



ergonomics Australia Journal

Ergonomics Australia Journal

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Case Study

Participatory Ergonomics Case Study: Coal Handling Train Crew Operations

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Abstract

Background: Musculoskeletal disorders associated with manual tasks are a common cause of injury across a number of industries. Almost three-quarters of all serious workers' compensation claims in 2010 -2011 across all Australian industries were the result of injury, with sprains and strains accounting for 42% of all serious claims. Mechanisms involving muscular stress while handling objects resulted in 32% of all serious injuries [1]. These injuries are often complex with multiple contributing factors including the environment, task characteristics, and individual factors influencing the mechanism of injury. While not all manual tasks are high risk, effective manual task risk management requires identification of hazardous tasks followed by assessment of the degree and source of risk associated with the task before effective controls can be implemented to either eliminate or reduce the risk. **Aim:** This paper describes a project undertaken at a rail coal handling facility. **Method:** A participatory ergonomics process was implemented to enable management to better understand the issues surrounding work methods and equipment used by work crews and how these events may be contributing to current and potential workplace injury risks. **Conclusion:** This paper describes the project and presents the risk assessments undertaken and potential control measures identified.

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Background

Participatory approaches to ergonomics developed from Japan [2], Northern European [3] and North American [4] management practices. While variations in the model exist [5,6,7] the common aspect is the assumption that those performing the tasks have expert knowledge of their tasks, and consequently they should be active participants in the process of improving their workplace. Participatory ergonomics has been described as: "the involvement of people in planning and controlling a significant amount of their own work activities, with sufficient knowledge and power to influence both processes and outcomes in order to achieve desirable goals" [8].

There is no single "right way" to implement a participatory ergonomics program and one of the strengths of the approach is its adaptability to the context and needs of specific workplaces and workers [9]. Participatory ergonomics has been acknowledged as providing a number of benefits including higher productivity and improved worker well-being [10,11] reduced work-related musculoskeletal injury rate and consequence [12,13,14]; enhanced team communication and job control [15]; and more rapid technological and organisational change [16, 5]. Participatory ergonomics interventions have been trialled across a number of areas including car manufacturing [17], meat processing [18], print media [19], health care [20,21], construction [22], and mining [23].

Important components of a successful participatory ergonomics interventions include "buy-in" in the form of management commitment and provision of resources; an

understanding of both ergonomic concepts and techniques by both management and workers; and a process to develop, document and implement control measures [24, 23]. The role of the ergonomist is to initiate and guide the process by providing the necessary skills, tools and ergonomic expertise to allow risks to be accurately assessed, and to facilitate the development of potential control measure by participants.

Managing manual task risk is an iterative process and needs to be repeated following implementation of any control measures to assess whether the measures are working effectively, and whether any new risks have been introduced in the process. It requires keeping records of the hazardous tasks identified, risk assessments, control measure suggestions and implementations, and reassessment to ensure effectiveness of implemented control measures. Ideally record keeping occurs in a format that can be easily shared across an organisation.

It is important to get the right mix of skills and experience to progress through the process and, ideally, this means involving workers, supervisors and specialists or advisors. Participatory ergonomics programs can be negatively impacted by lack of management support; lack of an "ergonomic champion" at the worksite; insufficient time and resources allocated to develop solutions; lack of ergonomic expertise at site; and organisational restructures and staff changes and turnover [25,26].

This paper describes the outcomes of a project undertaken at two rail coal handling sites. The aim of the project was to assess workplace injury risks and to identify potential control measures, where appropriate. The activities undertaken at the sites varied across train crew shifts however a number

of hazardous tasks were identified across sites by both management and crew as requiring intervention. In priority order of intervention following risk assessment these were:

- Handbrake application and release;
- Coupling and uncoupling of hoses whilst shunting;
- Lifting and carrying bags;
- Walking and working on and about the track - including ballast and access roads;
- Access and egress from the locomotive cab; and
- Locomotive provisioning.

Methods

Injury statistics

Injury statistics were reviewed prior to the workshops to gain an overall understanding of the nature and mechanism of injury across both sites. The statistics reflect combined total injury across both sites.

Participatory ergonomics workshops

Two participatory ergonomics workshops were conducted at each site. The initial workshop was attended by a cross section of experienced and novice crew (14 at one site, 8 at the other). The workshop provided attendees with information about the process to be followed, including:

- Designing an appropriate intervention to meet the needs of the organisation;
- Information on how to identify a hazardous manual task and the associated mechanism of injury;

- How to use a manual task risk assessment tool to assess the severity of identified workplace hazards, including direct risk factors (exertion, movement and repetition, body posture, exposure and vibration) and contributory risk factors; hazard identification; the use of and importance of adopting a hierarchy of control measures;
- The importance of a “champion” to drive the process forward; and
- General strategies to eliminate or control identified manual task injury risks.


Following the initial workshops, ergonomic task analysis was undertaken with the crews, and task risk assessment profiles were developed.

