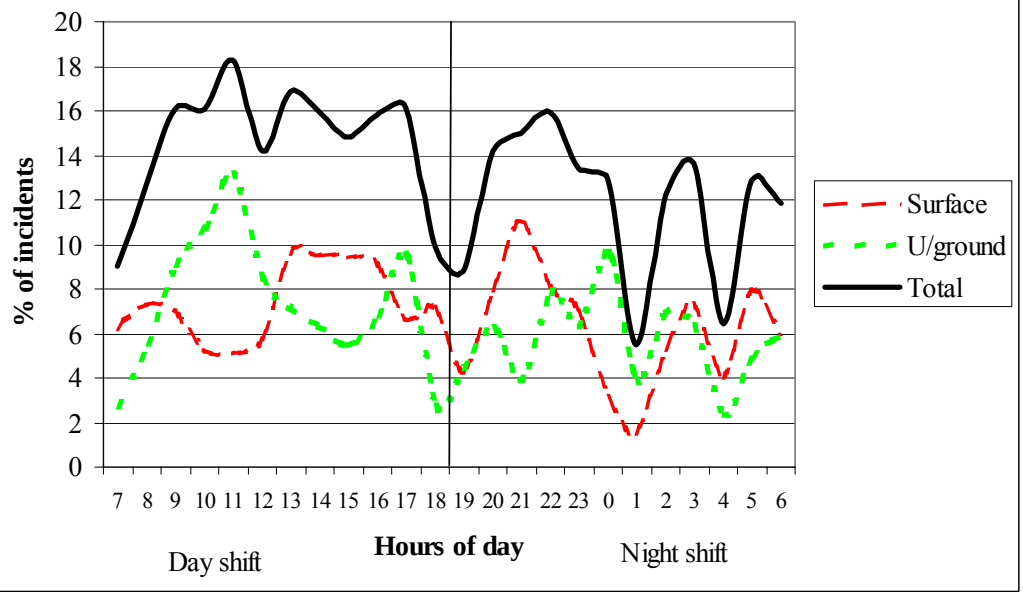
The pattern of HPIs generally follows the pattern of LTIs. Similar to the LTI data, there is an increase in the HPIs reported during the day even when weighted values are considered. There is a difference in the underground operations at approximately midnight with a rise in the LTIs and a dip in the HPIs.

Figure 4.5 Weighted surface results



In Figure 4.6, the HPIs and LTIs are combined to give an indication of the likelihood of an incident leading to a significant result.

Figure 4.6 Combined HPIs and LTIs



Based on the analysis of the LTI and HPI data, such a significant incident is more likely to occur on day than night shift. For day shift, there is no clear pattern across the day shift (with the exception of the beginning and end of shift). For night shift, an incident is more likely to occur in the first half of night shift.

Incidents involving open cut coal haul trucks and water trucks were extracted from the NRM High Potential Incident Database for the period July 2002 to June 2004. The type of variations to the NORM with human causal factors for open cut vehicle HPIs in shown in Figure 4.7, (NRM, 2004). A detailed investigation of the allocation of HPI

causal factors undertaken during the project indicates that there may be some inconsistencies and inaccuracies in the data. This should be taken into account when reviewing the HPI data.

Some form of human causal factor accounts for 89% of the reported HPIs relating to vehicles at surface mines. 45% related to not following a procedure or using an incorrect work procedure ie direct variations to the NORM. The remaining 44% are other indirect variations to the NORM.

System factors (inadequate training 5%, safety inspections 4%, maintenance 4%, directions 2% and management 2%) account for 17%. Lack of experience (2%), recklessness (2%) and other (1%) account for another 5%.

Awareness factors (inattention 10% and failure to recognise 9%) account for a further 19%. There is only a small proportion (3%) directly identified as being fatigued related, however, the fatigue and awareness issues are these that may be directly affected by work breaks.

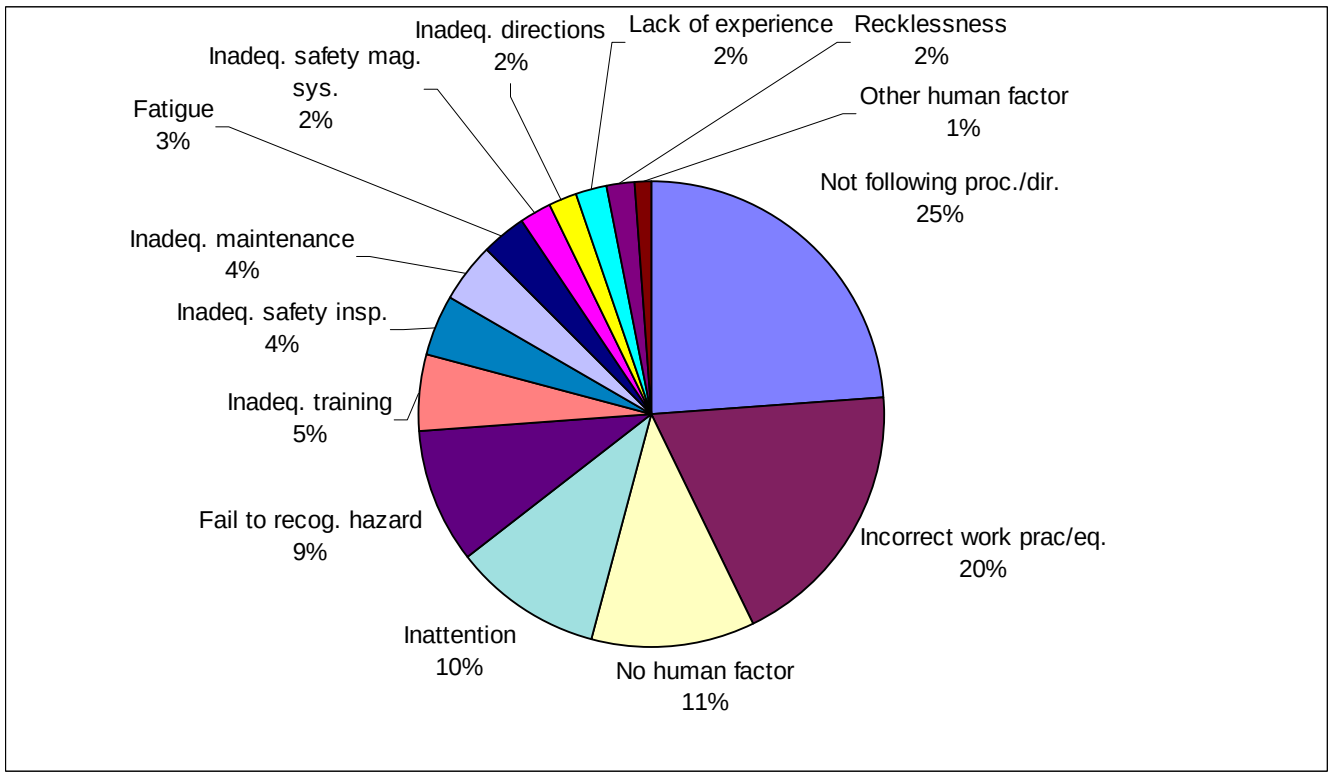


Figure 4.7: Coal Open Cut Vehicle HPIs – Human Causal Factors (n=96)

104 incidents were identified using the detailed descriptions of the incidents rather than from the official categorisation provided. Of these, fatigue was identified as being present in nine incidents. This represents 9% of those reported. This figure is probably an underestimate as fatigue was only reported when it was grossly present i.e. the operator fell asleep at wheel of truck. The distribution of the incidents as a function of time of day is shown in Figure 4.8. The nine incidents where fatigue was identified are displayed.

This data has not been normalised for the number of workers on each shift as production rosters tend to be run over the full 24 hours.

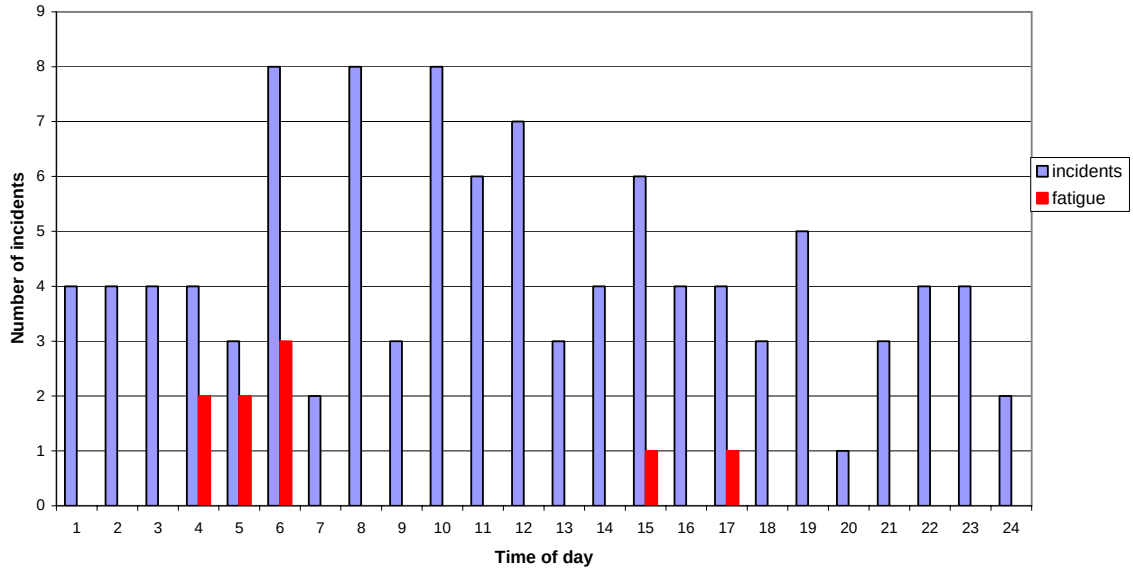


Figure 4.8 Identified fatigue incidents versus time of day.

There is a cluster of fatigue incidents from 4 – 6 am, however, the number of incidents is small and this small number needs to be considered before drawing conclusions.

4.7 The NORM and Work Effectiveness

Figures 4.9 (a) and (b) demonstrate the relationship between the NORM and the operational baseline. Viability of a site is dependent on the site meeting the requirements established by the operational baseline. When the NORM is consistent with the requirements of the operational baseline, and the costs and likelihood of variations to the NORM are such as to maintain this consistency, there is effective work.

The costs of variations to the NORM have been estimated to be an average of $23 500 for a significant incident resulting in either a lost time injury or equipment damage at surface operations and these incidents are more likely to happen on day shift or early into night shift. The variations to the NORM resulting from human causal factors account either directly or indirectly for approximately 90% of the variation leading to HPIs for vehicles. 22% of these factors (the combination of awareness and fatigue issues) might potentially be affected by work breaks.

