Managing musculoskeletal disorders

A practical guide to preventing musculoskeletal disorders in the NSW mining and extractives industry

NSW MINE SAFETY ADVISORY COUNCIL

NSW GOVERNMENT Industry & Investment

Acknowledgements

This publication is based on a joint project between Industry & Investment NSW and the Queensland Department of Mines and Energy (DME). This plain English version is based on the technical report produced by Trudy Tilbury from DME. The document includes worksheets reproduced with permisision from NSW WorkCover's *Manual Handling Risk Guide*.

The New South Wales Mine Safety Advisory Council initiated this guide as part of its focus on decreasing musculoskeletal disorders in the NSW mining and extractives industry. The Mine Safety Advisory Council would like to acknowledge the Health Working Party and the Musculoskeletal Disorders Project Steering Group for overseeing the development of this guide.

NSW Mine Safety Advisory Council

The NSW Mine Safety Advisory Council has the strategic objective of achieving world-leading occupational health and safety through the development of changes in health and safety culture throughout the mining industry in NSW.

The Council includes senior officials from some of the most respected bodies in the mining industry including the CFMEU (Mining and Energy Division), Australian Workers Union, NSW Minerals Council and Cement Concrete and Aggregates Australia. Two independent experts in occupational health and safety are also part of the Council. Mr Norman Jennings was appointed Chairman of the Council in 2006.

The Council was established to provide the Minister for Mineral Resources with advice on critical OHS issues to the NSW Government. The Minister brings these matters to the Council for its consideration, requesting its advice on appropriate ways forward in the continual drive to foster improved OHS performance in the industry.

Research into key OHS issues in the mining industry was commissioned by the Council and released as the *Digging Deeper Report* in 2007. The Council hosted a CEO Summit in November 2008 which issued a communiqué outlining a joint vision for the industry and an agreement on a set of guiding principles that will help ensure the industry has a dynamic culture to address key health and safety issues.

The Council is focused on addressing the areas of: culture change; fatigue; negative impacts of safety incentive schemes and production bonuses; the disconnect between OHS systems and practice; contemporary health issues, including musculoskeletal disorders; and OHS issues affecting contractors and inexperienced workers.

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Guide to the management of musculoskeletal disorders in the NSW mining and extractives industry
September 2009, version 1.0

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1. Introduction

1.1 About this document

Three levels of guidance to prevent MSDs

This document provides three levels of technical guidance for the prevention of musculoskeletal disorders (MSD) in the mining and extractives industry:

Level 1. Generic process/approach consistent with regulatory requirements and best practice

Level 2. Mining-specific information

Level 3. Practical examples, case studies and tools (such as checklists)

Readers can use the **hotlinks** and **tabs** in the document to navigate to areas of the document and the MSD risk management process of most relevance/interest to them.

1.2 Contents overview

A complete prevention resource

The document contains the following sections:

- About musculoskeletal disorders
- Preventing musculoskeletal disorders
- Surveys, checklists and worksheets
- Guidance
- Mining industry case studies
- Resources

1.3 Summary of the MSD risk management process

Six step prevention process

Preventing MSDs is a six step process:

Gather information
Group tasks by operational area
Review the risk factors
Assess the risks associated with the tasks
Control the MSD risk
Monitor and review

Remember, each step in the risk management process is supported by:

- Training
- Supervision
- Consultation

2. About Musculoskeletal Disorders

This section contains:

- Legislative obligations
- Definition of musculoskeletal disorders
- General risk factors
- Risk factors in mining
- How big an issue are MSDs in the mining/extractives industry?

2.1 What are your legislative obligations?

The OHS Act and OHS regulation contain principles and requirements for MSD prevention

The Occupational Health and Safety Act 2000 (OHS Act) and Occupational Health and Safety Regulation 2001 (OHS Regulation) set out the principles and requirements that apply to MSD risk management in the workplace. In brief, the regulation requires:

- Management of MSD to be part of an organisation's Health Management Plan
- Employer to obtain and provide information for identification, assessment and control of risks
- Use of hierarchy of controls
- Instruction, training and supervision
- Consultation
- Reviews of risk assessments.

The MSD National Code of Practice should be considered when developing prevention strategies

The new National Code of Practice for the Prevention of Musculoskeletal Disorders from Performing Manual Tasks at Work (2007) is likely to be adopted in NSW in 2009 when the review of the OHS Regulation is finalised.

In the interim, however, the new national code is considered relevant information and relevant sections must be considered when identifying, assessing and controlling hazards.

2.2 What is a musculoskeletal disorder (MSD)?

MSD is an umbrella term for various physical injuries and disorders

MSD is an umbrella term for injuries and disorders that include:

- Sprains and strains of muscles, ligaments and tendons (eg shoulder muscle strain leading to rotator cuff tear)
- Back injuries, including damage to the muscles, tendons, ligaments, spinal discs (eg ruptured discs), nerves (eg sciatica), joints and bones
- Joint injuries or degeneration, including injuries to the shoulder, elbow, wrist, hip, knee, ankle, hands and feet
- Bone injuries (eg fractures)
- Nerve injuries (eg carpal tunnel syndrome of the wrist)
- Soft tissue hernias (eg abdominal hernias)
- Muscular and vascular disorders as a result of hand-arm vibration (HAV)

MSDs can happen suddenly or develop over time

MSDs may:

- **Occur suddenly** as a result of a single forceful action like pulling a moving object, lifting a heavy object, actions causing overexertion or through a slip, trip or fall.
- **Develop over a longer period** as symptoms associated with minor tissue injuries (including nerve and vascular tissues) are ignored, eventually resulting in a more serious injury. Iinjuries suffered by workers (eg transport drivers, mechanics) doing repetitive work and/or work of a similar nature could also fall into this category.

2.3 Key risk factors and specific task characteristics that increase the risk of MSDs

Many factors contribute to MSDs

Based on research conducted in Australia and overseas, the key MSDs risk factors in a mining/extractives environment are:

- Awkward postures
- Bending and twisting
- Manual handling/load
- Forceful exertions
- Repetitive actions
- Duration of task
- Heavy lifting
- Vibration – hand/arm and whole body (including jolting and jarring)
- Access
- Slips, trips and falls
- Working long hours without opportunity for rest and recovery
- Exerting force in a static position for extended periods
- Problems with the work environment (eg working in hot or cold weather, rain and unpredictable conditions)
- High job demands and time pressure
- Fatigue
- Lack of job rotation and equipment change

☛ **Definitions of terms used in this text are found in the Resources section**

2.4 Related mining risk factors

Mining workplaces have their own contributing risk factors

MSDs are strongly linked to known contributing risk factors or hazards in the mining workplace, including:

- Workplace, equipment and vehicle (or cab) design
- The mine working environment factors; including the state of the decline and haul roads, uneven, muddy and wet ground, limited access underground and around equipment, poor visibility etc
- The characteristics and locations of tools and other equipment
- Work organisation, planning and systems or work, including rosters, shutdown deadlines and overtime

These contributing risk factors lead to, or cause, the direct risk factors in mining listed above.

2.5 Other issues to consider

Jobs need to suit individual workers not a notional average worker

Mining and extractive sectors now have a more diverse workforce with increased numbers of women, older workers and workers new to the industry.

Jobs and tasks need to accommodate the physical characteristics, skills and experience of individual workers rather than just a notional average worker. For example:

- Individuals will vary in the amount of force they can apply
- Some tasks promote awkward postures due to workers' physical size differences
- Less experienced workers may perform repetitive tasks more frequently due to errors, or if they are unfamiliar with the task
- Lack of rotation and equipment change
- Systemic organisation problems limiting rest periods at work, rest periods outside of work and appropriate intervals of rest periods at work.

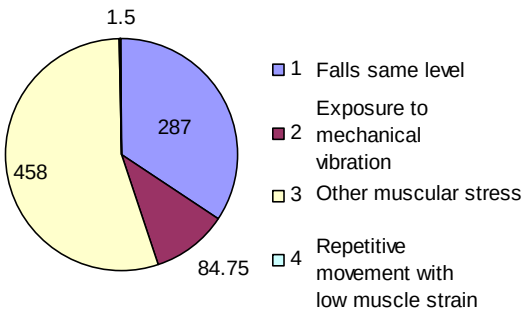
2.6 MSD – the most common workers compensation claim

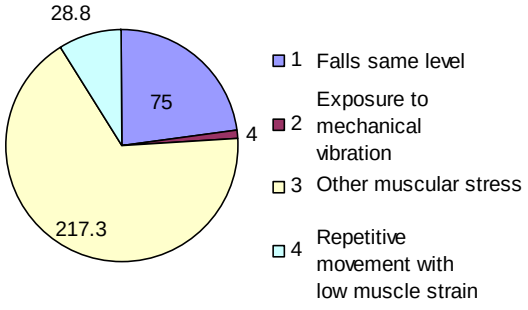
Many injured workers and big losses in time and money

From an analysis of workers compensation claim data:

- MSD from mechanical vibration, muscular stress and falls on the same level contribute approximately 50% of all claims from the WorkCover NSW data, and just over 46% of all claims from Coal Services Ltd
- Between 2002 and 2006 the two most common categories of injury in coal were other muscular stress and falls on the same level
- Metalliferous and extractives have a smaller percentage or musculoskeletal claims than coal mining (40% compared to 52%)
- There is a much higher proportion of vibration-related musculoskeletal claims in coal mining, while metalliferous/extractives have a much higher proportion of repetitive movement-related claims
- The five year claim costs for metalliferous/quarrying are much higher than for coal ($26 million compared to $17 million), however:
  * the average cost of claims is much lower in the metalliferous/extractives sector ($8,000 per claim compared with $13,000 per claim in coal)
  * coal has a lower average time lost per claim (2.3 weeks versus 3.5 weeks) but a higher proportion of claims extending beyond 4 weeks (18% versus 15% in the non-coal sector)

NSW coal MSD data	NSW metalliferous and extractives data
Average number of musculoskeletal claims per year (2002/3-2005/6)	**Average number of musculoskeletal claims per year (2002/3-2005/6)**





Links to source statistical publications:

Profile of manual handling and musculoskeletal claims in NSW coal mining

Profile of MSD claims in NSW metalliferous and extractive mining sectors

3. Preventing Musculoskeletal Disorders

This section contains:

- Preventing MSDs
- Identify hazardous tasks
- Review risk factors
- Review contributing risk factors
- Review other risk factors
- Assessing tasks
- Controlling risk for musculoskeletal disorders

3.1 Preventing MSDs

Preventing MSDs must be part of the OHS management system

MSDs need to be managed as an integral part of each organisation's OHS management strategy and system.