Follow up workshops were held at each site six weeks later, again during programmed “shut down” days. Initial attendance at scheduled workshops was lower than expected requiring additional workshops to be arranged, (in all 18 crew at one site and 20 at the other site attended). The workshops provided the forum for “brainstorming” solutions with the advantage of involving both experienced and novice operators in the process. This information was refined to develop a structured management report outlining recommended control measures and possible implementation procedures.

Risk assessment

Crew operations on two separate coal hauling lines were observed and analysis undertaken to assess current and potential workplace injury risks during the six tasks previously identified by both crew and management as potentially high risk. Informal employee interviews were conducted and still

Table 1. Risk assessment tool



Burgess-Limerick & Associates
Ergonomics and Research Consultants
ABN 84976421949

Task Characteristics				
	Exertion	Exposure	Posture	Movement
+1	Low force and speed	Task performed infrequently for short periods	Comfortable postures within a normal range about neutral	Dynamic and varied movement patterns
+2	Moderate force or speed, but well within capability	Task performed regularly, but with many breaks or changes of task	Uncomfortable postures, but not approaching an extreme range of motion	Little or no movement, or repeated similar movements
+4	High force or speed, but not close to maximum	Task performed frequently, without many breaks or changes of task	Postures approaching or at an extreme range of motion	Repeated identical movement patterns
+8	Force or speed close to maximum	Task performed continuously for the majority of the shift		

Environmental Characteristics

- heat or cold (+1)
- stress, lack of control, or time pressure (+1)
- cognitive overload or underload (+1)

- Whole body vibration moderate (+1 to back) high (+2)
- Hand/Arm vibration moderate (+1 to arms) high (+2)

Risk Scores

	Exertion	Exposure	Posture	Movement	Environment	Injury Risk (sum)
Back						
Arms						
Shoulders						
Legs						

and video footage of the tasks being undertaken was obtained. A risk analysis and evaluation was undertaken using the risk assessment tool (Table 1) provided by Burgess-Limerick [27]. ErgoAnalyst [28] software was used to document the analysis and evaluation.

The risk analysis process requires documentation of: (i) the task characteristics (exertion, exposure, posture and movement) for the back; arms; shoulders; and legs and (ii) environmental characteristics. Performing the task in excessive heat or cold; under stressful conditions, time pressure, and during periods of cognitive overload/underload, increase the baseline score, as does exposure to vibration. Each task is evaluated for both acute injury risk and cumulative injury risk.

Results

Injury statistics

Combined site statistics for the preceding 12 months (Table 2) indicated the most commonly occurring injuries (40%) resulted from slips/trips and falls occurring “while working trackside”. The statistics were based on injury narratives, and it was determined that the difficulty in assessing this task alone was that working trackside may include a number of irregularly occurring maintenance activities that may not be captured in a risk assessment at a given time, that not all terrains could be observed, and that the working trackside narrative may incorporate some of the other identified tasks requiring assessment. This made accurately assessing this task very difficult. Injury statistics indicated strain from either hand brake application or lifting accounted for 20% of injuries, and 40% of reported injuries were localized to the shoulder/upper limb. Thirty percent were localised to the lower limb and ankle, and 24% to the head, back and torso, with 6% having no injury site recorded.

Table 2. Mechanism of Injury

Mechanism of Injury	Percentage of Injury Total
Slips/trips/falls whilst walking trackside	40
Climbing	10
Strain – lifting	10
Car driving	10
Strain – handbrakes	10
Other (unrelated tasks/hit by object)	20

Slips, trips and falls were the highest reported mechanism of injury in the preceding 12 months. Following hazard identification across all tasks, the priority order of intervention was as follows:

- **Task 1:** Handbrake application and release;
- **Task 2:** Coupling and uncoupling of hoses whilst shunting;
- **Task 3:** Lifting and carrying bags;
- **Task 4:** Walking and working on and about the track - including ballast and access roads;
- **Task 5:** Access and egress from the locomotive cab; and
- **Task 6:** Locomotive provisioning.

Participatory ergonomics workshops

The participatory workshops needed to be structured differently between sites. While needing to be scheduled for “shutdown” days to maximise crew attendance and minimise work disruption, and to ensure attendance at workshops captured both experienced and novice crew members, they also needed to be flexible to accommodate changes in work demands on the scheduled days, and to address work culture differences between sites. Preliminary discussions were held off-site to ascertain the level of available resources, the most suitable structure of the workshops, and most importantly to ensure site access to tasks identified as hazardous. Both sites had a core workforce of experienced crew – many having long term employment in the industry, however both sites had recently recruited a number of novice train crew from varying skill backgrounds.

