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Participative Ergonomics for Manual Tasks (PErforM) Handbook

Reducing the risk of musculoskeletal injury through worker participation

Workplace Health and Safety Queensland






Department of Justice and Attorney-General

Queensland Government

Background

This handbook provides guidance to industry on preventing musculoskeletal injuries from manual tasks. It is based on the Participative Ergonomics for Manual Tasks (PErforM) program.

PErforM was initially designed for general industry as part of a manual tasks research project undertaken by Workplace Health and Safety Queensland (WHSQ), now a division of the Department of Justice and Attorney-General, in collaboration with the University of Queensland and the Curtin University of Technology.[1]

The PErforM program was subsequently modified for use in the surface and underground coal mining industries.[2] As a result of the successful implementation of PErforM in the coal mining industry[3], the program was modified for use in the civil construction industry. This project was known as PECivCon and was funded by WHSQ. A *Specific Participative Ergonomics in Civil Construction Handbook* was developed as part of this project and is available on the WHSQ website at www.worksafe.qld.gov.au.

Acknowledgments

This handbook is based on the *Participative Ergonomics for Manual Tasks (PEforM) Handbook* developed for civil construction which was written by Gary Dennis (PhD) and Robin Burgess-Limerick (PhD) from the University of Queensland. It has been modified for general industry.

[1] This research was funded by the National Health and Medical Research Council and WorkCover Queensland (QComp), (Burgess-Limerick, 2004; Straker *et al.,* 2004).

[2] This research was funded by the Australian Coal Association Research Program (Burgess-Limerick et al., 2004) and Coal Services Health and Safety Trust (Burgess-Limerick *et al.,* 2006; in press).

[3] Burgess-Limerick, R., Straker, L., Pollock, C., Dennis, G., Leveritt, S., and Johnson, S. (2007) Participative ergonomics for manual tasks in coal mining *International Journal of Industrial Ergonomics* 37, 145-155.
Straker, L., Burgess-Limerick, R., Egeskov, R. and Pollock, C. (2004) A randomised and controlled trial of a participative ergonomics program (PErforM) *Ergonomics*, 47, 166-188.

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Introduction

Purpose

This handbook provides guidance on how to implement a participative ergonomics program for reducing musculoskeletal injuries resulting from hazardous manual tasks, specifically the PErforM program (Participative Ergonomics for Manual Tasks). It provides specific information on the identification, assessment and control of manual tasks risk factors, as well as case studies designed to illustrate how PErforM can be used.

Objectives

After reading this handbook users should:

- have an understanding of the manual tasks risk factors
- be able to perform a manual tasks risk assessment using PErforM
- have an understanding of the hierarchy of controls, in particular design and administrative controls
- be able to participate in managing manual tasks risks through the development and implementation of effective controls.

This handbook can be used by managers, occupational health and safety staff and workers.

Managers can use the handbook to further understand the benefits of using a participative approach that obtains input from all areas of the workforce when managing manual tasks risks.

Occupational health and safety staff, and anyone responsible for managing health and safety issues, can use the handbook to systematically assess hazardous manual tasks, develop and implement controls, and train workers and contractors in the risk assessment process.

Workers will benefit from participating in the PErforM program by being able to identify risk factors and assist in developing controls that will allow the worker to play an essential role in reducing the risk of injury.

Manual tasks and musculoskeletal injuries

Manual tasks

Manual tasks are those workplace activities requiring the use of force exerted by a person to grasp, manipulate, strike, throw, carry, move (lift, lower, push, pull), hold or restrain an object, load or body part. Manual tasks cover a wide range of activities including:

- operating mobile plant
- putting stock on shelves
- changing a truck tyre
- mopping a floor
- lifting a wheelchair out of a car.

Musculoskeletal injuries

Musculoskeletal disorders are a real and growing problem. In 2007–08, musculoskeletal disorders accounted for over 62 per cent of serious non-fatal workers' compensation claims in Queensland, which represents an increase of 3 per cent since 2003-04. Statistics indicate that between the financial years 2003–04 and 2007–08, the number of work-related musculoskeletal disorders has steadily increased by 25.5 per cent.[4] Most of these serious injuries could have been prevented.

Manual tasks can contribute to a number of musculoskeletal injuries including:

- muscle strains and sprains
- ligament or tendon rupture
- prolapsed intervertebral discs
- tendonitis of the shoulders and elbows
- carpal tunnel syndrome.