The following steps need to be undertaken in consultation with those doing the work.

Prevention is based on:
*** clear objectives**
*** management support**
*** resources**
*** expert advice**
*** action plans**

A strategic approach:

1. Set your broad objectives – depending on the needs of your enterprise, your objectives could relate to legislative compliance, reducing the costs of workers compensation, or MSD incidents, improving productivity, operational efficiency or a combination of these and other factors

2. Appoint a management champion and a representative team to manage the process – this allocates responsibility for getting the job done and establishes a participative approach

3. Allocate resources (including a budget)

4. Consider the need for expert help and training of key personnel – MSDs are complex and multi-factorial, occupational diseases often requiring specialised understanding

5. Develop and implement an action plan including timeframes, targets and key performance indicators for MSD performance (see Guidance for MSD Lead Indicators).

Begin by reviewing the current situation

For many companies initial action will include:

- Conduct a stock take of what has been done/what is being done about MSD prevention and assess its effectiveness
- Review the OHS management system to ensure that it effectively integrates MSD prevention – in particular assess whether
  * the current OHS policy needs a specific target or priority statement related to the control of MSD hazards
  * responsibility for MSD management and performance has been allocated (see Guidance for Allocating Roles & Responsibilities)
- Determine whether the risk management process for MSDs meets legislative requirements.

3.2 Positive help – participatory ergonomics

Finding effective risk solutions: uniting workers experience with input from ergonomists

Participatory ergonomics involves workers being helped by an ergonomist, or those with ergonomic skills, to identify and manage ergonomic hazards. This approach differs from having an ergonomist 'independently' undertake a consultancy and develop solutions. Participatory ergonomics also differs from risk assessment of ergonomic hazards without involving someone with expertise in ergonomic hazards and knowledge of appropriate ergonomic controls.

Wilson (1995) in his chapter on *Ergonomics and Participation* (p.1075) states "as well as an ergonomics management programme and training and awareness for as many as possible in the company, participative ergonomics also requires the active involvement of relevant job holders in task, job and workplace assessments and in the generation and testing of alternative solutions." There have been several reviews of the effectiveness of participatory ergonomics (Cole et al, 2005, Rivlis et al, 2008) and participatory ergonomics is strongly supported worldwide and promoted by most jurisdictions.

Examples of the participatory ergonomics approach in the mining industry include the Badger Mining project referred to in Torma-Krajewski et al (2006), the work by Robin Burgess-Limerick et al (2004), and the Ergonomics Task Force currently in place at Crinum Mine in Queensland.

3.3 Good practice MSD prevention

MSD risk solutions need a range of strategies

- Use site or industry examples to show how risk factors cause injury or long-term disorders
- Use participatory ergonomics to consult and interact with workers (including contractors) to identify, assess and control MSD hazards. This will also help meet regulatory requirements (eg for consultation)
- Provide additional training to supervisors, Check Inspectors/OHS committee members/OHS representatives and others with obligations to allow them to facilitate risk assessments of jobs or tasks and evaluate control measures (See Guidance MSD Training)
- Use or develop simple-to-understand checklists, with pictures as prompts, for concepts such as posture and position, location and distance and workplace layout. These checklists can also be used as part of the risk assessment training
- Make sure that the facilitator or trainer has an understanding of the causes of MSD, the requirements of regulation and supporting material such as the National Code of Practice. Also make sure that the point of risk assessment is to identify the root cause or reason for the manual task being performed in the first place
- Use surveys of MSD symptoms or surveys to identify jobs or tasks that may not have obvious risk factors. These surveys also help prioritise implementation
- Use solutions from innovation awards, MIRMgate, or those developed on site, to show that control measures can be simple and cost effective.

3.4 Summary of good practice

This flowchart outlines the prevention strategy that follows

The process of MSD hazard identification, risk assessment and control is summarised in the following flowchart that forms the basis for the approach described in this document

Action	Outcome
1. Gather Information	A list of tasks most likely to be hazardous MSD tasks

Action	Outcome
2. Group tasks by operational area	A list of jobs, occupations, operational areas most commonly associated with high or potentially high levels of MSD

Action	Outcome
3. Review the risk factors	A list of tasks and/or jobs with identified associated risk factors

Action	Outcome
4. Assess the risk associated with the tasks	A prioritised list of tasks/jobs to be controlled – this could be in the form of an MSD risk register

Action	Outcome
5. Control the MSD risk	Control solutions and an associated implementation action plan

Action	Outcome
6. Monitor and review	Auditable records showing that MSD risks are being effectively managed

Training, supervision, consultation

Step 1 – Gather information

Consulting employees is essential

Objective:

In consultation with employees, and/or their representatives where appropriate, identify potentially hazardous manual tasks for further investigation.

There are many sources of information to help identify MSD hazards

How to do this:

Systematically examine available information about tasks with the potential to harm the musculoskeletal system. Common sources of such information include:

- Injury records and trends
- Incident and hazard reports
- Issues raised by Check Inspectors, OHS committee members, deputies, employees, permanent and intermittent contractors
- Proactive surveys or consultants' reports
- Health and safety committee meeting minutes or reports
- Industry reports or information on MSDs or ergonomics issues such as
  * ACARP reports
  * Coal Health and Safety Trust reports
  * MIRMGATE information or Safety Bulletins
- Records of production or service difficulties causing additional manual tasks
- Records of maintenance and service requests which mention physical difficulty in using equipment.

Sometimes consultants may be needed to help

If there is insufficient information, or insufficient resources at the site, it may be necessary to engage suitable consultants to observe the work processes and consult with workers and Check Inspectors/OHS committee members about which tasks are hazardous.

Review the information to identify tasks with MSD hazards

Review the information you have gathered and, in consultation with workers, contractors and health and safety representatives, make a list of:

- All manual tasks where an injury, pain or symptoms **which persist** have been reported (see example MSD symptoms/Difficult Job Survey)
- Manual tasks reported as **difficult to perform**, such as those that require more than one person to complete
- Manual tasks associated with **interruptions or difficulties with work processes**, particularly the need to redo work
- Tasks involving **equipment or hand tools** which are not working properly or which **are difficult to use**.

Other task characteristics that may help identify MSD hazards

You should also list:

- **New manual tasks** or those to be **altered** in some way or which are being undertaken in a changed environment
- **Manual tasks that have not previously been examined** for their potential as a hazard
- **Tasks which have led to reports of slips, trips and falls.**

☛ **Outcome:**

A list of tasks most likely to be hazardous manual tasks or cause MSD.

Good practice tips

The further the analysis is taken, the better the outcomes

It is good practice to examine and compare:

- Specific equipment and/or infrequent tasks, including shutdowns, breakdowns or other infrequent tasks
- The numbers of incidents/injuries in particular locations that have a manual task and/or slip, trip and fall component
- The frequency and severity of injuries and how these have varied with the number of workers, particular groups of workers (new, older, contractors), the hours worked and the areas of work
- The number of injuries related to each job and/or operational area and how serious these injuries have been.

Step 2 – Group tasks according to operational areas

MSD hazards should be related to operational areas

Objective:

This step is designed to make it easier for each operational area to determine their hazardous manual tasks and tasks with a risk of slip, trips and falls, as well as to see where more information is required.

Using outcomes of step 1 to identify MSD hazards in tasks, occupations and operational areas

How to do this:

Each operational area should now have a list of known hazardous manual tasks, or slips, trips and falls hazards, and a number of tasks or jobs where the MSD risk factors and overall risk is not fully known.

If the site has identified a hazardous manual task, such as cable handling, changing conveyors etc, the next step is to review the current risk assessment to determine if the MSD risk factors (see section below and page 3) are clearly documented.

When a hazardous manual task or a task with known slip, trip or fall hazard is present and information on risk factors is available, it is possible to move to step 5 – Control the MSD risk.

If the task or job or area is not easily identified as being hazardous, then the information should be reviewed to see if MSD risk factors are documented. Other helpful information will include the area of the body where injuries have occurred and any hazard reports or information on root causes. Whenever possible, information that includes photographs, videos, or other prompts, will make it easier for the risk assessment.

The more information available at this point on risk factors the better prepared the team will be in undertaking the risk assessment.

Outcome:

A list of jobs, occupations and operational areas most commonly associated with high, or potentially high, levels of MSD.

Examples of operational groups

Some tasks are already known to have MSD hazards

A number of jobs and tasks in mining have already been identified as having a high likelihood of a musculoskeletal disorder (Burgess-Limerick, Parker, McPhee). There are also jobs that have known exposure to multiple MSD risk factors, eg whole body vibration (WBV) for extended shifts, along with long duration of sedentary work.

Parker (2005) used the following operational groups in coal mining and found that there were differences in loading and demands between the groups:

- Deputies
- Electrical workers
- Mechanical workers/fitters
- Professional/administrative
- Operators/maintainers

Some jobs in underground coal mining that were demanding on the heart include cable handling, ventilation tube work and shovelling (which had the highest demands, reaching 80% maximal heart rate) (Parker 2005).

Examples of physiologically demanding tasks in mining/extractives include

- Most heavy vehicle maintenance/repair work in the field (if outside) or underground in summer
- Electrical work and shotfiring work in hot mines
- Cable handling in most mines
- Drillers offsiders in hot mines
- Heavy manual tasks requiring the wearing of respiratory protection and other protective equipment.

Step 3 – Review the risk factors

Find the root causes of MSD risks

Objective:

Find the root cause or source of MSD risk factors for jobs and tasks, including slips, trips and falls.

Group MSD information, then look for links and trends

How to do this:

Larger sites will usually benefit from grouping the MSD information collected in Step 1 into the operational areas eg mining (production), processing and maintenance. It may also be possible to group tasks by phase of production, eg shutdowns, planned maintenance, when higher risk activities are known to occur.

Then, for each operational area, look for trends in reporting injuries, hazard reports or other information that indicate MSD hazards. In many cases hazardous manual tasks will be easily identified. For example, previous mining studies have documented a number of hazardous manual tasks including changing rollers on conveyors, cable handling, handling drill rods, airleg drilling and dozer operations.

Grouping tasks or MSD and slips, trips and falls hazards by operational areas will allow for planning of risk assessments. Some operational areas may have more hazardous manual tasks than others. Planning for risk assessments (Steps 3 and 4) will include:

- Determining if there are gaps in the information collected
- Deciding if assessment of some hazardous tasks or jobs may require additional expertise
- Allocating enough resources and representatives to participate in the risk assessments.