Potential control measures were developed for each identified hazardous task at the second workshop at each site. While elimination is always the preferred control option, followed by engineering/design controls to remove or reduce the hazard, “administrative” controls were provided as short-term control options until elimination or design controls were agreed on and implemented. Work practices allowed the assessment of common themes across both sites (with the exception of locomotive provisioning), however it became apparent that quite different work cultures existed between the two sites visited. Where it was not possible to eliminate the task on currently used equipment, guidance was provided for management use in future procurement processes.

Risk Assessment

Tasks are listed below in order of intervention priority following risk assessment.

Task 1: Handbrake application and release

Task Description

The task involves awkward postures and forceful muscular exertions. It is most often undertaken trackside where both ballast condition and weather conditions are largely unpredictable. The task occurs when a locomotive is either stowed or unstowed, when shunting, when a shutdown occurs, or at a breakdown. Handbrakes are applied to wagons at the beginning and end of the train, the number depending on company policy regarding application in a given situation (ie. gradient and location of track where shutdown/breakdown location). Typically the time taken for task completion is approximately 30-50 minutes, and may be performed in a breakdown situation by inexperienced crew/ at night.

Task Analysis

Winding the handbrake off requires the brake lever to be disengaged (a sharp thrusting movement of the wrist) which allows the brake wheel to be loosened using bilateral shoulder movement. The brake is then rolled on or off. The task is often performed above shoulder height depending on locomotive location and ballast condition. Frequently coal material lodges in the brake mechanism causing it to jam, requiring awkward postures of the neck, shoulders, upper limbs, and trunk while the lower body provides stability so



Figure 1 A, B & C: Handbrake application and release

trapped material can be dislodged and the brake fully released. Wagons have bilateral brakes, requiring the opposing brake to be released/applied (Figure 1). The procedure is reversed for winding on the handbrakes, with additional force applied at the end of the procedure to ensure the brake is securely in

place. One crew member usually works from the front of the train and another from the rear of the locomotive.

Risk Assessment Scores

Risk assessment scores for this task are illustrated graphically in Figure 2.

Risk analysis indicates:

- High risk of acute injury to the shoulder and upper limb;
- Moderate risk of cumulative injury to shoulder and upper limb; and
- Moderate risk of both acute and cumulative injury to the back, and a low risk to the legs.

Possible Control Measures

An effective control measure implementation will likely require a combination of both short and medium term design or administrative controls to reduce crew exposure while task elimination options are investigated. Whilst not ideal, in reality short to medium term control measures may become longer term control measures depending on management financial commitment to eliminating crew exposure to injury risk. From the workshops the following control measures were developed:

Elimination:

- Spring loaded or pneumatic brakes on wagons.

Design/Engineering control options:

- Relocation of shaft to underside of deck of wagon.
- Reduce gearing to allow use of same amount of force throughout application.
- Use stainless steel chains (to prevent rusting).
- System to blow coal dust away (so dust does not “set like concrete” in the gear mechanism).
- A cover to reduce coal material jamming in the gear mechanism.

Risk Analysis: Application & Release of handbrakes

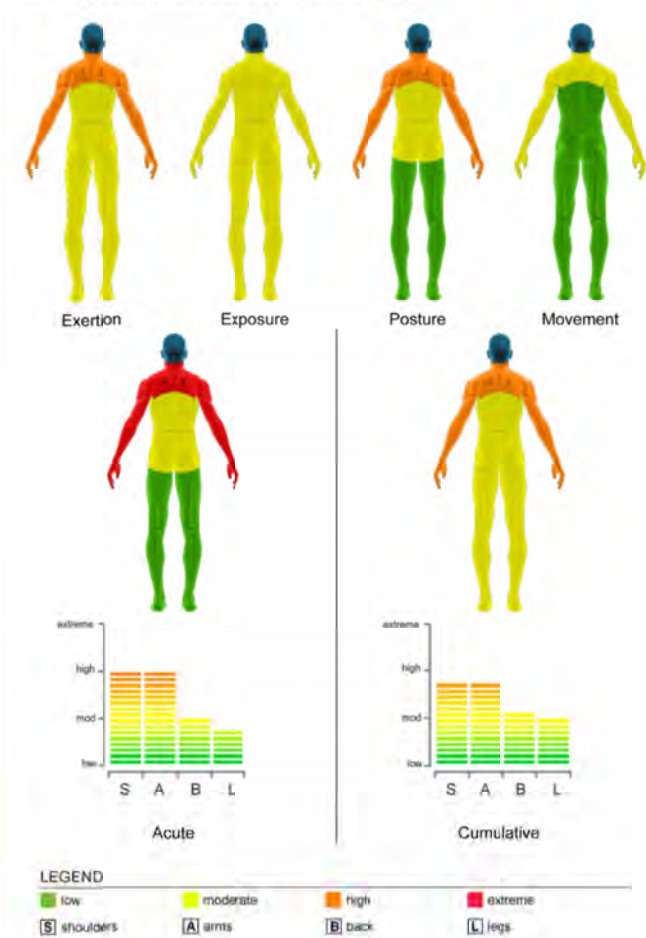


Figure 2: Handbrake application and release risk analysis and evaluation

Administrative control options:

- Stow trains at locations suitable, designated and well maintained to standard.
- Consistency in company policy between written policy and field requirements regarding number of brakes needing to be applied.
- Supply appropriate Personal Protective Equipment (PPE) for task and climate - gloves, clothing and footwear.