Musculoskeletal injuries can result in permanent injuries that can have a significant impact on a person's working ability and quality of life, as well as impacting on the productivity and economic performance of the company.

Mechanisms of injury

Musculoskeletal injuries are usually the result of repeated exposure to a variety of risk factors. Although a musculoskeletal injury can occur as the result of a single, one-off exposure, this is quite rare.

Injury occurs when the load applied to the musculoskeletal tissues is greater than the capacity of the tissues to withstand the force. The musculoskeletal structure can become overloaded and sustain an injury. Fatigue of the musculoskeletal structures can also contribute to damage and failure, or in the case of the body, a musculoskeletal injury.

4 Source: Queensland Employee Injury Database. Data is current as at October 2009 and is subject to change with further development

Manual tasks risk factors

Research has identified specific risk factors related to hazardous manual tasks that play a significant role in the development and onset of musculoskeletal injuries. By preventing or minimising the exposure to these risk factors, the risk of injury can be reduced.

The five manual tasks risk factors are:

- forceful exertions
- awkward and static postures
- vibration
- repetition
- duration.

Forceful exertions

Forceful exertions place high loads on soft body tissue such as muscles, tendons, ligaments, joints and discs. Muscles fatigue with increased exertion and need more time to recover. If soft tissue does not have time to recover, injury is likely to develop over a period of time. If the exertions are forceful enough, body tissues may be damaged immediately.

Forceful exertions include:

- forces exerted by muscles, such as when lifting items
- carrying loads
- holding one position for a period of time, or
- using a forceful grip.

Exposure to forces also occurs as a result of external forces applied to the body, such as the weight of a load being carried, hammering, or when jumping down when getting out of mobile plant.

It should be noted that it is the amount of force relative to the capability of the tissue which is important. For example, the small tissues of the hand may be injured by relatively low forces.

The level of muscular effort needed to do a job may be increased by factors such as:

- awkward or fixed working postures
- heavy, bulky, unstable or difficult to grip loads
- fast, sudden or jerky movements
- working with a grip that does not allow a large area of the hand to contact the load
- using vibrating tools that need more effort to grip
- wearing gloves
- using poorly designed hand tools
- the way loads are handled (e.g. physically lifting, pushing, pulling or carrying)
- poorly maintained tools and equipment.

Often it is a number of factors that will increase the risk of injury from forceful exertions.

Examples of tasks requiring forceful exertions

Pushing shopping trolleys

Assembling wheelchair

Cutting concrete pipe with hammer

Lifting side of cane bin

Awkward and static postures

The term awkward postures refers to any posture where the body parts are away from their comfortable, neutral position (e.g. a bent back, a bent wrist or arms raised above the head). Awkward postures result in stretching or shortening of the connective and nervous tissues. As a result, the functional capacity of muscles can be reduced and the tissues are at greater risk of injury. Awkward postures are not always harmful—it is only when they are repeated frequently or performed for a long time.

The term fixed or static postures refer to postures where part of or the whole body is kept in the same position for a long period of time (e.g. standing in one position with no movement). Static postures quickly fatigue muscles because blood flow is more restricted due to the lack of muscle movement. This can lead to blood pooling and a lack of blood supply to some areas of the body and increase the risk of injury.

Awkward or static postures can be caused by:

- the work area design (e.g. working at ground level or overhead)
- handling bulky, heavy or large loads
- using poorly designed hand tools
- pushing, pulling, or carrying loads which block the worker's view
- performing tasks which require loads or body parts to be supported or held for some time.

Examples of tasks involving awkward and static postures

Sorting tomatoes

Maintaining car engine

Concrete screeding

Reaching for electrical socket

Vibration

Workers can be exposed to vibration from a variety of sources including:

- while driving trucks
- operating mobile plant (e.g. excavators, forklifts)
- using jackhammers and power tools.

The two main types of vibration that can lead to musculoskeletal injuries are:

- whole body vibration
- hand/arm vibration.

Whole body vibration

Exposure to whole body vibration occurs when the body or parts of the body come in contact with a vibrating surface, such as the seat, pedal or floor of heavy vehicles or machinery. Whole body vibration exposure has been shown to be a strong contributor to lower back injuries.

Examples of exposure to whole body vibration

Driving truck

Driving forklift

Hand/arm vibration

Exposure to hand/arm vibration occurs when working with air-operated, pneumatic, electric, or petrol-powered tools. Exposure to hand/arm vibration primarily damages blood vessels and nerve tissue, typically of the hand and fingers. Prolonged exposure can eventually result in a disease known as Raynaud's syndrome or Vibration White Finger.