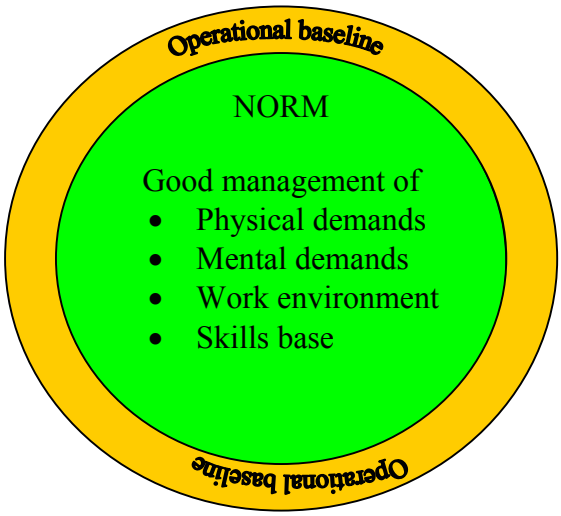


Figure 4.9 (a) Baseline and NORM consistent

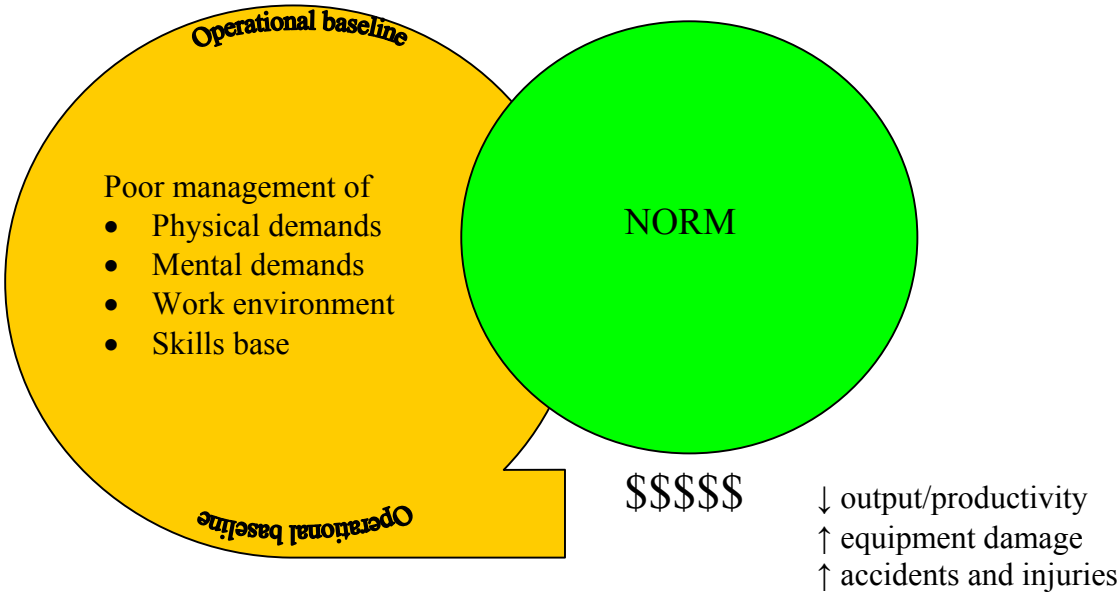


Figure 4.9 (b) Baseline and NORM inconsistent

5 BREAKS AND WORK EFFECTIVENESS

5.1 Factors affecting work breaks

In order to establish the factors that affect work breaks, workers in a range of operations including coal surface and underground and metalliferous surface and underground operation completed questionnaires. The results for the coal industry are presented with 136 underground workers and 596 surface operators completing the questionnaire.

5.1.1 Work break patterns

The scheduled work breaks were well identified and known at sites. There were two breaks in the 12 hour shifts and the breaks were generally of 30 minutes duration (time taken from when reaching the crib hut). The time until the first break was not to exceed 5 hours. There was considerable variation between sites in terms of break times and start times that will influence these results.

The unscheduled breaks showed greater variability (Figure 5.1(a) and (b)). There was generally shorter unscheduled breaks for the surface operations than the underground operations. This may reflect the different tasks involved in operation in the different sectors.

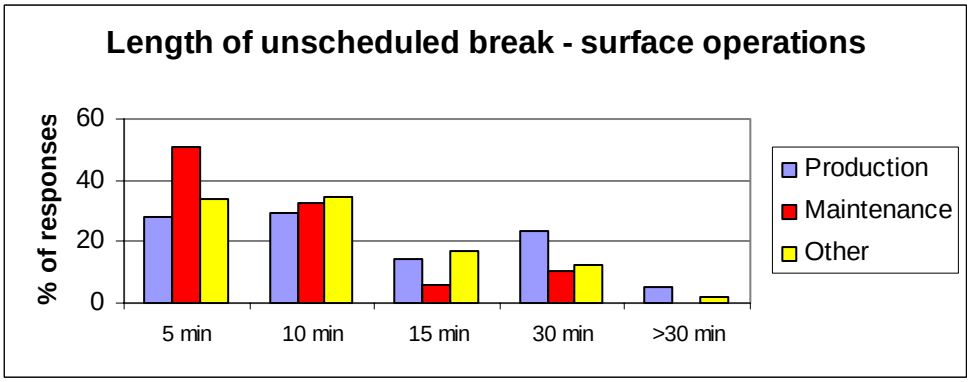


Figure 5.1 (a)

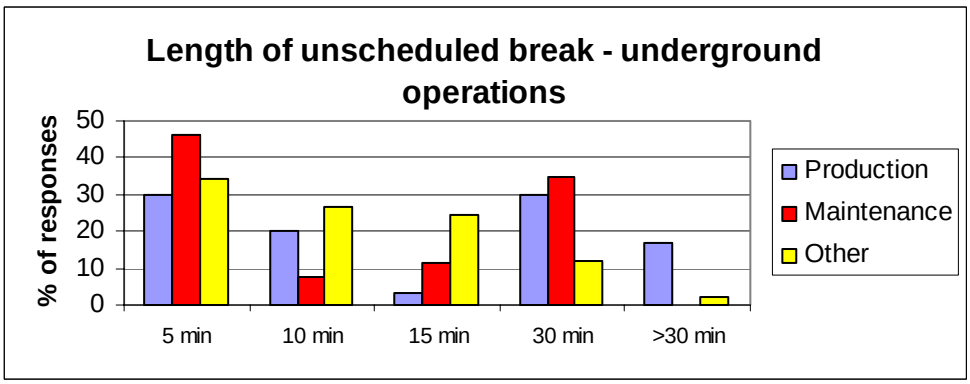


Figure 5.1 (b)

In addition to the information gained from the questionnaire, information from previous research was used (Bofinger et al, 2002). At two surface mines, mine 7 and mine 12, the times taken for breaks were recorded using log books (Figures 5.2 and 5.3). When the break times at these sites are overlaid on the LTIs reported for surface operations, there is some correlation with break time and low LTIs for the first break of day shift but this is not seen for other times.

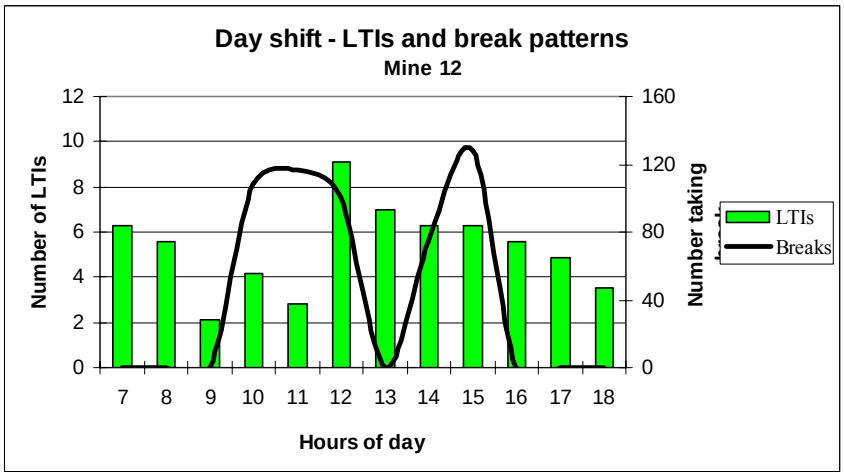


Figure 5.2 (a)

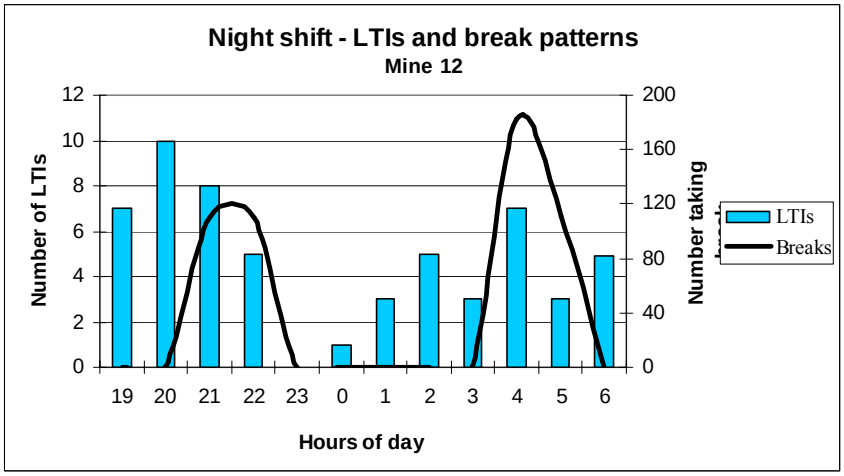


Figure 5.2 (b)

The pattern of breaks times recorded in the logs for both sites is consistent with the information supplied by management and individuals from other sites during the interviews. Generally, there is a broader spread of breaks during day shift. The second break during night shift is less spread. Some of the surface sites involved in the project indicated that because of the recognition of the issues associated with fatigue on night shift, production usually stopped during the second break to allow workers to have a short nap. Hot seat changing to keep production going is less practiced during this second break and hot seat changing at this time was not favoured by operators. They preferred to remain in the trucks for a rest or nap.

This is the time of the circadian low period and having a break during this time may be the reason that the LTIs are not as high as earlier in the night.

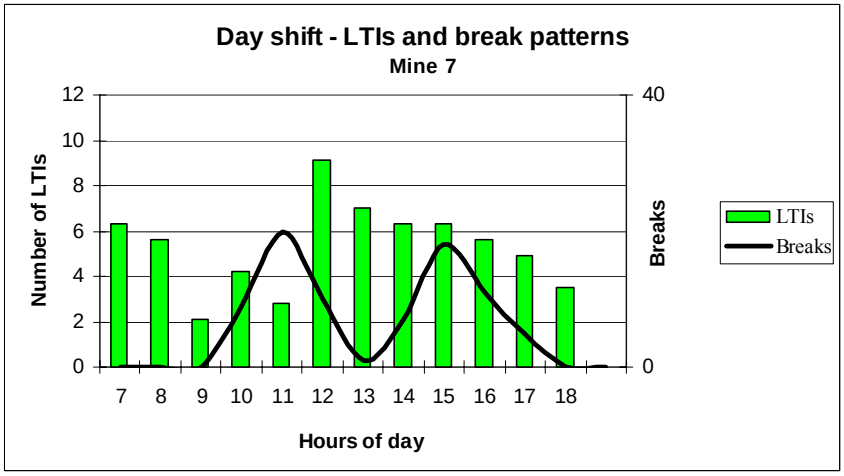


Figure 5.3 (a)

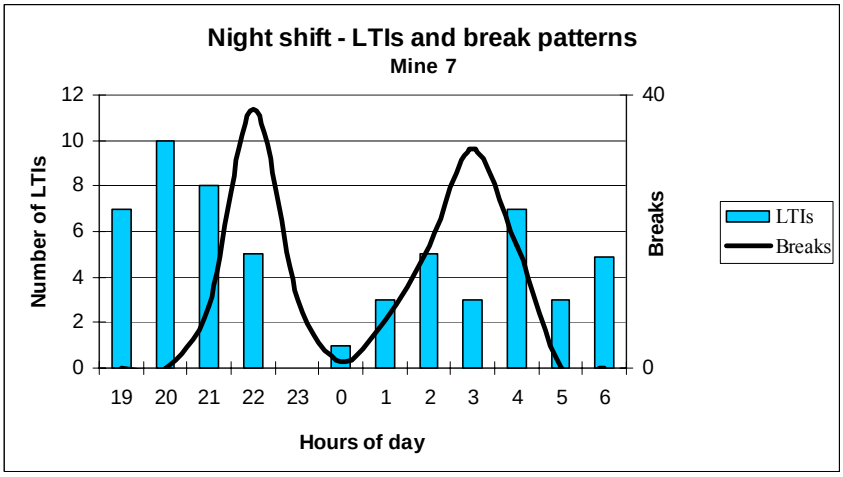


Figure 5.3 (b)

There was a preference expressed by some operators interviewed to delay the first break in a shift – mainly to assist in making the later part of the shift seem shorter. This was consistent for both day and night shift. They felt better able to handle fatigue earlier in the shift and the delay in the timing of the first break provided a rest time when fatigue and/or the effects of monotony were starting to take effect. The higher level of LTIs early in night shift does not seem to support this perception.

5.1.2 Effect of what is done during breaks

Although there was general consistency between the results from the questionnaire for the underground and surface operations for activities during breaks, as shown in Figures 5.4 and 5.5, there were differences. These tended to be related to the work environments eg the adverse conditions underground in terms of light, noise and mud makes activities such as reading more difficult than in surface operations.

The information provided in the interviews for the surface truck drivers was consistent with the results from the questionnaire. The activities undertaken during breaks changed according to the physical and mental state of the drivers. This allowed the operators to monitor and, to some extent, manage their own fatigue

levels. There was a good level of awareness about appropriate strategies that can be taken during breaks to assist in getting benefit from the breaks.