Task 2: Coupling and Uncoupling brake hoses

Task Analysis

On observation, significant variation in technique existed between experienced operators and novice or trainee crew when performing this task. Inexperienced operators needed to apply greater force to uncouple and couple the connection, usually taking longer to complete the task leading to awkward body posture being adopted for longer than that of an experienced operator (time pressure was reported by all operators when required to undertake the task in a trackside breakdown situation).

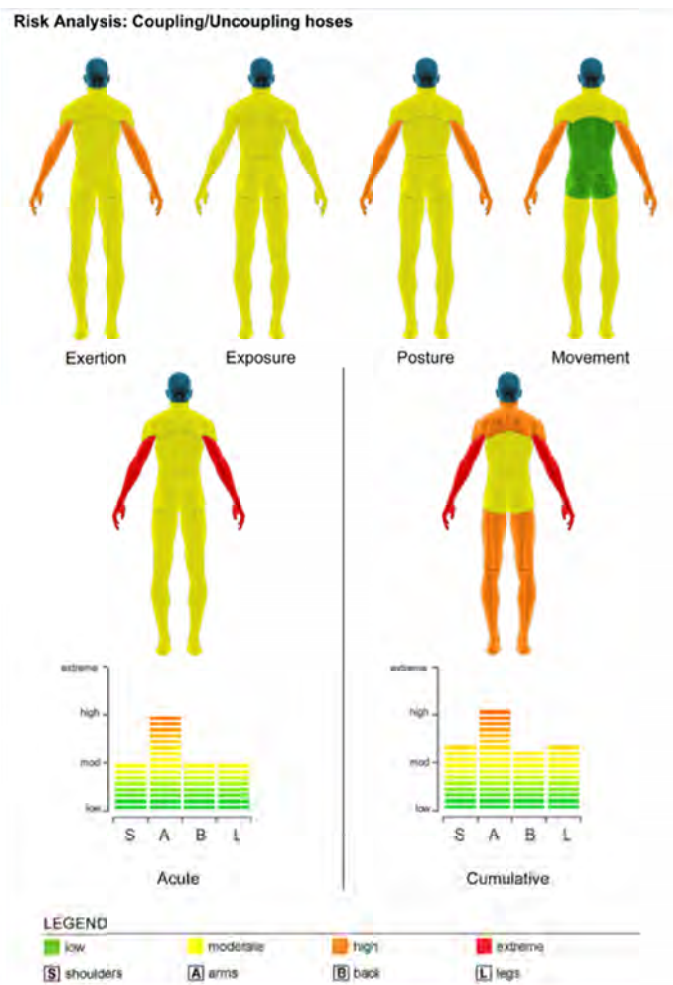
Uncoupling the brake pipe hoses requires the operator to squat between the wagons to reach the coupled hoses (Figure 3A), and again observed techniques varied between experienced operators and novices. One technique observed involved grasping the left (L) hose with the (L) hand and grasping the right (R) hose with the (R) hand and rolling the forearm over and around the hose so that the (R) hose could be lifted up and around in a scissor like mechanism to unlock the coupling (Figure 3B). Significant awkward wrist and upper limb postures were seen in combination with



Figures 3A & B: Coupling and Uncoupling brake hoses



Figure 3C: Removing jammed coal from the brake mechanism



Figures 4: Coupling and Uncoupling brake hoses risk analysis and evaluation

excessive force application. Operators reported the coupling end could swing out of their hand and injury their shin so usually they braced with their (R) leg to protect themselves against injury. In another technique observed the coupled joint was braced with hands at each end of the joint and both hoses levered upwards in a symmetrical movement to break the coupling joint, again requiring awkward wrist and upper limb postures combined with application of excessive force.

When recoupling, the (R) hose was held at 90 degrees upward and the (L) hose held in the (L) hand and brought up to meet the (R) hose allowing it to roll into the lock position – again awkward postures in combination with force was involved in task completion. Operators reported coal dust often jammed the mechanism meaning additional force was required to uncouple the joint (Figure 3C). Additional considerations to this task were walking on uneven ballast with/without long vegetation present, and working at night. No exposure to vibration was involved performance of this task.

Risk Assessment

Risk analysis and evaluation (Figure 4) indicated:

- High risk of acute and cumulative injury to the upper limb.
- Moderate risk of acute and cumulative injury to all other areas of the body.

Possible Control Measures

From the workshops the following control measures were developed:

Elimination:

- Air cut off - letting train movement separate cables.