When the body or limbs are exposed to vibration, the force of this movement is absorbed by the body's skin and the musculoskeletal system. Intermittent exposure to vibration may allow sufficient time for the soft tissues to recover between periods of exposure. However, long duration or frequent vibration exposure will significantly increase the risk of musculoskeletal injury.

Examples of exposure to hand/arm vibration

Operating petrol-powered jack hammer

Operating power drill

Repetition

Repetition means making the same type of movements over and over (e.g. laying bricks). The work cycle is the time taken to perform the task once without interruption (e.g. the time to lay one brick). Tasks involving short cycle times (less than 30 seconds) and performed for more than one hour, are considered to be a risk because the same muscles and other soft tissues are being used continuously. This contributes to their fatigue and risk of injury. Tasks involving longer cycle times and shorter task duration will have a lower risk of injury.

Examples of repetitive tasks with short cycle times

Laying paving blocks

Removing muffins

Sorting tomatoes

Sorting timber

Duration

Duration is the time taken to perform the task once, or perform the task repeatedly without a break. The longer a task takes, the greater the cumulative load on the musculoskeletal tissues. If the same musculoskeletal tissues are loaded without a break for extended periods, then the mechanical properties of those tissues begin to change, decreasing their functional capacity and increasing the likelihood of injury. Duration may be considered as a significant risk factor when a task is performed continuously for one hour or longer.

Example of tasks involving long durations

Screeding concrete

Working in flower beds

Identifying the risk factors

Manual tasks usually include a variety of risk factors that can interact together to create a risk. It is important to be able to identify all of the risk factors and what is causing them so that appropriate controls can be developed. Observing workers perform the task and obtaining their input will assist this process.

Which risk factors can you identify in the kerb removal task below?

Table of risk factors involved in the kerb removal task

Risk factor	Task observations
Forceful exertions	The worker is using relatively high muscle force to hold and push the jackhammer to break away the concrete.
Awkward/static postures	The worker holding the jackhammer is maintaining a static bent-over body position, whilst the person removing the concrete stoops over to lift the concrete and carry it to the dump truck.
Vibration	The jackhammer is a significant source of hand/arm vibration.
Repetition	The person lifting out the concrete is performing a repetitive 'stoop – lift – carry – dump' task over a short cycle time.
Duration	This task took over an hour to break away the required amount of concrete.

Manual tasks risk management

Risk management for manual tasks involves:

- identifying the hazardous manual tasks and prioritising them for assessment
- assessing the risk
- controlling the risk
- monitoring and reviewing.

Identifying hazardous manual tasks

Not all manual tasks are harmful, but those that could be should be identified. Hazardous manual tasks can be identified in the following ways:

- **After an incident has happened**—investigate all new incidents and look for trends in past records.
- **When there are indicators something could be wrong**—observe work processes and talk to workers.
- **When making a change**—consider the effects on workers when buying new tools or equipment, starting or changing work processes or work schedules.

Make a list of hazardous manual tasks in your workplace and prioritise them for further assessment.

Assessing the risk

Assessing the risk includes analysing the task to find out what risk factors are causing the problem.

Prepare

- Look at the task during normal working conditions.
- Find out about the work process, method of work, tools, equipment and work area layout.

Consult

- Talk to workers doing the job, their supervisors and others who may be able to provide information.
- Ask them if they have any ideas about what the problems are and how the task could be done differently.

Who should participate in the risk assessment?

Workers who perform the manual task, their supervisors and others who can provide information or may be affected by the changes to the design or process (e.g. maintenance staff, cleaners) should be involved in the risk assessment, including developing and implementing controls. This will ensure that:

- manual tasks risks are not passed on to other workers
- all issues are considered
- acceptance of the controls and changes that may be made to the task increase.

For example, operational staff may be included in the design of a new work area, but the cleaning of this new area may become a problem if cleaners have not been consulted at the initial design stage.

PErforM risk assessment tool

The PErforM risk assessment tool will assist you in:

- recording relevant information about the task
- identifying the manual tasks risk factors
- assessing the degree of exposure
- developing suitable controls
- prioritising the tasks which are creating the highest risk to your workers.

Completing the risk assessment form provides a record of the risk assessment and should be kept on file.

The PErforM risk assessment tool and instructions for completing it are provided in Appendix 1.

