QUEENSLAND MINING INDUSTRY

HEALTH & SAFETY CONFERENCE 2012

19th - 22nd August 2012

A New Era in Health and Safety

- New legislation
- Unprecedented growth
- Skills shortage
- Inexperienced workers

Peak groups unite to address skills shortage

IN the face of a worsening skills shortage, peak resou... and Queen... industry s...

Industry aims at zero harm

Mining safety Boom

THERE was a mining boom and now this could be the mining bang. Mines in regions battered by this year's wild wea... are battling to safely use explosives, a conference he...

Energy boom drives state's economy

QUEENSLAND is poised for a year of economic sunshi... under...

HAVE YOUR SAY ON MODEL WORK HEALTH AND SAFETY **LEGISLATION** FOR THE **MINING INDUSTRY**

AUSTRALIA will move to a national occupational health and sa... regim after state and territory governments recently a... their laws.

Choosy workers make it harder

ATTRACTING 30,000 workers to the Bowen Basin during the next six years will be hard enough, but if our choosy workforce is heading....

Mine jobs outlook booms

BOOM TIMES: There are plenty of jobs in mining, but not all sections of the community benefit. Picture: Bloomberg Source....

Demand for workers to soar to 40.000 with Boom Mark II

GET ready for Boom Mark II Queensland's resource sector will need 40,000 workers as $142 billion worth of projects come on line in the next nine years. .....

Mining injuries **at a low**

THE number of working hours lost because of injury in the Queensland mining industry has dropped to a low, new figures show.....

Townsville Entertainment & Convention Centre (TECC) and Jupiters Townsville

QUEENSLAND MINING INDUSTRY HEALTH & SAFETY CONFERENCE 2012

MMSA MobileMedicalServices AUSTRALIA

INNOVATION SUBMISSIONS 2012

The Innovation Submissions Book is Proudly Sponsored by Mobile Medical Services

Innovation Submissions

This year 25 submissions were received for the Innovation Awards

With a view to providing a wider circulation throughout the Industry, the Conference Committee has printed this publication which includes all the Innovations received for the 2012 Awards and the winner of the NSW Innovation Awards.

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Carbon Fibre Shuttle Car Collars

Xstrata Coal Queensland – Newlands Northern Underground

The Problem or Initiative

a) Identified problem

- Shuttle car maintenance occurs on a daily basis, and the current process and tools (steel collar) make this task hazardous for the operator.
- It is deemed to be hazardous due to the weight of the steel collar, the difficulty associated with manual handling this item, and the excessive time it requires operators to be in a hazardous zone (ie – underneath the shuttle car).
- The manual handling issues include awkward postures, excessive reaching and lifting excessive weight. 14kg held at arms length, whilst stooping, exposed the operator to sprain and injury.

b) How the improvement opportunity was identified

- In terms of the current process, fitters reach under the shuttle car and apply a mechanical stop (the current steel collar) to the hydraulic lifting cylinders. If the shuttle car was to lower inadvertently, the shuttle car would come to rest on these collars.
- As part of an overall process improvement and safety review, this particular improvement opportunity was identified through consultation with personnel doing the task and the Engineering department at Newlands Northern Underground.
- It was determined that the risk of injury while conducting this task was unacceptable.

c) What health and safety consequences were to be addressed

- Manual handling injuries (sprain and strain injuries) as a result of awkward postures, excessive reaching and excessive weight.
- The original collars are difficult to apply and place the fitters into a hazardous zone underneath the shuttle car, potentially resulting in crush injury if the hydraulics fail.

The Solution

a) Strategies and initiatives developed to identify and address the problem

- As the weight of the collar was the primary issue, the team commenced investigation of composite material alternatives.
- The project team identified carbon fibre as the best likely alternative, and the team was tasked with investigating the overall viability of carbon fibre as a high strength substitute for steel, relative to this specific application.
- A range of trials carried out by the project team confirmed carbon fibre as a suitable substitute – explained in more detail in section c) below.

b) Internal and external resources used

- The project team comprised of personnel performing the task and the Engineering Department at Newlands Northern Underground.
- An external manufacturing company was employed to manufacture the newly designed collar.
- There was regular consultation during the development stage of manufacture with the Development Mining Department.
- Communication to employees on the progress and implementation of the project was through Tour Starts and Health, Safety, Environment and Community (HSEC) Meetings.

c) Methods used to trial and test

- Extensive trials were conducted on the collars, which involved destructive testing.
- In the initial trials, the collars didn't fail, however the layers began to separate (and this has since been rectified).
- The collars are rated to 12.5 tonnes, however the destructive testing was taken to 75.0 tonnes without complete failure.

d) Implementation process

- The project team had a carbon fibre version designed and manufactured.
- The new collar weighs approximately 3kg and is rated to 12.5 tonnes as per the current steel collar.
- This rating is in accordance with half the weight of the shuttle car.
- End users of the innovation were consulted in the design and testing of the collar, with positive feedback received throughout the design and implementation process.

e) Demonstrate how hierarchy of control has been applied

- The task of applying a mechanical stop to the hydraulic lifting cylinder is a necessary safety precaution, therefore it is not possible to eliminate this task.
- This is a substitution level control, whereby we have substituted the material for a much lighter one..

Benefits / Effects / Outcomes

a) Describe the safety and/or occupational health benefits

- The carbon fibre collars are approximately 3kg (an 11kg reduction from the original version) and greatly reduce manual handling issues.
- As a result, the risk of strain and sprain injuries is minimised.
- The carbon fibre collars are easier and more efficient to apply and reduce the time that fitters will be in a hazardous zone underneath the shuttle car.
- This reduces the risk of a crush injury.

b) Supporting data

- Risk Rating (according to the Xstrata Coal Risk Management Standard) :
  Before implementation
  12M After implementation - 5L
- Physicality of Tasks Rating (according to a modified PERforM risk tool):
  Before implementation
  10M After implementation - 5L

c) Extent of deployment across the site

- The collars have been installed on all shuttle cars across the site and are currently being utilized for maintenance tasks.

Transferability

a) Potential for innovation to be used, modified, transferred across the industry

- The use of this material is already being trialed on other applications, eg development conveyor structure and underground ventilation tubes.
- All shuttle cars have mechanical stops for the hydraulic lifting cylinders, therefore this innovation is application for all operations where shuttle car maintenance is required.

Innovation

a) Originality of the innovation

- The innovation is unique to Newlands Northern Underground, and is the first design of its type across the industry (to our knowledge).

Approximate Cost

a) Statement of approximate cost, if known

- $1,900

Innovation

CHPP Tag Readers

Xstrata Coal Queensland – Newlands Surface Operations

The Problem or Initiative

a) Identified problem

- The primary issue is the risk of a bin discharging whilst the cabin of a vehicle is in the drop zone.
- This creates the risk of a potentially fatal hazard or serious crush injury.

b) How the improvement opportunity was identified

- In 2008 (at Ravensworth) a fatality occurred when a bin discharged while the cabin of a vehicle was in the drop zone.
- This clearly heightened the awareness and importance of working on a process improvement project to mitigate this risk.

c) What health and safety consequences were to be addressed

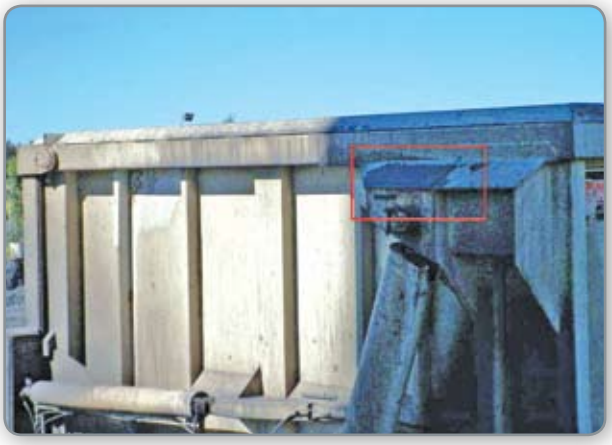
- The primary health and safety consequences are serious crush injury and fatality.

The Solution

a) Strategies and initiatives developed to identify and address the problem

- A project team was created to work with an external supplier on the development and implementation of a viable and effective solution.
- After reviewing alternatives, the use of a tag reader system was selected, designed and implemented to determine when it was safe for the reject truck to proceed under the rejects bin.
- The solution includes entry lights and reader and an exit reader.
- The tag reader system is superior to normal standards as it does not use optics or radar that may be affected by the environment they are installed in or a sequence of events that may be misinterpreted.

- The tag reader reads a dedicated number from the tag.
- From the numbers and the channel the numbers are received on, the control system is able to determine the position of the cabin.



- When the truck leaves the drop zone, the reject dump bin control is disarmed.
- The system is rearmed when the cabin of the truck passes under and past the drop zone.
- Traffic lights on the bin and SCADA screen indicate the system status.
- The tag readers may be utilized in the future to aid in the positioning of the trailers to improve loading of trailers.

b) Internal and external resources used
- The control room operators were involved with the process control engineers in the configuration of the control logic and the operator interface.
- The haulage contractors Operations Manager and Training Office attended the commissioning and fine tuning stages of the project.

c) Methods used to trial and test
- The system was bench tested by Logicamms at their Mackay office.
- The proven system was then sent to site and installed.

d) Implementation process
- While the system was being bench tested in Mackay the cables and supporting equipment was being installed on site.
- During a planned shutdown final installation and commissioning was completed.

e) Demonstrate how hierarchy of control has been applied
- Engineer / Redesign – Isolation. The tag reader system disarms the gate control when the trailer is detected leaving the drop zone.
- The gate control is armed when a trailer is detected entering the drop zone.

Benefits / Effects / Outcomes

a) Safety and occupational health benefits
- Mitigated the risk of serious crush injuries and potential fatality.

b) Supporting data
- An extensive commissioning process has proven that if a trailer is not detected, the system will not allow the bin to discharge.

c) Extent of deployment
- At Newlands Coal CHPP the reject bin is the only installation of this kind.

Transferability

a) Potential for innovation to be used, modified, transferred across the industry
- The tag reader could be used in any situation that requires the positive identification of an item to be transferred to a control system.

Innovation

a) Originality of the innovation
- Tag reader systems are usually associated with computer based systems and communications protocols not Programmable Logic Controllers.
- We believe this innovation is unique to Newlands Coal CHPP.

Approximate Cost

a) Statement of approximate cost, if known
- Hardware $10,000
- Engineering $14,000
- Installation $10,000

Evaporation Fans

Xstrata Coal Queensland – Newlands Northern Underground

The Problem or Initiative

a) Identified problem

- The core problem was the risk of water inrush to the underground working (especially in light of recent weather events).
- This creates an obvious risk for workers, as the risk of incident and injury increases with increase water make underground.
- The initiative was to design and implement a system to discharge water from site.
- There is also stringent Environmental Authority guidelines in place for Newlands Northern Underground lease in terms of water discharge.
- The underground has exhausted available options to discharge water offsite, which has a water quality not suitable for creek discharge.

b) How the improvement opportunity was identified

- Research into, and implementation of water discharge alternatives is a key priority and project for Newlands Northern Underground.
- With increasingly stringent requirements for water discharge off mining leases, a dedicated project team was created to investigate and review alternatives for water discharge. The inability to discharge water from site due to water quality and EA requirements resulted in an alternative method of discharge to be investigated.

c) What health and safety consequences were to be addressed

- Protecting workers from the risk of water inrush.
- Reducing the risk of injury and safety incidents as a result of increased water make underground.

The Solution

a) Strategies and initiatives developed to identify and address the problem

- After investigating and reviewing all options and alternatives, the installation of evaporation fans was agree to be the application of choice.
- The Newlands Northern Underground Engineering department did design calculations for pump and flow requirements.
- The team worked with the manufacturers (Sandquip) and ancillary equipment supplier (Dowdens Pumping) on the specific site and project requirements.
- 21 evaporation fans have been installed at the underground operations.

b) Internal and external resources used

- The Newlands Northern Underground Engineering department did design calculations for pump and flow requirements.
- Sandquip were utilized as the manufacturer of the fans.
- Dowdens Pumping were utilized as the supplier of ancillary equipment.
- Onsite labour was utilized to install the fans and ancillary equipment.

c) Methods used to trial and test

- This is a proven method for water removal.
- The installation was based on other installations.
- Six of the twenty fans were used as a trial and the remainder of the fans were brought into line in three stages (6 first, then 12, then 20).

d) Implementation process

- Onsite labour was utilized to install the fans and ancillary equipment.
- Implementation of the initiative was communicated to employees and contractors through the management of change process.

e) Demonstrate how hierarchy of control has been applied

- The evaporation fans are a substitute for pumping water offsite, which has a number of environmental implications.
- The evaporation fans were used in favour of Reverse Osmosis (RO) plants due to cost and safety requirements.

Benefits / Effects / Outcomes

a) Safety and occupational health benefits

- The trial of this method has enabled the successful discharge of water and minimized the risk of water inrush during the 2011 – 2012 wet season.
- The risk of inrush is reduced by minimizing water levels in pits prior to wet season.
- Reduction in safety incidents underground associated with increase water make underground.
- Reduces equipment downtime associated with increase water make underground.

b) Supporting data

- These fans are capable of discharging 9ML of water per day.
- With evaporation rates of 40 – 60%, the total discharge from evaporation would be 3.6ML – 5.4ML per day.

c) Extent of deployment

- The fans are currently being used on site.
- They are also being trialed at the Newlands Surface operations for dust suppression.

Transferability

a) Potential for innovation to be used, modified, transferred across the industry

- These fans can be utilised at any other surface operation where removal of water is required.
- There are other applications, such as dust suppression that the fans can be utilized for.
- This initiative is available for use in all applications where water discharge is required and stringent environmental regulations prevent the discharge of water through normal creek discharge.
- Areas of low humidity benefit the most from the evaporation method.

Innovation

a) Originality of the innovation

- Being used for a similar purpose at other operations.

Approximate Cost

a) Statement of approximate cost, if known

- $2.8 million ($15.0 million for an RO Plant.)

Final Drive Wiper Arms

Xstrata Coal Queensland – Newlands Surface Operations

The Problem or Initiative

a) Identified problem

- During the wet season, Dozer final drives get covered in mud, allowing the mud to work its way into the final through the duo-cone seal and causes significant damage. This damage results in considerable business impact, namely maintenance repair costs, production delays, and exposure of maintenance personnel to unnecessary risk.
- Each time a Final Drive is removed from a dozer, the machine is floated to the Workshop. Isolation is performed and the job commences.
- To complete this task the track must be split and removed and cranage plays a significant part exposing the Maintenance personnel to a high risk activity (Fatal Hazard Protocol #9) throughout.
- Hydraulic tooling is required to split the track and torque bolts. The hydraulic pressures Fitters are exposed to while using the high torque is 10,000psi.
- The actual monetary cost to the business is $20,000 (average repair cost) to reseal each final drive. This occurs on average five (5) times per year after the wet season resulting in 10 (ten) final drives sent off site.
- It takes approximately 5 days to reseal a final drive off site meaning that the dozer is out of service for this time and not available for Production.

b) How the improvement opportunity was identified

- This initiative was driven by an individual's response to an internal problem.

c) What health and safety consequences were to be addressed

- Cranage exposes the Maintenance personnel to a high risk activity (Fatal Hazard Protocol #9) throughout.
- Hydraulic tooling is required to split the track and torque bolts. The hydraulic pressures Fitters are exposed to while using the high torque is 10,000psi. This creates risk of operator injury.

The Solution

a) Strategies and initiatives developed to identify and address the problem

- Ashley Carvolth took the initiative to design a final drive scraper (wiper arm) which attaches to the final drive and removes mud and build up from accumulating around the duo cone seal area.
- This initiative is a cheap, simple and feasible engineering solution to a common and expensive business problem and reduces the exposure of maintenance staff to unnecessary risk.

b) Internal and external resources used

- The innovation was designed and developed by an employee of the Newlands Surface Operations Maintenance Department (as mentioned above) in response to an identified safety and production issue.
- The device is made up of:
  - -1 length of flat bar (different sizes for the D10 & D11 models)
  - - 2 pieces of angle iron
  - - 2 lengths of neoprene for the wiper arms
  - - 6 bolts
  - - 6 nuts
- The flat bar is rolled to a ring shape to fit around the final drive. The ends are bent to 90 degrees to form the clamping device. The angle iron is welded to the flat bar at 180 degrees apart. The neoprene is cut to length and bolted to the angle iron. Holes are drilled in the clamping device and the device is fitted to the machines.

c) Methods used to trial and test.

- The Planned Maintenance Coordinator has developed the design and worked closely with offsite suppliers to fine tune.
- The wiper has been running under trial conditions for 6 (six) months and has proved effective.

d) Implementation process

- It has been implemented through the NSO Planned Maintenance group.
- Now that trial stage is complete and the design will be installed on all machines the improvement has been communicated through email to each crew.
- This is now part of the planned maintenance strategy for all dozers on site.

e) Demonstrate how hierarchy of control has been applied

- There are a number of production and safety benefits to this innovation.
- Due to the nature of the tasks in Opencut coal mines, and the rain encountered during the wet season, this task is inevitable.
- However, through application of this engineering control, exposure to the task and to the hazards associated it is significantly reduced.

Benefits / Effects / Outcomes

a) Safety and occupational health benefits

- Maintenance personnel exposure to a high risk activity (FHP #9 Lifting and Cranage) will be reduced.
- Maintenance personnel are being exposed to 25-30% more final drive change outs than is necessary, increasing exposure to injury.
- Manual handling exposure will be significantly reduced
- Exposure to high pressure tooling will be significantly reduced.
- Reduction in the amount of dozer downtime (Final drive component life is 12,000 hours which is not consistently being achieved without removal and a reseal).

b) Supporting data

- The wiper has been running under trial conditions for 6 (six) months and has proved effective in reducing downtime and associated risks associated with the task.

c) Extent of deployment

- The design has been a success and the scraper will be fitted to all dozers in the Newlands Coal open-cut fleet.

Transferability

a) Potential for innovation to be used, modified, transferred across the industry

- This modification is not a standard dozer component. It is above normal safety standards due to the fact it has reduced the exposure of Maintenance personnel to high risk activities.
- The design has considered the possibility of machine damage in the event of a rock falling behind the track. The device is designed to spin due to it being clamped not bolted or welded. This will prevent damage to the device and machine.
- This innovation can be utilized for all other dozers across the industry. It requires no modification to the final drives.

Innovation

a) Originality of the innovation

- This is an original design, unique to Newlands Surface Operations.

Approximate Cost

a) Statement of approximate cost, if known

- Device manufacture and install is low cost.
- Total parts are $800 per machine.
- Total Maintenance hours to fit is 4 hours per machine.

Long Tyne Forks

Xstrata Coal Queensland – Newlands Northern Underground

The Problem or Initiative

a) Identified problem

- Manually loading the continuous miner with supplies exposed personnel to a range of strain and sprain related injuries.

b) How the improvement opportunity was identified

- The opportunity was identified as a result of injuries to personnel whilst loading the continuous miner, and lost production time due to the general inefficiency of the method.

c) What health and safety consequences were to be addressed

- Personnel were exposed to continual bending, lifting, twisting with awkward loads of varying weights, walking over uneven surfaces and up platforms/steps.
- This created the risk of strain and sprain related injuries.