Design/engineering controls:

- Change the position of hoses so coupling points are more accessible.
- Flexible hoses (new hoses are more rigid) - inclusion of snap lock system of joining/moulded hand grips/and/or a rubber cup for the joiner.
- Tool to hold hosebags in position so they easily drop down and hook up without application of excess force/ use of awkward posture.
- Design a seal for brake cable to keep coal dust off.
- Move the stopcock to side.

Administrative controls:

- Improved training - individual competency levels & particularly for new wagons coming in from China.
- Update maintenance strategies to minimise likelihood of needing to undertake the task trackside.
- Timetabling - so task not completed on night shift/difficult environments i.e. undertaken at areas of level ballast. The task was noted to be easier if two operators were rostered so could work from either side of the train.
- Negotiate with track owner for improved track maintenance.
- “Oncall” crew list to assist when required.
- PPE - when working at night - provision of head lamps and appropriate gloves (quality and purpose).

Task 3: Lifting and carrying bags

Task Description

Train crew carry bags containing their personal items with them onto and off of each shift involving awkward postures of the trunk and lower body while lifting above shoulder, and instability of the lower body. Bags vary in dimension and weight, and content is discretionary between individual crew members. Additionally, crew carry meal and water requirements for the duration of their shift, and procedure manuals/reference items required during the shift. The company has supplied a standard (high visibility) backpack but crew are not required to use this pack, nor are they restricted to one carry on bag. Locomotive access involves walking along track ballast (of varying heights and quality). Crew often stand on uneven surfaces while passing bags overhead to a crew member standing on the locomotive platform above (Figure 5). The ankle is particularly vulnerable to injury due to instability of the ballast surface. The task is undertaken infrequently, usually at start and completion of shift.

Risk Assessment

Risk analysis (Figure 6) indicates:

- High risk of acute injury to the shoulder and upper limb with this task.
- Moderate risk of cumulative injury for this area.



Figure 5 A&B:
Lifting bags onto locomotive at start of shift

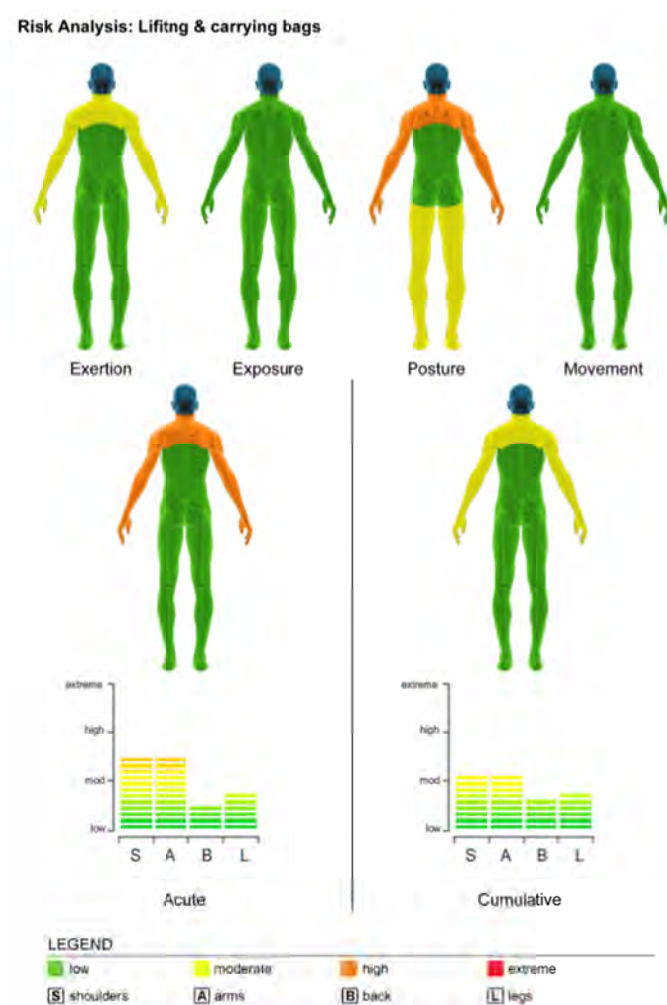


Figure 6: Lifting and carrying bags risk analysis and evaluation

Possible Control Measures

Design/engineering control options:

- Motorised pulley/boat cable winch system (hooked over handrail and bags winched up onto the locomotive).
- Hydraulic platform lift (similar to disabled taxis) accessed from the rear of the locomotive.
- Fold down pneumatic stairs.
- Luggage rack located on outside of locomotive.

Administrative controls:

- Consider placing manuals/Standard Operating Procedures (SOPS)/route manuals on ipad /tablet to reduce bag.
- Consider placing essential manual information in hard copy on locomotives.
- Track maintenance - designated change points on network/ improved track access.