Outcome:

A list of tasks and/or jobs with identified risk factors.

Four categories of MSD risk factors

1. Factors directly associated with hazardous manual tasks
   - Awkward postures
   - Forceful exertion
   - Difficult loads
   - Repetition and duration
2. Vibration
3. Contributing risk factors
   - Thermal work environment
   - Systems of work, work organisation, work practices
   - The work area design and layout
   - Nature of the load being handled
4. Other risk factors
   - Aging workforce
   - New workers or inexperienced workers
   - Tiredness and fatigue

You may find the Manual Handling Hazard Identification Worksheet useful in this step.

Step 4 – Assess risks associated with tasks

Assess the root causes of MSD risks

Objective:

Assess the root cause or source of MSD risk factors for jobs and tasks, including slips, trips and falls.

Use the appropriate risk assessment checklist

How to do this:

Each operational area will have a list of tasks or jobs from Step 3 requiring a risk assessment.

The risk assessment should explore the root causes of the MSD risk factors, including asking why the manual task is being undertaken. This will assist with the next stage of developing controls.

As part of the risk assessment the team will need to choose the most appropriate tool or checklist incorporating relevant MSD and slip, trips and falls risk factors. For example, the risk assessment of haul truck operations in an open cut mine would require a tool covering vibration, sedentary posture and vehicle design and access.

There are no specific tools that cover all the risk factors for MSD in mining. The examples listed below show what some mines have done to assess MSD risks.

There are some hot, heavy jobs or tasks where the risk may not be adequately assessed by some risk assessment tools. In mining/extractives these include:

- Most heavy vehicle maintenance/repair work in the field (if outside) or underground when hot
- Electrical work and shotfiring work in hot conditions
- Cable handling in most mines.

These jobs or tasks may require a tool looking at physiological demands or additional questions in risk assessment tools.

Outcome:

A prioritised list of tasks/jobs to be controlled – this could be in the form of an MSD risk register.

Examples of MSD risk assessments

Experience shows a number of risk assessment approaches are effective

Approaches to MSD risk assessment used in mining and extractive operations include:

- Adapt existing mining-specific checklists, such as that found in 'Ergonomics for the Control of Sprains and Strains in Mining' (pages 24 and 25) or the Manual Handling Management Audit Tool from the Mining and Quarrying Occupational Health and Safety Committee of South Australia (MAQOHSC)
- Specific manual handling risk assessment tools, such as the modified ManTRA tool in ACARP project C11058 or the Generic Ergonomics Risk Assessment Tool for Underground Coal Mining Equipment in C14016
- Manual/task/manual handling risk assessment guidance/worksheet from WorkCover NSW (Manual Handling Resource 2004 or Manual Handling Risk Guide 2007)
- Manual Tasks Injury Risk assessment document from Burgess-Limerick, R. (2008) Managing Manual Task Injury Risk
- Manual Handling or Manual Tasks risk assessment checklists from other jurisdictions eg QLD Manual Tasks Code of Practice (2000) or WorkSafe Victoria
- Adapt specific slips, trips and falls checklists, such as those in WorkCover NSW Manual Handling Resource or WHSQ Guide to Preventing Slips, Trips and Falls.
- External consultants or internal safety and health teams to identify and assess MSD risks using checklists from http://www.safeworkaustralia.gov.au/swa/HealthSafety/HazardsSafetyIssues/ManualTasks/ManualTasks.htm.

Resources for equipment and tool design risk assessments

Equipment design:

- Checklist for mining equipment – Reducing injury risks associated with underground coal mining equipment (ACARP project C14016)
- Checklist for selection/ use of hand tools

General manual handling/manual tasks risks in mining:

- Ergonomics for the Control of Sprains and Strains in Mining (McPhee 1993)
- Reducing Musculoskeletal Risk Open Cut Coal Mining (ACARP project C11058)

Physiological demands

- Worker surveys.

Step 5 – Control the MSD risks

Controls should eliminate risks rather than rely on people to do the right thing

Objective:

Develop controls for MSD risks based on the hierarchy of controls.
The hierarchy of controls is well recognised in mining and extractives. Controlling the risk directly – by designing out the hazard (high order control) – is generally more effective than lower order controls relying on physical barriers (eg personal protective equipment), or subjective barriers (relying on appropriate and/or compliant worker behaviour).

There is evidence that training in safe lifting techniques on its own is not an effective control for MSD. Manual task techniques training is therefore not an acceptable control measure on its own.

Eliminate the risk by eliminating the job or task

How to do this:

Based on the risk assessment findings, identify the hazardous manual tasks and the tasks where slips, trips and falls are a significant hazard.

Then determine why the manual task is being performed and if the task could be eliminated. This same process should be undertaken for slips, trips and falls – is it possible to eliminate the slip, trip or fall hazard by eliminating the job or task performed?

Reduce risk through engineering and design controls

Next consider an engineering or design control to reduce the risk of MSD. The control should deal with contributing risk factors causing the direct risk factor. For example, if the design of access to a vehicle is causing the direct risk factor of awkward posture or slips, trips and falls, then designing suitable access is the recommended control.

Ensure that if the risk factor is (for example) an awkward posture, then the control measure actually reduces or eliminates the awkward posture.

It is useful to focus on efficiency as well as risk reduction, as safer ways of doing work are often also more efficient.

A good source of equipment design and engineering controls for MSD risk factors such as manual tasks, whole body vibration, equipment access and egress can be found at the EMESRT website.

Principles for implementing risk controls

When implementing risk controls apply these principles:

- Use the hierarchy of control
- Trial solutions before making them permanent
- Review controls after an initial testing period as they may need modification
- Develop work procedures to ensure that the controls are understood and responsibilities are clear
- Communicate the reasons for the change to workers and others
- Train workers to use the controls
- Supervise the reliable implementation of controls

Examples of risk controls

Controls for operator risk factors – awkward posture and vibration/jolting and jarring

Controls for general hazardous manual tasks in mining:

- Case studies
- Controls – hand-arm vibration
- Controls for slips, trips and falls.

Outcome:

Control solutions and an associated implementation action plan.

Better design:

A key issue in reducing adverse MSD outcomes is better design. The Australian Safety and Compensation Council (ASCC) have produced a document titled *Guidance on the Principles of Safe Design for Work*.

You may find the Manual Risk Control Worksheet and Action Plan useful in this step.

Step 6 – Monitoring and reviewing

Make sure risk controls are effective

Objective:

Ensure controls are implemented and effective in managing MSD risks.

Effectiveness of risk controls can be reviewed by observation and feedback

How to do this:

Review the effectiveness of existing controls

- Consult with workers and supervisors regularly, especially those using the risk control measures
- Observe work activities during walk-through surveys
- Conduct audits and inspections
- Monitor hazard, incident and injury reports
- Conduct surveys of MSD risks

Review availability of control measures.

- Monitor equipment design changes available in industry that can potentially solve difficult MSD problems, eg mechanized processes for bolting
- Review mining innovation awards, industry-specific publications, trade shows, and updates from suppliers. The EMESRT project website contains information on effective design controls.

Record keeping.

- Keep records of hazard identification, risk assessment and control processes to help meet regulatory requirements and ensure that MSD risks in performing manual task issues are being managed.

Records will also help to keep track of:

- What has been done and what is planned
- Why you changed the task and ensure that old, 'unsafe' procedures are not reverted to in the future.

Outcome:

Auditable records showing that MSD risks are being effectively managed.

Tips for reviewing controls (from ACARP Project C11058)

Industry experience points to effective review strategies

Start by checking that all planned actions have been carried out.

Also:

- Check that risk controls are working successfully and are being used correctly. The tasks should now be easier to perform
- Look at the task in action to see whether the initial risk factors have been minimised as intended
- Make sure that a change introduced to solve one problem has not created difficulties elsewhere
- Make sure that changes are properly evaluated by people who do the job. If new problems have occurred, or if there has been change to the work requirements or equipment, then conduct a further risk assessment.

4. Surveys, Checklists and Worksheets

This section contains:

- MSD symptoms/difficulty job survey
- Checklist for assessing risk of MSDs – mining equipment
- Checklist – hand tool selection and use
- Checklist – purchasing large mining equipment
- Worksheets
  - Manual handling hazard identification
  - Manual handling risk assessment
  - Manual handling risk control
  - Manual handling action plan
  - Manual handling safe work procedure

(Worksheets are reproduced, with permission, from the Manual Handling Risk Guide – WorkCover NSW)

4.1 MSD Symptoms/Difficult job survey

MSD symptom survey – identifying and rectifying jobs that cause pain, ache or discomfort.

No employee will be discriminated against as a result of completing this survey. The material obtained will be used for data collection and research only.

Information about employees' symptoms such as pain, ache or other discomfort can help identify hazardous tasks at work. Even if there are no symptoms reported, workers will have a good idea of what might be contributing to the overall difficulties of the tasks.
Early reporting of symptoms or identifying the difficult jobs can lead to controls being put in place before injury occurs. The survey sheet below will help you identify and record instances where workers experience pain or symptoms that:

- persists, or
- reoccurs the next day, or
- persists after rostered days off

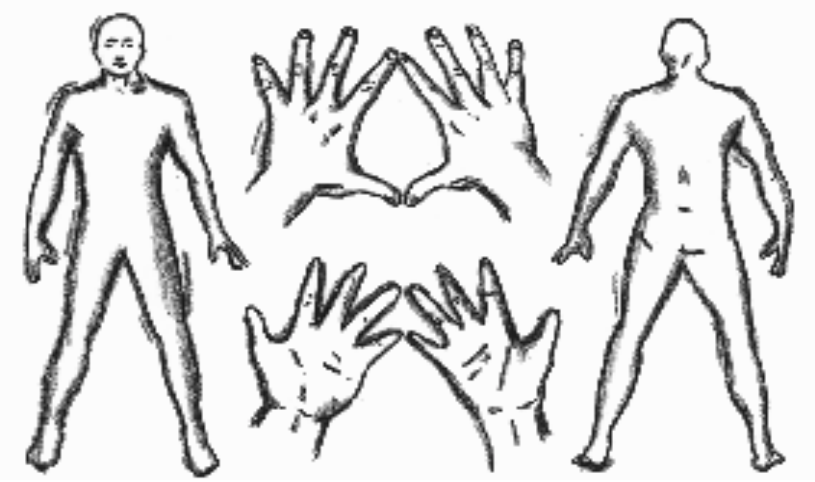
1. Name (Optional) _____

2. Work Group (Optional) _____

3. Work Area _____

4. Do you suffer from swelling, numbness, tingling, 'pins and needles', stiffness, aches and pains in any part of the body as a result of any specific jobs?