The Solution

a) Strategies and initiatives developed to identify and address the problem

- A project team was created to investigate and review alternative systems and processes.
- The team reviewed a wide range of options for supplying the continuous miner, discussed options with OEM's, engaged with other mining operations to review practices, and met with employees who had worked with alternative systems and solutions.
- The team initially implemented and trialed a solution utilising QDS racker to load and unload pods.
- There were issues with implemented system, crew talks came up with this alternative – jib & forks.
- A specialized set of quick detachment system forks was developed. These are suitable for loading and unloading bolt pods for a continuous miner in a development mining panel.

b) Internal and external resources used

- Onsite personnel
- External OEM – Fleet Industries

c) Methods used to trial and test

- Trialled 3 alternative loading processes using loaders – racker, jib and forks(standard).
- Crews favored the fork option but had some interference issues so changes were made to eliminate the issue.
- Modified 7t forks (long tynes and short backing plate) to make change over efficient, eliminated manual handling, No Go Zones in affect for process, change over incorporated into production cycle with reduced delays.

d) Implementation process

- Management of Change process utilized.
- Discussed at crew tool box talks to ensure consensus with preferred option.
- Training undertaken with crews - onsite.

e) Demonstrate how hierarchy of control has been applied

- Risk assessment included in the Management of Change, elimination of some of the hazards was the key objective for the change which resulted in a reduction of injuries with the resupply process.

Benefits / Effects / Outcomes

a) Safety and occupational health benefits

- No manual handling.
- Production delays reduced, no resupply related injuries.
- Short backing plate allows for closer access of the LHD to the rear of the CM without interaction with the tail of the CM and gives LHD operator improved visibility.
- Long tynes allows for easier locating of the pockets onto the tynes and improved loading/unloading capabiltity (better control for operator and allows to push rear of pod without interference of CM).

b) Supporting data

- Production reports – reduction in process delay.
- Injury statistics – reduction in supply process related injuries.

c) Extent of deployment

- Implemented in all 3 development panels at Newland Northern Underground.
- Rackers have become obsolete, multi use forks – still rated for 7 tonne so capable of using for alternative loads.

Transferability

a) Potential for innovation to be used, modified, transferred across the industry

- Transferrable to all other undergrounds that utilize the removable bolt pods – limitation maybe height due to requirement to lift the pod.
- Oaky No 1 are investigating implementing this system.

Innovation

a) Originality of the innovation

- Unique to Newlands Northern Underground.

Approximate Cost

a) Statement of approximate cost, if known

- $14,000 for the long tyne, short backing plate forks

Longwall 1500 Structure Cassette

Xstrata Coal Queensland – Oaky Creek No.1

The Problem or Initiative

a) Identified problem

- Currently laying out Longwall structure during Longwall install has been done the following way:
- Structure gets fixed and bundled up offsite then transported back to site. To minimise volume of the load, the structures get bundled up interlocking each other. The structure bundle is then transported underground on forks to be laid out.
- It requires two men to pull one structure from the bundle at a time due to its heavy weight and the way it's packed.
- This process is quite involved in terms of manual handling and there is potential for serious injuries.

b) How the improvement opportunity was identified

- The process of unloading and laying out structure was not carried out in an efficient manner.
- A large amount of structure gets transported and stored in cut through until such time that it is required to be laid out.
- This meant there was the need to double handle the structure, moving it from the cut through on to the belt road to unstrap and lay out.
- A further problem was created by the above procedure, double handling the structure meant doubling the likelihood of potentially causing an injury due to the additional manual handling required.

c) What health and safety consequences were to be addressed

- The main health and safety consequence to be addressed would be manual handling injuries such as back and hand injuries.
- In the process of separating the structure an underground worker has sustained a crush injury to his thumb.
- This further increased the urgency of completing and finalising the design and manufacture of the structure cassette.

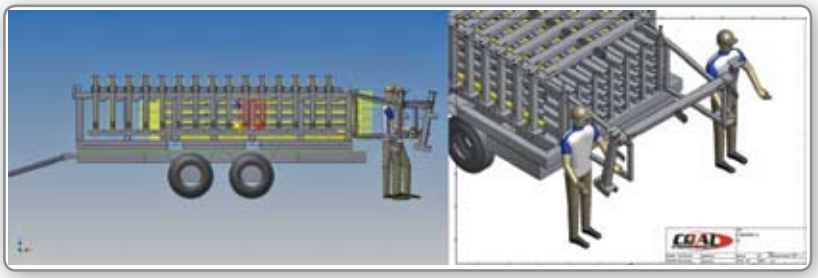
The Solution

a) Strategies and initiatives developed to identify and address the problem

- Oaky Creek Engineers came up with the concept and passed the information to Coal Engineering to complete concept 3D CAD drawings.

b) Internal and external resources used

- After final concept approval the design was forwarded to KEETECH - Mechanical Design for Mines & Manufacturers along with all required parameters needed to complete an engineering analysis to certify that the equipment will be fit for purpose.
- The cassette pod is shown below. The cassette is used on a suitable trailer where it is securely located and restrained from movement. Side fork pockets are used for loading and unloading the cassette pod.
- Assessments of stability and structural integrity are based on design measurements, comparisons with similar existing proven designs, tare mass and the WLL.



c) Methods used to trial and test

- After completing a site specific risk assessment with an experienced cross section of the workforce a visit was organized to Coal Engineering to review the manufacturing process and conduct some trials on the prototype.
- Some minor details were missed at the design stage which were identified during the trial and were rectified.

d) Implementation process

- On the arrival of the structure cassette on site further trials where completed on surface before officially introducing the new piece of equipment to site.
- A change management procedure was followed along with a Formal Site Specific Risk Assessment.
- A work instruction was also created outlining all steps required to safely load and unload the structure cassette.

e) Demonstrate how hierarchy of control has been applied

- The task still needs to be done; therefore the risk has not been eliminated.
- The method on which the structure is transported and handled has been substituted.
- The new procedure takes advantage of an engineered piece of equipment, in this case the structure cassette.
- Change management, Site Introduction and WI have been completed.
- All personnel working on laying out structure have will have all required PPE as per Oaky No1 PPE SOPS.

Benefits / Effects / Outcomes

a) Safety and occupational health benefits

- Improving the process of transporting and laying out structure with the aid of the structure cassette has significantly improved the rate at which Oaky No1 lays out and builds 1500 LW structure, and also greatly reduced the risk of crush and strain related injuries.

b) Supporting data

Before (Last LW Block)	After (Current LW Block)
100m of complete structure was laid out and built per shift	200m of complete structure was laid out and built per shift
1 crush finger injury and strained back	No injury

c) Extent of deployment

- This is currently operational at Oaky Creek No 1.

Transferability

a) Potential for innovation to be used, modified, transferred across the industry

- This innovation can be used throughout the industry.
- The cassettes were designed to fit 8T flattop trailers that were available on site but the design can easily be modified to fit on different trailer.

Innovation

a) Originality of the innovation

- This tool is an excellent example of innovation within tightly defined parameters. The costs both in real dollars and in time to implement the solutions were quite considerable.
- Being able to improve the efficiency of the process by laying out double the amount of complete structures in approximately the same time frame is the very definition of innovation.

Approximate Cost

a) Statement of approximate cost, if known

- Oaky No.1 has purchased four structure cassettes in total costing approximately $60,000.

Innovation

Manual Handling Booklet

Xstrata Coal Queensland – Oaky No 1

The Problem or Initiative

a) Identified problem

- Poor manual handling practice is one of the most common hazards confronted by people in all workplaces. No industry or workplace is free from manual handling hazards. However, the degree of risk differs significantly from one workplace to another and from one activity to another.
- Underground coal mining presents a number of challenges, as many tasks are manual by nature. Added to this is uneven, variable ground conditions, restricted spaces, dark areas and awkward postures and you're presented with quite a unique and challenging environment.
- Manual handling seldom causes fatalities, however the injuries that occur are often disabling, long term and costly.

b) How the improvement opportunity was identified

- Manual handling sprain and strain injuries makes up over 32% of OC1's Total Recordable Injuries since January 2009. OC1 has implemented a number of interventions to control manual handling risks, including a manual handling immersion program which utilised exercise physiologists working with each crew to make improvements in their work methods.
- It was from the immersion program where the manual handling awareness book was born.

c) What health and safety consequences were to be addressed

- Manual handling sprain and strain injuries.

The Solution

a) Strategies and initiatives developed to identify and address the problem

- A Manual Handling Booklet was developed to create awareness around the most common manual handling activities and the preferred physical techniques to safely complete these activities which as workforce driven .
- Many organizations utilize manual handling training as their primary means of control for sprain and strain injuries, however this often proves to be ineffective. Therefore OC1 have taken a more comprehensive approach by implementing a combination of hard controls e.g. innovations aimed at engineering controls and higher, and promotional and awareness tools such as the manual handling booklet.
- This is an excellent example where the employer and employees have worked together to identify, assess and control the risk of manual handling injuries.

b) Internal and external resources used

- The awareness booklet was developed in consultation between workers doing the tasks, safety personnel and exercise physiologists. The goal was to create a simple and easy to follow awareness tool that could be referred to frequently by workers conducting the tasks. The booklet fits into the pocket of workers, therefore is readily accessible whenever required.

c) Methods used to trial and test

- A draft was developed and reviewed by workers conducting the tasks, safety personnel, and XCQ personnel.
- A final draft was approved by the XC communications team and implemented into the workforce.

d) Implementation process

- The booklets have been deployed throughout the mine.

e) Demonstrate how hierarchy of control has been applied

- In many instances, it is not possible to eliminate a manual handling risk. This is the case at OC1.
- Despite a detailed risk management program in place, manual handling risks still exist, however the manual handling booklet (Administrative control) is used in parallel with the innovation program which targets the development of hard controls e.g. innovations aimed at engineering controls and higher.

Benefits / Effects / Outcomes

a) Safety and occupational health benefits

- Benefits of the pocket guide are that guidance on how to perform a task with correct manual handling principles are at the worker's fingertips.
- The information is presented in a simple, easy-to-follow guide, developed by knowledge experts in the task, in conjunction with knowledge experts in ergonomic principles.
- Workforce acknowledgement that more than 75% of development crew members were asked for one on one feedback and recognition of workmates through photography.

b) Supporting data

- Feedback from crews has been very positive in that as they were the providers of the technique improvements that were simply refined by the consultants there is minimal to no pushback with respect to task change.
- It has also lead to crews openly commenting to one another about their possible improvements.

c) Extent of deployment

- The booklets have been deployed throughout the mine in combination with further training.

Transferability

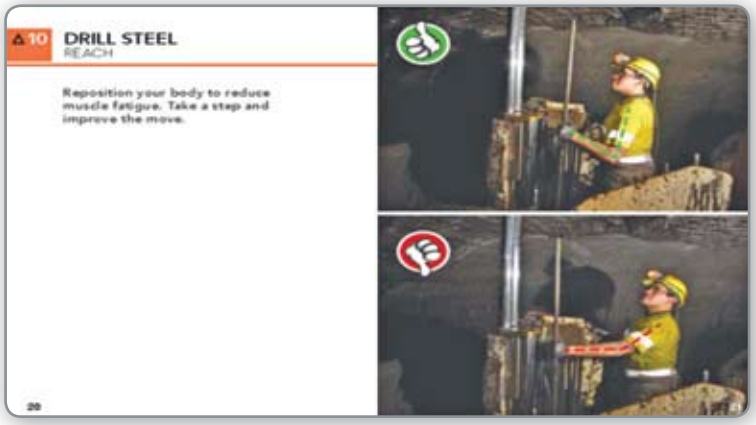
a) Potential for innovation to be used, modified, transferred across the industry

- This concept has transferability across any industry. Other operations would need to customize the photos to suit their operation, however the concepts within the booklet could remain standard.
- It is simple and inexpensive.

Innovation

a) Originality of the innovation

- The concept of pocket guides is not original, however the application of a pocket guide to manual handling, particularly to tasks that are actually being performed by people underground is a great idea.
- Many other pocket guides on the market are quite general in nature, however this guide targets the higher risk components of manual handling at Oaky Creek.
- Is an excellent way to ensure that new people to the industry get to understand best and most efficient practice for manual handling instead of simply following or copying a co worker who may or may not utilize the most efficient practices.



Approximate Cost

a) Statement of approximate cost, if known

- The cost of photography and printing was approximately $13,000.

Staple Removal Tool (Monorail)

Xstrata Coal Queensland – Newlands Northern Underground

The Problem or Initiative

a) Identified problem

- Typically the operator would use a non specific tool (ie – screwdriver) to perform the task of removing longwall staples.
- This increased the risk of hand injury.
- It prolonged the time the worker would spend working at heights.
- It forced the worker to operate in an awkward position, increasing the risk of injury.

b) How the improvement opportunity was identified

- The team identified this task as an opportunity for safety improvement after reviewing a variety of longwall related processes.

c) What health and safety consequences were to be addressed

- Hand injury.
- Working in an awkward position.
- Time spent working at height.

The Solution

a) Strategies and initiatives developed to identify and address the problem

- The team researched and reviewed a range of alternatives and ended up developing a specific tool by modifying a slide hammer.
- This tool allows both legs of the staple to have equal force applied to them for ease of removal.
- The tool allows the hose to be removed/installed with the tool.

b) Internal and external resources used

- As part of a mixed project team, Contractors and Employees consulted to determine the suitability of the tool.
- External stakeholders were utilized to develop the idea, modifying aspects after each site visit and trial.

c) Methods used to trial and test

- Hands on trials on surface applications prior to implementation in underground environment.
- Regular feedback to suppliers on changes necessary to better suit application.

d) Implementation process

- Use by longwall installation crews to limit exposure until trials have been complete and product has been optimised.

e) Demonstrate how hierarchy of control has been applied

- Engineering Control – Correct tools for the job.
- Minimise risk of injury due to awkward positioning and repetitive movements.

Benefits / Effects / Outcomes

a) Safety and occupational health benefits

- The tool reduces the awkwardness of the task. In some cases applying forceful exertions at awkward postures.
- The tool reduces the risk of hand injury because there is no risk to contact hands with a hammer.
- The tool increases the speed of task, thereby reducing the time needed to work at heights.

b) Supporting data

- Risk Rating (based on Xstrata Risk Matrix) :
  - Prior to deployment - M13
  - After deployment - L2
- Physicality of Task Rating (based on modified PERforM analysis):
  - Prior to deployment - 14
  - After deployment - 12

c) Extent of deployment

• All longwall applications where staple lock fittings and hoses are used

Transferability

a) Potential for innovation to be used, modified, transferred across the industry

• Ability to be used in any application where staple lock fittings and hoses are used.

Innovation

a) Originality of the innovation

• Innovation takes a standard slide hammer and utilises attachments for required application.

• You could manufacture any attachment, where the movement of a slide hammer action would assist in assembly or disassembly.

Approximate Cost

a) Statement of approximate cost, if known

• $1,000

Pontoon Pump Leveling Skid

Xstrata Coal Queensland – Newlands Northern Underground

The Problem or Initiative

a) Identified problem

- The aggregation of ground water adjacent to underground mining activities presents a risk to both production and personnel safety if not controlled.
- Over the last few years, Newlands Coal has received a significant amount of rain during the wet season, meaning that adjacent opencut pits have to be dewatered.
- The current process and solution increases the vehicle interaction and vehicle to pedestrian interaction through the use of earthmoving equipment, and therefore increases the risk of safety incident and injury.

b) How the improvement opportunity was identified

- The issue was identified through a mine management review.
- The original opportunity was to reduce the cost involved in the earthworks required to develop a level pad for each time the pump installation was required to be moved close to the water's edge.
- From a safety perspective, this movement requires new earthworks to be undertaken which present an increased risk to the personnel.
- Dewatering of adjacent open cut pits to the underground workings requires the installation of additional pump arrangements. These systems are traditionally shore mounted pontoons. These installations are positioned at the waters' edge where the ground is sloping due to the open cut profile.
- As the pumps are required to operate in a horizontal position, significant earthworks are required to set an installation up. As the pit is dewatered, the water recedes and the pump installation must be repositioned closer to the waters' edge.
- This was a significant non-value adding task.

c) What health and safety consequences were to be addressed

- To reduce vehicle interaction and vehicle pedestrian interactions.
- To minimise the requirement for the use of mobile equipment.
- To consecutively reduce cost, downtime and safety hazards.
- To reduce exposure to working near bodies of water.

The Solution

a) Strategies and initiatives developed to identify and address the problem

- The team designed, manufactured and installed a leveling skid for skid base diesel pump.
- Using the leveling skid, diesel powered dewatering pump systems can be positioned to eliminate the requirement for earthmoving equipment to rebuild new pads each time the pump is repositioned closer to the water's edge.
- This allows the skid mounted pump to be moved on an incline without the need for a level pad to be made by earthmoving equipment
- The cost of earthworks to develop a sufficient pad is approximately $10k per pad
- There are typically a large number of repositions across the course of a wet season.
- The cost of a skid is approximately $20k and this innovative solution requires less labour to reposition as the water increases and decreases.

b) Internal and external resources used

- Site fitters, the outbye engineering department and Glenden Hardware (local fabrication company) were utilized to develop the innovation.

c) Methods used to trial and test

- The sleds were trialed in the workshop to determine usability and safety.
- Once confirmed they were the correct design for the task, they were implemented and used around the site.

d) Implementation process

- A Design review was undertaken by the Northern Underground Engineering department.
- The Management of Change process was applied to this innovation.
- Communication to workforce was conducted as part of the Change Management Process.

e) Demonstrate how hierarchy of control has been applied

Benefits / Effects / Outcomes

a) Safety and occupational health benefits

- The initiative reduces vehicle interaction and vehicle pedestrian interactions.
- The solution minimises the requirement for the use of mobile equipment.
- The solution consecutively reduces cost, downtime and safety hazards associated with earthworks.

b) Supporting data

- The skids are currently in use and have shown a significant time saving in pump moves.
- The associated reduction in risk is also noted.

c) Extent of deployment

- The skids are currently being used at major water catchments on the surface.
- Presented at the 2012 Xstrata Coal Sustainable Development Forum where it was selected for the Xstrata Coal Chief Executive Innovation Award.

Transferability

a) Potential for innovation to be used, modified, transferred across the industry

- The solution can be used at any operation operating shore mounted pontoon pumps.
- All areas – surface, underground and wash plant – can benefit from this application.
- The sled can be adjusted to suit any ramp grade and can be towed or pushed into position, making it suitable for most environments.

Innovation

a) Originality of the innovation

- This design is unique to Newlands Northern Underground.
- This innovation was selected as the winner of the Xstrata Coal Chief Executive Innovation Award for 2012.

Approximate Cost

a) Statement of approximate cost, if known

- Cost of sled is approximately $20,000.

Trickle Duster

Xstrata Coal Queensland – Newlands Northern Underground

The Problem or Initiative

a) Identified problem

- The current process requires 3 personnel to hang 2 x 1 tonne bags (on chains) behind the exhaust of the auxiliary.
- The hanging process was a high risk, time consuming operation.
- The primary safety issues were manual handling and the risk of strain and sprain, working at heights and working with suspended loads.
- The system of hanging bags of dust was the standard at use on site and other undergrounds.

b) How the improvement opportunity was identified

- Concerns were raised by the workforce as to the safest method for completing the task.
- This was a common task performed by crews during panel advance.
- A risk rating analysis was completed for this process, and the improvement opportunities were identified and discussed.

c) What health and safety consequences were to be addressed

- Manual handling
- Working at heights
- Suspended loads
- Inefficient dispersion of stonedust into the return (statutory).