Task 4: Walking and working on and about the track - including ballast and access roads

Task Description

The task is undertaken frequently by all crew and performed in a variety of environmental conditions (heat, wet weather, night) and locations. The difficulty in assessing this task is that it often involves specific maintenance tasks which need to be assessed individually to understand how targeted design/engineering controls can best be implemented. Crew drive by 4WD, often on unsealed access roads/tracks/ballast (of varying dimensions and quality) to access the locomotive, and undertake a number of observational/maintenance tasks including walking the length of the train to observe any faults or maintenance issues; carrying out maintenance work and routine procedures, such as handbrake application and release; and provisioning prior to commencement of shift. Stressful conditions may arise when fault detection and repairs are required either at initial inspection or following a breakdown during a shift. Awkward postures of the trunk and lower body are often adopted in order to provide trunk and lower stability while standing on an uneven surface and undertaking a specific task (Figure 7). The ankle is particularly vulnerable to injury due to reduced stability when standing on ballast. A moderate level of exertion may be required, if crew need to carry maintenance /replacement equipment and undertake maintenance tasks.



Figure 7 A, B & C: Examples of walking and working trackside

Risk Assessment

Risk analysis (Figure 8) indicates:

- Moderate risk of acute injury to the shoulder, upper limbs and back.
- Low risk of injury to the lower body.

The assessment tool does not give consideration to the terrain in which the task is performed – the uneven and shifting nature of the ballast surface underfoot indicates ankle injury may occur with this task.

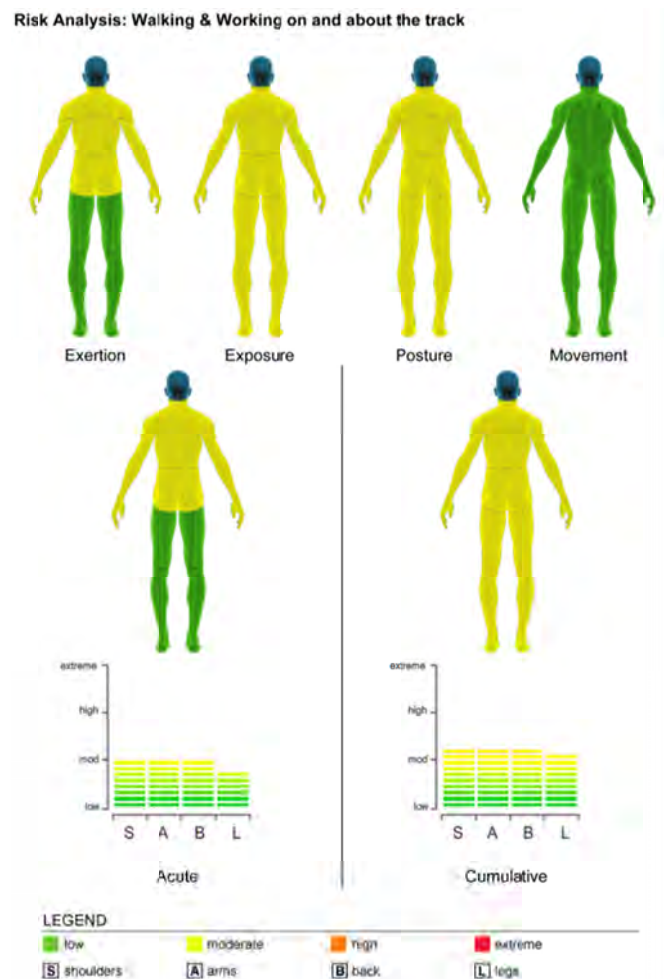


Figure 8: Walking and working on and about track risk analysis and evaluation

Possible Control Measures

Design/engineering control options:

- Individual maintenance tasks need to be assessed to understand if targeted design/engineering controls can be implemented.
- Designated maintenance/change out platforms.
- Design tools that are light weight and appropriate for the task.

Administrative controls:

- Maintenance of track and walkways to acceptable standard/Improved vehicle access/4WD training.
- Provision of tool belt - to carry water bottle, tools etc.
- Provision of appropriate footwear.
- Provision of appropriate clothing for environment.

Task 5: Access and egress from the locomotive cab

Task Description

Access and egress is typically performed once per shift unless unforeseen maintenance issues arise. Locomotive access and egress is via a vertical ladder situated toward the rear of the locomotive, leading onto an external platform (within the profile of the train) to the cab of the locomotive (Figure 9A). The platform is narrow requiring crew to walk side-step along it to the cab (approximately 10 metres) and is accessed via an outward opening door. To egress, crew pivot on the platform so as to exit facing backwards and retaining three points of contact (Figure 9B). The final step down to ballast/ground may be up to half a metre and onto uneven and moving surface/with or without long grass surrounding it. Depending on change of shift location crew may be required to undertake this task in the dark, and/or on unfamiliar sections of the track.



Figures 9A & B: Access and egress from locomotive cab

Risk Assessment

Risk analysis (Figure 10) indicates:

- Moderate risk of acute injury to the shoulder and upper limb.
- Low risk of injury to the lower body (consideration needs to be given to the state of the ballast surrounding the ladder as this may influence the potential for ankle injury).
- Moderate risk of cumulative injury to back.