Indicate in the diagram below where the problem occurs:



MSD Symptoms/Difficult job survey (Page 2)

5. Do you ever feel tired or fatigued when performing jobs or tasks at work? Yes No

   If yes, please **outline** the particular tasks.

   _____

6. When performing tasks/jobs at work do you ever feel pain or discomfort? Yes No

   If yes, please **outline** the particular tasks/jobs.

   _____

7. Do you find that you have to adopt any work postures that are awkward and/or make tasks/jobs more difficult? Yes No

   If yes, please **outline** the particular tasks.

   _____

9. Do you find that difficult access to the any work area makes a task/job awkward to perform? Yes No

   If yes, please **outline** the particular tasks.

   _____

10. What jobs or tasks would you change if you could?

    Please **list** jobs/tasks.

    _____

    _____

11. Please **list in the table below** the top 5 most "Gut Busting" jobs/tasks that you perform.

12. How often do you perform these jobs/tasks?

13. What time does it takes to complete the job/task?

11. Task (hardest a to e.)	12. How often?	13. Time to complete the task
a.		
b.		
c.		
d.		
e.		

Thank you

(MSD Symptom Survey – adapted from the *National Code of Practice for the Prevention of Musculoskeletal Disorders from Performing Manual Tasks at Work* 2007)

4.2 Checklist for assessing risk of MSD – Mining Equipment

This checklist can be used to:

- Conduct pre-purchase or onsite review of equipment risks
- Assist workers to consider equipment risks in risk assessments
- Assist in training

Is there safe and easy access to the machine by the operator?

☐ Are steps, stairs, ladders, walkways and access platforms provided where necessary and are they safe to use under all foreseeable conditions (ie risks of slips, trips and falls are minimised)?

☐ Are there handrails and handholds where necessary?

☐ Are doorways wide and high enough?

Does the equipment allow safe and efficient operation?

☐ Can the operator see and hear?

☐ Can the operator understand and act appropriately when given information?

☐ Can the operator manipulate controls easily and without confusion?

☐ Can the operator work in reasonable comfort without unnecessary or excessive physical and/or mental stress or fatigue?

☐ If operators are working extended shifts, has this been considered in the risk assessment?

☐ Are breaks adequate for recovery from the demands of the task?

Do the environmental conditions in the cab allow for comfort, communication and adequate protection from noise, vibration, dust and other risks to health?

☐ Can the cab be kept at a reasonable temperature for sedentary work (20-25 C) – is adequate heating, cooling or air conditioning provided where necessary

☐ Can the operator communicate easily and without misunderstanding people outside the cab?

☐ Can doors and windows be closed and are seals adequate to prevent the ingress of unwanted, distracting or excessive noise, dust, fumes or other environmental contaminants?

☐ Is the whole-body vibration reduced to an acceptable level? Does it meet the Australian Standard for WBV (AS2670 – 2001: *Evaluation of human exposure to whole-body vibration*)? NB: Measurement of WBV, interpretation of results and management often requires specialised skills, competencies and familiarity with mining conditions and practices

Are operators aware of all features on the vehicle, how to use them optimally and why it is important that they do?

Is there suitable competency training available for operators and maintenance personnel?

☐ When considering specific hazard areas such as whole-body vibration, it is important to recognise that the training should include training in the company vibration management plan and/or policy dealing with seat change outs and early warning signs of seats potentially bottoming out

Is there easy access to machine parts or areas requiring attention, and are there suitable tools readily available in maintenance and servicing of equipment?

☐ Can the equipment be towed readily to the workshop to avoid field servicing whenever possible?

Are the demands of maintenance tasks within the capability of all maintenance personnel?

☐ Maintenance does not require undue force, awkward posture or dangerous practices?

4.3 Checklist – Hand tool selection and use

Hand tool selection	Hand tool use
Hand tools should be selected if they: ☐ Can be held in a neutral wrist or handshake position ☐ Allow the hand to retain a comfortable grip span ☐ Can be used by the worker in one hand ☐ Are well balanced (the heaviest part of the tool should be behind the wrist) ☐ Are suitable for use by either hand ☐ Provide a good grip surface ☐ Prevent a worker from adopting a pinch grip with high force or for prolonged periods	Minimise the level of muscular effort needed to use hand tools, particularly of the shoulder and wrist by: ☐ Using power tools where possible ☐ Suspending heavy tools where they are used repetitively and in the same place ☐ Counterbalancing heavy tools that are used repetitively and need to be kept away from the body ☐ Using trigger locks where the grip has to be sustained for more than 30 seconds ☐ Holding the work piece in place with jigs or fixtures ☐ Selecting tools that produce the least amount of vibration ☐ Reducing impact shocks ☐ Limiting torque or kick back reactions

4.4 Checklist – Purchasing large mining equipment

Questions for operational areas:

Before purchasing any fit-for-purpose equipment, ask:

- What is the age range of the users/operators?
- How big, how strong are they?
- What are they expected to do with the machine? ie what is the nature of the work?
- Where will they be working – under what environmental conditions (eg high humidity, heat, toxicity of dust, etc)?
- When do they do the work? ie time of day, seasons, whether, etc.

Questions for the OEM/supplier:

These questions will assist in determining the key components of the equipment that must be addressed in the purchase. For example, certain environmental conditions will require very good internal seals for dust minimisation, and high humidity may require additional measures to reduce humidity inside the cab.

- What is their experience with supplying similar machines in these environments and with these users?
- Are they compliant with the EMESRT design principles (for open cut and extractives)?

Questions 1 to 3 are criteria for safe purchasing of heavy equipment and evaluating equipment by a suitable team of safety and health, purchasing and engineering/maintenance personnel when it arrives on site:

1. Is there safe and easy access to the machine by the operator that meets relevant standards?
   - Are steps, stairs, ladders, walkways and access platforms provided where necessary and are they safe to use under all foreseeable conditions? Ie the risk of slips, trips and falls are minimised?
   - Are there handrails and handholds where necessary?
   - Are doorways wide and high enough?

2. Does the equipment allow safe and efficient operation?
   - Can the operator see and hear?
   - Can the operator understand and act appropriately when given information?
   - Can the operator manipulate controls easily and without confusion?
   - Can the operator work in reasonable comfort without unnecessary or excessive physical and/or mental stress or fatigue?
   - If operators are working extended shifts, has this been considered in the risk assessment? Are breaks sufficient for recovery from the risk of the task?

3. Do environmental conditions in the cab allow for comfort, communication and adequate protection from noise, vibration, dust and other risks to health that meet relevant standards?
    - Can the cab be kept at a reasonable temperature for sedentary work (20-25°C) ie is adequate heating, cooling or air conditioning provided where necessary?
    - Can the operator communicate easily and without misunderstanding with people outside the cab?
    - Can doors and windows be closed and are seals adequate to prevent the ingress of unwanted, distracting or excessive noise, dust, fumes or other environmental contaminants?
    - Is whole-body vibration reduced to an acceptable level? Does it meet the Australian Standard for WBV (AS 2670-2001): Evaluation of human exposure to whole-body vibration – General requirements)? Note: The measurement of WBV, interpretation of results, and management often requires specialised skills and competencies as well as familiarity with mining conditions and practices.

Questions 4 and 5 assist with operator and maintenance training and competencies and with risk assessments for operators and maintenance workers interacting with the equipment:

4. Are operators aware of all features on the vehicle, how to use them optimally and why it is important that they do?
    - Can the supplier of OEM offer training for operators or company training personnel?

5. Is there suitable competency training available for operators and maintenance personnel? When considering specific hazard areas such as whole body vibration, it is important to recognise that the training should include training in the company vibration management plan and/or policy dealing with seat change outs and early warning signs of seats potentially bottoming out.

Questions 6 and 7 assist with risk assessments and serviceability issues:

6. Is there easy access to machine parts or areas requiring attention, and are there suitable tools readily available for maintenance and servicing of equipment?
    - Can the equipment be towed readily to the workshop to avoid field servicing whenever possible?

7. Are the demands of maintenance tasks within the capabilities of all maintenance personnel?
    - Maintenance does not require undue force, awkward postures or dangerous practices?

If the answers to questions 1 to 7 are yes, then the machine can be said to be well designed from an ergonomic point of view.

(From Barbara McPhee, Usability Standards for Large Vehicles, Ergonomics Australia)

4.5 Manual handling hazard identification worksheet

Task description and location:

_____
_____
_____
_____

Task on this sheet identified from (tick one only):

☐ Incident records ☐ Direct observation at work ☐ Consultation

☐ Other, please describe: _____

Information

1. How many workers do this task? _____
2. How long do they do it (duration)? _____
3. How often do they do it (frequency)? _____
4. How many workers have reported discomfort/pain from this task? _____
5. How many injuries have been attributed to this task? _____
6. What risk factors appear to be the main problem(s) with this task? (please tick)

☐ Actions and movements
☐ Workplace and workstation layout
☐ Working postures/positions
☐ Load location and distances moved
☐ Duration and frequency
☐ Weights and forces
☐ Characteristics of loads and equipment
☐ Work organisation
☐ Work environment
☐ Skills and experience of worker
☐ Age of worker
☐ Clothing
☐ Special needs of worker
☐ Other factors (specify)
_____
_____

7. Are there other similar tasks?

☐ Yes ☐ No

8. If so, how do we currently manage them?

_____
_____
_____

9. Does this task require more detailed risk assessment?

☐ Yes, complete the *Manual handling risk assessment worksheet* and *Manual handling risk control worksheet*

☐ No, copy this for filing and make available for consultation

Developed by: Date

4.6 Manual handling risk assessment worksheet

Task description and location:

_____
_____
_____
_____

Postures/actions

Actions and movements

☐ Bending or twisting the back

☐ Reaching/working above the shoulder

☐ Reaching/working below mid thigh height

☐ Sudden or jerky movements

☐ Repetitive bending, twisting or overreaching

Workplace and workstation layout

☐ Workplace layout makes it hard to reach things involved in the task

☐ Work heights and/or seat heights unsuitable

☐ Insufficient space for all necessary movements

☐ Mechanical aids are not available or easily accessible

Working postures/positions

☐ There is frequent or prolonged forward bending or stretching of the back

☐ There is frequent or prolonged twisting or sideways bending or stretching

Duration/frequency

☐ Task is done for a long time by one worker

☐ A repetitive action is done at speed

Load/force

Load location and distances moved

☐ The object is carried, pushed or pulled over a long distance or unnecessarily handled

Weights and forces

☐ More than 4.4kg lifted while sitting

☐ More than 16kg is lifted while standing

☐ Combined with other risk categories:

- it is necessary to pull, push or slide objects that are difficult to move

- a large force is applied while seated

Characteristics of loads and equipment

☐ Live loads are manually lifted or moved

☐ Objects handled are large or have awkward shapes

☐ Objects are hard to grasp or hold

☐ Objects are wet, greasy or dirty or cannot be held close to the body eg very hot or cold

☐ The object blocks the view when handled

☐ The load is unstable or may move suddenly

Management/environment

Work organisation

☐ There are busy periods when workers have difficulty keeping up with demands and no rest/recovery breaks

☐ Workers are not available for team lifting when required

☐ Manual handling equipment is not regularly maintained or is unsuitable or unavailable.