The Solution

a) Strategies and initiatives developed to identify and address the problem

- After researching and reviewing alternatives, a modified QDS pod was designed to disperse stone dust.
- The pod design was specifically for positioning behind an auxiliary fan in a development panel.
- The QDS rubbish pod (already onsite) was modified to incorporate a steel frame internally as a trial.

b) Internal and external resources used

- The team brain-stormed for alternative methods, and modified an existing pod onsite to trial new system.
- Utilized external manufacturing business to engineer and manufacture pod.

c) Methods used to trial and test

- Put in place and replaced standard setup to get field trial.
- Monitored performance and relocation/re-establishment advantages.

d) Implementation process

- Once proven (and feedback from workforce) modified, then engineered and purchased first pod.
- Eliminated all the existing risks associated with standard previously utilised process (hanging bags).

e) Demonstrate how hierarchy of control has been applied

- Risk ranking of the new system resulted in elimination of the primary risks
- Management of Change process utilized

Benefits / Effects / Outcomes

a) Safety and occupational health benefits

- No working at heights
- No manual handling
- No suspended loads
- Quantifiable stonedust applications in the return
- No wastage (previous system had wastage onto the floor)

- No rubbish (no empty bags or pallets to remove)
- Only requires one operator to setup
- Doubles as a baffle for the auxiliary fan
- Double QDS allows for quicker relocation and resupplying of the pod
- Quicker installation during panel advances, now get 2 panel advances before refilling required.

b) Supporting data

- Panel Advance flow charts completed by panel officials with time frames for tasks – indicating a reduction in setup times
- Prior setup time was 135 minutes (it took 3 personnel 45 minutes).
- New setup time is 5 minutes (it takes 1 person 5 minutes).
- Positive feedback from all crews regarding the improvement in safety / reduction in risk.

c) Extent of deployment

- All development panels at Newlands Underground.

Transferability

a) Potential for innovation to be used, modified, transferred across the industry

- Can be utilised at all underground operations in development panels, no modifications required to current system/pod.

Innovation

a) Originality of the innovation

- Unique to Newlands Northern Underground.

Approximate Cost

a) Statement of approximate cost, if known

- $15,500

Telescopic Barricade

Xstrata Zinc – George Fisher Mine

The Problem

The primary use of chain barricading is to prevent harm to personnel through the restriction of access and travel to firing zones and high hazard areas, and for supplementary purposes such as the protection of critical infrastructure. This method of barricading is effective only to the extent that our personnel consistently and unfailingly perform the function. Though as we know, the discretionary nature of human behaviour can pose an unacceptable risk to personnel if not properly countered or managed by optimal equipment and process design. At Xstrata Zinc's George Fisher Mine, there persisted the risks of incorrect installation of chain barricades, manual handling injury, and the risk of heavy equipment becoming a projectile when transported in the operators' units.

The Solution

Driven by the need to mitigate these unacceptable risks to the safety and health of our personnel, a more permanent barricading solution was sought. Borne of an internal joint initiative between the Mine Manager and Irata Tofinga, a Servicemen, a steel barricade was conceptualised, and a prototype fabricated onsite and trialled.

The trial consisted of a series of installations, using a success/fail criteria which was measured by the ability of the barricading to remain in place and the amount of equipment damage occurring. The trial was monitored and recorded for one month until design changes were evident and the final design conceptualised and completed. The final design allowed for the recess of the barricade into the side wall, to ensure that the control was completely effective and damage was prevented to the structure.

The installation was presented at the Zinc Safety Leaders' Forum to all supervisors, superintendents and managers. It was also communicated throughout the George Fisher Mine using our LCD screens to ensure exposure to personnel of the process from concept, design, and through to installation. Encouraging feedback was provided at both operational and supervisory level. The fabrication of the final design was then outsourced to a local manufacturer and the Telescopic Barricade was implemented throughout the ore body in both the North and South mines.

The Telescopic Barricade works by eliminating the risk of the barricading falling down, a common occurrence with chain barricading. Further, the innovation eliminates the risk of manual handling and vehicle transportation issues during the construction and transport of the chain barricading equipment. Telescopic Barricading has to be physically retracted which allows for the installation to meet our barricading requirements by incorporating the relevant signage. It also further enhances the safe work environment at George Fisher Mine by ensuring the structures permanently remain in place.

It reaches up to and including 8.5m in length, and a production drill hole is drilled into the wall at 110mm diameter 4.5m/5m in depth to accommodate the outer tube. The receiver is bolted to the wall on the opposite side of the drive and has a locking mechanism to allow the barricade to be locked into position. The structure consists of lightweight aluminium and is designed with a wiper ring to allow for cleaning through retraction, thereby eliminating the susceptibility of the retractable pole to block through material build up. The Telescopic Barricade is wholly interchangeable through the design including 6 bolts that allow for the complete change out of all working mechanisms should damage occur after installation.

Photo 1: Components of the Telescopic Barricade

Photo 2: Telescopic Barricade installed but not grouted

Photo 3: Permanent barricade installed into the sidewall in "closed position"

Photo 4: Telescopic Barricade in "opened position"

Photo 5: Telescopic Barricade locked into receiver on opposite sidewall

Benefits / Effects

The overarching agenda of George Fisher Mine in undertaking this initiative is, as it has always been, the wellbeing of its personnel. The mine is entering a new era in safety performance, and this is supported by a significant decline in recordable injuries. In improving the permanency of the barricading used throughout the mine, George Fisher has been further able to fulfil this agenda in a number of ways –

- Telescopic Barricade equipment is lightweight. Operators are no longer required to transport heavy chain barricading equipment in their units, or carry the equipment from units to barricade location – heavy manual handling and improperly secured load (projectile) risks removed;
- The sign hanger cannot be removed and the attached sign holder allows for signs to be readily hung task-dependent – risk of harm or injury by inadvertent removal of signage removed;
- Firings have a negligible effect on barricade stability, ensuring the barricade remains at all times to serve its purpose of protecting personnel – risk of serious harm or injury by unintended deconstruction of barricading removed;
- The Telescopic Barricades are recessed into the sidewalls – risk of damage minimised.

Deployment of the Telescopic Barricade throughout the mine has been incident free. During the display of innovations at the Xstrata Zinc Safety Leaders Day, the Xstrata Zinc Lead Smelter saw the potential to utilise this barricading technique within the plant.

Transferability

The design is limitless in its application across the resources industry. Indeed, there are further innovations planned for George Fisher Mine and the Lead Smelter with current efforts focused on the development of an intrinsically safe LED version of the barricades.

Innovation

To the extent of Xstrata Zinc's knowledge and research, this is the first type of this barricade within the industry. While Telescopic Barricade technology is commercially available, the point of difference is the design features of this barricading for use and application in the underground mining environment.

Approximate Cost

The cost of construction of the barricade is $2800, with installation costs at approximately $700. Concept and design costs for the entire process were completed utilising George Fisher Mine personnel time and experience.

Motor Drive Belt Change Out Maintenance Tool

Rio Tinto Alcan- Weipa Operations

The Problem

In Weipa, the sewage treatment plant is owned and operated by Rio Tinto Alcan Weipa. There is a significant amount of scheduled maintenance to ensure the plant runs efficiently and to prevent plant breakdowns. As part of this routine preventative maintenance the Aeration Blower Machine requires the drive belts to be changed out on a regular basis.

The removal of a drive belt is a labour intensive task. It requires one person to apply considerable force through a pry bar to lift and hold the electric motor in order to take the tension off the drive belt. An additional person is then required to remove the safety cover, remove and install a new drive belt, all while the motor is being held in position via the pry bar. This task requires significant exertion through the back and limbs, particularly the shoulders and arms. There is also the risk of the bar slipping resulting in lacerations, crushes and pinch points.

Figure 1:
Method of loosening belt

The Solution

A new maintenance tool has been designed and engineered to reduce the manual handling risks and time associated with the belt change out on the Aeration Blower. The tool is fitted on top of the machine and the chain and bar at the bottom of the tool is hooked onto the spring on the motor (shown in Figure 2 & 4). The tool has been designed specifically to fit on the machine and has guards at each end to prevent it from slipping during operation. Once in place, a spanner is used to tighten the nut on the top of the tool to lever up the motor spring, loosening the belt tension. This tool design allows one person to complete the task. This modification has significantly reduced the cumulative risk of shoulder, arms and back injury, as well as risks associated with pinch points.

Figure 2:
Drive belt change out maintenance tool.

Figure 3:
Lifting up drive shaft belt using tool

Benefits / Effects / Outcomes

The benefits of using this innovation include:

- Eliminates repetitive movement of the arms and shoulders.
- Reduces the risk of pinch points and hands being in the red zone.
- Provides a simple system to loosen motor belts.
- Significantly reduces time taken to complete task (up to 2 hours).
- The cost of the innovation was minimal at $250.
- Allows the task to be performed by one person.

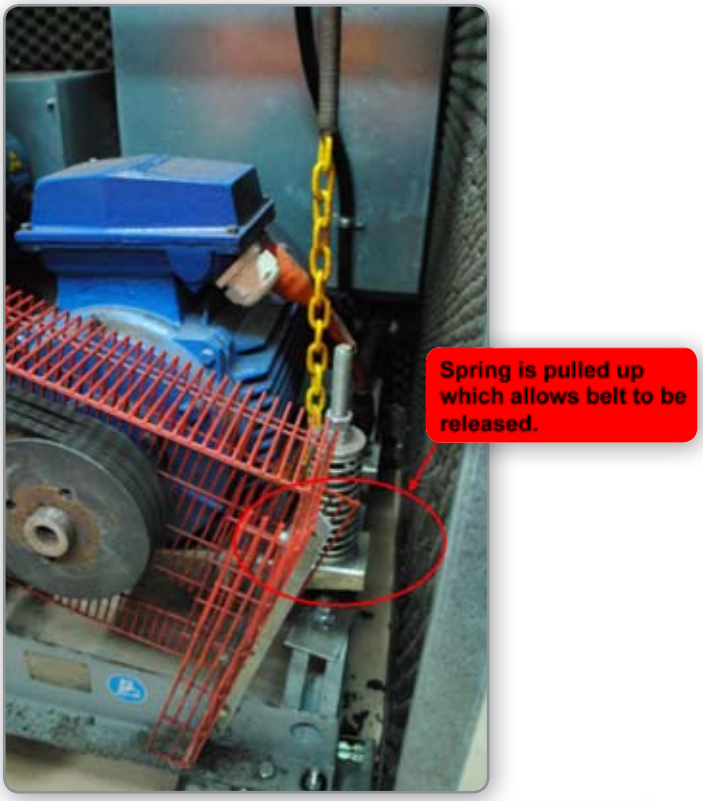


Figure 4:
Drive shaft tool pulls spring up.

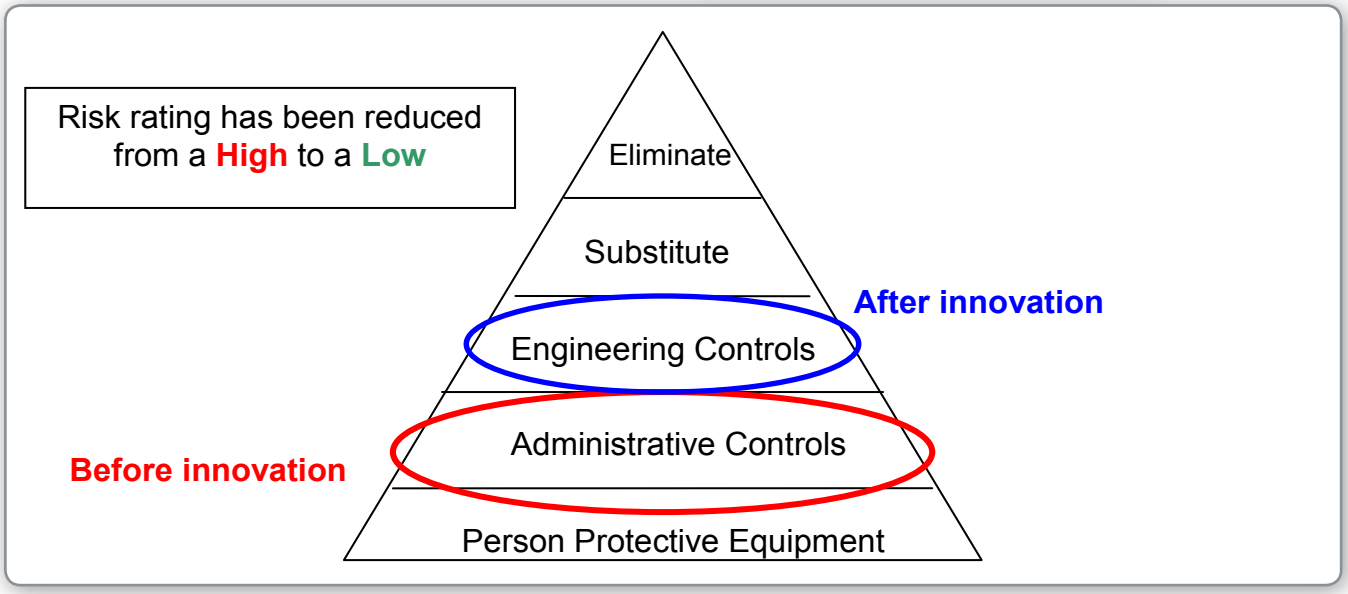


Figure 2:
Hierarchy of Controls – The innovation is an engineered tool that eliminates repetitive manual handling and pinch point risks.

Transferability

This tool deign could be tailored to suit a range of different maintenance applications within heavy equipment workshops, mechanical workshops and insitu equipment where there is a requirement for belts to be loosed, removed and changed.

Innovation

A Rio Tinto Alcan Weipa Plumber identified the need for this tool as belts on the equipment are required to be changed on a regular basis. The tool was developed and trialled, ensuring it is adequately rated for the task. Approval was granted by the management team and it is now being used on a regular basis and included in work procedures for this task. Employees have noticed a significant reduction in resources and time required and muscular stress on the body.

Starter Motor Jig for Caterpillar 776D Belly Dump Trucks

Rio Tinto Alcan- Weipa Operations

The Problem

Heavy mining equipment requires substantial maintenance and repair activities to be carried out due to the nature of the working environment. One such task is the removal and replacement of the starter motor in a Cat 776D belly dump haul truck. This labor intensive task requires personnel to position themselves under the truck while reaching up to a height of approximately two metres to access the starter motor. The Cat 776D starter motor weighs over 20 kilograms and requires the use of ropes and come-a-longs to hoist it up and down. High physical workload combined with prolonged awkward positions and the potential for pinch points categories this as a high risk task.

The Solution

Boiler makers in the heavy equipment workshop developed a purpose built tool to eliminate the associated manual handling risks and have significantly reduced the turnaround time for changing out starter motors. The design involves two cradles attached to an extendable pole operated by a remote control. The design allows the user to securely attach the jig securely to the starter motor and operate from a safe distance.

Our site management of change processes was completed with approval and sign off by management and the innovation was implemented and shared with other departments on site.

Figure 1:
Starter motor jig being bolted into place

Figure 2:
Jig extended into place

Benefits / Effects / Outcomes

The benefits of using this innovation include:

- Dramatically reduces manual handling risks associated with task.
- Eliminates the potential for movement of raised or supported equipment during maintenance activities as it is securely attached to the jig.
- Removes any element of guess work when placing jacks under equipment, which is currently the alternative method.
- Provides simple system for all maintainers to follow.
- The cost of the innovation was minimal at approximately $3,000.
- Significant reduction in time up to 2-3 hours.

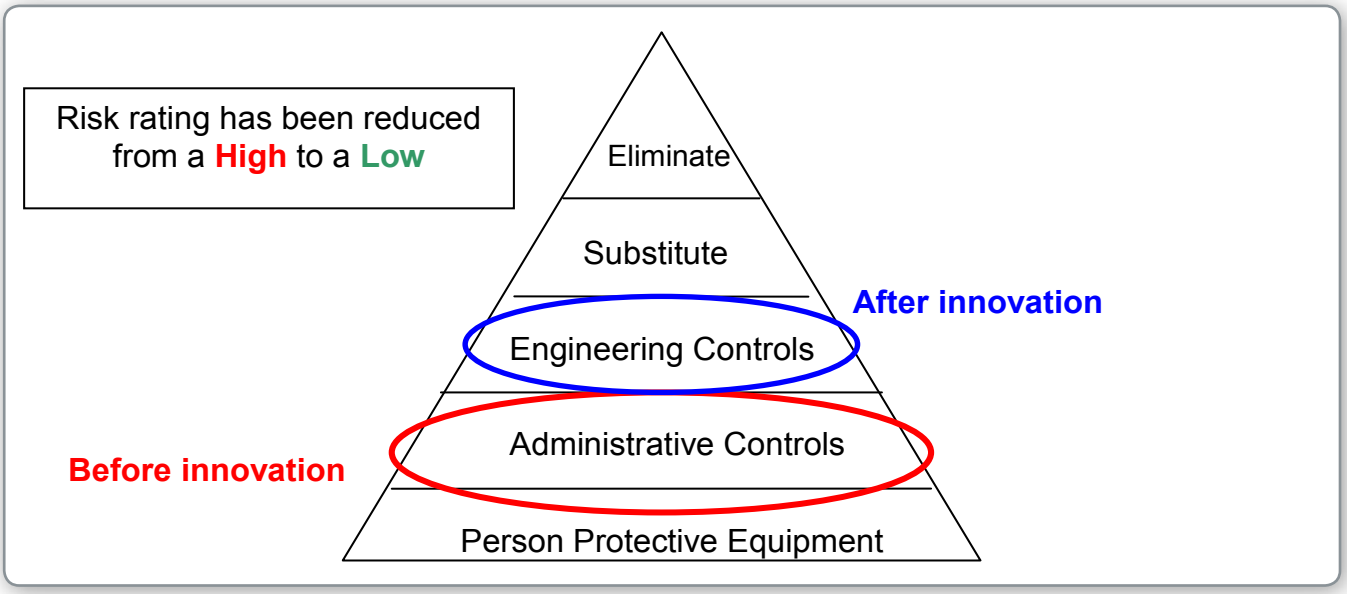


Figure 3:
Hierarchy of Controls – The innovation is an engineered solution that provides an effective jacking method preventing uncontrolled movements and eliminating manual handling of the equipment.

Transferability

This device could be utilised for similar styles of equipment that have the potential for uncontrolled movement during maintenance activities where awkward, heavy work is required. The use of the extendable pole and remote control can be readily adapted to suit other applications where there is overhead work.

Innovation

An employee identified that the current method of securing and the removing the starter motor during maintenance could be improved. The employee worked on the design ensuring it is adequately rated for the load and gained approval from site and managers.

Innovation

Brake Disc and Hub Removal Tool

Rio Tinto Coal Australia-Hail Creek Mine

The Problem

Rio Tinto's Hail Creek Mine operates a fleet of Bucyrus MT4400 Electrical trucks, which play an important role in the pre-strip operations throughout the mine.

Regular maintenance to the trucks includes the rebuild of the rear brakes and replacement of wheel motor. These tasks often involve the removal and installation of the brake disc and hub. At approximately 100kg the brake disc and hub could not safely be manually removed by a single person. Due to its awkward positioning and weight, manual removal by two people also created a heightened safety risk.