Possible Control Measures

The workshops provided the following information regarding control measures for reducing the likelihood of injury from this task. Effective control measure implementation may involve a combination of both design controls and some administrative controls, if elimination of the task is not possible.

Risk Analysis: Access & Egress from loco cab

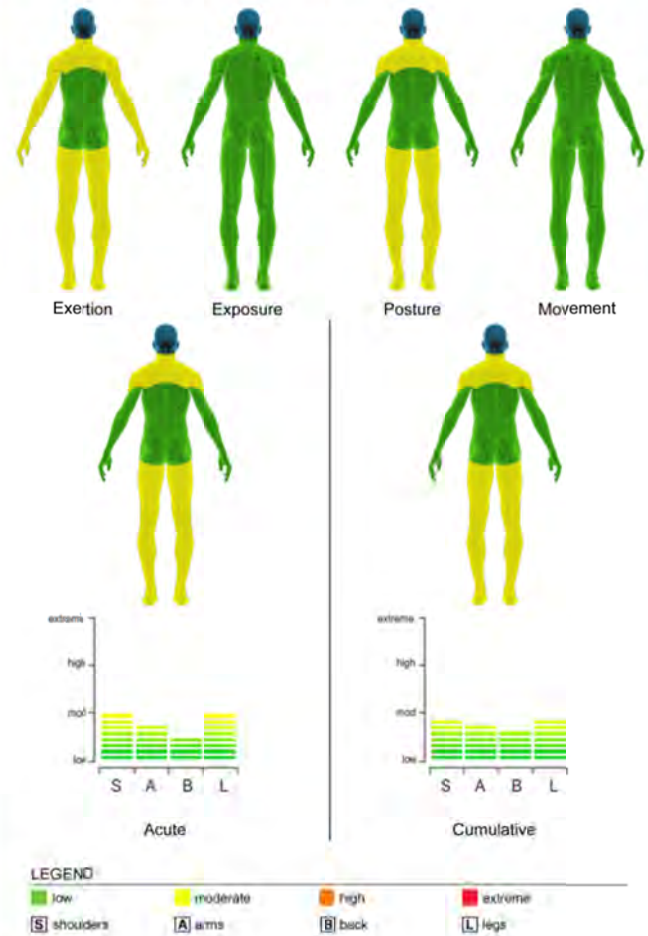


Figure 10: Access and egress from locomotive risk analysis and evaluation

Design/engineering control options:

- Redesign the locomotive ladder - consider retracting stairs/extension ladder with spring adjustment release.
- Install LED lighting on bottom rung of ladder.
- Install handrails on bottom of locomotive footplate - provide support when walking on uneven ballast.
- Longer handle on door locking mechanism of cab door.

Administrative controls:

- Increase number of change platforms on line.
- Maintenance of ballast.

Task 6: Locomotive provisioning

Task Description

This task is performed infrequently, and varies between the two lines. One line (A) has contractor assistance with provisioning. The other line (B) does not - meaning all provisioning undertaken by one person usually taking around two hours to complete. Currently, the task is performed outside and in all weather conditions. Forceful manual effort and awkward body postures are required while connecting the fuel hoses, during the refueling process itself, and while starting the compressors to power the sand pods (Figures 11 A & B). Line (A) has a vehicle fitted with a motor operated platform providing operator access to refueling points without the

need for excessive manual effort or awkward postures (Figure 11 C). Postural demands were far greater on Line B with the procedures having less variation in movement patterns and being largely repetitive in nature, while Line A procedures had more dynamic and varied movement patterns. The task is performed infrequently but may take up to two hours to complete (short periods of varied tasks) on Line B.



Figures 11 A & B: Provisioning of Locomotive (Line B)
Figure 11 C: Provisioning (Line A)

Risk Assessment

Risk analysis (Figure 12) indicates:

- High risk of acute injury to the back and moderate risk to the shoulder, arms and legs.
- Moderate risk of cumulative injury for all areas.

Noise levels while provisioning was identified by crew as a problem, and a recommendation was made to also engage an occupational hygienist to review air particle contaminants associated with the provisioning process.

Possible control measures

The workshops provided the following information regarding control measures for reducing the likelihood of injury from this task. Hazardous procedures were identified when undertaking various components of the task - these included fuelling, sanding/sand pod use, lifting of oil drums and subsequent oil leaks.

Elimination:

- Construct purpose built facility or hire the existing facility from track owner.

Design/engineering control measures:

Fuelling:

- Consider a lighter fuel hose.

Sanding:

- Gas struts/lighter material for lid - existing heavy to remove.
- Sand hose nozzle heavy - replace with aluminum/lighter weight material.
- Portable sanding delivery system.
- Extend current gravity feed hose (apparently 60cm too short).
- Fit a "T piece" to the sand hose.
- Provide additional pods - reduce need to move equipment during task.