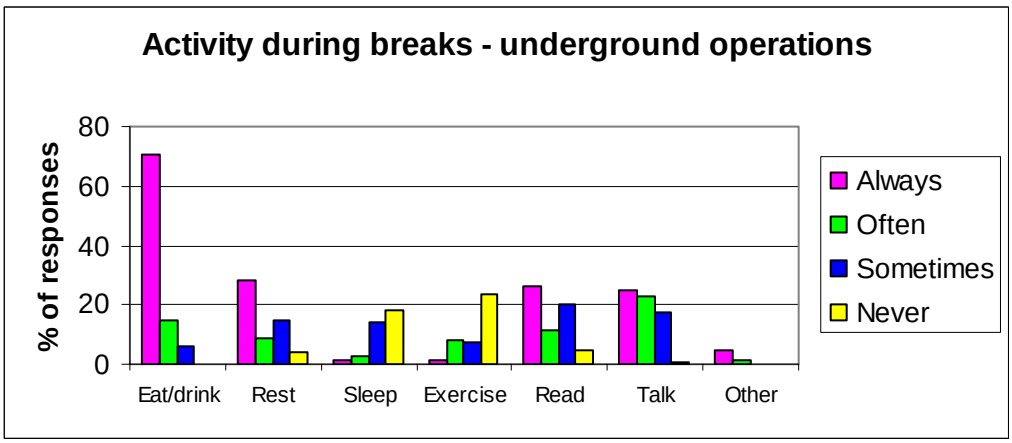


Figure 5.4

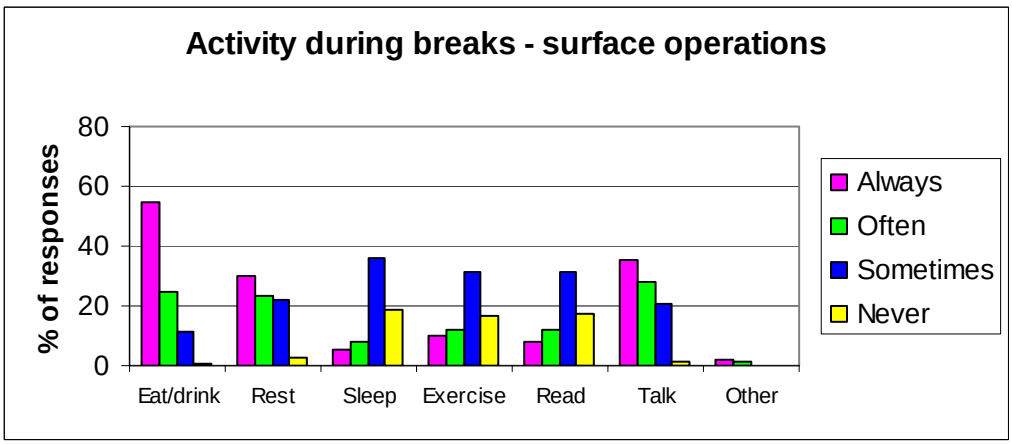


Figure 5.5

5.1.3 Control of formal and informal breaks

Operators were asked to identify who controls the timing of both formal, scheduled breaks and also informal breaks that may result from a breakdown or other unexpected cause. This was an area of significant difference between the surface and underground operations (Figures 5.6 and 5.7).

The underground operators reported having considerable individual control over when breaks were taken and also being able to work with the rest of the crew and supervisor to be able to plan official breaks. The surface operators reported much greater control by the supervisor. These results were consistent for both the official and unofficial breaks.

Within the underground and surface sectors there were some variations between the production, maintenance and other areas as to the way in which unofficial breaks were taken. Production workers were able to take advantage of breaks caused by breakdowns.

It was identified by the surface operators in the interviews that there is limited ability to take official breaks based on need rather than scheduling. This results in a number of "unofficial" breaks being organised to allow for some rest or change to work arrangements eg toilet breaks or refuelling. This introduction of unofficial breaks was generally preferred by operators to reporting fatigue officially.

During the interviews, surface operators reported taking considerable advantage of breaks due to breakdowns or gaps in the work processes.

This was modified to some extent by the relationship reported with the supervisor. If there was a good relationship, reporting of fatigue was more likely, often still in an unofficial way rather than through the formal processes available at sites.

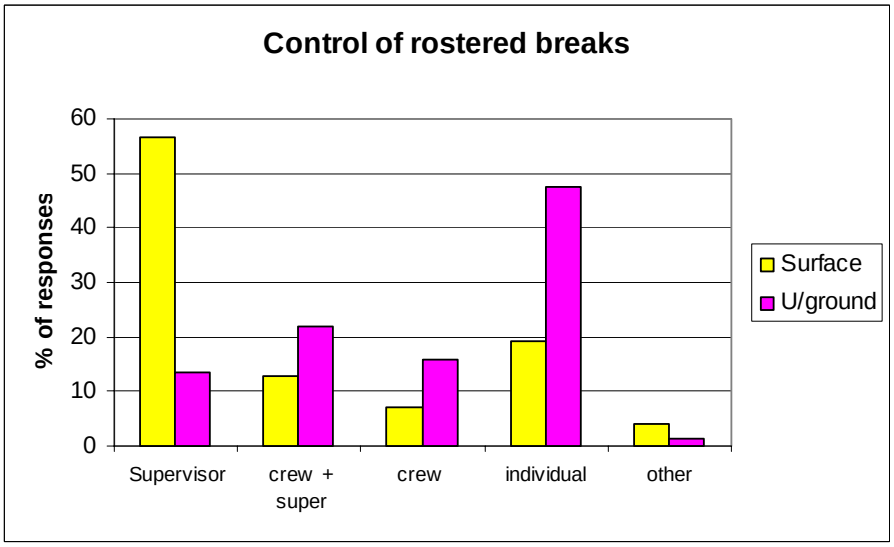


Figure 5.6

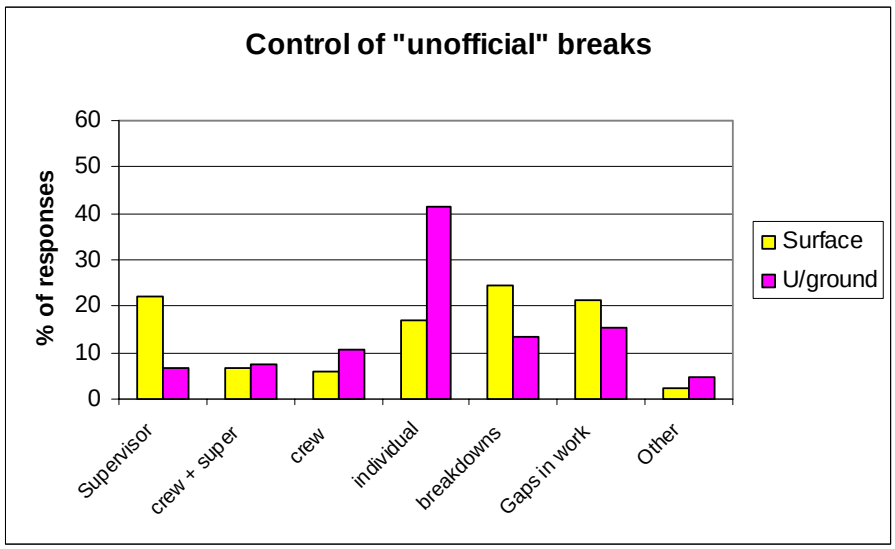


Figure 5.7

5.2 Effect of break patterns on work effectiveness

5.2.1 Effectiveness and appropriateness of Breaks

Workers were asked if they considered the current breaks they took to be adequate. The results are shown in Figures 5.8 - 5.10.

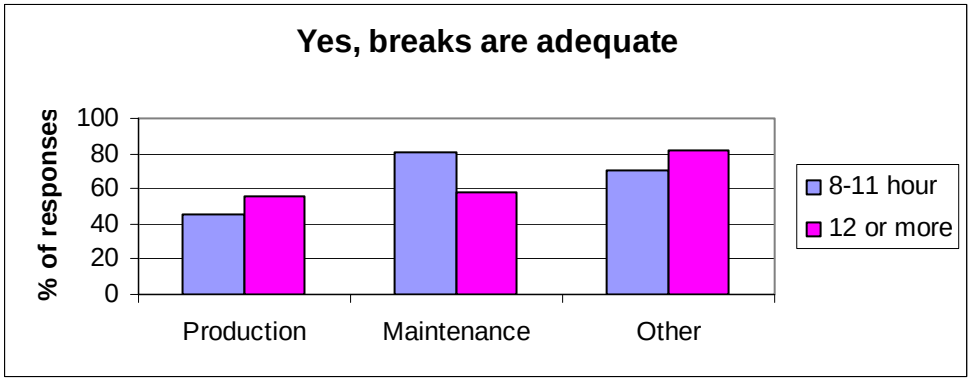


Figure 5.8

Based on the length of shift, there was less satisfaction with breaks within the production areas than the maintenance or other areas in shifts of various lengths.

This difference is less obvious when the surface and underground sectors are considered. Although there is less individual control over the timing of breaks at surface operations, surface operators reported current break patterns at being adequate more often than underground operators (Figure 5.9 and 5.10).

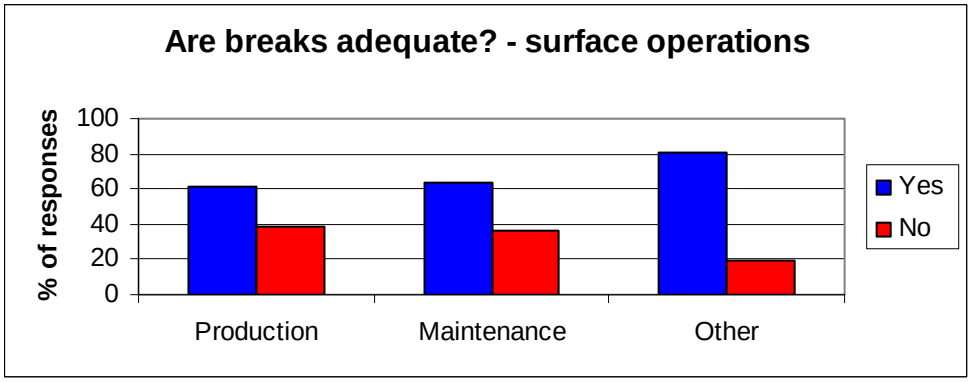


Figure 5.9

The response for the surface operations from the questionnaire is consistent with the views expressed during the interviews. Overall, operators reported that breaks were adequate and longer breaks would not have a greater benefit.

The results are interesting in that the underground operators have greater control over break patterns but less consider the breaks to be adequate. It is not possible to determine what effect the unfavourable conditions underground have in influencing these results.

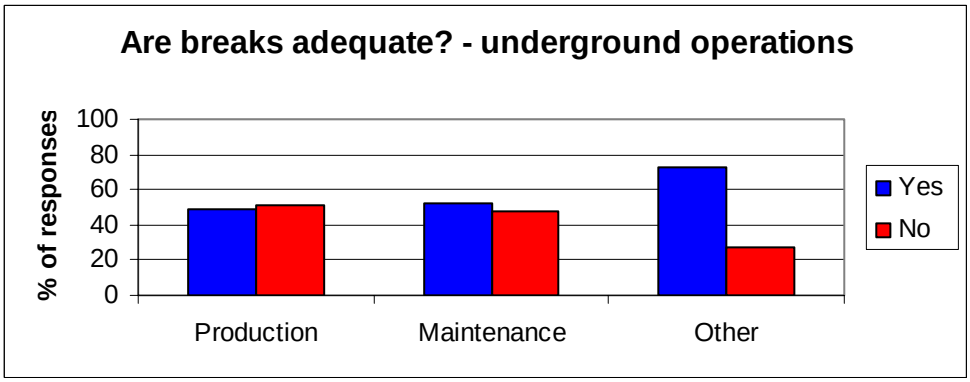


Figure 5.10

The questionnaire allowed participants to comment on how breaks could be improved. These comments are shown in Appendix D. 218 comments were received from the questionnaires completed by surface mine operators and 56 for the underground operators. A summary of the most frequently reported comments is shown in Table 5.1

Table 5.1
Comments on Questionnaires

Comment	Surface operations (% of comments)	Underground operations (% of comments)
Longer breaks	23	23
More frequent breaks	21	32
No work through 2nd crib	10	
Better crib facilities	8	9
Later breaks	4	

Overall, operators reported that current breaks are adequate but between 40 – 50% also indicated the longer or more frequent breaks would improve the situation. The highest number of LTIs and HPIs occur early in the shifts on both day and night shifts. These comments relating to break length and frequency may reflect personal comfort rather than the effect on fatigue.