A safety assessment was conducted during the removal of the brake disc and hub and it identified that the:

- the method was unsafe and a risk to finger, hand, back and wrist injury.
- the location of the brake disc and hub did not allow the attachment of conventional lifting equipment (Crane).
- a tool would have to be designed and developed specifically for this purpose.

Location of disc and hub

Coal Tray width did not allow using the lifting crane.

The Solution

An expert team was formed to brainstorm possible design ideas that would lead to the development of the most suitable tool for the effective and safe removal of the brake disc and hub with minimal manual handling.

The team of experts were:

- Richard Espinoza - Maintenance Engineer
- Lionel Kennedy - Maintainer
- Bucyrus (Hastings Deering) representative

After several discussions and taking into account previous work experiences, we established the specific requirements and specifications for this tool which are:

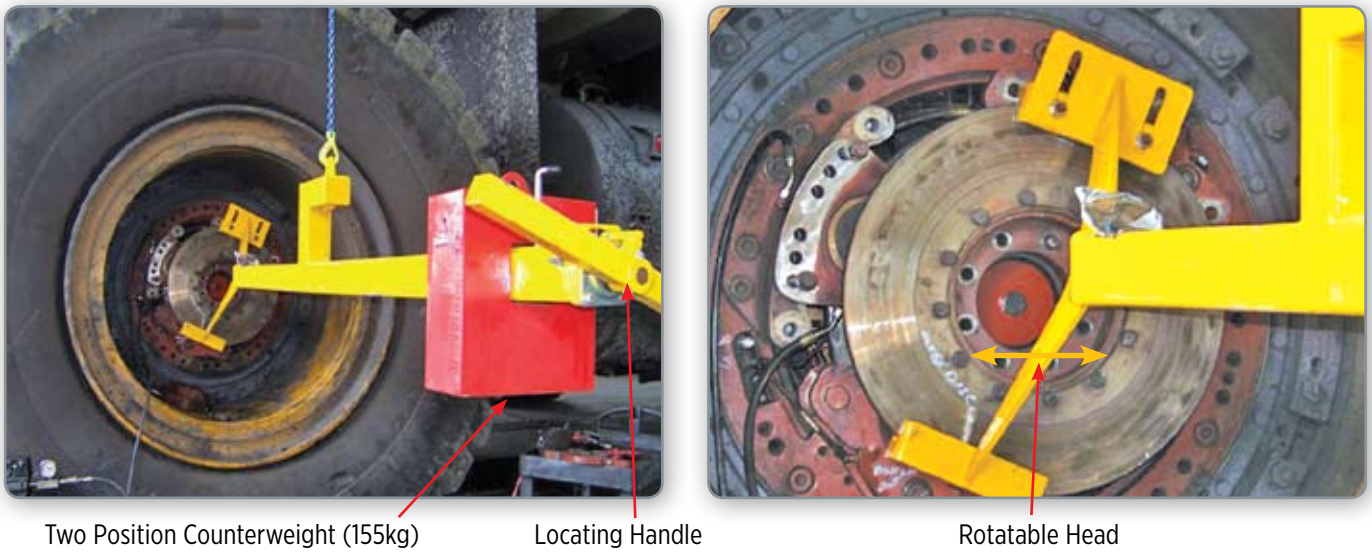
- Safe
- Single person use
- Rotatable head
- Sufficient reach

Firstly, and most importantly, the tool must be safe to use and by a single person if possible. The tool should have a rotatable head to facilitate ease of use and the alignment of the bolts via the rear handle. It should be long enough to avoid any contact between the lifting equipment and the tray of the truck.

Finally, the tool should have a movable counterweight to compensate for the weight of the disc during the removal or installation process. This will provide balance and aid in the safe use of the tool. All of these details were taken into consideration during the brainstorming session and eventual fabrication of the tool, which was entrusted and supervised by our OEM (Original Equipment Manufacturer) representative who was also very involved in this project.

The first trial identified that the tool did not function efficiently because it was too long thus creating an imbalance. We subsequently rectified the design by reducing the tool length from 4500mm to 3075mm and repositioning the lifting point. The lifting point was key to the design as it allowed perfect balance once the brake disc and hub and compensation weight were in place.

Finally, an Information Bulletin was developed to inform to Supervisors and maintenance staff that this new tool was available and where and how it is to be used. Moreover, the JHA (Job Hazard Analysis) to remove and install the brake disc was also modified in order to reflect the use of this tool.:



Benefits / Effects / Outcomes

The implementation of this tool eliminates the need to remove or install the 100kg brake disc and hub manually therefore extensively reducing the risk of finger, hand and wrist injuries. Additionally, this tool decreases significantly the risks associated with working in awkward postures, e.g. Back injuries.

Since its creation, a job that took two people now only takes one and has provided the secondary benefit of freeing up man hours on site. The tool will now be considered for deployment across other Rio Tinto Coal operations.

Transferability

The basic concept of this tool could be replicated to other mining trucks equipped with brake discs at the rear.

Innovation

This tool fulfils the basic innovation concepts because most of its components such as the rotatable head and counterweight were designed considering our specific needs and requirements.

However, the design of some parts involved some failed attempts which were overcome through the trial process and the feedback from the members of the team.

Approximate Cost

The cost was approximately AU$8,000 including tool certification.

Caterpillar 24H Motor Grader Rear Window Access System

New Acland Coal

Background

New Acland Coal (NAC) has a high focus on continuous improvement in all areas of the business. The mine site also operates a number of proactive procedures that are aimed at identifying potential hazards that give rise to early rectification in an attempt to reduce the risk of incidence or injury.

Equipment operators are required to perform formal pre-start inspections on all mobile & ancillary equipment at the start of each shift or accompanying a change in operator. Additionally, all employees are issued with a 'Hazard Report' booklet through the site induction process that is utilised to formally identify potential hazards and deliver applicable corrective actions through the supervision hierarchy. Hazard reports form part of the sites 'lead' indicator pool which has proven to have a distinct correlation with the reduction of incidents on site.

With regard to equipment operation, prior to the end of each shift, the operators of all equipment are required to ensure the cab is clean and all mirrors, windows and windscreens are also cleaned for the oncoming operator. This practice has been implemented to ensure that the oncoming operator is assured of entering a piece of equipment with no visual impediments.

New Acland Coal currently operates 2 x Caterpillar 24H Motor Graders and 1 x Caterpillar 16G Motor Grader in its production equipment fleet. All graders have limited accessibility to the rear windscreens for cleaning purposes.

The Problem (Hazard)

During the end of shift process of cleaning the rear windows of the 24H Caterpillar Motor Grader, it was identified that cleaning of the rear windows presented a slip or fall hazard due to accessibility issues. The practice was to access the windows for cleaning via the tandem housing steps. In turn, this process would see the operator standing in the articulation area while utilising a long handle squeegee mop to access the windows. There was also an ever present risk of over stretching, potentially resulting in muscle tear or strain.

Through the site 'Hazard Reporting' process, this practice was noted as a potential hazard. The 'Hazard report' was forwarded to the relevant Production Supervisor/OCE who in turn followed site protocol by forwarding the report to the NAC Maintenance and Safety Departments for action.

A corrective action was issued to the NAC Maintenance Superintendent (responsible for all site Mobile Maintenance) for investigation into alternate methods that would reduce the risk of injury to personal while completing the task and decreasing the individual's exposure to risk.

The Solution

It was resolved that the solution to the problem identified through the hazard identification process needed to reduce the exposure of an operator to potential serious injury due to slip or fall and/or overstress. A risk assessment was completed on the task, and utilising the recognised 'Hierarchy of Control' methodology, it was decided by the Mobile Maintenance team to engineer a solution.

Due to existing platforms located around the front and side sections of the cab, and with the existing hydraulically activated access steps, the solution that appeared 'best fit' was to utilise an extension of the existing platforms. Interestingly, this scenario presented logistical issues due to the articulation of the motor grader in operation. As such, a 'fixed' platform was not deemed a possibility. A retractable platform was viewed as the most practical outcome utilising the existing hydraulic circuitry of the in-situ hydraulic access steps as a trigger to lower and/or raise the platform. This outcome meant that operation of the motor grader would not be compromised yet a safe and effective means of accessing the rear windows could be incorporated into the design of the machine.

After an initial site inspection, and after determining the required specifications, an external contractor (MRG) was engaged to assist in design and preliminary design drawings were drafted. Consideration was given to operator safety, maintenance issues, visibility, access, and emergency egress.

The initial design drawings incorporated a fold-down platform design but was deemed not acceptable due to the fact that the platform's default position meant that it was not a fail-safe system for the operator. Through the risk evaluation process, it was noted that should an operator be standing on the access platform and a mechanical failure occur, the platform would fold down to its default position, trapping or dislodging the operator. The second attempt at design proposed a design in which the platform defaulted to a lowered position in the case of mechanical failure. While this new design presented a limited amount of risk of platform damage if the platform was to lower while in operation, warning systems from the existing hydraulic access systems already incorporated in the operator cab meant that this risk was minimal and adequately controlled when considering potential outcomes. As such, this design was approved for construction and trial. In conclusion, the final design incorporated the platform in a fold-up state when actuated by the existing stairs hydraulic circuitry with a fail safe to the deployed position. Additionally, a set of emergency egress steps were incorporated into the design for redundancy.
This unit has now been operational in trial for more than 12 months, with positive feedback from all operators on safety, operation and visibility. There has been no case of mechanical failure of the platform or operating systems.

Benefits

This access system has allowed unfettered access to safely clean rear windows on the right hand side of the 24H Motor Grader with minimal reach to clean all rear window areas of the machine. Emergency egress stairs are manually folded up with sufficient clearance for full functionality of the blade and all other operations of the motor grader. These stairs are easily deployed with a foot lever – further reducing the likelihood of manual handling related incidents. The platform is automated as it raises to the 'hold' position as soon as the hydraulic steps are powered and raises. As soon as this function is actuated, the rear access platform folds up allowing full articulation and use of grader functions. Until the existing hydraulic stairs are fully retracted and the machine handbrake released, the machine is safe guarded and will not move.

Transferability

With the platform made to fit location tabs on the existing cab, the platform system can be manufactured to fit to any Caterpillar 24H Grader with confidence and minimal effort. This design with minimal changes, could be fitted to any Motor Grader fitted with a hydraulically powered step or alternatively with a self contained hydraulic power supply. Additionally, the concept of utilising existing systems to be integrated with additional safety controls has endless possibilities.

Innovation

The platform system has allowed the operators to clean all the windows on the Caterpillar 24H by safely folding up, and interlocking with the existing stairs without additional control panels or switches.

In summary, the Mobile Maintenance team was presented with a problem. A solution was found by utilising risk assessment tools and techniques, recognising the hierarchy of control and integration with existing systems. The team has shown that with innovation, team work and dedication, it is possible to remove potential hazards, reduce risk and improve safety at the workplace. During the initial design concept, the team identified a number of changes required, came up with solutions as a team and drove this innovation from an idea to a solution.

This innovation and outcome demonstrates the value of early identification and reporting processes with redundancy. The Caterpillar 24H Motor Grader Rear Window Access System is testimony to a process that starts from the initial identification through the site 'hazard reporting process' through to the final outcome. It demonstrates that all reports are treated with a view to true resolution and reflects a robust safety culture in which all staff feel confident in reporting hazards.

Approximate Cost

The approximate cost of the design and fabrication of the Caterpillar 24H Motor Grader Rear Window Access System is approximately $9,450 (including initial prototype development costs). It is anticipated that with a number of systems being fabricated concurrently this cost would substantially reduce.

Picture 2
Rear access platform and emergency egress steps in raised position.

Picture 1
Rear access platform in the 'raised' position.

Picture 3
Access platform in the deployed position.

High-Voltage Electrical Flashover Prevention

Downer EDI Mining

The Problem or Initiative

Following a series of wet-weather events in 2010, two diesel-electric haul trucks in the Downer EDI Mining (Downer Mining) fleet at one of its Bowen Basin projects experienced high-voltage inverter cabinet flashovers.

The flashover events were the result of arcing across high-voltage terminals and busbar0F1, causing the following damage:

- Insulated gate bipolar transitor IGBT module failures (12 in total);
- Vertical busbar failure;
- Capacitor busbar failure; and
- Switching control fibre optic damage.

In total, six inverter cabinet flashovers occurred in 2010; three per truck. Each failure cost $100,000-$150,000 to repair, and the trucks were out of service for an average of 500 hours per truck, causing significant loss of production.

Most importantly, however, the flashover events had the potential to cause serious injury to the operators of the trucks, people servicing the vehicles and other workers on the mine site.

A flashover in the haul truck cabinet causes the loss of the retard braking dynamics. This places the operator at risk, as well as all the other vehicles on the road – including both light vehicles and other heavy equipment. There is also the risk of serious injury through: fly objects from severe damage of the cabinets; molten material; and/or electrocution.

Investigation into the cause of the flashover events revealed that they seemed to be occurring after extended shutdowns as a consequence of wet-weather events.

When trucks are operating in dry conditions:

- The cabinets are hot and dry, with an internal temperature of around 80°C; and
- Any dust entering the inverter cabinet sticks to the components due to a static charge.

When there is a wet-weather event sufficient to stop operations, there is usually very high humidity and lower-than-normal temperatures. Trucks are parked up as a safety measure, generally for over 24 hours, as haul roads become wet and slippery.

When this happens:

- The air inside the cabinet contracts, drawing in cold, humid air;
- Condensation forms inside the cabinet; and
- The busbars and metal components cool to the ambient temperature.

Once the weather warms up and the haul roads dry out, so that operations can recommence:

- The ambient temperature warms the cabinet;
- The condensation inside creates a humid environment;
- The large copper busbars are still cold and dusty; and
- Condensation forms on the busbars and dampens the dust.

The trucks are then sent back to work and, in the case of the flashover events, the following occurred:

- Voltages rose on the busbars;
- The dampened dust became a conductive1F2 solution;
- Electrical arcs formed, effectively causing a short circuit; and
- Electrical energy discharged causing a large arc blast, which is four times hotter than the surface of the sun.

The Solution

Having ascertained that it was the combination of dust and moisture that was the root cause of the problem, various remedies were tried in consultation with, and with the involvement of, the relevant OEMs:

- The initial response was to thoroughly clean all the busbars, and then use smoke bombs to ascertain where dust may be entering the cabinet. Damaged gaskets were replaced, and Silastic2F3 was used to seal any leaking seams.
- Secondly, silicone desiccant gel bags were placed inside the inverter cabinets to absorb any moisture inside the cabinet.
- When neither of these proved effective in preventing the flashover events, attention was turned to the area of the busbars on which the dust was accumulating. Through research and some very innovative thinking, Downer Mining Electrical Superintendent, Elton Cousins, formulated a solution using insulating vinyl stickers. This is illustrated in Figure 1.

Elton approached electronic, electrical and mechanical suppliers, and even the manufacturer of the decals for Downer Mining vehicles for stickers, which were then tested by placing a high-voltage charge each side of them. Ultimately, it was the product from the provider of the decals that proved to have the ideal qualities.

The supplier was provided with a template of what was required, and the stickers were manufactured and trialled on a truck. When there was no flashover event on that particular truck following the next wet-weather event, the stickers were applied to all the diesel-electric trucks that had the potential for flashover events.

To date, Downer Mining has not had another flashover event. With regard to the hierarchy of control, it may be considered that two aspects of this have been applied:

- Engineering control: the busbar has been engineered to stop the arcing; and
- Elimination: The ability for contaminants to access the critical area of the busbar has been eliminated, along with the ability for an arc to short it out.

Image 1: Sheet of insulating vinyl stickers.

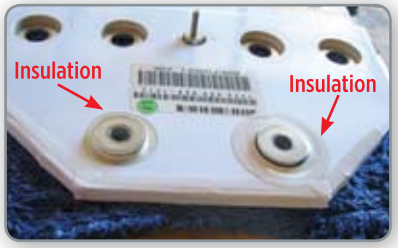


Image 2: Busbar showing insulating vinyl stickers in place.

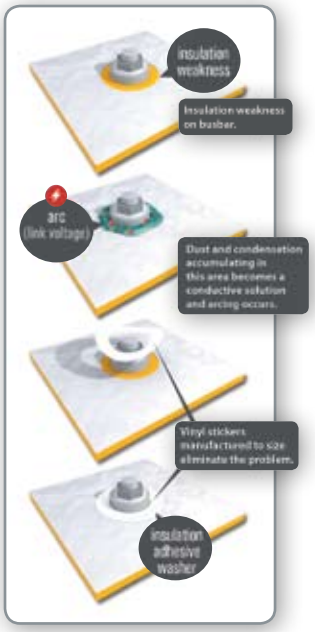


Figure 1: Eliminating the insulation weakness on the busbars.

Transferability

The vinyl stickers have now been applied to all the diesel-electric trucks that had the potential for flashover events.

The transferability of this innovation has been proven by the fact that the manufacturer of the busbars has now modified its design, incorporating the insulating vinyl stickers, (see below) and is trialling them across other sites.

Benefits / Effects

This innovation has considerable safety and cost-saving benefits. As detailed above, these simple insulating stickers:

- Eliminate or reduce the risk of a flashover in the haul truck cabinet, thereby preventing the risk of injury to employees and other personnel from:
    - Loss of the retard braking dynamics;
    - Fly objects from severe damage to the cabinets;
    - Molten material; and/or
    - Electrocution;
- Save repair costs of up to $150,000; and
- Prevent production downtime of up to 500 hours per incident per truck.

Image 3: Busbar with Downer Mining insulating vinyl stickers.

Image 4: New busbar produced by manufacturer with modified design.

Innovation

The need to find a solution to the arcing problem to eliminate the risk of harm to employees and other workers was time critical. In the absence of an immediate 'off-the-shelf' remedy, and once the more obvious quick fixes had been tried, tested and found to be insufficient to solve the problem, all that remained was to think 'outside the box' and explore less obvious, more creative ways of resolving the issue. This ultimately led to the innovation that is the subject of this submission.

The adoption of this solution by the busbar manufacturer also highlights the originality of the idea, given that this was the chosen engineering modification employed rather than something different.

Approximate Cost

The solution to this problem cost just $135 per sheet of 200 stickers, with each sheet having the potential to save up to $150,000 worth of damage. It requires just one sheet per haul truck.

Inexperienced Mine Worker Program – Developing Safe Behaviours in the Mining Industry

Myne Start Pty Ltd (wholly owned subsidiary of Mastermyne Pty Ltd)

The Problem or Initiative

Mastermyne Pty Ltd, founded in 1996 as a service provider to the QLD and NSW coal mining industries, currently employs in excess of 1100 experienced employees. Until recently, like most mining organisations Mastermyne utilised traditional onboarding methods to meet the demand of engaging personnel for their underground operations.

Similar to other mining companies, Mastermyne has experienced difficulties in engaging suitable skilled personnel to maintain and meet the growing labour demand of their businesses due largely to a diminished pool of suitable labour. Not only has this restricted their ability to fully access the potential of present and future coal mining opportunities, it has also exposed their business to potential unacceptable risks in personnel health and safety due to the unique nature of the work environment and the higher dependence on a suitable skilled workforce.

The initiative as describe in this submission aims to lessen some of the impact of the skills shortages experienced through the development and operation of purpose built training facilities. These facilities incorporate the use of a simulated underground coal mining environment, focusing primarily on the training required to consistently introduce inexperienced personnel into the underground coal mining industry, thereby maintaining and potentially reducing some a number of the potential health and safety risks.