Manual handling risk assessment worksheet (Page 2)

Work environment

☐ Floors are slippery or uneven

☐ There are different floor levels in the work area

☐ The work area is cluttered, untidy or confined

☐ Lighting is inadequate for the task

☐ Work is done in very hot, cold or windy conditions

☐ There is vibrating machinery

Clothing

☐ Protective clothing or equipment is unsuitable or unavailable (eg slippery shoes, loose gloves and clothing that restricts movement)

Skills and experience

☐ Workers have not received appropriate training in manual handling

☐ Workers have not been properly instructed in safe work procedures

☐ Demands of the task exceed the physical capacity or experience of workers

Age

☐ Workers under 18 performing strenuous repetitive tasks or lifting objects weighing more than 16kg

☐ Older workers performing tasks unsuitable for their physical capabilities

Special needs

☐ There are workers at higher risk (eg due to injury, pregnancy, recent illness, new employees or persons with a disability)

Other

☐ Are there risk factors not covered by the checklist? Provide details:

_____
_____
_____
_____
_____
_____
_____
_____
_____

4.7 Manual handling risk control worksheet

Elimination
Can the manual handling task be eliminated? For example, redesign work activity, object or working environment.

☐ Yes, how can this be done?

_____
_____
_____
_____
_____
_____

☐ No

Substitution
Can the hazard be substituted with one that gives rise to a lesser risk? For example, reduce load size and shape.

☐ Yes, how can this be done?

_____
_____
_____
_____
_____
_____

☐ No

Isolation
Can the hazard be isolated from the worker at risk? For example, remote manual handling techniques.

☐ Yes, how can this be done?

_____
_____
_____
_____
_____
_____

☐ No

Manual handling risk control worksheet (Page 2)

Engineering

Can engineering controls be used? For example, modify equipment or provide mechanical aids.

☐ Yes, how can this be done?

_____
_____
_____
_____
_____
_____

☐ No

Administration

Can administrative controls be used? For example, change in work practice, implement job rotation, training, develop/implement safe work procedure.

☐ Yes, how can this be done?

_____
_____
_____
_____
_____
_____

☐ No

What training or instruction may be required?

_____
_____
_____
_____
_____

Personal protective equipment (PPE)

What PPE could be used to reduce risk? For example, use gloves to improve handling of load.

☐ Yes, how can this be done?

_____
_____
_____
_____
_____
_____

☐ No

Manual handling action plan

Complete the action plan for all tasks that achieve completed risk assessment and control worksheets. Attach references to other documents such as drawings, detailed plans and work procedures. Outline how you will involve workers and what action will be taken to improve management of the risk.

Work location/department: _____

Task description	Control measures	Approved by	Implementation date	Person responsible	Evaluation date	Progress

Developed by _____ Date _____

4.9 Manual handling safe work procedure worksheet

Task description and location:

_____
_____
_____
_____
_____
_____

Steps	Risks	Controls

Developed by:

_____ _____
Manager's name Worker's name

_____ _____
Manager's signature Worker's signature

_____
Date created

_____
Review date

5. Guidance

This section contains:

- Regulatory requirements for MSD prevention
- Direct risk factors
- Contributory risk factors
- Other risk factors
- Vibration
- Musculoskeletal training
- Roles and responsibilities
- MSD lead indicators

5.1 Regulatory requirements for MSD prevention

The OHS Act and OHS regulation contain principles and requirements for MSD prevention

The Occupational Health and Safety Act 2000 (OHS Act) and Occupational Health and Safety Regulation 2001 (OHS Regulation) set out the principles and requirements that apply to MSD risk management in the workplace. These apply from 1 September, 2008.

The OHS Regulation sets out the obligations of employers with respect to risk management. Risk management of manual tasks and slips, trips and falls follows the same process of hazard identification, risk assessment and elimination or control of risks.

Most of the obligations for risk management for manual tasks, slips, trips and falls and equipment (plant) are covered in the OHS Regulation.

In brief, the regulation requires:

- Employer to obtain and provide information for identification, assessment and control of risks
- Use of hierarchy of controls
- Instruction, training and supervision
- Consultation
- Reviews of risk assessments.

The MSD National Code of Practice should be considered when developing prevention strategies

The National Code of Practice for the Prevention of Musculoskeletal Disorders from Performing Manual Tasks at Work (2007) is likely to be adopted in NSW in 2009 when the review of the OHS Regulation is finalised.

In the interim, however, the new national code is consider relevant information and relevant sections must be considered when identifying, assessing and controlling hazards.

The new national code provides more guidance (than previous versions) on musculoskeletal risk factors such as work organisation, whole body vibration and hand-arm vibration, as well as the role of training in manual tasks. The new code also adopts the term manual tasks to encourage identification, assessment and control of all manual tasks, including those requiring manual handling.

5.2 Direct risk factors

Awkward posture

Awkward postures are common in mining and extractives due to the nature of the work environment, the equipment used and the confined areas where tasks are performed.

Force

Applying force, especially for body areas including the low back, shoulders, wrists and hands, is strongly linked to MSD. Force on the low back is common in manual handling of loads. Manual task hazards in mining are worsened due to significant work design factors, including lack of adequate lighting, wet and/or muddy and unstable ground conditions, and limited or restricted space to move. These contributing factors are discussed in the next section.

Manual tasks (forceful exertions), combined with other risk factors, such as awkward posture or vibration, will significantly increase the risk. Some excess forces to the hands and wrists are found when using hand tools, gripping objects, or loosening tight parts.

- *Manual Handling*
  MSD of the back, shoulder, arms, knees and neck also need to be considered as a minimum. Manual task hazards are compounded by significant environmental factors underground, including lack of adequate lighting, wet, muddy and/or unstable ground conditions, and limited or restricted space.
- *Difficult loads*
  An additional characteristic of hazardous manual tasks is where the load is unstable, unbalanced or difficult to grasp or hold.

Repetition and duration

Repetition exposure occurs when similar movements are required to be performed for one hour or more. This includes situations where similar actions are performed across a number of tasks during a shift and the same muscles and other soft tissue are being used continuously. Examples include the use of hand tools in maintenance and handling of bolting equipment in bolting operations.

Duration is the length of time a task is performed. The longer the task is performed the higher the risk. Extended shifts should be taken into account for duration. Operating mining vehicles in open cut mining is one of the most obvious tasks where duration is a factor.

Vibration

Three categories of vibration should be considered:

- Whole body vibration -steady state
- Whole body vibration - jolts and jars (transient mechanical shock)
- Hand-arm vibration

5.3 Contributing risk factors

Look behind direct risk factors to find contributing causes

To assess and control MSD risk factors it is important to find out why direct factors (ie those directly linked to a possible MSD outcome) are present. These are the contributing risk factors

For example, the contributing risk factor or root cause for the risks associated with shovelling coal off walkways is most likely the design of the system causing coal spillage. Other contributing risk factors will be related to the nature of equipment or work environment, eg. mesh walkways require shovelling to clear the coal but a different design, eg specially design checker plate, could be hosed to clear the coal.

Another example of contributing risk factors includes awkward postures in underground mining caused by the work environment or the nature of the load or equipment.

In mining and extractives direct risk factors will generally be due to contributing:

- Organisational factors including systems of work and work practices
- Nature and design of equipment and loads
- Work environment issues.

However, it is important to look for other less obvious contributing risk factors in the risk assessment. The full list of contributing risk factors can be found in the National Code of Practice (2007).
http://www.safeworkaustralia.gov.au/swa/HealthSafety /HazardSafetyIssues/ ManualTasks.htm

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The work environment

The physical work area design and layout can significantly affect the way work is done, particularly in underground mining where **uneven work surfaces** and **obstructions** related to limited housekeeping are common. There are also equipment interaction issues in the work area and the equipment itself creating MSD risks. The interaction of workers and mining work environment cause direct risk factors of:

- Sustained exertion of force
- Sustained awkward posture
- Slips, trips and falls
- Repetitive reaching, bending or twisting
- Increased frequency of tasks.

Uneven surfaces, poorly designed steps, ramps and contaminants on working surfaces can lead to:

- Slippery and uneven working surfaces that may increase the exertion required to perform manual tasks, as well as create a slip or trip hazard when undertaking a manual task;
- Difficulty maintaining balance and increased friction when moving objects; or
- Awkward postures due to the need to see the stairs or ramps while handling a load and ascending/descending.

Obstructions related to inadequate housekeeping and cleaning can lead to:

- Awkward postures such as reaching or bending over obstacles
- Slips, trips and falls to avoid the obstruction
- Awkward postures such as side bending to see path of travel and avoid obstructions
- Increased forceful exertion due to the stop/start nature of moving objects around the obstacles

Difficult lighting conditions may lead to awkward or sustained postures, such as leaning backwards or forward to improve viewing or avoid glare, reflection and excessive light. Some instances in mining and extractives include glare from the sun when operating vehicles, glare from lights at night and insufficient lighting underground for highly visual or technical tasks.

Organisational factors, including systems of work and work practices

In large mining organisations most planning, purchasing and design decisions are made external to the mining workforce doing the work. These decisions impact on the way work is organised or the way procedures are designed and applied. Some organisational factors may result in manual tasks being performed in a way which affects the musculoskeletal system. For example:

- Production and time pressures may increase the frequency at which repetitive tasks are performed or introduce a risk of slips, trips and falls.
- Under resourcing of workers may increase the duration of risk exposure.
- Overtime and inadequate scheduling may reduce recovery time between tasks.
- Maintenance tasks may need to be performed in the field, increasing the amount of force required because of lack of equipment.