Oiling:

- Purpose built platform for oiling requirements.
- Air pressure drum (with hose reel) to dispense oil.
- Oil drum on stand/reservoir moved to increase accessibility.
- Oil in smaller container (5 litre) rather than lifting 20 litre drum (only small quantities are required to complete task).
- Redesign access point for oil delivered to compressors for easier access.
- Work from the head end for provisioning/fault finding - eliminates need to walk back to the remotes.
- Dipsticks re-positioned either side for checking engine oil.
- Provide degreaser to counter oil spillages.

Administrative control measures:

- Provide additional staff/third driver (night fuelling of remote locomotives).

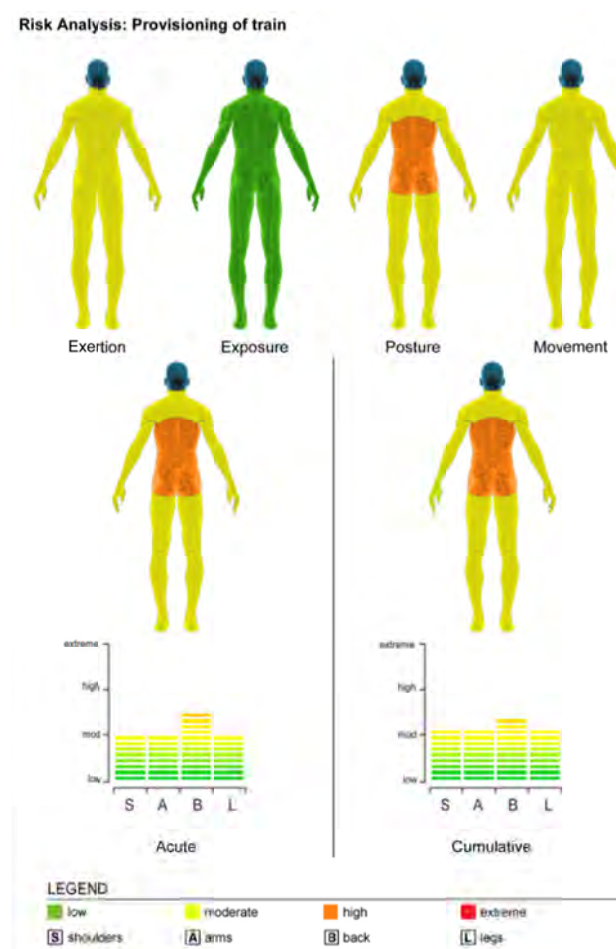


Figure 12: Train provisioning (B line) analysis and evaluation

Discussion and conclusion

This research has focused on the tasks over which the organisation has the greatest opportunity to implement effective injury reduction control measures. Part of the overall value of the participatory ergonomics process is the demonstration of “ownership” of the task by crew and their willingness to share information within a group where their expert knowledge is recognised and utilised. Crew also need the confidence that management supports moving forward and is willing to demonstrate commitment to the reduction of manual task injury within their workforce. The workshops provided crew with the tools and knowledge needed to accurately identify risk, assess tasks within their work environment, interpret the results of their assessment and translate the findings into effective control measure options. Additionally, they provided a forum for discussion, and an extensive list of control measures were developed during the workshops. The participatory ergonomics approach has both successes and setbacks which were demonstrated within this study. While the workshops generated practical solutions across all levels of the hierarchy of controls, no “site champion” emerged from crew level across either site - this led to management delegating the role of champion to “mid-level” management personnel at each site. A weakness, or threat to the opportunity of success of a project like the one identified in this case study is turnover of key staff within the organisation, resulting in failure to ensure sufficient numbers of staff remain engaged in the project with adequate influence within the organisation to drive initiatives forward.

There was difficulty within the workshops gaining consensus of control measure options across both sites, and within sites across different shift working crews. Different workplace cultures appeared to exist between sites - this was most noticeable in crew comments regarding perceived management commitment to the process. A weakness that may significantly impact upon the success of this project is the speed of implementation of agreed control measures, and the subsequent message this sends to workers about management support for the success of the project. A more significant setback to the program may be that suggested interventions are not implemented at all by management, or not implemented in the form envisaged by those providing the expert knowledge input to the workshops. This project operated across two sites, different geographical locations with no interaction between crew from each site, but under the same management administration. This highlights the need for effective and open communication between all parties involved and strengthens the need for facilitation of this process, whether by the designated “site champion” or the facilitator engaged for the participatory ergonomics process.

Implementation of a participative ergonomics program is an effective evidence based method of reducing injury risks associated with manual tasks [29, 15]. Involving workers can produce effective control measure options. Translation of this knowledge into effective implementation strategies requires genuine management “buy in” and willingness to take the appropriate actions to demonstrate commitment to reducing injury risk in their workforce.

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