Trainees completing a Task 5 prior to commencing tasks

Roadway in Myne Start training complex

The Solution

To address the problem Mastermyne set up a subsidiary to their business, Myne Start Pty Ltd, for the sole purpose of establishing and operating unique purpose built underground training facility in Mackay and more recently in Brisbane; unique due to their physical structure and the diverse range and depth of training that they provide. Presently these are the only facilities in Queensland offering this type/depth of simulation/training outside of an operating mine site.

Myne Start's objectives are to provide the mining industry with controlled, consistent pathways by which inexperienced personnel can gain a more indepth level of understanding of the underground mining environment, its unique hazards and associated control processes, whilst accelerating them into more productive work in a far reduced timeframe when compared to traditional training methods.

To achieve these objectives the Myne Start facilities needed to:-

- Have a strong resemblance to the underground mining environment, providing the trainees with hands on access to current mining plant/equipment and operating system/practice.
- Focus on introducing inexperienced personnel into the underground coal mining industry, with the training programs/curriculum offered concentrating on this purpose. It is also recognised that the facility, though most beneficial for the training of inexperienced personnel, can as well be utilised for refresher training and assessmentactivities for existing experienced employees. This applies to both underground and surface mining operations.
- Maintain a strong alignment with current underground coal mining practice and mine site skilling needs. Linking where possible the programs delivered within the facility with mine site activities, onsite training plans and monitoring processes designed to monitor the effective implementation of the initial off site training.
- Maintain and where possible reduce potential operational risk levels in regards to health and safety of the inexperience personnel and their future fellow employees.
- Demonstrate a higher level of training quality and consistency than is current, involving the use of innovative/interactive/engaging training and assessment methodologies which will move industry training benchmarks forward.
- Recognise the requirements for continual improvement of training to suit economic and industry demands in conjunction/partnership with Government and industry bodies.
- Be credible and recognised by the relevant industry sectors in Queensland, nationally, and potentially internationally.
- Partner with a Registered Training Organization (RTO), able to issue national qualifications for the training delivered.

Myne Start operates under a Safety & Health Management System, adopting procedures and controls similar to that of a typical underground coal mine site (where relevant). This system was developed to show alignment with the Workplace Health and Safety legislation due to the nature and location of the complex, as well the Coal Mining Health & Safety legislation due to the training outcomes required. Examples of the implementation of this system include the requirement for participants to;

- Wear appropriate PPE at all times.
- Participate in random drug and alcohol testing.
- Tag in and out when entering the underground facilities.
- Restrict taking contraband items into the underground facilities.
- Follow recognised fatigue management guidelines.
- Conduct SLAM/SAM/Take 5 observations prior to undertaking a task.
- Isolate, tag and lock out plant/equipment similar to a working mine site.
- To conduct pass/toolbox meetings the start of each training day.

The nature of the Myne Start underground facilities allows the delivery of the training program to be highly interactive, focusing primarily on work based/on the job training activities to demonstrate and reinforce learning. A diverse range of topics are delivered within the inexperienced employee program, as well as the presentation of a range of induction/standard operating procedures (SOP) topics relevant to all mine sites and enhancing the delivery of the hands on training program through the use of various simulation tools.

Throughout the training program the effectiveness of the training and in turn the traineesÐ introduction into the underground mining environment is measured by;

- Feedback/signoff from site trainers - once the trainees have completed training at Myne Start they are required to continue their training onsite in line with detailed training plans, generally for a period of 2 to 3 months.
- Feedback from the trainees - with a formal program feedback of the training scheduled at the completion of each program.
- Program debriefs - the program is formally reviewed by the Myne Start management representatives, trainers and site management team members.
- Interviews via site Project Managers - at the completion of their onsite training plan requirements each trainee is interviewed by the Site Project Manager to ensure that they hold the relevant knowledge/skills necessary to work under general supervision.
- Employment probationary period - standard employment measures are applied and monitor the trainees throughout their probationary period of 3 months.

To date the mine site hosts have recognised the effectiveness of the training within Myne Start, reducing the required cleanskin training period on site by the training time within the facility and/or reducing the ratio of experienced to inexperience personnel working underground, with large mining companies including BMA and Anglo American working with Myne Start to deliver the program to their own newly employed permanent inexperienced workforce. General feedback from mine sites has been extremely positive, clearly indicating that the employees who have completed the program are far more advanced in not only their safety awareness but in the industry knowledge and skills required to effectively commence operation in the underground environment, when compared other inexperienced employees that have gone direct to site.

Working belt and roadway in Myne Start training complex

Trainee roof bolting in Myne Start training complex

Benefits / Effects / Outcomes

The main benefit recognised from the introduction of the Myne Start complex is the formation of clearly identifiable pathways for introducing inexperienced personnel into the underground coal mining industry. When compared to the traditional introduction methods the pathways are:-

- Accelerated, allowing inexperienced personnel to enter into a productive mode within a quicker timeframe.
- Less disruptive, with a larger percentage of the training conducted off site, reducing the potential training impact/disruption on site.
- Better aligned to the trainee's needs, both in learning methods/styles (i.e. practical hands on) and experience level, with training programs being purpose built and focused on the training of inexperienced personnel only.
- Focused, providing the trainees with a more indepth level of understanding of the underground environment and the unique hazards and control processes involved.
- Reduced risk to all workers when the inexperience workers commences on site.

Transferability

Since the implementation of the first inexperience employee program, Myne Start has also been utilised and/or modified to suit the following training programs and workshops;

- One day Supervisors Safety Workshop for the refreshing of key principles from a supervisory role, utilising on the job activities with the inexperience trainees.
- 1st year engineering apprentices in specific underground coal mining applications.
- International miners in specific Australian underground coal applications.
- Experience metalliferous miners in specific underground coal applications.
- "Open Days" for Mastermyne/Myne Start employees and family members.
- "Women in Hard Hats" program facilitated by the CQ University in Mackay.
- "Toolkit for Girls" event for female students in Years 10-12.

Myne Start's future focus is to be credible and recognised by the relevant industry sectors in Queensland, nationally, and potentially internationally as well as targeting other pressing industry training needs including;

- Underground Mine Deputies/ERZ Controller programs.
- Mobile Operator Training (Man Transporter, Loader).
- Underground Mine Fitter Trades programs (additional to already existing Electrical Trades programs).

Eimco used by trainees throughout the course

Longwall chocks and shearer arm in Myne Start training complex

Innovation

Prior to commencing with the development of the Myne Start facility representatives of Mastermyne attended a range of meetings and made presentations aimed at:-

- Raising awareness of the proposed facility.
- Verifying an assurance of need for a facility of this nature.
- Ensuring that the facility was not duplicating other facilities in place or proposed.

These meetings were with representatives from:-

- Government; Local, State and Federal.
- Industry Groups; Queensland Resources Council, Mining Industry Skills Centre.
- Mining Organisations;
- Higher Education Sectors.

All presentations were well received with clear indications of support obtained for the development of the proposed facilities.

Myne Start is clearly an improvement on existing processes of recruitment and training of inexperienced workers. This innovation is sustainable and will continue to grow and diversify to meet the ever changing needs of a growing industry.

GET Removal Tool

MMG – Century Mine

The Problem or Initiative

The change-out of the GET (Ground Engaging Tool) on Liebherr 996 shovels at MMG Century, as at other mine sites, presented a number high safety risks due to the equipment's size and weight.

The first high risk factor was that the current process required tradespeople to manually handle the GET from the bucket. The second high risk factor was that the lugs had to be welded to the GET to enable it to be removed from the Liebherr bucket. While lifting lugs are incorporated into the design of the GET, they detach from wear during operation.

As a lifting tool to assist with the safe change-out of GETs was not available, Century's Mine Maintenance Workshop (MMW) undertook a project to develop such a tool.

The Solution

The MMW boilermaker team worked with Century's engineering department to develop a lifting tool to safely and efficiently remove the GET from Liebherr buckets.

During the design phase, the aim of the team was to develop a device – the GET Removal Tool – to remove GETs that:
Eliminated the need to manually handle the GET; and
Eliminated the need for another lifting lug to be welded onto GET for removal.

The device is used by:
A prototype (see Figure 1) was then developed based on these requirements, with the site's engineering department certifying that the device was safe for use before it entered service as a trial. This process confirmed that the tool met stringent load-testing requirements and was certified with a working load limit of 100 kilograms.

Safe Work Instructions (SWIs) and other operation instructions were also developed and personnel trained in the GET Removal Tool's use before it was entered into service, in accordance with Century's strict safety and health standards.

Once in trial, the diesel fitters using the GET Removal Tool were asked for their feedback about its effectiveness and put forward suggestions to improve the device. Feedback has been extremely positive, with no recommendations put forward to further improve the tool. Following the completion of the trial, the tool is now used whenever a GET is change-out on a Liebherr shovel.

There is no alternative to removing the GETs from the shovel. Therefore, while the process cannot be eliminated or substituted – the first two solutions on the Hierarchy of Controls – an engineering control has been developed to address risks associated with changing-out GETS.

It should also be noted that the serious risks associated with needing to manually handle and weld a lifting lug to the GET have been completely eliminated by the development of the GET Removal Tool.

Benefits / Effects / Outcomes

The safety benefits associated with the GET Removal Tool include:
- Risks associated hot work (welding) have been eliminated as this is no longer required; and
- Muscle strains, pinched and crushed fingers and other injuries resulting from manual handling the GET have been eliminated.

Other benefits have included:
- Downtime and labour required to service Liebherr buckets has decreased as a lifting lug is no longer required to be welded to the worn GET for removal. Therefore removing the boiler maker from the task, reducing labour from three trades people to two (Crane operator & Rigger);
- Costs have reduced; and Machine availability has improved as downtime associated with these change-outs has reduced, as the welding procedure is a lengthy task.

Transferability

This tool is easily transferable to other mining operations as the due diligence process has been followed. Engineering drawings, certification, operating procedures and training material are available to enable such a transfer.

As a result, the GET Removal Tool can be easily produced at other mine sites. The GET tool can now also be resized to suit other machines currently using the Esco posilok GET system.

Innovation

The GET Removal Tool is the first of its kind, as a similar device had never previously been developed for commercial use.

The manufacturers of GET Removal Tool have produced a product with a moulded lifting lug for fitment but no tooling for removal at end of life.

It was also designed to improve the productivity levels of the mine by reducing the downtime of the machine, thereby increasing equipment availability.

The introduction of this tool has also reduced costs associated with the process by removing the need for hot work and reducing the number of staff previously involved with this task.

The GET removal tool is simply attached to the worn tooth, a lifting device attached to the tooling (e.g. Crane or VLC) and then the tooth is removed from the bucket adaptor and placed straight into the service vehicle.

Figure One: GET Removal Tool

The Redigrip PSM (Precision Steel Manipulator)

Redpath Australia Pty Limited

The Problem or Initiative

Working with suspended loads remains an identified significant risk within the mining industry, which can be compounded by cramped spaces and tight clearances in underground work areas.

During the tender process for the disassembly and re-construction of an overhead workshop gantry crane, at an underground mine, Redpath identified during a pre-project risk assessment, an opportunity to improve the safety of the work by eliminating the need for the slinging of beams and columns during construction, by way of the design and use of a fit for purpose Redigrip PSM (Precision Steel Manipulator).

The use of the Redigrip PSM also reduces the risk from limited headroom above the gantry structure and removed personnel from the hazardous areas adjacent to slinging and carrying of beams.

The Solution

Through the combined efforts of Redpath, Mecad Engineering, Doherty's and M&J Hydraulics, the concept advanced into a hydraulically controlled beam manipulator which was able to grab "I Beams" up to SWL 1.2 tonnes and manipulate them with: 360 degree rotation; 40 degree side tilt left and right; 140 mm side shift; 180 degree primary tilt; 600mm of telescopic extension; and provide a reach of over 8 meters. This was achieved by being attached to and powered by a Volvo L120 front end loader (FEL).

The Redigrip PSM

The major components of the Redigrip are an "Engcon" rotatilt 15 tonne excavator attachment, with specifically designed telescopic jib in conjunction with a hydraulic gripping clamp developed to suit I beams.

The machine was assembled in Redpath's Brisbane workshop and extensive testing was under taken. The machine was load tested to 2.4 tonnes, with the restricting factor being the L120 FEL. Once the SWL and associated certification had been obtained, a comprehensive risk assessment was completed for use and the L120 FEL and Redigrip were sent to site.

Further testing and training was undertaken on the surface at the project site, with operators certified in the use of the Redigrip and it was then put to work on the underground workshop crane structure installation.

The first significant task was the erection of the vertical columns which were fabricated from 460UB67 beams at up to 8 meters in length. The first column took over 3 hours to install while educating the team on the construction technique. However installation time per column by the end was just 25 minutes, this was a full cycle which included tramming to the preparation area, securing the column with the Redigrip, tramming the column back to installation location, aligning and bolting down. Whilst there were several issues which impacted on the construction programme, the erection of the steel frame work was achieved in less time than programmed. The heaviest section of steel handled on this project was a 350WC197 beam at 5.6m long with a weight of 1.1 tonnes, which the Redigrip handled with ease.

I-Beam installation on site

During the design risk assessment, it was identified that dropping a hydraulically controlled beam was a significant risk, as hydraulic pressure could be lost due to:

1. Engine failure
2. Hydraulic system failure, including blown hose.
3. Unintended release of clamp (operator error) or
4. Electrical or control failure.

Contingencies were included in the design to prevent beam movement in the event of any of these failures.
The following controls where put in place to mitigate these risks:

- The clamp has inbuilt load check valves which are attached directly to the clamp body;
- The clamp control valve is 2 way normally open valve, meaning that with lose of electrical power, hydraulic pressure is still directed to the clamp;
- The controls for clamping / unclamping are safety latched, requiring two separate movements in sequence by the operator to open the clamp. Which was also accompanied by a time delay;
- The clamping circuit is fed from the main system hydraulics of the L120 through a check valve. The circuit has 2 accumulators and a pressure switch. The result is that if the L120 suffers hydraulic system pressure loss, the check valve will not allow clamp pressure to be drained back through the L120 system, while the accumulators will account for any leakage in the clamp circuit itself;
- The pressure switch is attached to a warning light in the cabin and red and green lights outside on the front of the cabin. The light in the cabin warns the operator if clamp circuit pressure is below optimum. The red and green lights on the front of the cabin above the windscreen are control by the pressure switch and also by a manual switch in the cab. The red light would be turned on by the operator whenever he is operating the Redigrip. Once the beam is positioned ready for riggers to install the bolts the green light is turned on and the red light is turned off. In this way the crew knows when it is safe to approach the clamped beam.

Underground workshop crane structure installation

Benefits

The Redigrip PSM had numerous benefits to the safety of the project and an efficient construction program, including:

1. Eliminating the use of a conventional crane in a confined space with very little headroom;
2. Eliminating the use of slings for moving horizontal and vertical beams;
3. Eliminating personnel from the traveling areas of suspended loads;
4. Positively controlling the fine degree movements which reduced the risks associated with adjusting or manoeuvring a load to align bolt holes;
5. Eliminate damage to the painted and prepared surfaces of the steel structure with the use of a non-slip rubber seat and neoprene gripper finger pads.
6. Minimising personnel exposed to potential manual handling, nip-point, and crush type injuries.
7. Reduced personnel required for the project, thereby reducing costs and potential for injury;
8. An efficient installation cycle due to positive beam control and minute adjustment ability, for trouble-free bolt hole alignment; and
9. Equipment flexibility, whereby the utilised L120 FEL was also a project forklift, loader, man basket and the specialised steel work installation tool. The L120 FEL used was able to be returned to other duties within 15 minutes on this project, where it worked with the dayshift service crew performing normal duties and installing steelwork on nightshift with the installation crew.

The use of the Redigrip PSM ensured the new 10 tonne gantry crane structure was assembled without incident and within program, to the satisfaction of the both the customer and Redpath, whilst offering the lowest construction risk solution possible.

Transferability

The Redigrip has many safety and productivity benefits that are not just restricted to the underground mining environment. With minor modifications this unit could be used for ground support steel-set erection, installation of large rising main pipes and paste fill delivery lines.

There is also the option to use the Redigrip in sheds and fixed plant installations on the surface. This can be done with minimal modifications for safe, flexible and rapid steel structure erection. The Redigrip could also be suited for use with a Telehandler, which would allow greater flexibility with potentially larger sections and greater lifting heights achievable.

Innovation

The principle innovation in the Redigrip PSM is in the unusual combinations of components and systems. As previously mentioned the primary component is an Engcon rotatilt 15 tonne excavator attachment, which gave the main range of movements. However the beam grab component was actually a forest industry product that was engineered to attach where an excavator bucket would typically sit. These two elements were then fitted to a manufactured beam which was designed to fit inside the OEM jib attachment on the Volvo and be hydraulically controlled to slide, which gave the additional telescopic movement.

Two additional hydraulic functions (the machine as a standard has two) were also added to the Volvo L120, which now gave boom slide and attachment tilt to the already raise/lower and bucket tip functions.

The Redigrip was controlled by an added Joystick and PLC which allowed fine adjustments via proportional solenoid valves. However, the rotatilt was designed for open centre hydraulics common with an excavator axillary circuit, not the load sensing hydraulics of the FEL. This was overcome by the innovative addition of a proportional solenoid valve controlled by the PLC which electronically manipulated the load sensing hydraulics to be able to operate all the movements necessary.

The combination of components and systems then allowed the Redigrip a 360 degree rotation; 40 degree side tilt left and right; 140 mm side shift; 180 degree primary tilt and 600mm of telescopic extension, to a height in excess of 8 meters.

Cost

The approximate cost to design, develop, and manufacture the total Redigrip PSM package, including the additions of purpose fitting the control systems to the FEL, was $124,000.

Measuring and Managing Road Surface Friction Risk

RoadSafety Training Services Pty Ltd

The Problem or Initiative

Uncontrolled vehicle movements are an ever present mining hazard; be they a result of intermittent rain events or overwatering practices. Vehicle related incidents account for a large proportion of safety related reportable mine events and uncontrolled movements due to deficient surface friction.