(a) Alertness logs

In work previously completed (Bofinger et al, 2002), alertness logs were kept by surface operators over a number of sets of rosters. Results for mines 7 and 8 are shown are in Figures 5.11 and 5.12. These logs involved self – reporting of alertness levels each hour during the shift and for travel to and from the site. The logs showed that there is a reduced level of alertness reported during both day and night shift that continues to fall during the shift. The night shift fall in alertness is greater. Both sites had two scheduled breaks of 30 minutes duration.

There is no reported increase in alertness resulting from breaks. It is possible that the breaks may serve to limit the effect of the circadian rhythm, but with the limitations

of self reported information, this is not possible to evaluate without undertaking a large experiment in which breaks are either allowed or not allowed.

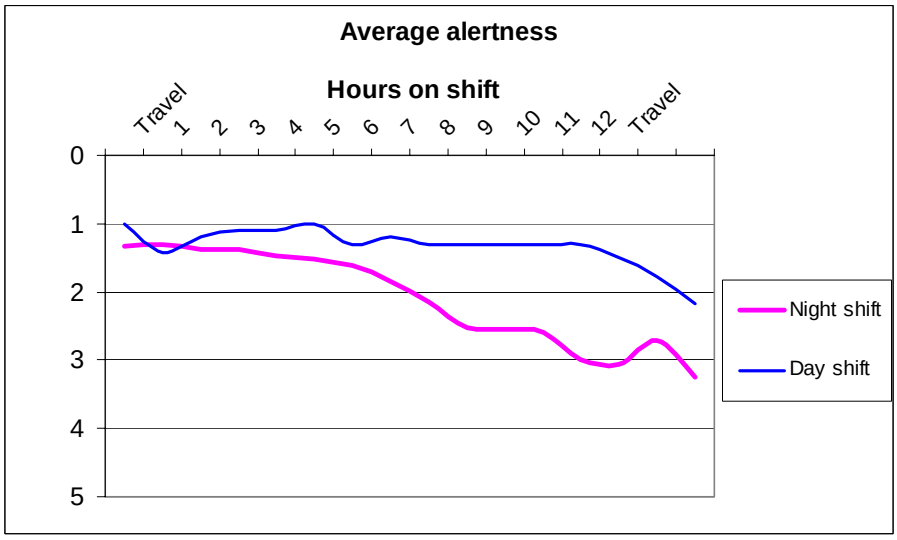


Figure 5.11 Mine 7

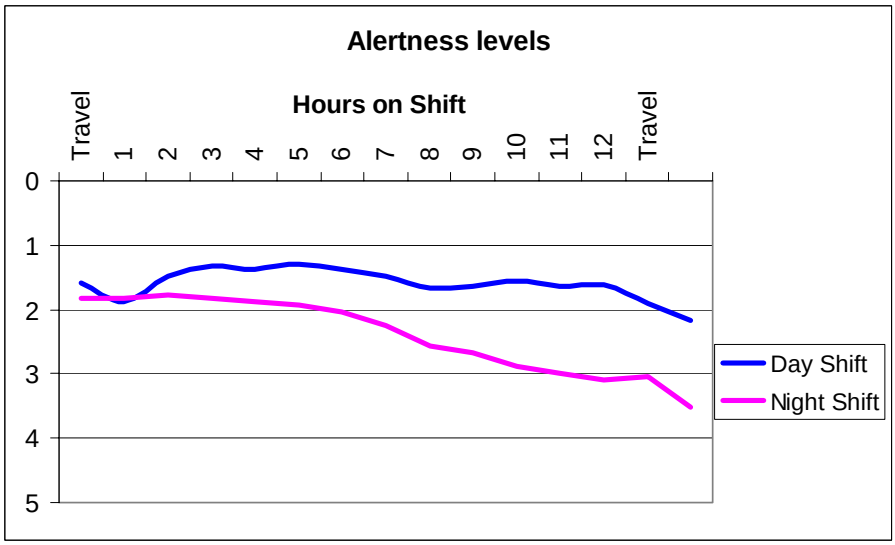


Figure 5.12 Mine 8

5.2.2 Economics of break patterns

Most of the costs and other economic factors involved with break patterns and duration of breaks are determined by the work agreements in place for scheduled breaks and, as such, are not included here.

The major economic factor that was identified as affecting the effectiveness of break patterns was the requirement at sites to maintain productivity during breaks by hot seat change-outs ie having a relief driver while the operator is on the break and the operator moving to the crib room. These were practiced at most sites involved in the project.

The operators who were interviewed during the project were generally accepting of this process and it did not affect the effectiveness of the break. The break where it was identified as being a disadvantage was the second break during night shift. During this break many operators identified that they prefer to remain in the cab of the vehicle and have a nap or rest. Having to move out of the vehicle into the crib room limited the ability to have a nap or rest.

6 FATIGUE, WORK EFFECTIVENESS AND WORKBREAKS

Work factors or other issues outside the workplace can cause fatigue. These have been effectively identified in a range of projects completed in the mining industry and a number of guidelines and other guidance material is available (Baker and Ferguson, 2004; DME, 2001, NSW Minerals Council, 2003). This guidance material provides generic information on the types of work with a high risk of fatigue and the scheduling and duration of work breaks to manage the risks associated with fatigue.

A range of factors also determines work effectiveness. A baseline of safe operation is established and the NORM of operations may comply with the baseline or be significantly different. Unless the outcomes of factors affecting the NORM are identified in terms of costs and likelihood, it is not possible to determine the appropriateness and effectiveness of changes to these factors.

The factors affecting the NORM fall under physical demands, mental demands, work environment and skills base. These factors also influence the fatigue associated with work.

Unfortunately fatigue is not easy to quantify and it is also not easy to quantify the costs to a site of factors affecting the NORM that may cause undue fatigue. Only outcomes leading to accidents, incidents or potential damage are generally reported and it is difficult to determine the influence of fatigue.

The WEM outlines a process to allow the identification of the NORM and the factors affecting the NORM. In this project, the effect of work breaks was considered for a task with an identified high risk of fatigue – haul truck driving at surface mines.

Perhaps due to the focus on fatigue in the mining and other industries in recent years, there was good understanding and application of processes to manage fatigue applied by individuals. This focus on fatigue management may also have led to the absence of any clearly identifiable impacts of work break patterns on quantifiable and reported outcomes.

6.1 Applying the WEM

This project collected and reviewed data from a wide variety of sources including operator and manager interviews, questionnaires, high potential incidents and other company documentation. In addition, it undertook a review of the relevant scientific literature and applicable legislation.

Based on all this, the WEM was developed. The WEM process can be modified for any mining task. An outline of the process including information required is included in Appendix A.

Using the WEM framework to guide the data analysis, the most important findings of the project were:

(a) Assessment of work effectiveness for haul truck driving in surface coal mining operations

i. Resources are available to establish the baseline of safe operations:

   - competencies and training:
   - procedures.

   However, some formal written procedures were found to be inadequate at recognising physical and mental demands of tasks.

ii. The variations from baseline to NORM are not significant for the sites involved in this project. It is recognised that by agreeing to be involved in this project, these mines are likely to be proactive and positive. At other sites, the NORM may vary significantly from the baseline.

   Most important aspects of establishing the NORM identified by the operators were:

   - The relationship with and respect for the supervisors;
   - The workplace culture – specifically management support for individuals. This related to more than just fatigue issues

iii. The average cost of variations to the NORM for the designated task was $23 500.

iv. The likelihood of these variations leading to significant results that might be affected by work breaks was determined to be approximately 20%.

Therefore, work effectiveness for haul truck driving could potentially be improved by maximising the benefits associated with work breaks.

(b) Current situation with work breaks

i. It was not possible to identify any definite link with time of breaks and incidents occurring. It was not possible to determine any pattern associated with shift length. LTIs and HPIs occur throughout the shift.

ii. The alertness logs found that operators generally got less alert during shifts (especially night shifts). Within this project it was not possible to compare the effectiveness of current break patterns with alternative break patterns to help reduce this alertness loss. However, the general scientific literature would suggest that operator alertness would be far lower without any work breaks, and that shorter, more frequent breaks are preferable to a single break.

iii. The operators engaged in the task studied for this project generally had a reasonable break structure and good understanding of fatigue.

iv. Overall, operators reported that current breaks are adequate but between 40 – 50% also indicated the longer or more frequent breaks would improve the situation.

The data and information collected indicated that current work break times and durations are generally adequate for managing the fatigue associated with haul truck driving but improvement are possible.

(c) Maximising the benefits of breaks

i. Allowing operators some control over break timing is valuable, however, breaks should not be excessively delayed. As such, more education and publicity about the effectiveness of regular breaks is strongly recommended.

ii. Providing an area where breaks can be safety taken in reasonable comfort is important. This allows for an operator to engage in different activities (eg food, rest, conversation).

iii. More frequent breaks (eg two 30 minute breaks per shift rather than one 60 minute break) are generally preferred by operators. Similarly, the scientific literature generally supports the use of more, shorter breaks.

iv. Extra short partial breaks (of less than 10 minutes) towards the end of shift might help to combat fatigue, reduce work errors and maintain work performance.

v. Generally voluntary fatigue breaks were perceived as being viewed negatively by supervisors and co-workers. As such, having an optimal break pattern where excessive fatigue does not arise is preferable (so limiting the need for voluntary fatigue breaks). Using the WEM can help establish this optimal pattern for other mining tasks.

6.2 Conclusions

Overall it is concluded that the methods and framework outlined by the WEM can be valuable to help assess the adequacy of work break patterns. It is strongly recommended that the WEM be used to assess other mining tasks.

It is acknowledged that other jobs in mining might not be so positive in terms of their break patterns and operator knowledge. The WEM that was developed should prove to be useful to help review these situations, and to provide directions for suitable countermeasures.

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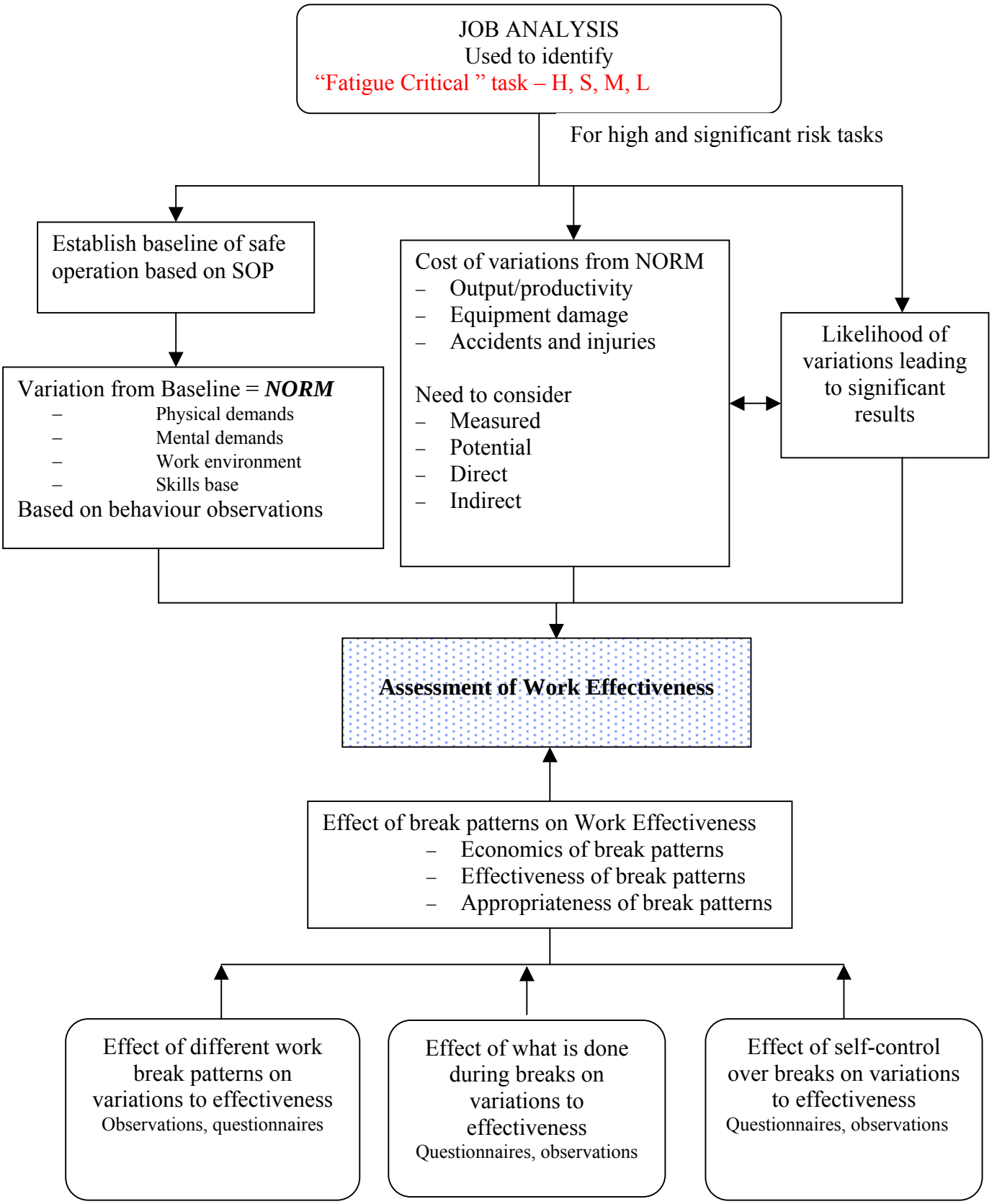
Appendix A - Work Effectiveness Model