Thermal work environment

Workers may be exposed to a variety of thermal environments in mining and extractives leading to:

- Increased grip force due to reduced sensitivity in the hands in cold environments or difficulty grasping due to hand perspiration in hot environments.
- Sudden high force due to loads slipping from the hand.
- Sustained forceful exertion to maintain grip.

Nature and design of equipment, tools and loads

Mining uses equipment, tools and loads best suited for the production environment and material being mined. In some sectors, for example underground coal, some equipment design and tools have not greatly changed in the past decade. With advances in technology it is possible to review the match between the equipment and the workers to determine if a better fit is possible. The key factors to review are:

- Poorly designed or inadequate plant causing more frequent repetitive tasks and awkward postures.
- Inadequate seating causing poor posture or increased whole body vibration.
- Poor design of access points on plant causing increased likelihood of slips, trips and falls.
- Poorly designed or inadequate hand tools causing increased forces and exposure to hand/arm vibration
- Bulky, awkward and poorly designed loads leading to high, sudden or unexpected forces when handling them.

Risk factors for risk assessment of manual tasks and slips, trips and falls risk

Direct risk factors:

- Awkward postures
- Force (including manual tasks and high, jerky, unexpected forces)
- Repetition of movements and duration of the task
- Vibration – whole body, hand/arm and jolting/jarring

Contributing risk factors:

- Organisational factors including systems of work and work practices
- Nature and design of equipment and loads
- Work environment

Other factors:

- Tasks designed for average workers.

5.4 Other risk factors

Ageing workforce

The main issues for older workers are:

- Ability to undertake physically demanding or physiologically demanding work. Strength and endurance of legs, then trunk, then shoulders, decline with age (Parker 2005). Tasks which older, injured miners rate as significantly more physically demanding than older, injury-free miners include:
  - manual tasks (lifting, carrying, lowering)
  - pushing, pulling, dragging (eg cables, hoses, other loads)
  - reaching forward, bending, twisting, stooping
  - prolonged work in an awkward or uncomfortable posture
  - shovelling
  - repetitive physical work

- Increased risks of slips, trips and falls. Factors relate to loss of balance and the lack of ability to recover from a slip. Specific risks include:
  - effects of ageing on vision (older workers have more difficulty in noting trip hazards unless illumination and contrast is increased)
  - loss of strength and endurance in the lower legs
  - changes to sensory and motor function affecting balance
  - potential cumulative effects of injuries over time.

- Older workers will often have more falls than younger workers and have a more severe injury outcome.

Slips, trips and falls risk factors

In mining and extractives industry, the hostile environmental conditions and regular interaction with plant and equipment are major risk factors contributing to slips, trips and falls. Specific risk factors include:

- Work at night or underground (limited visibility)
- Work in, on and around uneven and hazardous ground conditions
- Poor access to heavy vehicles for operators and maintainers

Risk factors in underground mines include:

- Very low levels of lighting
- Wet, boggy, muddy and uneven ground conditions
- Restrictions in interacting with equipment and objects due to seam conditions, mine plan and ground conditions
- Dirt and mud obscuring visual features of steps and platforms
- Dirt and mud clogging footwear treads
- Wet conditions restricting choices of footwear
- Frequent changes in conditions due to shift and mine life.

New workers

New workers in any hazardous job have an elevated risk of injury.

- Are new workers likely to rush to volunteer or assists in tasks they are not familiar with?
- Do they understand the need to pace themselves with some of the physically demanding tasks?
- Are they aware of the MSD hazards – working beyond their physical capacity for prolonged periods?
- Are they given the jobs no one else wants?
- Do they know exactly what to do and how?
- Will they ask for assistance?

5.5 Vibration

Whole body vibration

Information is available for the mining and extractives industry on managing the risk of whole body vibration (WBV) in the publication *Bad Vibrations*. Although the information in *Bad Vibrations* is predominantly for the coal sector, metalliferous mines and extractives will find it useful.

Equipment operators are exposed to WBV in both sitting (most equipment operation in mining and extractives) and standing (eg jumbo operators in underground metalliferous) operations. Common operational groups include drivers, operators and passengers in a variety of vehicles such as bulldozers, dump or haul trucks, graders loaders, personnel and equipment transport and load-haul-dump (LHD) machines used in surface and underground operations. Rides in most of these vehicles include jolts and jars, as well as steady state vibration.

Three main sources of harmful vibration

There are three main sources of harmful vibration in vehicles and machines:

- Rough road and poor work surface conditions
- Vehicle activity – eg ripping versus pushing material in a dozer
- Engine vibration, but to a lesser extent.

Factors that increase or decrease driver exposure

There are many factors that can either increase or decrease the exposure for the driver. These include:

- Road construction and maintenance (grading etc)
- Vehicle type and design
- Age and condition of the vehicle
- Maintenance of vehicle suspension systems
- Seat design, suspension and maintenance
- Cab layout, design and orientation
- Vehicle or machine speed, driver skills and awareness
- Lighting and visibility
- Task design and work organisation

WBV hazards need an appropriate method of risk assessment and control

Based on this, the hazard of WBV needs to be followed through using an appropriate method of risk assessment and controls. WBV guidance may be addressed by measuring and analysing exposure to vibration, comparison with Original Equipment Manufacturers (OEM) and ISO/ASNZ standards, equipment design and seating, training to minimise exposure. (For more information see *Bad Vibrations* which includes a checklist for sources of vibration).

Some controls for WBV

Road maintenance

- Planned, systematic road maintenance programs
- Dedicated vehicles and drivers for road maintenance
- Effective communication of road conditions (eg signposting, markers)
- Prompt repair of poor road conditions

Vehicle and seat design

- Vehicle suspension appropriate for loads – no bottoming out
- Good seat design and suspension
- Improved visibility from cab, especially at night (headlights)
- Forward facing passenger seating
- Fully adjustable seating

Operator training and awareness

- Raise awareness of harmful effects of vibration
- Driver competency training
- Regular breaks out of cab

Speed

- Enforce speed limits
- Appoint competent, safe drivers
- Speed limit vehicles in specific situations

Vehicle maintenance

- Planned maintenance of vehicle and seat suspensions
- Specialist maintenance for vehicle and seating suspension systems

Miscellaneous

- Ensure adequate shot firing standards
- Equipment exposure limits
- Equipment changeout and swap arrangements

Jolting and jarring (transient mechanical shock)

WBV includes exposure to high amplitude and infrequent mechanical shocks. These can appear on incident reports as jolting and jarring, seats bottoming out and workers reporting rough rides (ie jolting and jarring while a vehicle is in motion).

Although rough rides may be less common in the metalliferous underground sector this is dependent on the state of the decline, driver speed and the appropriate seat design and adjustment by workers.

Hand–arm vibration

Hand-arm vibration (HAV) is transmitted as a result of work processes or tasks to workers' hands and arms. Common sources of HAV in mining and extractives are from:

- Hand-held power tools (used in maintenance for process plants, fixed plant, some mobile equipment)
- Hand-guided powered equipment (mainly hand-held drills, airleg drills, drill rigs)
- Powered machines where vibration is transmitted via body to hands (operating jumbos without vibration dampening).

The main HAV risk factors to review

The main factors to review include:

- Length of exposure – the longer the worker is exposed to the vibration (ie uses the vibration causing equipment) the more likely a negative outcome
- The vibration level of the equipment, usually measured in m/s^2. Common mining vibration levels range from a low value of 2 m/s^2 for some lower vibration rattleguns to close to 6 m/s^2 for low level rock drills (OPERC 2007). In a South African metalliferous mining evaluation rock drills had weighted vibration levels in excess of 20 m/s^2.

5.6 MSD training

MSD training should be given in a number of situations

Training should be provided when:

- A worker is inducted into a job with manual tasks
- A new manual task is introduced
- A manual task is being redesigned
- New equipment requiring a manual task is introduced.

Most people in the workplace need MSD training

Training should be provided to:

- Workers carrying out manual tasks
- Health and safety representatives
- Managers and supervisors
- Those selecting/purchasing equipment used in manual tasks
- Those designing manual tasks or systems of work, or the layout of a workplace where manual tasks will be carried out
- Those involved in identifying, assessing and controlling MSD hazards
- Those involved in monitoring, reviewing and evaluating risk control measures.

The type of training should relate to the manual tasks

The type of information, instruction and training required will depend on the manual tasks being considered and the hazards and risk associated with these tasks. However, training should provide information on:

- General risk assessment principles
- Task-specific safe methods of manual tasks
- Safe use of items and systems of work.

Training objectives must be practical

Workers trained in manual tasks should be able to demonstrate how to:

- Use risk control measures such as mechanical aids and safe systems of work
- Carry out basic assessment of their tasks to recognise MSD hazards
- Reduce the risks from hazards (by techniques including getting assistance when required)
- Select and use the appropriate techniques
- Perform tasks safely
- Report any hazardous aspects of manual tasks
- Consult with supervisors and others in solving MSD problems.

MSD training for purchasers and designers

Purchasers and designers should be trained in:

- How to identify MSD hazards
- How to identify design factors that could contribute to the risk of MSD
- How MSD can be prevented through appropriate design.

MSD training for workers

Workers involved in risk management should be trained in:

- Factors that cause MSD and slips, trips and falls
- How to identify jobs and workers at risk
- How to undertake hazard identifications and risk assessments in consultation with other workers and employees
- Facilitating risk controls in conjunction with others
- Effective measures to control the risk of MSD and slips, trips and falls
- Evaluating controls to reduce risk.

Training records

Employers should record attendance details of training sessions, including:

- A description of each training session
- The date and location of the session
- Details of the training provider
- Details of the participants.

For more specific training content and application see the QLD Manual Tasks Code of Practice (2000) which contains appropriate information on training for the area of manual handling in Section 5.

Good Practice: training on manual tasks, including a practical risk assessment exercise

A medium–sized open cut metalliferous mine in Queensland used the QLD Manual Tasks Advisory Standard (2000) as the basis for their approach to manual handling training. The training included identifying, assessing and controlling manual task hazards, as well as task-specific training on common manual tasks issues at the operation.

The safety and health department instituted a homework exercise for all employees and contractors as part of the training. After the training session participants were given a checklist and returned to their operational areas to conduct a manual tasks risk assessment. These assessments were then returned to the safety and health department to evaluate and prioritise.