[1]*Analysis of reported incidents and observations by inspectors during follow-up inspections has shown:*

- *Most of the incidents (59%) took place on ramps*
- *Watering or excessive watering was identified as the primary cause of such incidents (46%)*
- *Wet road conditions due to rain has been a causal factor in (8%) of incidents*

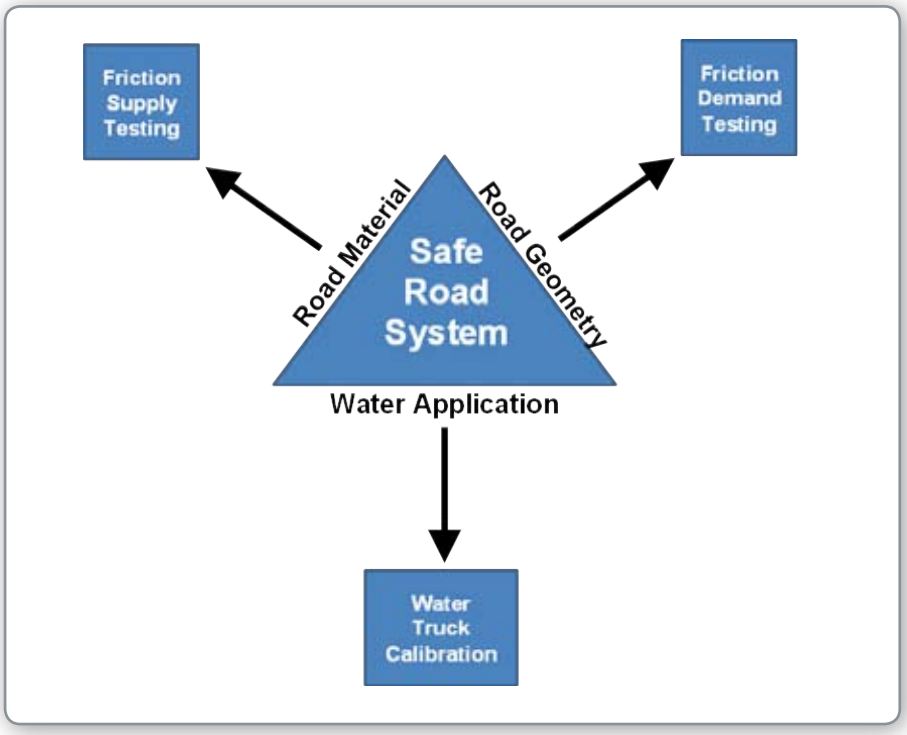
The material types used by mines for road construction, including on the road surface to provide for frictional value, require urgent review (S 128 (2), CMSHR).

The challenge confronting surface mining operators is the inherent conflict between managing dust and friction. This difficult situation is exacerbated by demanding and variable geometry combined with water sensitive clay based road materials.

Rain events pose an additional intermittent hazard for safe vehicle movement. The *Safe Road System* provides a comprehensive solution to manage this risk.

Traditionally, this risk is managed by reliance on operator experience and judgement. This *Road Safety System* provides scientific and objective friction evaluation that complements current subjective industry experience and knowledge. This is consistent with the hierarchy of control risk management methodology.

[1] Safety Bulletin No. 99 (Version 1) 23 August 2010



The Solution

The three elements of the *Safe Road System* are road material, geometry and water application. A Safe Road System can be established where the available friction supply not only exceeds the friction demand, but provides a factor of safety for safe operation of mine vehicles.

The objective was to develop a reliable and affordable method for mine operators to assess their existing road materials for friction and water sensitivity properties. By adopting this methodology, mine operators can measure and identify the risk of uncontrolled vehicle movement events. After rain events, mine operators may measure and manage friction risks. The Safe Road System complements the knowledge and experience of miners, in determining safe operating parameters.

Two mining operators participated in a field evaluation of the Safe Road System, comprising the below elements. The trial confirmed the Safe Road System to be a robust real-world solution to managing uncontrolled vehicle movements.

- Mine Friction Test Procedure
- Global Friction Template (Risk Matrix)
- Water Truck Calibration Method
- Water Application Guide

A robust standalone dynamometer (accelerometer) was selected to conduct friction measurement testing. This scientific instrument is portable, user-friendly and provides instant field results utilising readily available mine light vehicles. The device is used extensively by road authorities and law enforcement agencies to determine road friction values.

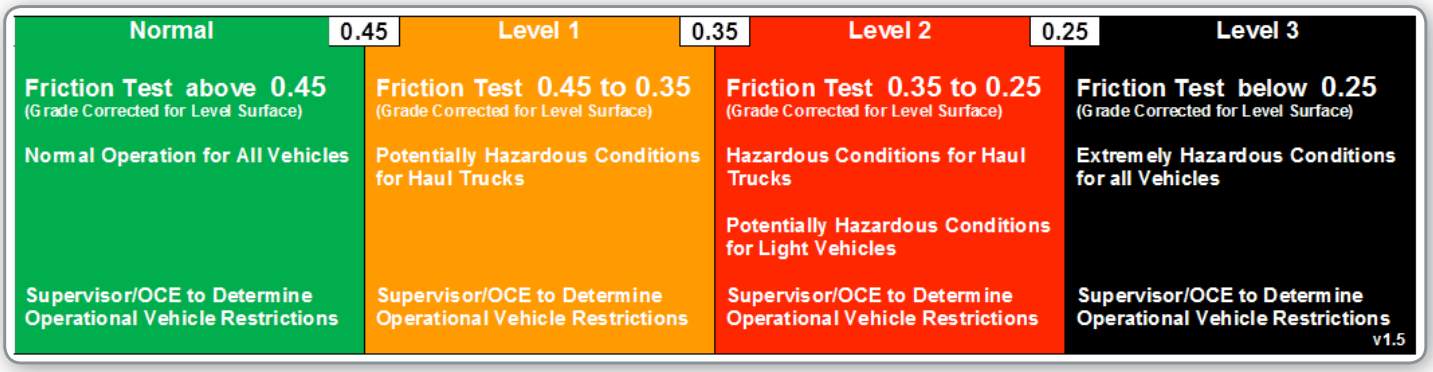
The field test procedure provides a reliable and safe light vehicle test that correlates to a mine heavy vehicle friction measurement result:

- Two pilot mines participated in field trials.
- Common on-site mine light vehicles were used for testing.
- Both antilock braking systems (ABS) and conventional brake systems were trialled.
- Mine haul truck road surface friction test results were correlated with the light vehicle by providing analogous road surface conditions.
- Water application was controlled by water to ground rate calibration of the on-site water trucks used in the procedure.
- Grade adjustments for all tests allowed for level surface comparison for road surface testing.

The implementation of the Safe Road System is a low cost, practical and technically robust measurement means to assist mine operators in determining conditions for safer vehicle operations.

Field testing provides instantaneous friction values, enabling reference to the *Global Friction Template* for both heavy haul trucks and light vehicles. The Global Friction Template accounts for demanding geometry such as 10% ramps with an inbuilt safety margin for normal operations.

The below *Global Friction Template* provides for vehicle specific risk management in all friction conditions and hierarchy of control applications can be readily matched.



Global Friction Template

Benefits / Effects / Outcomes

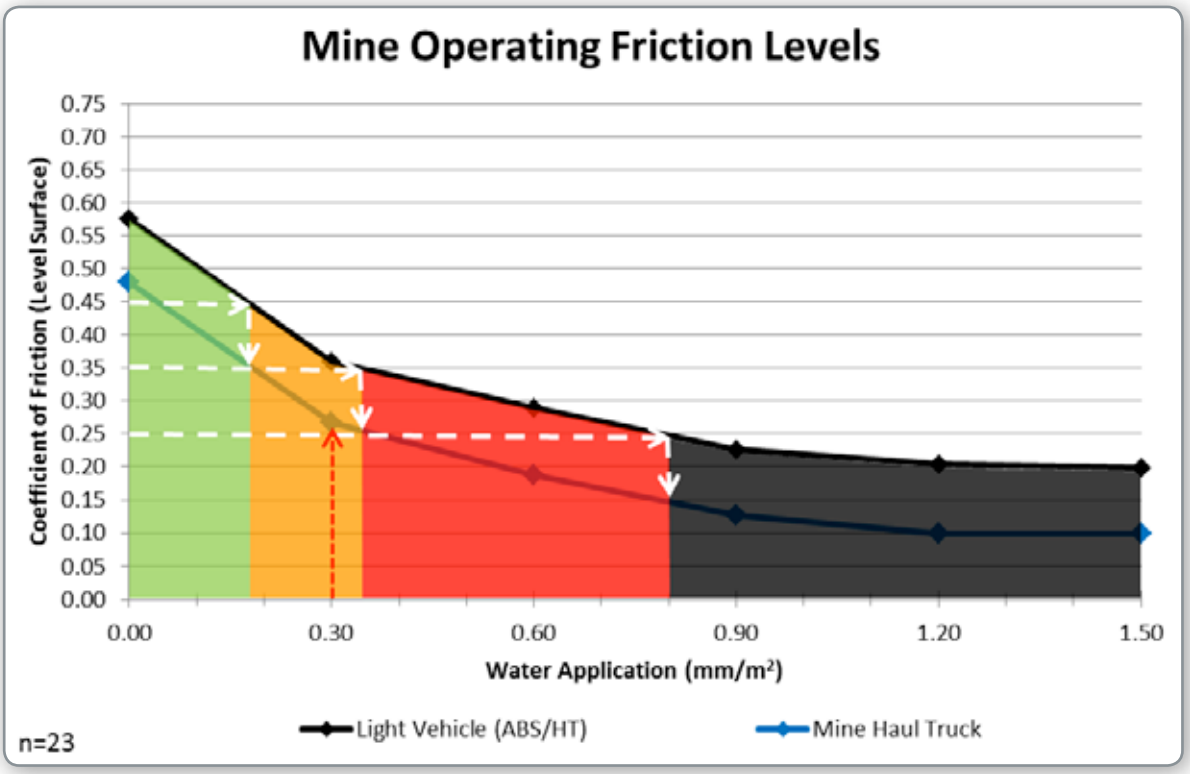
Uncontrolled vehicle movements, particularly those involving heavy vehicles are high potential incidents. Deficient road surface friction environments are common upon mine sites and typically friction values are unknown to the operator until an incident occurs.

The *Global Friction Template* provides a reliable and effective means to interpret friction values with the following road safety benefits:

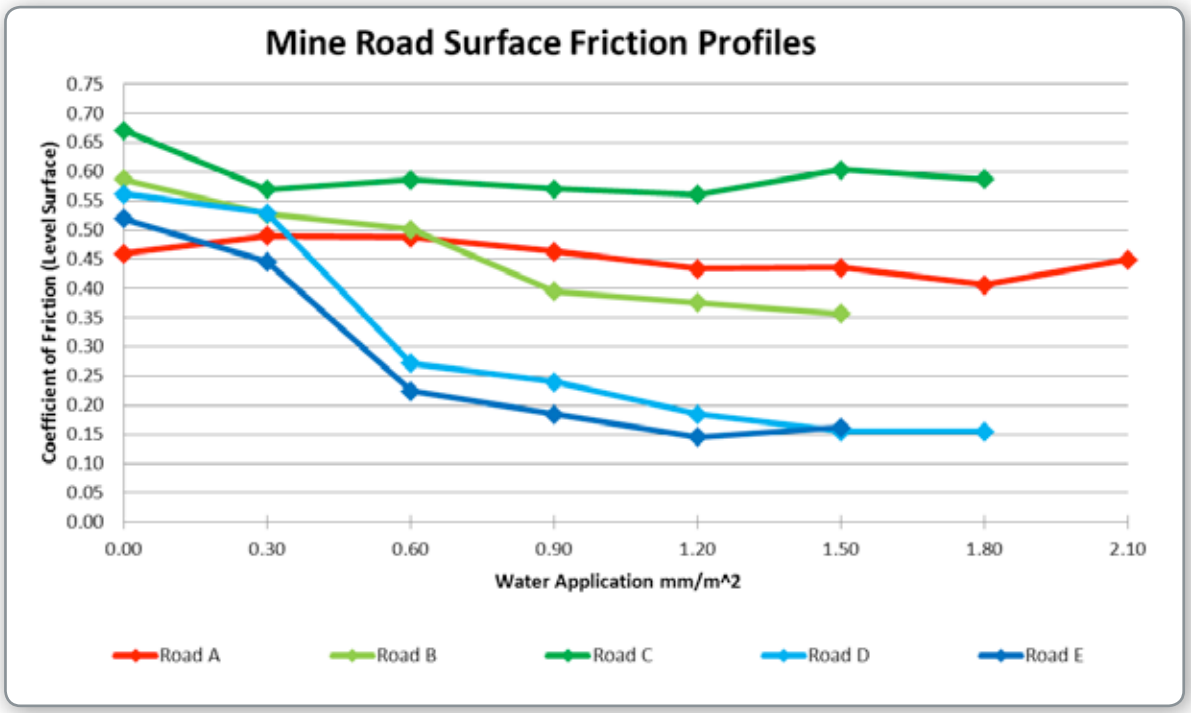
- After rain event road surface friction assessment (back to work decision)
- Road watering safety management practices (live audits)
- Road surface material friction properties evaluation (to sheet or not)
- Uncontrolled vehicle movement Incident Investigation (friction deficiency or other)

The *Mine Operating Friction Graph* combines test friction data for higher risk road surfaces from 12 operating mines. This data capture is a world first initiative that provides for direct correlation between light vehicle tests and heavy vehicle friction results. The *Global Friction Template* has been developed in conjunction with this on-site research data using operational mine vehicles on active mine circuits.

The friction results are correlated with calibrated water cart water application and rainfall events. This is an important process that allows for accurate road friction profiling of roads with diverse geotechnical road surface properties.



Mine Operating Friction Graph



Example of mine road surface friction profiling graph

This *Safe Road System* has now been adopted at three operating mines and several other mines are in the early stages of deployment across their road networks.

Transferability

The *Safe Road System* may be utilised in any unsealed road network environment. The *Safe Road System* is not limited by vehicle type, road geometry or design. This innovative safety system may be readily deployed in any mining environment.

This system adds tangible value to existing road design and associated road safety practice.
Specifically:

- Mine Friction Test Procedure
- Global Friction Template (Risk Matrix)
- Water Truck Calibration Method
- Water Application Guide

Innovation

Public road authorities in Australia do not have a system of measuring unsealed road friction as it is considered too difficult a task. Current road surface friction systems for sealed roads do not transition to unsealed road environments. The friction values ascribed to these mainstream systems are only comparable within their own system of measurement and therefore limited in their application.

The *Safe Road System* provides friction values that cross over to road design and road safety criteria. For example a 10% mine ramp requires a surface friction of (0.1g) for a vehicle to maintain a stationary position and therefore requires (0.1g) more friction to maintain safe vehicle movement than an equivalent level surface.

The *System* affords the ability to measure not only the surface friction supply but also friction demand which is a combination of vehicle speed, road geometry and operator input. These analogous (g) values enable an accurate assessment of the uncontrolled vehicle movement risk or safety margin at any location on the mine road network.

This innovative system is original in its application of the laws of physics, together with the aid of an affordable, user friendly scientific instrument and test procedure. Ready access to consistent and objective data assists mine operators make superior road safety judgements to reduce the risk of uncontrolled vehicle movements on their road networks.

Cost

The instrument used to conduct the procedure costs ~$4000. There are no other ongoing or maintenance costs as the instrument is self-calibrating and used in readily available mine light vehicles.

Road friction test Instrument mounted in test vehicle.

Scale Diverter Chute

Incitec Pivot Limited

The Problem or Initiative

During the production of fertiliser, a Sulphuric Acid/Phosphate rock slurry is filtered with the aid of a vacuum process to extract Phosphoric Acid. During the extraction process Gypsum scale builds up on the internal walls of the filter vessels and pipes. The traditional way of cleaning these vessels is to shut the plant down and High Pressure Water blast the acidic scale off the walls. Due to the configuration of the vessels and pipes the removed scale can build up and fall down into the suction side of the acid pumps. This results in further cleaning of the acid pumps. If the scale is not removed totally the acid pumps can be damaged on start-up.

To prevent the pump contamination from happening Maintenance Fitters are required to remove a section of pipe above the pump (just above floor level) and place a cap over the open end of the pipe leading to the pump. When cleaning commences all of the acidic scale spills directly over the floor creating a Health and Safety risk to everyone in the area. The removed scale would then be manually cleaned up using a shovel. Also, the removal of the pipe section would constantly disrupt the integrity of the vacuum system. The section of pipe also holds up other components that have to be manually held in situ during removal and manoeuvred back into place upon assembly.

The cleaning of the filter vessel is an important and routine task but it generates a lot of extra work by having to clean up the hazardous contamination resulting from the High Pressure Water Blasting. The opportunity to "shortcut" the removing and fitting of pipe work exists by not re-fitting all of the pipe flange bolts. This leads to continued disruption to the integrity of the vacuum system. A solution was needed to improve the contamination clean-up process and to maintain the integrity of the vacuum system.

The Solution

A section of the pipe directly below the filter vessel was cut away and fitted with a "Quick Release Insert". The insert was shaped in the same profile as the internal pipe so as not to disrupt the flow of the Phosphoric Acid. A "Scale Diverter Chute" was manufactured to use the same mounting flange as the Insert. This chute married up to the internal profile of the pipe so that when it was installed it created a seal inside the pipe wall. When the Scale Diverter Chute is installed and cleaning is in progress the removed scale falls down the pipe, hits the Scale Diverter Chute and leaves the pipe to be collected in a wheelbarrow/industrial bin that can be emptied at a later time.

Quick Release Insert in place

Scale Diverter Chute in place

Scale Diverter Chute

View inside pipe when fitted

View showing Pipe Assembly at bottom of Filter Vessel

Benefits / Effects

- It no longer requires 2 Maintenance Fitters 2 hours to remove the section of pipe and install the blank. The Scale Diverter Chute can be fitted in 5 minutes by one Maintenance Fitter.
- The time taken to dispose of the removed Acidic Scale has been dramatically reduced as it is diverted directly into a wheelbarrow/bin which is emptied at the end of the job.
- It has reduced people's exposure to Phosphoric Acid as the Acidic Scale is diverted directly into a container and not onto the floor to be cleaned up later.
- The integrity of the vacuum pumping system has increased due to less interference in the gaskets surrounding the pipe work.
- The re-work in tightening the flanges surrounding the pipe work after start-up has ceased.
- The manual handling risk has reduced due to the fact that these large sections of pipe are no longer being man-handled in and out of position.

Transferability

The Scale Diverter Chutes are being retro-fitted to all other down-leg pipes where scale collection is an issue. Our Phosphoric Acid Plant expansion project is having Scale Diverter Chutes fitted as standard equipment to all down-leg pipes identified for cleaning.

The Scale Diverter Chute could be used in other industries where a temporary diversion of material is required. The ease of installation and low maintenance design make it a viable solution in hazardous cleaning environments.

The cost is largely driven by the physical size of the chute and the type of material used in its construction. In our highly acidic environment the chute assembly is made from Super Duplex Stainless Steel but there is no reason why it can not be manufactured from mild steel or whatever is appropriate for the material being diverted.

Innovation

The problem was identified by our Production Department with the Health and Safety of the staff conducting the clean up task the driving influence. The challenge to find a solution was placed with our Maintenance Department. A "brain-storming" session was conducted around the pipe work and vessel with various solutions put forward. A prototype of the chute was manufactured and installed and further suggestions for improvement made. The design achieved its purpose however further modifications were made to reduce the physical size and weight of the chute. A new design is being tested for curved sections of pipe work.

The Scale Diverter Chute was designed, built and tested on site.

Cyclone Spiggot Change Out Tool

Evolution Mining – Pajingo Site

The Problem or Initiative

The reason behind the design of the cyclone change out tool was to eliminate the need of three men to do the job of a simple one man task. The other reason is that at Pajingo Mine we use ceramic lines spiggot's that if not aligned properly can be easily cracked, which is costly and causes excessive wear. When Spiggot's were changed out in the past they were often hard to fit correctly lined up. The tool eliminates the issue of incorrect alignment and manual handling.

The Solution

After a discussion between co-workers a resolution to the problem was reached. After a proto type was designed it was found to work but lacked in the safety aspect, which was later resolved by making a second tool that was able to clamp to the cyclone. The hierarchy of control was applied with elimination being our goal, and was achieved through a change of design.