Work Effectiveness Model WEM

Appendix B - Tools used for information gathering

1. Management interview template;
2. Operator interview template;
3. Work breaks questionnaire

Template for Management Interviews

Date and contact details	Mine	Details of breaks
	Name No of employees Shifts worked Average age Average experience Characteristics of operation eg length of haul etc	General comments - Processes to manage fatigue
		Formal Breaks No of breaks Length of breaks Timing when breaks are taken Who controls when breaks are taken Why was this break pattern chosen
		Informal Breaks What work processes allow informal breaks Length of breaks Timing when informal breaks are taken Who controls when informal breaks are taken Other comments

Questions for operators interviews

Age

Gender

Experience

1. Effect of task rotation

2. Personal coping methods

3. Effect of formal breaks

4. Effect of informal breaks

5. Timing/length of breaks

Workbreaks Questionnaire

1. What type of operation do you work at?

1 ☐ Metals - Surface
2 ☐ Metals - Underground
3 ☐ Coal - Surface
4 ☐ Coal - Underground
5 ☐ Quarry
6 ☐ Other

2. What area do you work in?

1 ☐ Production
2 ☐ Maintenance
3 ☐ Management/administration
4 ☐ Other _____

3. What is the length of shift you normally work (no overtime included)?

1 ☐ Less than 8 hours
2 ☐ 8 hours
3 ☐ More than 8 and less than 12 hours
4 ☐ 12 hours
5 ☐ More than 12 hours

4. How many shifts do you work in a row?

1 Day shift _____

2 Afternoon shift _____

3 Night shift _____

5. What is the normal start time of the shift?

1 Day shift _____

2 Afternoon shift _____

3 Night shift _____

6. How many official breaks are allowed in a shift? eg 1 x 30 minute, and 2 x 15 minutes

Duration of break	Number of breaks
Less than 15 minutes	
15 minutes	
Between 15 and 30 minutes	
30 minutes	
Between 30 and 60 minutes	
60 minutes	
More than 60 minutes	

7. Who usually has control of when you take your official breaks?

1 ☐ The shift supervisor
2 ☐ The crew members in consultation with the supervisor
3 ☐ The crew members organise it themselves
4 ☐ I have significant control over my own work and I decide when to take breaks
5 ☐ Other _____

8. What do you do during your breaks?

Activity during break	Always	Often	Sometimes	Never
Eat / drink				
Rest and relax				
Sleep				
Exercise eg walk around				
Read				
Talk with others				
Other _____				

9. If you extend your shift by overtime, do you get an extra break?

1 ☐ Yes
  a ☐ at the end of the rostered shift before starting overtime
  b ☐ during the overtime

2 ☐ No

10. Does you job allow you to take other "unofficial" breaks during a shift?

1 ☐ Yes
2 ☐ No

11. How are unofficial breaks decided?

1 ☐ The shift supervisor
2 ☐ The crew members in consultation with the supervisor
3 ☐ The crew members organise it themselves
4 ☐ I have significant control over my own work and I decide when to take breaks
5 ☐ Breakdowns/maintenance
6 ☐ Gaps in the work eg loading/unloading/roof bolting/moving equipment/blasting
7 ☐ Other _____

12. How long do unofficial breaks usually last?

1 ☐ Up to 5 minutes
2 ☐ Up to 10 minutes
3 ☐ Up to 15 minutes
4 ☐ Up to 30 minutes
5 ☐ Longer than 30 minutes

13. Do you think you have sufficient breaks during your shift to make sure you work safety and efficiently?

1 ☐ Yes
2 ☐ No

14. How do you think breaks could be made better?

Thank you for completing this survey!

Appendix C - Details of interviews

1. Details of management interviews
2. Details of operators interviews

Mine 1	Details of breaks
74 FTEs 68 permanents and rest contractors 2 x 12 hour shifts worked, 5 days per week. No week-end work Production 4 x 12 Mon – Thurs (Fri o/t for a small group) Maintenance work Tues to Friday CHPP 12 hours 5 nights (Mon- Fri) then WTF days, then MTWT days Short haul on a 2way haul road ~ 6 cycles per hour Average age in early 40s 2.1 million tonnes per year produced. ~4 million tonnes mines	General comments There is little formal process to manage fatigue at this stage. There are limitation on hours worked per shift and per roster cycle as per the Regulations. Workers get paid for 12 hours and 25 minutes. Start time is 6.35 for the pre-shift hot seat change. There are keys points in the work processes where it is necessary to maintain a continuous work process to allow others to continue their work eg digger. Supervisors often step into the role of operator during breaks excavator driver, train loader. There is no drilling or blasting. Task rotation is practiced but that depends on the skills of the workforce. The large number of thin seams to be mined and the specialist skill level required limits task rotation. No record is kept of cycle times, just the total amount of coal hauled in the shift. There is no monitoring in trucks or electronic recording of time of day at present time. Radio and communication important for the management of fatigue as evidenced by chatter on radio during last hours of night shift. A contracting company hauls the coal from the CHPP to the rail load out. There is the possibility of moving to 10.5 hour shifts in the future. This would mean only one break. Travel – 45 minutes each way would be the maximum. Some workers travel up and stay locally during the roster cycle. Most do not travel every day. Staff hours are similar to other mines. Will be monitored with swipe card to be introduced soon.

Mine 1	Details of breaks
12 –15 metres overburden	Formal Breaks There are 2 x 30 minute breaks per shift. The break is counted from when the worker enters the crib room ie break does not include travel time Workers are broken into 2 groups to have breaks to maintain operations. Usually 4 –5 hours from the start of shift and same after for second break. The two crews tend to take slightly different breaks with on 15 –20minutes later than the other. The priority is that the digger runs. In the first break the excavator keeps operating – in the second break it is refuelled. (both on day and night shift) There is more flexibility in the CHPP. Supervisors determine who takes what break. The break pattern was chosen due to the Award.
	Informal Breaks The work processes change continuously and there is very little time during eg loading for a break. There is not much in the way of queuing for loading. There is an acceptance of the need for drivers to take breaks and the self identification of fatigue. There are no official records kept of this. Generally supervisors respond to needs of workers and the situation. There are no spare people – but there are good relationships between supervisors and crews eg supervisors may take over a machine or arrange for the water truck driver to take over to keep the equipment going.

Mine 3	Details of breaks
~ 90 employees 2 x 10 hour shifts worked, 5 days per week. No week-end work 7 kilometre haul on a 2way haul road Average age in early 50s	General comments There are keys points in the work processes where it is necessary to maintain a continuous work process to allow others to continue their work eg excavator driver, train loader. There is a lack of redundancy in these areas to allow flexibility in breaks. Man management and knowledge of crews by supervisors is essential to effectively manage fatigue. Supervisory and workers look after each other. BBQ on Friday evenings. Task rotation is practiced but that depends on the multi-skilling of the workforce. There are weekly production meetings but no record is kept of cycle times. Flexible policy to manage fatigue. Radio and communication important for the management of fatigue.
	Formal Breaks One 30 minute break at around the fourth hour. There is flexibility in when breaks are taken and workers are scheduled for different breaks on different shifts eg early break one day – late break the next day. The timing of the official break is historical. Workers are picked up and taken to crib rooms. Break starts from when the worker arrives at the crib room. If there were two shorter breaks, the breaks would cut into production due to the travel time Overtime – 30 minute break at start of overtime – some do not take the second break and finish 30 minutes early instead. These workers would generally be rotated through other equipment if give them a change.

Mine 3	Details of breaks
	Informal Breaks Unofficial breaks due to backing up of trucks during loading. Drivers can get out and go for a walk. Flexible fatigue management policy and practices. OCEs have several breaks as required – particularly during summer due to complexity and manual nature of work

Mine 9	Details of breaks
No of employees 50 employees with 3 employees in the washery per shift Also road haulage contractors Shifts worked Production 2 x 10 hour shifts Monday to Friday 7am – 5pm 5pm – 3am Short day of 7 hours on Friday 7am – 2pm 2pm – 9pm Washery 7 x 12 hour shifts 6am –6pm – 6am (4 week cycle with 2 weekends off) Maintenance Maintenance work 2 x ~11	General comments - Processes to manage fatigue The mine has been operating since 1995. It currently mines ~1.5Mt to increase to 2.5Mt in 2 years. Some (most) production workers rotate through day and afternoon shifts. There are 2 permanent afternoon shifts operators and some permanent day shift operators. Production have 50 –60 loads per shift. There is a short haul. There are 3 trucks under the excavator and 2 trucks under the loader The strip ratio is 3.5:1. There is also a contractor operation for overburden. These work 12 hour shifts but day shift only. There are 8 employees on the scraper crews. In the Washery, 30-40% of workers would live away. 3 camp in a company hours while they are on shift. Most production workers live away. Most contractors live locally. There have not been any travel related incidents Workers are encouraged to report fatigue. Overtime is monitored and there is tracking of hours weekly. There is rostered overtime. Overtime is self-managed on the back shift and the OCEs are responsible.

Mine 9	Details of breaks
hour shifts and some weekends. They rotate shifts Average age Washery ½ in 50s and the rest would be in the 30s or 40s. Production Younger with an average age <40 4 OCEs are >50. Average experience 50% would be experienced in the mining industry Characteristics of operation eg length of haul etc	Formal Breaks No of breaks and length of breaks Production - One 30 minute break Washery – 30 minute and 2 x 15 minute breaks Length of breaks Timing when breaks are taken The rostered break is taken after 5 hours of work. There is about 5 minutes travel time to the crib room. Break starts in the crib room. Who controls when breaks are taken The rostered break is taken together – there is no staggering of the break.
	Informal Breaks - Informal breaks are taken. What work processes allow informal breaks - This is more so for the trucks rather than the excavator or dozer. In the Washery, there is more self management of breaks Other comments Thermos are supplied and breaks can be taken “on the run” – this allows a structured informal break on afternoon shift.

Mine 10	Details of breaks
No of employees 530 operators and some contractors 15 females Shifts worked All on 12 hour shifts except shot-firers Start time 6.30. Maximum of 3 shifts in a row. Every second week-end off Average age Operators 49. Slightly lower now due to new starters Average experience Older workers are very experienced Mixture of experience levels for new employees Characteristics of operation	General comments - Processes to manage fatigue Mine has been operating for 2 years. Shift length is actually 12 hours 40 minutes due to hot seat change. The CHPP has been working this roster for 3 years. Some operators have been sent to a sleep therapist when they complain about not being able to sleep when on night shift There are fatigue risk guidelines in place and these have been reviewed this year (guideline and review provided). There was a team involved in the development of the guidelines. The roster had been pre-decided and the group worked within the roster. It was recognised there was a need to keep IR and HR separate. Both work and home p0ersepctives were considered. Supervisors are more familiar with the guideline than employees. Unions took part in the consultation. There is a overtime quantum for workers. This is controlled by the department manager. Task rotation is strongly encouraged and most operators have a range of skills to allow task rotation There is a “fatigue” button in the trucks that allows operators to identify they are fatigued while not on the 2-way to let everyone know. There is concern by employee that this is a “big brother” situation as the times the button is used will be recorded. Generally, the workers and supervisors use the informal control that are in place in preference.