Having a practical component to the training and development teams in operational areas is an effective way to encourage workers participation, as well as equipping them with tools to identify hazards in their jobs and develop and assess control measures.

5.7 Roles and responsibilities

Role	Responsibility
Senior managers	• Set targets for reducing injuries from manual tasks and reducing slips, trips, falls • Make managers accountable for health and safety performance, including manual tasks and slips, trips, falls in areas under their control • Provide resources and other support for implementing a health and safety management system with MSD prevention and achieving targets • Consult with employees
Safety and health manager for manual tasks or slips, trips and falls (can be including in existing safety and health portfolios)	• Assist to develop and maintain a list of manual tasks to be assessed in each operational area • Assist in determining the priority for assessing each manual task • Assist operational areas develop realistic schedules for risk assessments and introduction of solutions/controls • Ensure that risk assessments and solutions are documented • Assist in the development of solutions and recommend solutions for implementation • Liaise with operational areas on implementing solutions • Assist to evaluate implemented solutions • Evaluate manual task procedures and suggest improvements • Act as a resource for risk assessment teams • Report progress regularly to the OHS committee • Participate in consultation with employees
Check inspectors and/or OHS committee members, including risk assessment team for each operational area	• Identify tasks involving hazardous manual tasks in the work area and encourage employees to provide input • Prioritise identified manual tasks requiring assessment and set time frames • Assess tasks according to agreed schedules • Develop solutions for assessed tasks • Evaluate implemented solutions • Ensure the list of manual tasks is kept up to date • Ensure that hazardous manual tasks are identified and assessed before the changes proposed are made to tasks, the work area and equipment • Participate in consultation with employees
All workers	• Participate in manual task training • Follow safe work procedures to minimise risk of manual tasks or slips, trips, falls • Report all hazards to the supervisor and check inspector/ OHS committee member and ensure they get followed up • Participate in bringing forward issues to the health and safety committee when identified • Assist with risk assessments and surveys • Participate in consultation

5.8 MSD lead indicators

Lead indicators measure the effectiveness of strategies to prevent MSD injuries

The following potential lead indicators may be adapted for use in managing the risk of MSD:

- Number (percentage) of hazard reports on MSD factors that identify possible higher order controls
- MSD symptom surveys conducted annually
- Purchase of all new equipment includes consideration of ergonomics and MSD factors
- Contracts include manual tasks and slips, trips and fall risk management commitment from contractor
- Training in manual tasks and slips, trips and falls hazards and risk assessments, refresher training and HSR training on manual tasks and slips, trips and falls completed on schedule
- Reviews of manual tasks and slips, trips, falls risk assessments completed annually or more frequently as a result of new information
- Toolbox talks on risk factors for MSD in each area at 80% of planned
- Percentage (number) of completed hazardous task risk assessments including engineering or elimination controls
- Number or percentage of manual tasks hazard reports closed out with higher order (elimination/engineering) controls
- Successful close outs (percentage) of committee health and safety items related to elimination or engineering controls of manual tasks/slips, trips and falls
- Proportion (80% plus) of near slips or trips of overall incidents involving slips, trips and falls
- Number or percentage of MSD solutions submitted for awards, recognition and/or assisted to submit to trial.

6. Mining Industry Case Studies

This section contains:

- Case study: Risk Assessment
- Case study: General manual handling solutions
- Case study: General manual handling solutions
- Case study: Control of slips, trips and falls

6.1 Risk assessment of manual handling hazard

Company Beltana Coal Mines Ltd., Xstrata Coal: Beltana Tyre Handler.

Issue Tyre handling of new 10SC32 shuttle cars carrying 16 tonne of coal was a problem identified by a crew hazard report.

Main MSD issues/manual task hazard identified:

- Manual handling of newer, heavier 700 kg tyres
- Ageing workforce issues

Other safety hazard identified:

- Crush injury

Risk assessment The risk associated with the tyre changing issue was assessed by the development management team using the Xstrata 5x5 matrix in a WRAC format and was ranked as high.

The overall score using the tool (see below) for the lower back is 14, but this would increase by a loading (+1) for the environment (underground coal) and +1 for other factors (ageing worker issues). This means that the task would be assessed a hazardous manual task for the majority of workers.

	Green 1	Yellow 2	Orange 4	Red 8
Exertion				x
	Low force and speed	Moderate force or speed but well within capacity	High force or speed but not close to maximal hard work	Force or speed are close to maximum the person is capable of
Exposure		x		
	Performed infrequently for short periods	Performed regularly but with many breaks or changes of task	Performed frequently, without many breaks or changes of task	Performed continuously for majority of shift
posture		x		
	Comfortable posture within a normal range about neutral	Uncomfortable posture but not involving postures at the extreme of range of motion	Postures at the extreme of range of motion	
Movement and repetition		x		
	Dynamic and varied patterns of movement	Little or no movement or repeated or similar movements	Repeated, identical movements	

6.2 Underground mining – tyre change

Company Beltana Coal Mines, Xstrata Coal: Beltana Tyre Handler

Issue Manual handling during tyre change on shuttle car

Risk control process

The risk control process was based on the risk assessment by the development team outlined earlier in this section.

Current engineering solutions were reviewed and found unsuitable. The workforce were asked for ideas and provided four design options. Each was assessed through a design risk assessment.

Keeping the design simple, user-friendly and safe was important. Beltana personnel, including the safety systems co-ordinator, workers and the process engineer, were involved in the design risk assessment. The final selected design was returned to the workforce for input.

Implementation

A prototype tyre handling attachment for an Eimco or forklift was fabricated by an engineering firm and reviewed by the mine mechanical engineer and shift engineer. Modifications were identified and made before the attachment was sent to site. Onsite, the prototype was reviewed by the development crews, process co-ordinator, process engineer and engineer co-ordinator, who identified further modifications before testing. The attachment was certified by an engineering specialist and transported back to the site for testing.

A post implementation review was conducted and a further improvement (converting attachment from fort tyne mounted to QDS attachment) was identified and is being investigated.

A training package and assessment were developed and all crews (longwall as well as development) were trained and assessed in the use of the tyre handler.

The tyre handler
Approximate cost: $7,500
Productivity increased because it takes less time to replace the tyre

6.3 Surface mining – cleaning feeders and chutes

This case study is project C11058, reproduced with ACARP permission*

Task description

Operators were required to loosen clay and coal build-up in chutes up to two or three times per shift, depending on feed conditions. Crowbars were used as the primary means to loosen build-up.

Manual tasks risk factors

The risk assessment identified forceful exertions and awkward postures, particularly for the upper body. Over the year numerous injuries, including shoulder and back strains, have been attributed to this task.

Design controls

Install a water injection system directly into the chutes significantly reducing the amount of collected material and the need for maintenance. The system can be operated from the control room.

Replace crowbars with water lances. The water lance is a length of 1 inch pipe with a valve and “minsup” coupling. It was manufactured on site. The water hose is attached to the firewater system for greater water pressure. The lance reduces the worker’s need to use upper body strength and force.

Operator holding water lance

* The case study (including image) is reproduced from Appendix D of the C11058 final report (Nicholson & Leveritt 2004)

6.4 Control of slips, trips and falls (underground coal)

Company

Ulan Coal Mines Ltd., Xstrata Coal: The Underworm Pontoon Plate

Issue

Ulan has the longest longwall in Australia (400m wide x 2.9m high), known as The Fat Face.

Main MSD issues/manual task hazard identified:

- Slips, trips and falls on the longwall resulting in sprains and strains of ankles and knees

Risk assessment

The risk of a slip, trip and fall was rated as high

Risk control measures

Control measures from risk assessment included:

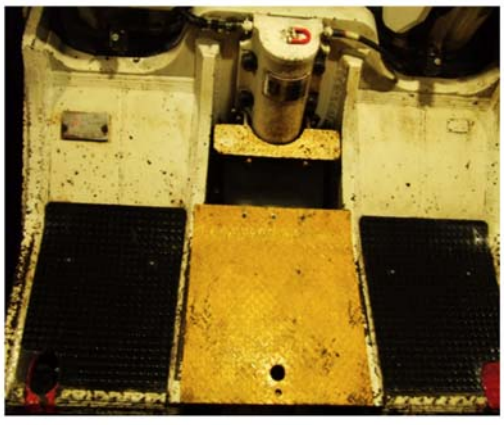
- Adjustment of base lift control parameters to suit different mining conditions
- Anti-slip checker plate with anti-slip paint
- Retention chain

Implementation

An initial trial of the high-visibility anti-slip checker plates was undertaken. The trial was a complete success. Reports of sore knees and feet from the longwall crews have ceased, even after 4000m of cutting in an eight hour shift.

- Simple, low cost idea – trial $200 each
- Fully install $160 each
- Total costs - $32,000 for the 400m long wall.

Before



After

7. Resources

This section contains:

- Definition of terms
- Hierarchy of control
- Lessons using participatory ergonomics
- Resources for risk management
- References and further reading

7.1 Definition of terms

Awkward	Posture or action creates discomfort, pain or cannot be maintained due to being at extreme range of normal movement.
Constrained	Posture is forced, cramped, restrained, unnatural, confined or restricted.
Environmental conditions	In mining refers to the environment in which workers work. This includes the following factors often exacerbated in underground mines – lack of lighting generally and at night; muddy, wet and unstable ground; heat and humidity; high noise levels and confined access.
Ergonomics	The design and evaluation of tasks, jobs, environments and systems to make them compatible with the needs, abilities and limitations of people.
Good practice	Based on criteria from the European Agency for Safety and Health and Work, this should: • Be implemented following a proper assessment of the hazards and risks • Improve working conditions and promote health, safety and efficiency • Prevent identified risks at source • Be identifiable as the action reducing the risk • Achieve identifiable permanent benefit • Meet relevant legislative requirements and preferably exceed minimum standards • Include a participatory approach between employers and workers.