Benefits / Effects / Outcomes

By using the spiggot tool it has eliminated the use of hammers and screwdrivers when fitting the clamp that hold the spiggot housing to the lower cone of the cyclone, it also cuts out a lot of the manual handling and hours used for the job. Through asking other crews onsite doing the same job, it shows that the tool does work in the sense of making the job safer and easier to do. Because the tool is user friendly simple training for other crews has made it versatile to be used by all workers on site.

Transferability

Cyclones are widely used throughout the mining industry where milling and grinding is used therefore the cyclone spiggot change out tool could be easily modified to fit different sized cyclones.

Manual Task Risk Assessment Tool

Xstrata Copper North Queensland

The Problem

Workplace injuries sustained while undertaking everyday manual tasks are statistically over-represented in our business. Xstrata Mount Isa Mines classifies a manual task as any activity that uses the musculoskeletal system, including lifting, reaching for, pulling or pushing a heavy object, operating machinery, hammering or screwing in fasteners, climbing a ladder, or typing on a keyboard and using a computer mouse. These injuries have a significant impact on the short and long-term wellbeing of our workers, as well as the productivity and sustainability of our operations. For this reason, raising awareness of the causes and addressing the occurrence of manual task related injury has been identified as a key focus area for injury prevention initiatives across our north Queensland operations.

Strategies used in the past were considered too complex to be effective in the daily task risk assessments conducted by our workforce. Despite significant and ongoing effort, statistics indicate the risk remains, and a more simplistic, accessible solution was required to proactively and creatively address the occurrence of manual task related injury.

The Solution

We developed a simple, interactive Manual Task Risk Assessment (MTRA) tool that can be used to assess the risk of sustaining both acute and cumulative injury while carrying out manual tasks. The tool is used to clearly and visually illustrate the risk factors that can lead to manual task related injury. It works as a guide to assess the hazards and better understand the risks associated with manual tasks, and can be applied across all roles throughout our operations, from administrative or office work, to processing and production line tasks and machinery operation.

At Xstrata, we take a positive approach to workplace safety, with a strong focus on accountability. We believe the adoption of punitive compliance methods breed negativity and resistance against workplace health and safety standards and procedures. Instead, we aim to empower our people at all levels of our operations to take ownership of ensuring the safety of their environment at home and at work.

The first step we take in implementing any occupational health and safety initiative is to educate our people. We understand that individual awareness of manual task risk is our main defence against injury and that understanding the risks inherent to tasks is likely to support decision making. We believe a self-aware workforce operating with a fully-developed understanding of the potential hazards they may encounter in their work, and with the knowledge required to control these hazards is much more likely to observe, account for and mitigate potential risks before they actualise. Essentially, the MTRA tool aims to increase awareness of the risk factors associated with manual tasks, and thus influence the way our workers behave. Considering the Hierarchy of Controls (refer to Appendix A) “Managing worker behaviour” is at the lower end of the scale. However, we recognised that where there is a need for human involvement in a task there is an inherent injury risk, and that our last and most important lines of defence against injury are the behaviour of and decisions made by the person performing that task.

Design

During the design phase, we determined to be most effective the MTRA tool must meet a defined set of objectives.

It must:

- Be creative, interactive and attractive to users Use simple language and operate with minimal instruction
- Be applicable to all operational areas and roles
- Be available in various formats and sizes
- Be tactile and provide immediate feedback
- Deliver outcomes in line with best practice knowledge regarding the risk factors associated with manual tasks
- Ensure inclusion in existing personal risk identification strategies is achievable without the addition of further documentation or reporting.

A concept design was developed by Xstrata North Queensland’s Safety and Health, Health Risk Management and Occupational Therapy team, which was subsequently manufactured in prototype form.

The prototype clearly defines the risk factors for both acute, or immediate injury *(refer to Appendix B)* and cumulative, or long-term injury *(refer to Appendix C)*. These risk factors include weight of load and speed of movement *(refer to Appendix D)*, body position and posture *(refer to Appendix E)*, and repetition of movement, or “How often/How long?” *(refer to Appendix F)*.

To use the MTRA tool the operator simply identifies the weight being handled or the speed of movement and postural requirements of a task they are about to undertake. The operator moves the appropriate dials on the tool face and the mechanically gearing within

automatically moves the risk indicator dials to display the immediate (acute) risk level associated with performing that task (refer to Appendix G, 1). By then indicating the repetitiveness of the task on the "How often or How long" dial, the tool will automatically display the risk of long-term (cumulative) injury associated with undertaking that task consistently over a prolonged period of time (refer to Appendix G, 2).The operator can then consider control options to decrease the risk of injury associated with this task based on the risk factors identified.

With application directed towards increasing the knowledge and awareness of individuals this innovation is clearly at the lower, "behavioural" end of the hierarchy of controls. Acknowledging that the highest potential ongoing influence on manual task risk and control sits with the individual performing the task, it has been deemed appropriate to direct some of our strategic effort at this level. The higher level design control of manual task risk relies on the identification of risk; therefore, increasing knowledge and awareness at this level ensures appropriate allocation of resources to those areas of highest risk and therefore greatest need. Empowering and up skilling our people to better protect themselves is certainly something to which we are happy to commit.

Trial and feedback

The MTRA tool prototype was trialled across Xstrata's north Queensland underground mining, maintenance, and metallurgical processing, smelting (refer to Appendix H) and refining operations by Occupational Therapists in order to determine the efficacy of the tool against expected outcomes and use.

The assessment tool was presented to operational staff during daily, pre-work Positive Attitude Safety Sessions (PASS) followed by hands-on trial and assessment of upcoming tasks (refer to Appendix I). Senior staff were introduced to the tool in order to gather feedback with regard to area-specific use.

Comment was sought directly from workers in terms of:

- Usability
- Practicality in existing risk assessment procedures
- How it would be most effectively applied in their work area
- Suggested changes or improvements they would make to the tool

Feedback received across all operational areas was positive. The easy-to-use and interactive design of the tool, and its intended purpose as a method of simply assessing risks and increasing awareness without additional paperwork or administrative requirements was seen as particularly attractive. Discussion around how the tool could contribute to existing risk identification and mitigation strategies was clear and well described by all participants. Employees who trialled the tool commented that it would enable detailed description of specific manual tasks and the associated risks, without having to guess the level of potential risk and the effectiveness of controls. This was particularly relevant in assessing the risk factors for cumulative, or long-term injury.

All participants in the trial were engaged and willing to provide specific detail as to how they would use the tool, and the formats in which they would prefer it presented. This will allow for tailored implementation dependent on area-specific need.

Following is a summary of the key feedback received:

1. Workers in areas where task requirements were varied within and across shifts highlighted the value in having access to the tool for use when approaching a new task while "on the job".
2. In high traffic areas where large numbers of workers meet suggested that a large wall mounted version (1200mm x 1000mm) would be beneficial and would encourage use both due to novelty and access.
3. All workers identified the requirement to have access to the tool for pre-shift PASS and other such meetings. This could be either a large wall mounted or desk sized tool (370mm x 235mm).
4. Operational areas where task requirements are predictable (Eg. various roles at Xstrata's Townsville Copper Refinery and Refractory Maintenance), identified that large wall mounted versions located strategically across the site would be used. Smaller areas also acknowledged the value of a desk sized version for similar reasons.
5. Many workers commented that they would like to pursue procedural means of reporting tasks identified as an unacceptable immediate or long term risk (via use of the tool) through the management structure in order for controls to be investigated and implemented. A validation tool in line with best-practice knowledge such as this would prove useful.
6. The development of the tool in electronic format, accessible via the Xstrata intranet was also suggested, and has since been completed by Xstrata's IT Department *(refer to Appendix J)*.

Introduction into our business

The final design and mechanical development of the assessment tool was undertaken in collaboration between Xstrata Occupational Therapist, Joel Edson, and Michael Farrell of Calculated Engineering.

To provide opportunity for evaluation, specific sites across Xstrata's north Queensland operations were selected for the initial roll out of mechanical versions of the assessment tool, with the electronic version being made available via the Xstrata intranet across all of our north Queensland sites.

Implementation and further development of the assessment occurred in a step by step fashion as an adjunct to current processes. As the initial roll out was undertaken, further data gathering occurred to ensure subsequent strategic planning was in line with uptake and demand. Initial implementation occurred with the direct input of relevant Managers, Superintendents, Supervisors and Safety Advisors and was driven locally rather than as a standard process across operations. It was acknowledged that the needs of different operational areas varies as does the use and requirements of the assessment. This process included the development of procedures for reporting and use, both formally and informally, in personal and other risk assessment frameworks; development of electronic recording mechanisms; and, integration with existing electronic reporting formats. Planning for the delivery of the assessment across Xstrata's operations globally is currently underway.

Benefits

Along with awareness and engagement, we expect that workplace understanding of specific manual task risk factors, and therefore control options, will naturally develop as use of the assessment increases. The driving intent for the development of this tool is to protect our workers and reduce injury.

All General Managers, Managers, Superintendents, Supervisors, Safety and Training Advisors and Sustainable Development committees across our Mount Isa operations, as well as two primary and secondary smelting crews at our Copper Smelter, crushing and conveying, ore handling, and infrastructure crews within our Mount Isa Copper Operations (which encompasses our Enterprise and X41 copper mines' underground and surface infrastructure, and our Copper Concentrator), and all crews at our Zinc-Lead Concentrator have been trained in the use of the tool and are currently using it in their daily risk assessments. Given the size of our operations, the roll out of the MTRA across our Mount Isa Operations, and its value as a simple and engaging way to increasing awareness of manual task risk, has the potential to improve the wellbeing and safety of work practices for almost 5000 people.

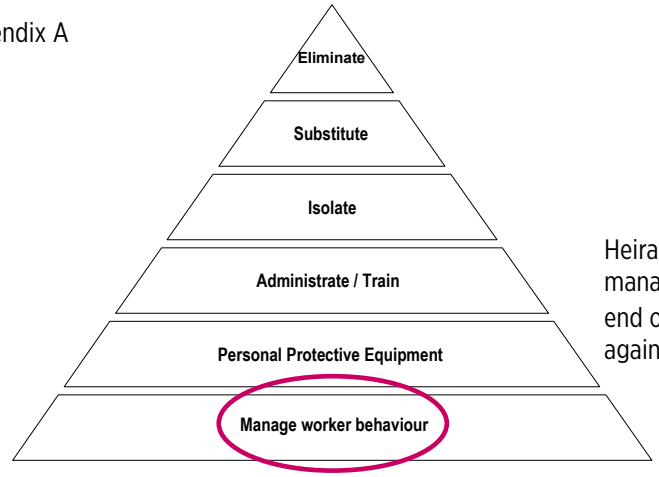
Transferability

The Manual Task Risk Assessment has application potential not only across the resources industry but any industry where manual tasks pose an injury risk and where greater understanding of risk factors, and therefore control options, is desired. The key element here is the focus on individual understanding and awareness of manual task risk and its contributing factors. Much of the information made available to operational personnel is derived from academic biomechanical and ergonomic material and is presented in a way that is too technical and complicated to be effective. This assessment tool has applied the relevant academic knowledge, in a format guided by the workers who will be using it to ensure clarity, relevance and effectiveness.

Innovation

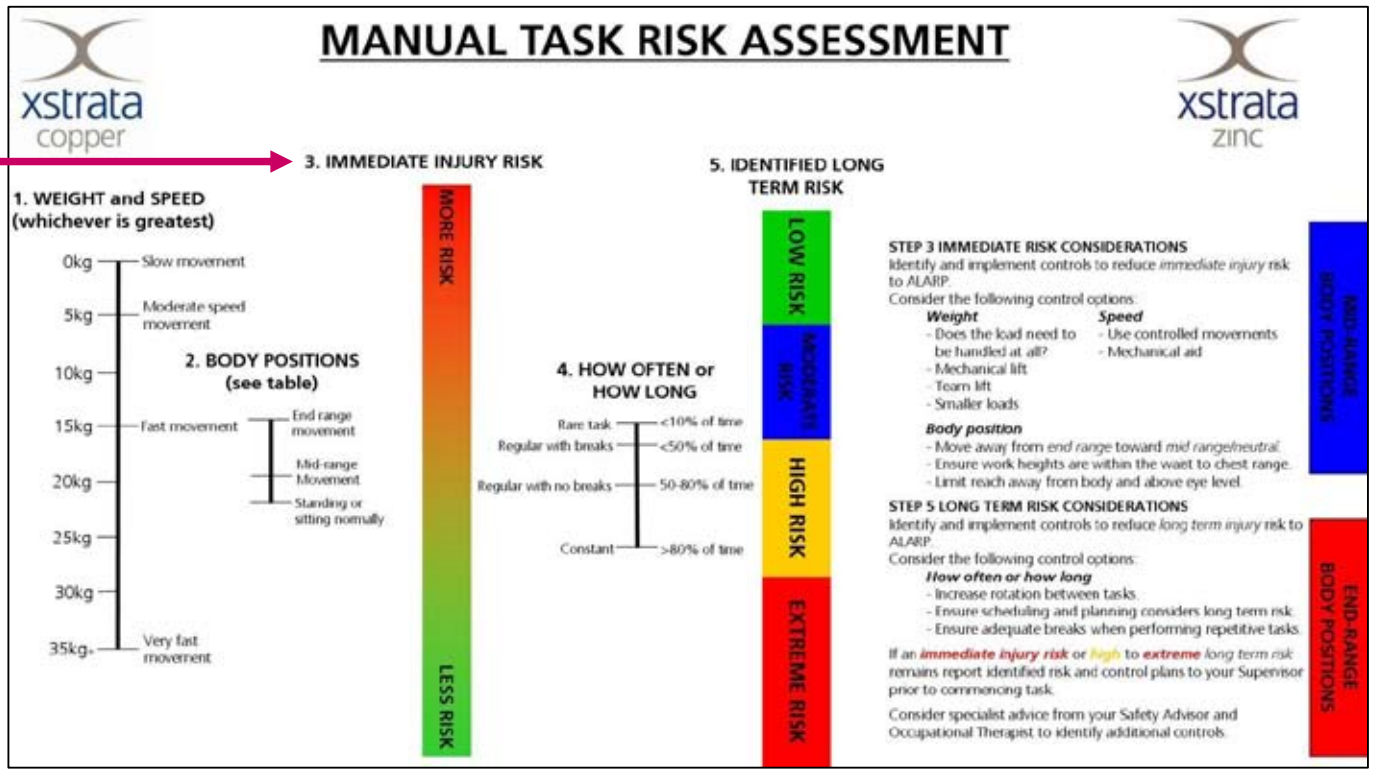
Although the design is based on the existing "tie-line" principle, the application to manual task risk is unique. There have been valid and effective attempts by various companies across a range of industries to mitigate manual task risk however, based on the research conducted, this assessment tool has addressed the issue in a new, creative and innovative way.

Appendix A



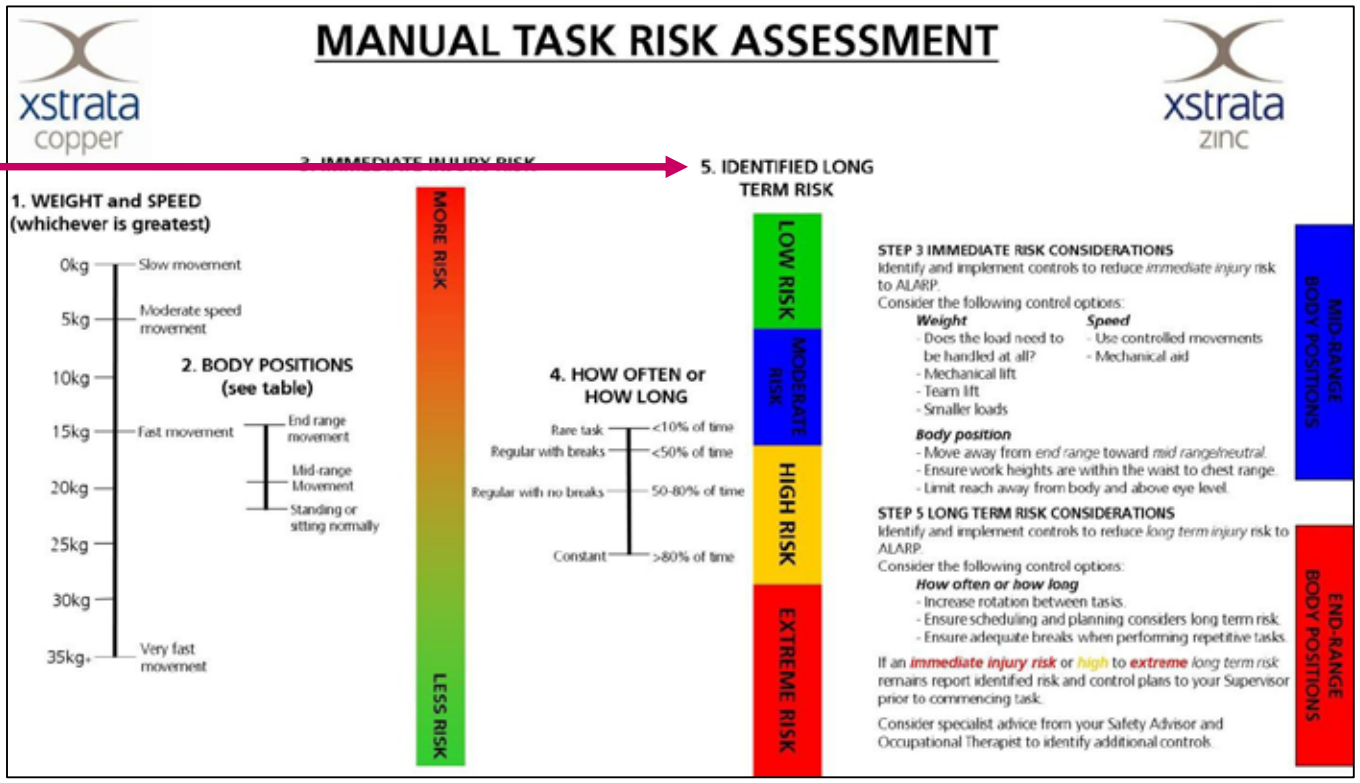
Heirachy of Controls – behaviour management, while on the lower end of the scale, is the last line of defence against an manual task injury.