Mine 10	Details of breaks
eg length of haul etc Truck and shovel operations. Depth of overburden varies due to dipping of seam. Length of haul varies. Tends to be shorter on coal run	Formal Breaks - No of breaks 2 formal breaks Length of breaks 30 minutes. Time taken from crib hut. OCEs are fairly informal about the length of break. Timing when breaks are taken - Most breaks taken within 5 hours of start. Workers prefer breaks to be as late as possible Who controls when breaks are taken - Breaks are controlled by the dispatcher. But this is flexible and depends somewhat on production and breakdowns Why was this break pattern chosen - This pattern was voted in. There was a history from the CHPP Some shifts park up for second crib to allow operators to have a rest or nap. If production demands it, they will work through second crib.
	Informal Breaks - What work processes allow informal breaks Most work processes allow some informal breaks – but normally of short duration. Length of breaks - Normally of short duration Timing when informal breaks are taken - As possible Who controls when informal breaks are taken - The OCEs tend to control the longer informal breaks when an operator identifies that he is fatigued. Otherwise the breaks tend to be part of the production process Other comments - Having a sleep is accepted onsite. This is in the crib hut or in the truck during second break. Operators prefer to stay in the truck which is comfortable and warm.

Mine 11	Details of breaks
No of employees 201 Shifts worked 4on 4off roster 12.5 hours shifts starting at 6.30 Average age Approximately 40 Average experience 3-5 years with a number of employees from metalliferous Characteristics of operation 5 diggers and dragline Coal haul of 5 km is longest Depth of cover 75m with a	General comments - Processes to manage fatigue There has been a relatively recent shift change from 6 on 3 off to the 4 x 4 roster. This change is very popular with the employees. Task rotation is limited due to the skills base Operators are encouraged to call up supervisor if too fatigued to work but this happens only rarely. Workers are expected to live in 80K radius while on shift to limit travel. Max of 15 hours per day (this includes travel time). This can be exceeded at the discretion of the project manager. Supervisors are currently working at this maximum No more than 7 days straight Max of 80 hours in any 7 day period Contractors fill out fatigue form outlining work for the previous 7 days Mine Owners monitors hours for production workers and has minimum standards but these are not prescriptive – merely reflect the requirement of the legislation Hours for staff are a problem due to long hours worked and no monitoring.

Mine 11	Details of breaks
steeply dipping 10 metre seam of variable quality	Formal Breaks No of breaks - 2 breaks in shift Length of breaks - Each break is 30 minutes Timing when breaks are taken - There is a window of opportunity but breaks are organised by the supervisors. The crews pull up for the break and the break timing starts from when the operators reach the crib hut. Who controls when breaks are taken - Formal breaks are controlled by the supervisor Why was this break pattern chosen - Historic and convenient
	Informal Breaks - What work processes allow informal breaks - Breakdowns mainly or gaps in the work flow Length of breaks - This varies depending on the situation. Timing when informal breaks are taken - Limited opportunity for any planning – take them as they come up. Who controls when informal breaks are taken - Supervisors mainly but also equipment

Mine 20	Details of breaks
No of employees 250 + contractors – total up to 400 Shifts worked 4/4 12 hour staff 5/2 Average age 40 -45 Average experience 20 years Characteristics of operation eg length of haul etc Longwall UG coal mine Camp based	General comments - Processes to manage fatigue Fatigue Management Plan includes: Hours of work Transport and accommodation – quality of rooms and food Overtime limits Self management of fatigue on shift – mainly non start or extra break Focus in summer on hydration Job rotation heavy workload and humidity FAID benchmark 4 nights score 118 nothing more than this allowed.
	Formal Breaks No of breaks 2 Length of breaks 40 mins and 30 mins in EBA Timing when breaks are taken Windows 4 –5 hours and 7.5 to 9 hours production maintained Who controls when breaks are taken Supervisor/deputies Why was this break pattern chosen History and advice from Brad Strahan + award conditions

Mine 20	Details of breaks
	Informal Breaks What work processes allow informal breaks Longwall – rotate crews Development rotate crews Length of breaks 5 – 10 minutes Timing when informal breaks are taken Discretion of deputies Who controls when informal breaks are taken deputy Other comments Informal breaks integral part of FMP

Mine 1 Operator Interviews

Operators	Effect of task rotation	Personal coping methods	Effect of formal breaks	Informal breaks	Timing/length of breaks
Male, Permanent 23 years in the coal mine Likes 8-10 shifts	Drives dump truck all night	Nothing unusual, eats fruit and nuts. Will keep the heater on for a short period and than turns it off Doesn't eat much on night shift Dislikes exercise and is moody at home from night shift	2 x break`	When tired on shift will try and walk around the truck and yard Will shut eyes for a break while waiting for load Knows if he gets really tired will have a 20 mins breaks. Drinks coffee to stay awake. Radio keeps you awake	Likes two breaks only but would like to spilt the shift and spend half the time driving the dump truck and on another piece of machinery
Male, Permanent,16 years in mine	Drives dump truck all night	Sleep 4-4 half hours before going to work Drink water, no snacking, but will have a cup of tea No smoking	2 x breaks which is great. 3 breaks would mean you would have to stay longer Just eat foods and doesn't sleep at all in breaks, but will shut eyes if need to First night is the hardest	Listen s to chatter on radio and radio music Drinks water. Doesn't like to exercise. Will not eat extra food.	Happy with breaks. Doesn't want to change it. Shorter shifts would be great-10 hours than go home and sleep. Moody with shiftwork

Operators	Effect of task rotation	Personal coping methods	Effect of formal breaks	Informal breaks	Timing/length of breaks
Male, Permanent . 16 years in mine	Drives dump truck all night. Can choose to drive loader if he wants likes Dump Truck would like to rotate machinery	Splashes water on face Eats in truck-fruit and nuts	1 break – eats smoko 2 breaks – sleeps. Likes current break times When really tired will go and have asleep No coffee and tea at work	Lays back and rests between loads. Exercise in breaks. Would like to have a gym at work or a walking track. Reads newspaper and mags in truck	Likes current breaks but wants 10 hr shifts for sleep
Male, Permanent, 16 years in mine	Drives dump truck only but would like to rotate on machines Drinks coffee and snacks on fruit	Drinks coffee. Read in the truck.	2 x breaks but three would be great. No exercise at all. Rainy nights are hard eyes are very tired and have to concentrate	Turns heater on and off to keep awake. Production is important so no sleeping. More 5 mins breaks would be great. Tired from rainy nights and the bright lights.. Chatter and jokes on radio helps. Listens to music and tapes	Likes 2 x breaks buts wants to add more coffee breaks. Wants to work 8 hr shift. Travel to work takes 50 mins

Operators	Effect of task rotation	Personal coping methods	Effect of formal breaks	Informal breaks	Timing/length of breaks
Male, Casual, Drives dump truck or water truck. Been with the company 12 months. Lives 10 mins away	Stays on one machine all night. Works only 1 or 2 shifts per week. Runs a farm during the day.	Exercises constantly when he can at work. He suffers from muscle fatigue from sitting in one spot, so exercise. Doesn't drink coffee or smokes	2 x breaks 1st break walks for 5 mins and won't eat big meals Great if a walking track was made .	Radio and chatter on radio helps. Eats food, nuts, biscuits, fruit. Long haul roads are the hardest, so boring. Reads the paper but eyes get sore. Air conditioning and lighting causes eyes to become sore	3 x breaks would be good plus exercise walk added. Shift spilt into 4 hour s. 10 hour shifts would be great, 12 hours shifts dangerous .
Male – 4 weeks experience	Prefers to stay on one truck all night	Don't eat as much on night shift and lighter food. No tea or coffee but water Chatter on 2 way at night to help people stay awake No family so sleeps well through the day	First break goes to crib room – 2nd break just parks up	Walks around while waiting to load Encouraged to let supervisor know if fatigued	
Male – 17 months experience		Splash face with cold water Prepare for night shift Same food on day and night shift Listens to radio	Option to sleep in truck or have crib – better to have something to eat and drink	Walk around the deck when waiting Have a read Management good with fatigue	

Operators	Effect of task rotation	Personal coping methods	Effect of formal breaks	Informal breaks	Timing/length of breaks
Male – 6 months experience, casual and on-call work	Likes to stay on truck for full shift Would like to train on other equipment	Eats same meal but not as much on night Tries to prepare for night shift Radio and chatter on 2 way is important Constant things during night shift make a different eg don't change routes during night shift	Bigger meal at first break	Ties not to have a nap while loading as makes feel worse Reads a book or paper	Break at 3am is good
Male – 11 weeks permanent but has been on site longer	Drives same truck all night	Eats similar on day and night shift. Snacks while driving and drinks water Radio at night is important – feels isolated in trucks	Has a nap during breaks some night shifts	Reads and writes during loading – gets out and walks around	Crib breaks are good for timing but could use more
Male – 14 years experience	Stays on same truck all night	Fruit and nuts in cab and water	Snacks or sleeps in second break	Exercises out of truck every couple of hours for back and for fatigue Good management processes for fatigue	2 breaks enough Second break could be shorter 10-20 minutes

Operators	Effect of task rotation	Personal coping methods	Effect of formal breaks	Informal breaks	Timing/length of breaks
Male – Casual, 6 weeks experience	It is easier to stay on one truck all night	Prefers night shift and sleeps well through the day Snacks on night shift and drinks water Chatter on 2 way and radio makes a difference	Treats both breaks the same, eats on both breaks	Supervisors are good for managing fatigue Short informal breaks under digger Clean truck windows	2 breaks are enough
Male – 13 months experience		Radio is good Eat fruit in lunch Just water in the cab		Reads newspaper during informal breaks	More short breaks would help
Male casual – 19 year experience	Being on truck all night is not an issue	Listens to radio Tries to get sleep before night shift – sleeps well during the day Snacks in cab and has water	Has sandwich in first break and a snack in the second break	Sometimes reads during informal breaks or have a bit of a nap	2 breaks are adequate

Mine 2 – Operator interviews

	Effect of task rotation	Personal coping methods	Effect of formal breaks	Informal breaks	Timing/length of breaks
Contractor, female	One job per night doesn't worry	uncertainty for contractors means preparing for work not easy	• 10 min break at about 4 am – all pull up • 30 min crib in crib room – longer would be waste of time	• would prefer to get out and walk around rather than sleep • if call (?) up tired can take up to 15 minutes to get someone to relieve	One break – could do with a short break in morning
Male	stay on one machine all shift – rotating not a practice within shift	• doesn't eat much while on shift • Does go onto automatic pilot on night shift	30 minutes is long enough – otherwise would get sick of it	Tries to keep active through shift, does not sleep under loader or while waiting	Breaks in 12 hrs – smoko @ 10am, crib 1pm, work through til 6pm
Male	Usually stay for full shift or a week – ask to change out	Snacks throughout night		does sleep during loading – nearly every shift	• day shift breaks ok • length is ok on night + extra break would be good
Male	Variety when dozing – no problems on night shift - change out during shift	try to eat healthy due to limit of exercise	with crib relief some workers get a very late crib	Can take some unofficial breaks during loading etc	Single break is a bit short
Contractor, female	Prefers to stay on a singe truck – some want to rotate	• eat and drink – need to recognise non fatty foods • Exercise – helps	Having company at crib can help	• Chatter on radio through night helps. • Uses Discman for music at times to	Night shift needs second break

	Effect of task rotation	Personal coping methods	Effect of formal breaks	Informal breaks	Timing/length of breaks
		overall but not sure about night shift		keep awake	
Contractor, male			Digger and truck drivers all go to crib together	• Resting on steering wheel during loading. • Supervisor on Sunday night shift brings coffee around only 12 personnel • some chatter on two way but not encouraged	• Likes late as possible for break as makes last part of shift go faster • Length of break doesn't matter so much
Contractor, male	Stay a whole shift but would prefer to change over after crib	Not hungry on night shift so don't eat much	Eat, drink and then back to work	"unconscious competency" during monotonous tasks	
Male		• big meal before start of work • Herbal teas • Autopilot puts you to sleep	supervisor is good with recognising fatigue	• Snacks in truck and drinks water • Reads book under digger then turns radio up and then takes off Has gone to sleep at 9am day shift under digger – once	
Male	Normally on excavator all night	Normally sleep for reasonable no of hours		Naps when under digger but feels worse when wakes up	Time off between roster – 24hour break between Friday night