Hazard (for MSD)	Any thing or situation, potentially causing or contributing to the development of MSDs in those performing manual tasks or exposed to conditions causing slips, trips and falls. It may include the type of work performed, the environmental conditions, and the way the work is performed, including the use or handling of items.
Hazardous manual task	Has any of the following characteristics: • Repetitive or sustained application of force • Repetitive or sustained awkward posture • Repetitive or sustained movement • Application of high force • Exposure to sustained vibration • Manual tasks involving the handling of unstable loads or loads which are difficult to grasp or hold.
Manual tasks	Activities requiring a person to use their body (musculoskeletal system), including work involving lifting, lowering, pushing, pulling, carrying, moving, holding or restraining a person, animal or item. Manual tasks also include tasks with repetitive actions, sustained postures and may involve concurrent exposure to vibration.
Musculoskeletal disorder (MSD)	An injury or disease of the musculoskeletal system caused by manual tasks in the workplace, whether suddenly or over a prolonged period.
Physiologically demanding jobs	Place demands on the circulatory system (heart), respiratory system (lungs) causing increased heart rate, blood pressure and respiratory demands. They can involve repetitive overhead work, significant periods of climbing, heavy work using the arms when squatting, heavy work wearing restrictive personal protective equipment (particularly respiratory) or working in heat and/or humidity.
Sprain/strain	Traumatic or cumulative injury damaging and inflaming joints and adjacent muscles. It is usually accompanied by pain and stiffness often resulting in swelling and loss of function of the areas involved.
Task	A set of human actions contributing to a specific functional objective and ultimately to the output goal of a system.
Work organisation	The way work is organised and procedures administered.

7.2 Hierarchy of control applied to mining

Hierarchy of control	Examples of manual tasks control measures (adapted from ACARP project C11058)
Eliminate hazards	
Elimination	• Eliminate the problem task completely, eg automate a complete job process (such as using remote controls) or aspects of a particular task • Purchase materials in bulk and pump or move them by forklift instead of handling individual bags or drums • Deliver goods directly to the point of use and eliminate multiple handling
Minimise residual risks	
1. Substitution	• Replace heavy items with lighter objects, smaller objects and/or objects with better handling characteristics (such as handles, less awkward size and shape). This may involve making arrangements with suppliers, packaging departments and delivery providers • Upgrade to better quality tools with improved efficiency to reduce force required to perform task
2. Isolation	• Isolate vibrating plant from the user, eg fully independent seating
3. Engineering	• Redesign the workplace/cab layout, eg more cab space to reduce awkward postures, adjustable benches or seating in maintenance workshops • Introduce mechanical lifting aids to eliminate manual handling (eg Beltana Tyre handler) • Use damping materials around tool handles to absorb vibration and reduce impact on workers. Damping materials can also be used in floors and around vibrating machinery to reduce exposure to whole body vibration
4. Administration	• Consult workers about sharing tasks that require prolonged fixed postures or heavy, demanding work • Arrange workflows to avoid peak physical and mental demands towards the end of the shift
5. Personal Protective Equipment	• Wear full lace-up supportive footwear for tasks requiring prolonged standing and walking in underground environments

7.3 Lessons using participatory ergonomics

Keys to success and lessons learned	In recent year's researchers at The University of Queensland and NIOSH Pittsburgh Research Laboratory have undertaken demonstration projects in which participatory ergonomics programs have been implemented in a range of sites in the mining and extractives industries. The lessons learned have been documented in Burgess-Limerick et al 2007 and Torma-Krajewski et al 2006 and are summarised below:
Use of a site champion	An on-site person who drives the process appeared essential – this person needed to have easy access to, and support from, management to proceed with projects. Sites without such a person struggled to implement the suggested controls. (Burgess-Limerick et al 2007: p148).
Committee participants	It is important to select participants who want to be part of the process and to allocate sufficient time for participants to perform their role. The Bridger Coal Company included ergonomics committee participation in the performance plans for salaried personnel and altered employee schedules to allow sufficient time for committee activities. Additionally, committee members helped each other with tasks when members did not have time to complete their assignments. Staff turnover affected the progress of control ideas at some sites. At one site a member of staff left and with him went all knowledge of the trial he had just conducted for a short-term control for belt lifting (Burgess-Limerick et al 2007: p 149).
Process development	There is no single process that will work for all companies. Although the ergonomics committee was given a lot of information and ideas on how to proceed, committee members determined what would work best to meet their needs. It is critical to have employees on the committee who were dedicated to a successful process.
Process implementation	Sufficient time is needed for a committee to become thoroughly familiar with its procedures (eg for MSD or ergonomic hazard reports) prior to giving employee training and requesting that employees submit concerns.
Supervisor training	Supervisors should receive additional training specifically addressing their role in the ergonomics process. It should demonstrate management's support and be done prior to the employee training so the supervisor can support implementation. Training is critical for supervisors who may have employees reluctant to participate. Also it is imperative that supervisors be fully aware of the way the company plans to address ergonomic concerns.

Management commitment	Despite considerable advances in mining technology, underground coal mining is still characterised by relatively high exposure to hazardous manual tasks. While production loomed large in the consciousness of management, there also needs to be a genuine commitment to health and safety. (Burgess-Limerick et al 2007: p148)
Practical group - based training using workplace specific videos	After a relatively short training period coal miners were able to undertake manual task risk assessment and generate potential control options. Industry and workplace specific video footage was effective in conveying the required skills and knowledge and maintaining motivation and attention of the trainees. (Burgess-Limerick et al 2007: p148)
Incorporating homework in training	Employees were given two 90 minute sessions, one week apart, with a homework assignment encouraging employees to complete report cards identifying risk factors for two of their job tasks.
Participatory risk assessment and involving experienced operators	The PErforM tool was easily understood and the risk management approach and control hierarchy was a familiar strategy to all. The speed with which the nature of the risk and the suggested control ideas were generate by using the tool was impressive. The information typically required considerable refinement following the brainstorming stage, however, the benefits of having a number of experienced operators involved in the process cannot be over-stated. (Burgess-Limerick et al 2007: p149) Highly developed safety management systems, combined with low staff turnover are a good combination for skills in manual task risk assessment and control to be used and design changes implemented. Conversely, the size of the organisations and the complexity of the workplaces, created challenges for ensuring that controls generated by participative ergonomics were evaluated, trialled and implemented. The additional hazards of working in an underground environment such as the overriding concern regarding the control of ignition sources means that implementing controls for underground coal mining can be particularly slow. Certainly new designs takes time. This can be frustrating for the workers concerned and lead to dissatisfaction with the process. The initial implementation of quick controls, even if they are not the highest risk tasks, may be beneficial to maintain motivation. Part of the attractiveness of the participative ergonomic process was the sense of ownership that developed over an implemented control idea. Management at most mine sites were able to identify one or two controls implemented over the years that – at some expense – just did not catch on. A lack of participation is the likely cause at least in some cases, given that traditional change implementation strategies have been top-down.

Documenting

Documenting both successes and failures is an important step. If an idea has been trialled and failed a few years ago it may be worth revisiting the concepts and considering alternatives in light of subsequent technical developments. This is difficult to do without available documentation.

Obstacles

Shiftwork was an obstacle to direct communication with employees. Seeking feedback for a change or modification to plant and equipment from all users is not easily done and was not often done very well.

The process had the greatest potential to breakdown at the refinement stage. The expertise used to identify the nature of the risk and suggest control ideas may not be the same expertise needed to design and implement the controls. Input from other areas may be required for a variety of areas, eg to ensure that:

- Materials introduced into the underground environment are intrinsically safe
- The use of new controls will not create a flow-on effect on any other part of the operation
- Costs are realistic
- Controls comply with regulatory requirements, site and company guidelines.

Conclusion

"While there is no doubt that the participative ergonomics process described here has the capability of producing effective control solutions, achieving this potential and translating the results into reduced risk exposure required the genuine commitment of management to implement control measures identified during the project. Equally important was that this commitment was perceived to exist by the workers. Consequently, the role of the participative ergonomics facilitator often needed to extend beyond purely providing manual tasks risk control skills, but also to facilitating communication between management and workers. Other threats to the successful implementation of control suggestions included turnover of key staff and failure to ensure sufficient participation in the implementation stages." (Burgess-Limerick et al 2007 p149-150)

7.4 Resources for risk management

MSD risk management guidance, including some MSD checklists	ASCC (2007) *National Code of Practice for the Prevention of Musculoskeletal Disorders from Performing Manual Tasks at Work* Burgess-Limerick, R et al (2004) *Reducing Musculoskeletal Risk in Open Cut Coal Mining* ACARP project C11058, final report, Brisbane Burgess-Limerick, R (2007a) *Reducing injury risks associated with underground coal mining equipment* ACARP project C14016, final report – Appendix A, Brisbane *MAQOHSC Manual Handling Hazard Audit Tool*, Adelaide http://www.maqohsc.sa.gov.au/_upload_docs/20080129031123.MiningAuditTool.pdf McPhee, B (1993) *Ergonomics for the Control of Sprains and Strains in Mining*, Sydney: The Joint Coal Board Health and Safety Trust and WorkSafe Australia McPhee, B (2007) *Practical Ergonomics* Sydney: The Coal Services Health and Safety Trust WHSQ (2000) *Manual Tasks Code of Practice* 2000, Brisbane WorkCover NSW (2007) *Manual Handling Risk Guide*, Sydney WorkSafe Victoria
Slips, trips and falls checklists	WorkCover NSW *Manual Handling Resource* WHSQ *Guide to Preventing Slips, Trips and Falls*
Vibration specific information	HSE website: *Hand-arm Vibration at Work* McPhee B, Foster G, and Long A, *Bad Vibrations: A Handbook on Whole-Body Vibration Exposure in Mining*. 2nd edition 2009
Good practice controls measures / solutions for MSD hazards	MIRMgate portal on MISHC site: http://www.mirmgate.com

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Phone: 02 6738 8500
Fax: 02 6772 8664

Broken Hill

Industry & Investment NSW
Level 2, 32 Sulphide Street
Broken Hill NSW 2880
(Note changed PO Box number)
(PO Box 696 Broken Hill NSW 2880)
Phone: 08 8088 9300
Fax: 08 8087 8005

Cobar

Industry & Investment NSW
Government Offices
62–64 Marshall Street
Cobar NSW 2835
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Phone: 02 6836 6000
Fax: 02 6836 4395

Lightning Ridge

Industry & Investment NSW
Miners Association Building
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Lightning Ridge NSW 2834
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Fax: 02 6829 0825

Lithgow

Industry & Investment NSW
Hartley Building
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Lithgow NSW 2790
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Fax: 02 6352 3876

Orange

Industry & Investment NSW
161 Kite Street, Orange 2800
(Locked Bag 21, Orange NSW 2800)
Phone: 02 6360 5333
Fax: 02 6360 5363
After hours – emergency only –
02 6360 5343

Singleton

Industry & Investment NSW
Coal Services Building
1 Civic Avenue, Singleton NSW 2330
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Wollongong

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