Appendix B



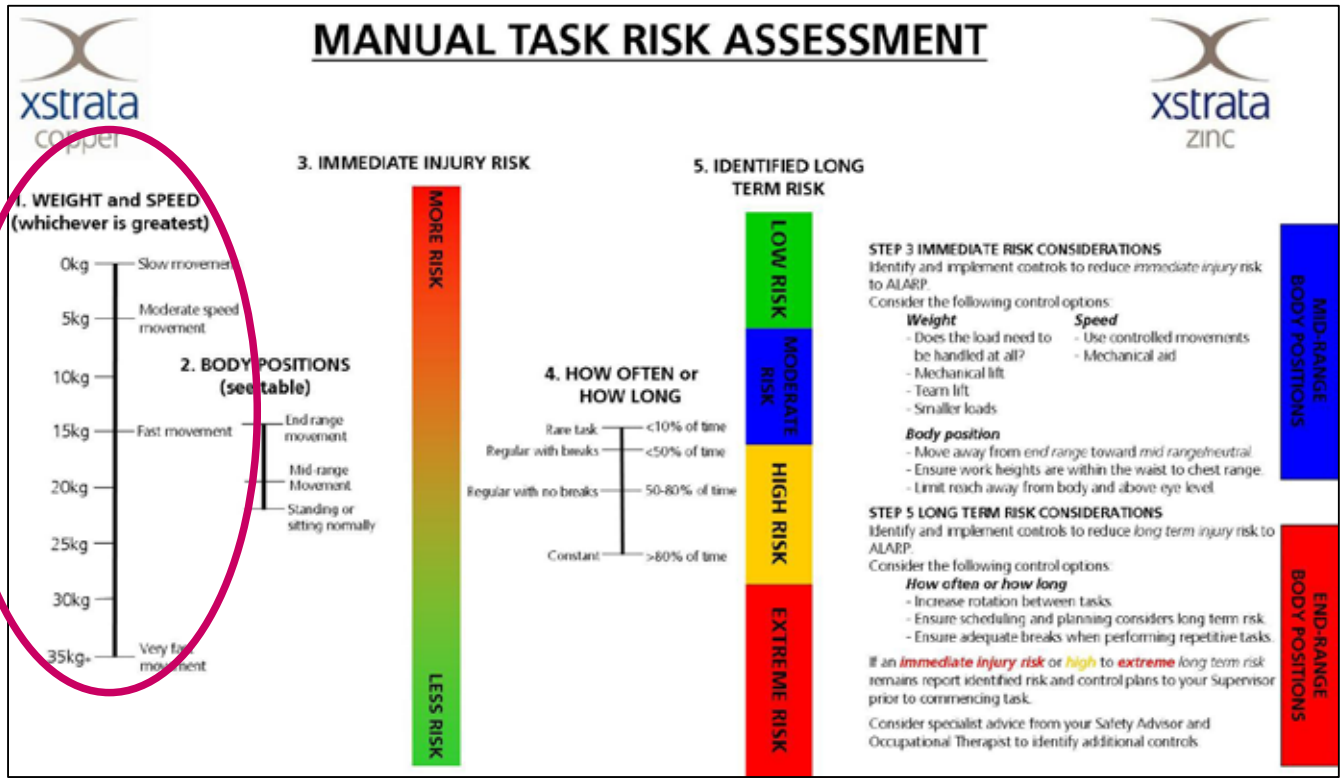
The combination of weight and speed and body position equates to the risk of acute, or immediate, injury.

Appendix C



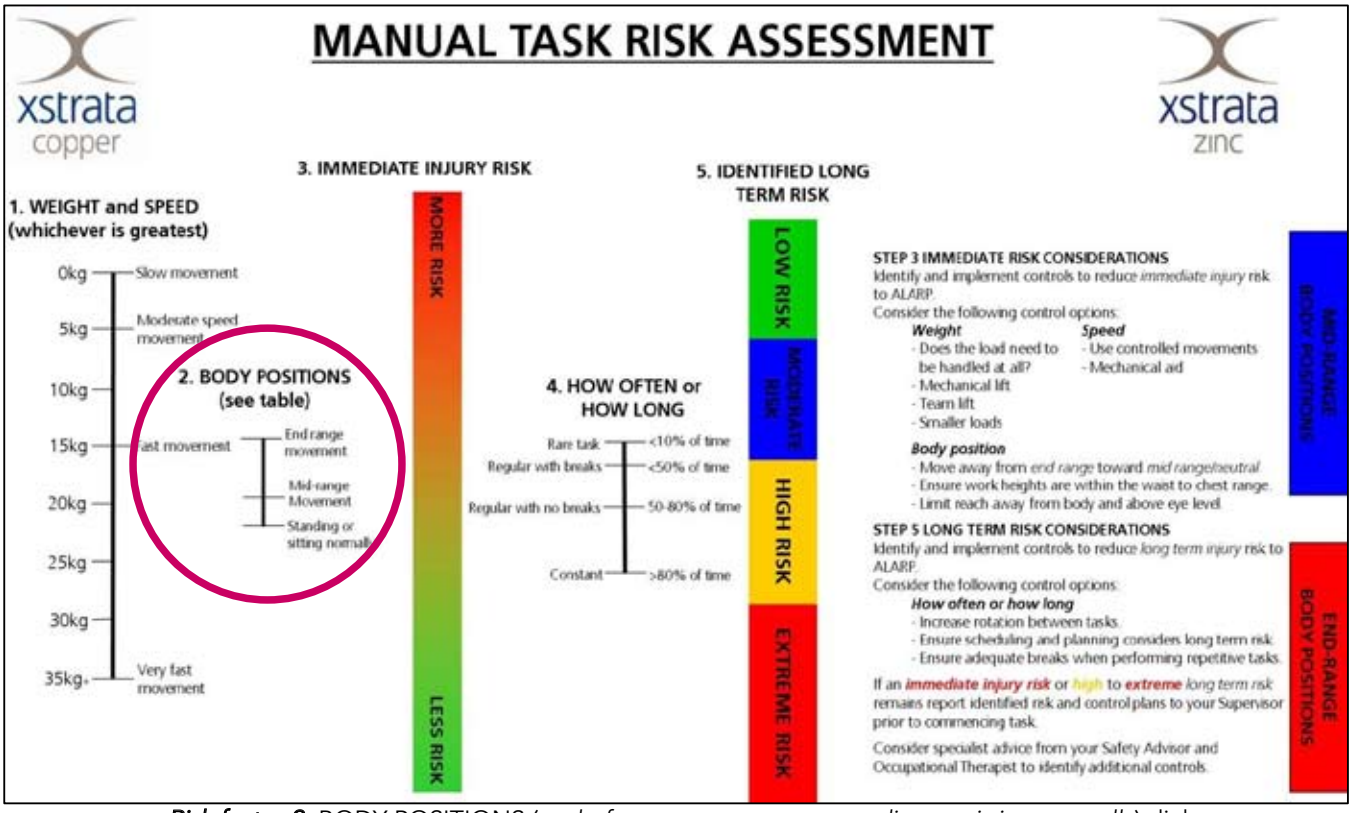
The combination of all three direct risk factors (weight and speed, body position, how often/how long?) equates to the risk of cumulative, or long-term injury.

Appendix D



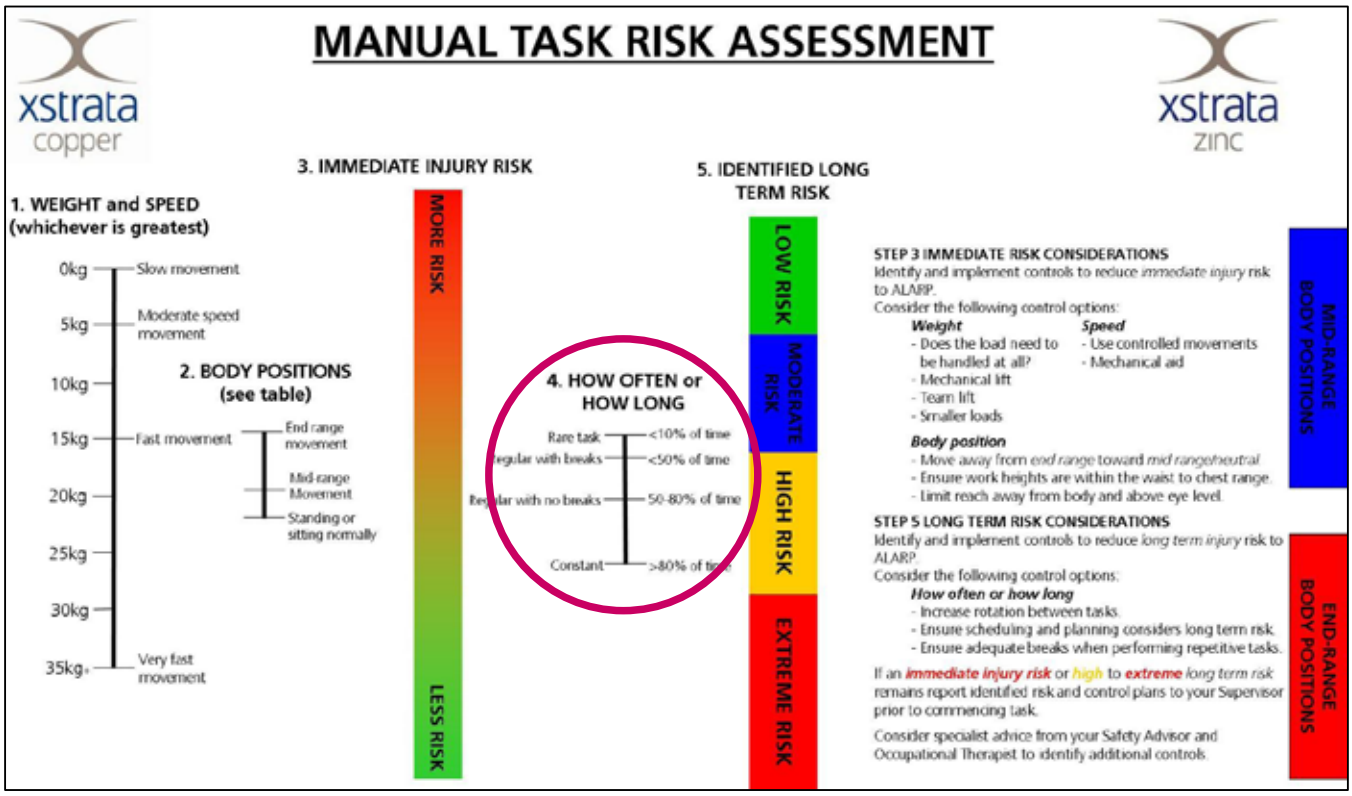
Risk factor 1: WEIGHT (0 – 35+ kilograms) and SPEED (slow – very fast movement) dial

Appendix E



Risk factor 2: BODY POSITIONS (*end of range movement - standing or sitting normally*) dial

Appendix F



Risk factor 3: HOW OFTEN (rare task – constant) or
HOW LONG (less than 10 per cent of the time – more than 80 per cent of the time)

Appendix G

1. The images below illustrate the risks associated with lifting a load (5 kilograms, then 15 kilograms), using mid-range movements. The task is classified as rare, or not undertaken often. ***Note the increase in risk levels (both immediate and long term) as the weight of the load increases.***

2. The image below illustrates the risks associated with the same task (lifting a 5 kilogram load using mid-range movements), however, this time the task is classified as constant, or undertaken more than 80 percent of the time. ***Note the low immediate risk level, but the high long-term risk level.***

Appendix H

Joel Edson, Occupational Therapist, Xstrata North Queensland using the MTRA to conduct a Manual Task Risk Assessment with Shayne Dunbar, Anode Production Supervisor, Copper Smelter

Appendix I

Joel Edson, Occupational Therapist, Xstrata North Queensland (top right) overseeing Crushing and Conveying team from our underground copper mine using the MTRA in a pre-start risk assessment

Appendix J

Jessica Edwards, Graduate Community Relations Advisor, Xstrata Mount Isa Mines, trialling the electronic MTRA, available via the Xstrata Mount Isa Mines intranet

Reduction of DPM in the Underground Coal Environment

BMA Gregory Crinum

Initiative
The primary objective of this project was to control the exposure of underground coal mine workers to the products of diesel exhausts to levels that are within industry standard and as low as reasonably achievable (ALARA).

Solution
- Purchase device for measuring the Exhaust Emissions.
- Built MS Access database to capture and analyze test results.
- Implementation of MST equipment tracking system.
- Linked the Emissions database to the tracking system.
- Testing and validating for correct operation.
- Personal exposure testing carried out.
- Training and communication to the work force.
- Risk assessment and develop procedure.
- Change management.

Benefits / Effects
- Reduction of exposure to DPM and exhaust gases to mine workers.
- Efficient use of available ventilation.
- Improved and proactive maintenance of diesel fleet.

Transferability
- System can be installed in any UG coal mine requiring access of mobile diesel equipment to ventilation controlled areas.

Innovation
- Live, automated feedback to machine operators of ventilation capacity of specified underground working areas before they access the area in a diesel machine.
- Ability for live tracking of individual machine's locations underground
- Ability of an automated system to identify and record non-compliance by individuals to the underground panel ventilation access requirements.

Ultra Lightweight Ventilation Tubes

West Cliff Mine NSW

The Problem

The installation of temporary ventilation tubes in underground coal mine development panel operations is used to control gas and airborne dust levels at the coal face. During the development mining process operators are frequently required to lift and handle the ventilation tubes.

For some time fibreglass ventilation tubes have been used for this purpose. Each fibreglass tube weighs between 33kg and 40kg and is 618mm in diameter and 2.5 to 3 metres in length. Installation of the tubes requires two operators to lift and carry each tube a short distance over uneven, unstable or slippery ground to the back of the continuous miner where it would be manually lifted from the floor above their heads to secure its position to the roof. A functional task analysis has shown that a single person installing fibreglass vent tube is required to occasionally lift 30 kg (75 per cent x 40kg) from floor to above shoulder height and undertake a bilateral carry of 30kg.

Over time the tubes can become progressively heavier with the accumulation of sludge and repairs to fibreglass that add to the tube weight. The tubes also become harder to fit together as they become older and their fibreglass ends split and fray.

These factors combined can result in increased exposure of workers to the potential risk of:

- musculoskeletal injury to the shoulders, neck or back, due to the heavy weight and awkwardness of the load;
- awkward postures associated with working overhead;
- lifting the load through range from floor to roof;
- environmental conditions (poor lighting, often wet/slippery/uneven ground, may be standing on platform of miner or not); and
- sudden exertion of high force to lift tube and the suction pressure pulling the tube in.

Over the last five years at Illawarra Coal, 30 per cent of all musculoskeletal injuries involved back, neck or shoulder. Heavy repetitive manual handling, such as installing and removing ventilation tubes, is a likely cause of these injuries

Solution

A project team established at West Cliff Mine, which included development operators, engineers, coordinators and health and safety representatives, embarked on a project to reduce manual handling risk in development panels; particularly in relation to shoulder and back injuries. Workshops and presentations were held in which information from injury data, hazard reporting and behavioural peer on peer observations were analysed.

Functional task analyses were undertaken within the development panel using the JobFit System task assessment tool and crew members were consulted in the process. Training sessions and workshops were provided to crews on managing musculoskeletal disorders and identifying, assessing and controlling risks associated with manual tasks. Handling fibreglass ventilation tubes was identified by operators as one of their top five hazardous manual tasks (see Table 1).

As ventilation is necessary for safe operations underground it was not possible to eliminate the handling of ventilation tubes altogether. The project team then looked at options for substituting the fibreglass tubes with a lighter weight product. A carbon fibre manufacturer was sourced to produce a lighter weight ventilation tube and it was trialled at the mine. Carbon fibre is a very strong and light fibre-reinforced polymer. It has a very high strength to weight ratio.

Rank	Development team - Top five highest risk manual handling tasks	% of participants that agreed
1	Handling/ hanging old vent tubes	75%
2	Lifting CM cable into hangers, reclaiming CM cable and services	75%
3	Installing and removing belt structure, rollers, belt advance	58%
4	Installing bolts from CM, bolting	50%
5	Roof Mesh onto C/M	42%

Table 1: Top 5 hazardous manual tasks in development, as nominated by operators during workshops in 2011

The carbon fibre ventilation tube weighs 9kg and is the same size as a fibreglass tube. The carbon fibre tubes are four times stronger and can handle sixteen times the differential pressure of fibreglass tubes. They have been purpose built to be compatible with existing tubes and were introduced into underground production for a trial in June 2011.

The tubes have been used successfully in one of our development panels for the past nine months. They are lighter and easier to use, have better wear and durability, better strength, collapse less often, are easier to fit together as the ends do not fray and generally last longer. Accessories (T pieces, 45Ð and 90Ð bends, end caps and regulator tubes) as well as flat tubes and flat-to-round adapters have since been designed and ordered.

During implementation, we sought feedback from development operators on the new ultra light weight vent tubes. Everyone surveyed reported that they were easier to use and required less physical exertion to install and retrieve. Some of the comments from operators included:

- "Very light weight, awesome"
- "They are unreal, great idea"
- "Very light, easy to put up. Get rid of the old ones"
- "The sooner we get rid of the older tubes the better. Less injuries".
- "More tubes more quickly. Old tubes are hazardous"
- "Lighter the better. Thank you"
- "It's the best thing that I've seen introduced to underground coal mining in the last 10 years"

There have been no reports of injury with the carbon fibre vent tubes and reducing the weight of the tube (from 35-40kg to 9kg) has substantially reduced the risk of injury associated with this task.

Photo 1: Carbon fibre ventilation tube weighing 9kg

Photo 2: Carbon fibre ventilation tube in production underground mine

Photo 3 and 4: Accessories made from carbon fibre

Application of risk management principles

The site adopted a number of risk management principles in identifying the hazard, assessing the risk, determining a lighter weight alternative to the heavy fibreglass tube and implementing/integrating the carbon fibre tubes into the production process. Project team members were systematic in assessing the problem. The team was transparent and inclusive, and consulted all relevant stakeholders; including operators, engineers, coordinators, health and safety representatives and carbon fibre manufacturers, to ensure that all available knowledge and expertise was utilised in determining the most appropriate and effective controls. The ultra light carbon fibre ventilation tubes underwent certification by the manufacturer to MDG3006 MTR8 (fire resistance and electrical resistance tests) and Illawarra Coal site introduction of new equipment requirements and risk assessment prior to being introduced underground, including updates to job instructions. Tool box talks kept operators informed of progress during the project.

An implementation program with trials was undertaken over a number of months. Following the introduction of the new tubes into the panel, feedback was sought from the operators and a further functional task analysis completed.

Consultation processes

The project team consulted widely with operators, engineers, coordinators, health and safety representatives and carbon fibre manufacturers throughout the project. The team reviewed the current state of the existing fibreglass ventilation system and determined a suitable ultra light weight alternative. Team members consulted with the site HSEC committee and behavioural awareness committee and participated in pre-shift 'tool box talks' to explain the new carbon fibre tubes being trialled.

Benefits and Effects

Since the introduction of the ultra light weight tubes into our development panel feedback from our operators has been very positive. By substantially reducing the weight of the tube from 35-40kg to 9kg, the physical exertion required to lift the tube into an overhead position is substantially lessened. Since the implementation of the ultra lightweight tubes there have been no reports of injury or illness associated with the task. The new tubes are lighter, fit together more easily, are stronger, have greater tolerance to damage and are inherently fire retardant. Additionally, the tubes have enabled productivity gains as they take less time to lift and install and less time to retrieve/recover.

The working environment conditions in underground coal mining do present additional challenges for tasks that involve materials handling; such as poor visibility, uneven and unstable ground, wet and slippery floor. Whilst we are constantly working on improving the work environment conditions by addressing roadway standards, substituting fibreglass with a substantially lighter weight material (carbon fibre) has enabled a reduction in manual handling risk associated with this task.

An unexpected benefit that has arisen from the success of the project is the endeavour by the site to remove other heavy lifting tasks by substituting heavier materials (such as steel) with carbon fibre. The site is investigating options in relation to manufacturing a carbon fibre belt spool to replace the existing steel 150kg belt spool and SMV bonnet.

Transferability across the industry

The carbon fibre ventilation tubes are compatible with current fibreglass ventilation tubes and can be integrated within current ventilation systems. There is widespread transferability across the mining industry. Carbon fibre may also be used as an alternative to steel for other equipment in mining.

Innovation and originality

Implementing a carbon fibre ventilation tube (9kg) is both innovative and original in the mining industry. To our knowledge, West Cliff Mine is the first underground coal mine site in NSW to trial these tubes and only one of two sites in Australia.

Notes

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