	Effect of task rotation	Personal coping methods	Effect of formal breaks	Informal breaks	Timing/length of breaks
					and Sunday day
Male	prefers one piece of equipment all night	• eats healthy • has time to exercise and helps to cope with shiftwork	supervisor is good with recognising fatigue	• snacks through night shift but not coffee or tea only water • sometimes reads the paper when waiting for filling but not normally dozing (sleeping)	
Male	likes to stay on one truck all night but will do other machines if required	• food + drink makes difference – eat light • eats before coming in on night shift	formal breaks work well – good supervisor + good shift and evolving well as shift together	• informal breaks work well • never eat in truck – only drinks water	

Mine 10 Operator interviews

	Effect of task rotation	**Personal coping methods**	**Effect of formal breaks**	**Informal breaks**	**Timing/length of breaks**
Male permanent 29 years experience Car pool for travelling	• Task rotation is good • Short haul is better	• effects for night shift • nibbles throughout the shift – muesli bars and fruit • drinks water • Light meal before sleep and sandwich on waking • No changes to crib on day or night shift	• Drinks coffee at crib time	• Gets out and walks around • There is management support for the identification of fatigue by operators	• Length and number of breaks is good • Later crib is better – last part of shift goes faster
Male Permanent 23 years experience Lives one hour away and travels with car pool	• Would prefer to stay on one piece of equipment all shift but likes to be part of a crew • Prefers the short haul and not to see the view • Seats are difficult to adjust and not comfortable	• Likes night shift best – no family issues and likes to be independent • Has a sleep in the afternoon- not in morning and not before night shift • Doesn't snack – drinks lots of water • Uses music to keep awake • Likes cool air going • Sometimes has a		• Would not tell supervisor or use button – prefer to stop for toilet etc	• Current breaks are adequate. Prefers later in shift

	Effect of task rotation	Personal coping methods	Effect of formal breaks	Informal breaks	Timing/length of breaks
		short nap during loading. Reflections and glare from lights can be an issue			
Male-permanent 12 years experience Car pools	• Likes to stay on trucks all night – doesn't like to rotate	• No napping during shift • Normal meals but occasionally snacks through the shift • Drinks water • First night shift is OK but copes better with second night shift	• Always get out for first crib – eat and snack • Second crib – prefers to stay in truck and have a sleep – uses mobile phone as an alarm	• Fog and rain give a break • Fatigue button not a success – "Big brother" – but management is reasonable about fatigue	
Male permanent 10 years experience Car pools	• Likes to rotate tasks and prefers to start on the trucks • Prefers longer hauls to shorter hauls • Need to make sure people have more than one skill so they can swap – need more training	• Has a sleep in the afternoon before night shift but 3 shifts is difficult. Not good at sleeping during the day. • Drinks 2 litres of water each shift • Uses air conditioning • Bad weather keeps awake as need to concentrate – doesn't like daylight	• Doesn't eat on night shift "dog watch belly" – indigestion • First crib – coffee • Second crib – sleep if possible • Prefers to not be relieved so that can sleep in truck during second crib	• Gets out and walks around • Cat naps in the dozer occasionally • Management (foreman) is good – recognises fatigue on the night shift • Would not use fatigue button due to concern about appraisal	• Would prefer late cribs eg midnight and 4.30.

	Effect of task rotation	Personal coping methods	Effect of formal breaks	Informal breaks	Timing/length of breaks
		saving • Night shift is easier as less people around • Radio is important			
Male permanent 2 years experience Lives 30 minutes away and car pools	• Prefers to task rotate and not sty on truck all night – rotates on to grader • Short hauls are preferred as you need to keep thinking • Crew is good with swapping. Operator would like more skills	• Sleeps in afternoon and sleeps well between night shifts • Shiftwork causes problems with training for sport • Likes night shift and daylight saving • Radio reception is good • Has selective hearing for chatter on the two-way	• Day shift – eats during both breaks • Night shift – eats first break, sleep though second crib either in truck or manhaul	• Gets out and walks around • Refuelling gives a break • Foreman is good and understands about fatigue – flexible in terms of family and social commitments	• two breaks are good. • Longer until first crib is better
Male permanent 8 months experience – new to industry and shiftwork 30 minutes drive – starting to carpool	• Currently just driving trucks – swapping would help	• Doesn't sleep well before first night shift – reasonable sleep between night shifts • High concentration causes tiredness • Same food during day and night shifts • Snacks in truck – chocolate, fruit,	• First crib – toasted sandwich – second crib – fruit and biscuits • Second crib – sleep in truck if possible	• Every couple of hours – have a break and get out and walk around – self management	• No worries with timing of crib – like to have evenly spaced

	Effect of task rotation	Personal coping methods	Effect of formal breaks	Informal breaks	Timing/length of breaks
Has fallen asleep during drive home		chips.			
Male contractor 14 years experience ten minutes travel	• Works on different equipment – one change per shift is good for variety	• Eats healthy and plans around the day when working – very limited alcohol • Rest before first night shift – good meal at end of shift and then sleep – Sleeps between consecutive night shifts • Drinks 2 litres of water • Tries to exercise every day	• Doesn't eat much on night shift	• Gets out and moves around – does stretches	• 2 x 30 minute cribs are good – better than one of 60 minutes
Male permanent 8 years experience Travels by carpool	• Rotates through 3 tasks and also drills	• Sleep in afternoon before first night shift • Sleep between night shift varies from good to bad • Has stayed home due to fatigue • Eats if bored but not lollies	• Eats same food on day and night shift - sandwiches on first crib, fruit on second crib • Doesn't sleep in second crib	• Gets up and moves around if tired • Relationship with supervisor is important for managing fatigue	

	Effect of task rotation	Personal coping methods	Effect of formal breaks	Informal breaks	Timing/length of breaks
Male permanent 24 years experience Car pools – 30 minutes travel	• Likes to rotate through equipment • Need to have a range of skills	• Has a sleep before first night shift. • Uses prescription tablets between night shifts • No snacking in the cab • Smooth roads make you go to sleep • Heater can make you sleepy but weather not a problem • Working radio is important • Lights at night and glare is a problem	• Normally a hot meal at first g\crib whether day or night shift • Second crib – day, sandwich – night, cereal • Doesn't drink much – water only at crib	• Get out and have a stretch if needed • Management are fair in terms of fatigue	• two breaks are good. • Later breaks are better
Male permanent 9 months experience		• Sleep in afternoon before night shift – takes time to recover from night shifts • Radios are important	• Feed in first breaks and light snack in second • Coffee doesn't make any difference • Getting swapped out in second crib makes a negative difference	• Getting out and stretching is important • Informal breaks are important • More likely to take an informal break than press the fatigue button	• breaks are adequate • Standard breaks would be better-known time to look forward to.
Male, Permanent 11 months	Drives dump truck all night, but will rotate once trained on	Stays in bed and rests Put on weight since starting work. Eats	2 x break – Likes breaks. New employee and wouldn't tell	When tired on shift will try and walk around on the truck	Breaks – would like 20 mins first break, 40 mins –2nd break

	Effect of task rotation	Personal coping methods	Effect of formal breaks	Informal breaks	Timing/length of breaks
years in the coal mine Lives 1 hour away	machinery. Four hourly rotation	nuts, sultans in truck. Cant' pick up all radio stations so listens to own music/Cd. Puts his head over the wheel 2/5 times a night. Reads in truck	employer he is tired No Smoking	Will drink red bull if tried. Uses mobile phone during shift to keep awake Would like chin up bar on truck to exercise	. Sleeps in 2nd crib 1 brk-main meal/coffee 2 brk-sleeps and eats snack food Would like to bring family member on truck.
Male, Permanent, 7 years. Lives half hour from home.	Drives dump truck and rotates 3 times during shift-likes to rotate- breaks boredom	Nothing unusual but if he drinks too much he will stay up all day, peeing. Drinks coffee and water in truck. Used to eat rubbish but put on to much weight. Sucks lollies.	2 x breaks, which is good. 2nd break would like to sleep but is noisy in the crib room. Can't sleep in truck. If tired pull over to rest but fills up truck with petrol and can sleep fro 10 mins.	Reads radio and doesn't listen to two way hates it. Exercise at work when he can. Equipment break down can sleep. Text messages on phone. Will put head on wheel when tired depends on how tired he is	Drives when fatigue. Eyestrain from lights at night. Wont' hit fatigue button because it will go against you.
Male, Permanent. 3 months. Lives close during N/S and longer drive home	Drives dump truck all night but would like to rotate but can't due to lack of skills.	First day-up earlier to gym and exercise and back into bed and sleeps until start of N/S. Eats fruit and vegetables in truck.	2 break – would like breaks staggered When really tired can tell management but wouldn't do because doesn't want to cause problems. No coffee	Lays back and rests between loads as has problems with back. Walks on truck when he can Reads and radio and hates the 2 two way.	2 break – would like breaks staggered and the second break longer to sleep. Would like trivial game on radio to keep awake.

	Effect of task rotation	Personal coping methods	Effect of formal breaks	Informal breaks	Timing/length of breaks
			and tea. Eats light meal only and diet coke. No sleep in breaks	Turns air-cond up to keep awake.	
Male, Permanent,4 months, 20 years in mine. Lives close	Drives dump truck only but would like to rotate on machines but doesn't have skill level	First day – sleeps in the afternoon. No coffee or lollies aware of health . Radio, doesn't like 2 way radio, reads paper and walks around truck	2 x breaks great. 1st break – sandwiches/no sleep 2nd break – no sleep and small amount of food.. Machine breaks down, rests. Hates night shift and rests on wheel every time.	Wont' tell boss if tired as he loves his job. Doesn't use air-cond or heater. Seat back and will try and shut eyes during shift.	Happy with timing of breaks. Sleeps 6-7 hours on shiftwork
Male, Perm, . 3 yrs, 23 yrs in mine. Lives 25 k away.	Rotate 3 times a night and thinks it great.	Nothing different. Drinks coffee and water. 2/3 times head down and rest and shut eyes. No lollies	1st break – big meal/coffee 2nd break – light meal/coffee .	If tired will pull over. Would push the button if fatigue, Doesn't use heater or air-cond.. Will walk around when tired.	Would like to have 1st crib as late as possible . Would like a chat station on 2 way.
Male, Perm, 2 years. Lives 40 mins	One job per night drives dump truck Doesn't rotate but that's not a problem	1 day relaxs, sleeps if possible, 3 night feels really unwell. Drinks water and eats fruit in truck. Exercises on truck	2 x breaks 1. light meal/coffee 2. Head down and sleeps in truck	If tired ring supervisor and let him know but would press the fatigue button. Reads, radio (ABC Quiz on night shift). Window down, heater off and air-cond on to keep awake.	Would like 3 breaks = half long only when on night shift. Fatigue project completed at work but management didn't do anything with it. Would like trivial

	Effect of task rotation	Personal coping methods	Effect of formal breaks	Informal breaks	Timing/length of breaks
					questions on radio.
Male, permanent, 2 years, 45 mins away from home. Car club with 3 other guys	Rotates 3 times a night – loves it, make the night go quicker	Normal routine on 1st day of shift. In truck chews gum, no coffee but eats fruit. Reads, radio, doesn't use 2 way. Lays seat back a couple of times a night. Listens to radio.	1 break – heavy meal/coke 2 break – fruit/cup of tea	Sleeps in truck in second break. Will call supervisor if tried. No heater or air-cond.	Happy with breaks
Male, permanent, 9 years, lives 45 klms away – car pool	Rotates – 3 times a shift which is great	1st day – sleeps in – big lunch- few beers, sleep and than work.. Reads paper, radio, use 2 way to say awake. . Sleeps in break down.	1 break – sandwich/coffee 2nd break – sleep if he can	When tired fills up truck and has a sleep, scared of hitting the fatigue button. Puts head over wheel and sleeps very often, depends on tiredness.	1st break = good 2nd break – would like extra 10 mins
Male, perm 12 months. Car pools	Rotate = 3 times a night and loves it	Eats lollies and will have a V drink if really tired. Healthy diet. Puts water on face. Walks on tray. Sends SMS messages. 2nd night harder than the first.	1st break = light meal/tea 2nd break = no food but sleeps when he can	Wouldn't hit fatigue button worried about what would happen. Tell supervisor he is tired. Gets fuel when really tired.	Happy with breaks

	Effect of task rotation	Personal coping methods	Effect of formal breaks	Informal breaks	Timing/length of breaks
		Reads, radio, and will listen to the two way now and than..			
Male, permanent, 12 years in min. Car pools	Doesn't want to rotate like just to drives truck	1st day – gym training, no sleep before work. Chews gum, diet coke. Eats nuts, sultanas, only has four hours sleep a night. Dislikes 2 way. SMS on machine and text on phone	1st break = light meal 2nd break = don't usually sleep	Tired – fuels up and walks around truck. Write songs and listens to music. Rests when filling up.	Happy with breaks Gym would be great
Male, permanent, 3 years, 20 years in mine	Usually works on the pump station but drives dump truck when drivers on break	1st day = relax and rests Drinks water but no coffee. Eats only healthy. Reads, radio but 2 way drives him crazy	1st break = light meal/tea 2nd break = sleep if possible	Rest eyes when he can, every load if he is really tired. Walks around truck. Would hit fatigue buttons. Management is helpful with the lights, etc will move them if it is a problem.	Not sure if he wants to change the breaks or what is best.
Female, perm, 6 months. Lives 25 kms away	Rotates = 3 times a night and like this.	1 st shift = stays up late the night before and sleeps before going to work. Drinks water and cordial. Hates gum. Reads, radio and likes the two	1st break – light meal 2ns break = sleeps if he can or gets up and walks around	Tries to shut eyes and rest eyes. Walks around, leaves window down. No heater.	Breaks are great

	Effect of task rotation	Personal coping methods	Effect of formal breaks	Informal breaks	Timing/length of breaks
		way. Uses SMS in truck. Tries to keep fit. Read books			

Mine 11 - OPERATOR INTERVIEWS

	Effect of task rotation	Personal coping methods	Effect of formal breaks	Informal breaks	Timing/length of breaks
Male – 6 months at site Years of experience before then	Can change to other tasks but prefers no to as more paperwork but it does stop you being bored	Doesn't eat at the end of night shift to get a good sleep. Occasionally used sleeping tablets. Drinks plenty of water	• Nibbles through night shift and has substantial snacks at break	• Gets out and walks around when possible	• Breaks are adequate • Prefers later breaks as end of shift seems faster
Male – 29 years experience on shiftwork	Stays on one piece of equipment all night. Prefers the digger due to concentration	• Uses chiropractor and masseur weekly to relax • Very conscious of health but limited in exercise • Would be good to get another radio station than ABC • Very sceptical about fatigue management process	• Food depends on what is available at camp • No snacking during shift	Sometimes has a nap while waiting for loading	• 2 breaks are good but more shorter breaks would be better
Male – 15 years experience	Stays on truck all night	• Doesn't sleep much during the day • Drinks water – no coffee • Radio is good but reception is limited	2 breaks are good Night shift could have more	Reads under loader Not happy to do an informal pull-up due to fatigue	• Adequate opportunity to eat and drink during break • Prefers later breaks as end of shift seems faster

	Effect of task rotation	Personal coping methods	Effect of formal breaks	Informal breaks	Timing/length of breaks
Male – 17 months of shiftwork	Happy to stay on one truck all night	• Listens to the radio at night • Salad as main meal – not too heavy • Snacks on snickers bars and crackers	2 breaks are good	Gets out and walks around when possible eg refuelling Happy to call up supervisor and tell too tired to work	Prefers later breaks as end of shift seems faster
Male – 8 years on and off	Happy on one truck Settles into rhythm and keeps going	• Same things on day and night shift • Good sleeper through day • Preparation very important • Drinks water		• Doesn't get out of cab • Not time under loader for a break	Good breaks but could be shorter
Female – 9 years experience	Moves across different machines but stays on truck for whole shift	• Listens to radio – need music channel not just ABC • Keep mind occupied • Gets 2-3 hours sleep before first night shift • Fruit in truck for night shift • Drinks water • Chatting on 2-way would help	2 x 30 minute breaks are good Drinks coffee in crib time	Reads while loading Change out if fatigued but response to asking may be different – more accepted now	Timing of breaks if OK

	Effect of task rotation	**Personal coping methods**	**Effect of formal breaks**	**Informal breaks**	**Timing/length of breaks**
Male – 24 years experience	On truck for whole of shift	• Likes night shift – 4 years permanent • Apples while driving – not heavy meals • Doesn't use radio	Naps at crib time	• No problem with reporting fatigue • Not much gap for informal breaks	•
Male, Contractor 27 years in the coal mine Likes 4x4 shifts. Lives in camp and has 4 good sleep between shifts	Drives dump truck all night, but would like to rotate job, but doesn't think it will work.	Nothing unusual, eats lollies and gum. Uses cold water bottle. Heater turned off and leaves window open, uses air cond. Doesn't eat much on night shift Exercise use gym and health program (Roche) regularly.	2 x break – Likes breaks. Must have a break 5 hours after starting. Will not sleep at work in breaks. If he was tired is aware he can have a sleep but doesn't because he doesn't want to be a wimp. No Smoking Health-blood press tab, cod liver tabs m multivit tabs	When tired on shift will try and walk around on the truck and yard Will shut eyes for 2 -3 times while waiting for load Knows if he gets really tired will have a 20 mins breaks. Drinks coffee/soft drinks only in breaks. Radio, music, 2way, newspaper keeps you awake	Likes two breaks only.

	Effect of task rotation	Personal coping methods	Effect of formal breaks	Informal breaks	Timing/length of breaks
Male, Permanent,12 months, 12 years in mine. Camps in Mine, lives on coast	Drives dump truck or digger all night but wants to rotate jobs.	First night is the hardest but sleeps all day.	2 x breaks are great. 1 x 15 break would be great. No Snacking, drinks water. Coffee and tea in breaks only .Shut eyes after every load after midnight	Reads, radio doesn't work and hates it. Can't talk on 2 way. Doesn't like to exercise, smokes. Light food only on night shift. Would use gym if available If break down stays in crib room or truck and sleeps.	Drives when fatigue. Eye strain from lights at night.
Female, Permanent . 2 years in mine. Lives in town	Drives dump truck all night. Would like to rotate machinery	Splashes water on face Chew gums and eats in truck- First day-sleeps in relaxs but the 1st day is the hardest. After 3 days feels sick	2 break – would like 10 min coffee break When really tired can tell management but wouldn't do because doesn't want to cause problems . No coffee and tea. Eats light meal only and diet coke. No sleep in breaks	Lays back and rests between loads. Gets out of cab as much as possible. No reading makes you sleep. Listen 2 two way, but not allowed to talk, listens to radio. Heater is but turns it when tired. Has air con on. All factors helps fatigue.	Would like to have trivial games on radio/2 way to keep awake. Would like to work part-time

	Effect of task rotation	Personal coping methods	Effect of formal breaks	Informal breaks	Timing/length of breaks
Female, Permanent,2 years in mine. Flat in town, catches bus	Drives dump truck only but would like to rotate on machines	Read in the truck., radio & two way. No walking in truck. 1st day of shift, no different to other day. Chews gum, no snacking. Drinks water Eats healthy	2 x breaks great. 1st break –evening meal/coffee and sleep. 2nd break – sleep. Machine breaks down, rests. Hates night shift and rests on wheel every time.	Turns heater off when tired uses air-cond. Stop and gets coffee if tired and will ask if needs a break. Light hurt eyes.	Tried all different type of ways to manage shift work but nothing works
Male, Perm, . Been with the company 2 years, Mining since 97. House in town	Drives dump truck all night but wants to rotate.	Before night shift, late night and sleeps in. No exercise and gym wouldn't help. Light hurts eyes. Leaves air cond on and keeps. windows down. Sleeps 6 hours on night shift	2 x breaks for day shift and night shift 1 extra break of 10mins to walk around. Won't eat big meals. Tired will call up	Radio and chatter on radio helps. Lighting causes eyes to become sore. Suffers from asthma. Reads in truck.	Doesn't sleep at work .

	Effect of task rotation	Personal coping methods	Effect of formal breaks	Informal breaks	Timing/length of breaks
Male, Perm, 3 years. Lives in town	One job per night drives dump truck Would like to rotate driving machinery at night	Sleeps before going to work each day. Doesn't eat much food at night. 1st day okay 2nd shift is worse. 1st shift, sleeps in and takes it easy	2 x breaks 1. eat lunch 2. Head down and sleeps	Can't nap doesn't help, Doesn't exercise because of problems with back. Eats badly. Brings CD, hates 2 way radio chatter. Drinks water and has "red bulls". No heater at all, and has the air-cond on face. Reads in truck . No snacking. Light and bad roads causes fatigue	3 x 20 mins breaks would be great to get out and stretch. Fatigue is betters since 4 x 4 shifts

Appendix D - Comments from questionnaire

Surface Operations	Underground Operations
This is a pointless question as the company will not allow other breaks. This company is dictated by the profits first and duty of care to workers second. 12 hour shifts are too long and we are bound to do them by economic necessity	Work too long before having a break.
More frequent	Break after every 3 hours
Manage them better	Spread out during shift
Having longer breaks	Would help with fatigue
No moving out of machinery on night shift to crib time	More comfortable places to take a break.
The 20 minute break should be longer and too much activity goes on during this break	More evenly spaced out during the day. We may not have lunch until 2:00pm after starting at 7am.
Complete isolation eg no two-way or changing of machines at crib breaks	Longer break
3 breaks	Yes
longer	More evenly spread.
Longer for crib	Made longer, meal breaks especially.
longer	Have a break after 2 hours of work for at least 10 minutes.
40 minutes main crib with 2 x 20 minute smoko breaks on night shift - day shift is OK	More shorter breaks
More days off	More breaks. One in 9 hours ain't enough.

Surface Operations	Underground Operations
Make longer	Difficult for deputies to have a set break time. Mostly occurs at end of shift while doing reports.
Longer beaks	There should be a morning tea break. One 1/2 hour break in 9 hours is not enough.
Free time with whole of drew at the same time	A ten minute morning tea break.
2 x 1 hour	Work one shift.
Longer	"so so"
Longer	One other short break
Not to stagger your crib breaks. Have a set time on all night shifts and day shifts	Longer or more often
2 x 40 minute breaks	I'm happy the way it is
Longer crib breaks	Less time more frequently.
Two longer breaks instead of 1 long and 1 short	Longer breaks
Making them longer	Less noisy location for crib rooms
More breaks and longer	Longer breaks
We need a break between start and lunch	Two breaks
Shorter shifts	Shorter shifts

Surface Operations	Underground Operations
Made longer	Another shorter break during shift
Swap people to different jobs or machines	Longer breaks and more
Night shift breaks could be longer	Lighter work loads
More breaks through shifts	Should be a 15min break for a drink during shift.
2x 40 minute breaks on night shift	Stay the same.
Longer	Longer
No 12 hour shifts	Legalise sleeping underground.
Longer. No working through small crib breaks on night shift	Longer breaks
All 40 minute	More often and longer.
Longer breaks	More comfortable seating/lighting
12 hour shifts - 2 x 40 minute breaks	.More of
Longer	More and longer.
Every 4 hours or 8 hour shifts	By sitting down with other team members about the job at hand.
To have a sleep bay when required to stop fatigue and accidents	Away from work place.

Surface Operations	Underground Operations
Longer	N/A Self managed.
Longer	Two half hour breaks.
Longer breaks on night shift	To work in with your and company requirements and needs.
A smoko break at 9 o'clock	Some situations require recognised breaks ie pillar extraction operations.
Longer	If starting to get tired or fatigues on machine, I got out and have a small break
More breaks	Longer and away from job
Smoko break 9.00am. Lunch 12.00 Arvo break 4.00pm	System works OK
Should be allowed to stop for a drink or something to eat at any time	longer
We are made to work from 7am to 12pm on day work with on coffee break and same on night shift	longer
Have a break in the first 5 hours	yes
Longer breaks or short and broken up more evenly	water bed
No advantage to change	If 2 or 3 ;people had their breaks together
we should be able to have morning tea	Monitored and ensure that people take them. Exercise.
More of them	Better planning of day.

Surface Operations	Underground Operations
Allowed not penalised to have coffee breaks	
Too long between shift start and first break eg 7.00 - 12.00 5 hours before first	
To have them when you feel the need for them	
More breaks should be allowed	
One 15 minute break every 2 hours and one 1 hour break after 6 hours	
20 minute smoko break	
All work and equipment stops, no two way talk and no one working during breaks	
Longer	