Controlling the risk

Reducing risk requires implementing effective controls which are accepted by workers and do not introduce new risk factors into the workplace. Consider the following three elements when planning a control strategy:

1. The effectiveness of the new controls.
2. The successful implementation of new controls.
3. Managing potential new risk factors.

Encouraging work teams to participate throughout the control strategy process should ensure these elements are considered. Worker participation is critical to the overall success of the control strategy.

1. Effective controls

To be effective, controls should:

- target the risk factors present in the task
- meet the needs of all workers who will undertake the task.

2. Successful implementation

A number of people will play a role in the implementation of a control strategy. All people who are likely to have some responsibility at the implementation stage need to be involved from the very beginning, particularly operators and maintainers who are the 'hands on' deliverers of a control strategy. Involving workers right from the beginning and listening to their input and ideas will give them a sense of ownership over the proposed controls.

Worker commitment can be achieved by:

- providing clear and specific training associated with the control strategy, such as any new work methods, safe and appropriate use of tools and equipment, and implementation timeframes
- communication from management on organisational expectations
- feedback to the work team on the basis of the changes, such as the reason behind decisions
- recognition of worker commitment to the control strategy.

Successful implementation requires the commitment of people at all levels, including management.

Support and recognition from management are important factors in demonstrating organisational commitment and encouraging the workforce. The organisational climate at the time of implementation must also be considered, as factors, such as organisational activities, workload demand, resources (human and financial) and workforce presence (e.g. the absence of key players), can impact on the success of implementation.

3. **Managing potential new risk factors**

To reduce the likelihood of creating new risks, ensure that:

- relevant workers, including experienced workers who have the ability to provide critical feedback based on their experience, are included in the design and development stages
- controls consider all stages of the operational lifespan (e.g. long term maintenance requirements as well as day-to-day activities)
- controls are monitored and reviewed.

Other things to consider

Other issues that need to be addressed as part of the overall risk management plan include:

- **Design**—when purchasing materials, tools, equipment and plant, it is important to consider the impacts on the workers and the manual tasks performed.
- **Consultation**—talk to workers before changes are made to work processes or new equipment is purchased.
- **Keeping records**—of tasks assessed, specifications of plant and work processes, incident reports, actions taken, maintenance records and training activities.

Control strategy

Ways to minimise risk

The manual tasks risk factors are caused by the:

- Work area design which includes the work area and the environment where the job is based. Poor design may cause forceful exertions and awkward and static postures.
- Tool design which includes the design of the tool being used. Poor design may cause vibration, forceful exertions, awkward and static postures.
- Load handling design which includes the characteristics of the load and the method of handling. Poor design may cause forceful exertions and awkward and static postures.
- Work organisation which includes issues such as the length of the shift, how often the task is performed, the number of workers assigned to the task and the pace of work. Poor design may cause repetition and duration.

When a manual task risk factor has been identified, it is important to determine what is causing it. In order to eliminate or minimise the risks, controls should be aimed at modifying the work area, tool, load, and method of handling and/or the way the work is organised.

Hierarchy of controls

Control options are ranked according to the hierarchy of controls. Manual tasks controls may be divided into design controls and administrative controls.

Design controls

Design controls involve redesigning the task, workplace or tools to eliminate or reduce the risk. Design controls include elimination, substitution and engineering controls. Some general examples of design controls are discussed below.

- **Elimination**
  - Eliminate the problem task completely (e.g. automate a complete job process or aspects of a particular task).
- **Substitution**
  - Replace heavy items with lighter, smaller and/or easier to handle items (e.g. items with handles). This may involve discussions with manufacturers, suppliers and/or delivery providers.
  - Substitiute a cotton mop-head with one made of microfibre.
  - Use of polypropylene wheelbarrow instead of steel.
- **Engineering**
  - Provide work benches or store items between knee and shoulder height to reduce awkward postures and increased force.
  - Use mechanical lifting aids such as cranes, forklifts, pallet jacks and trolleys to move items.
  - Cover tool handles with dampening materials to absorb vibration. Use dampening materials in floors and around vibrating machinery to reduce worker exposure to vibration.

Administrative controls

Administrative controls are less effective than design controls, require ongoing supervision to ensure they are followed. They may be forgotten under stressful conditions, such as when trying to meet deadlines, or when there are fewer staff available to do the work. Rather than controlling the risk directly, administrative controls reduce the time that workers are exposed to the risk.

Administrative controls focus on implementing policies and procedures such as Standard Operating Procedures (SOPs) and typically include:

- maintenance programs to ensure plant, tools and equipment are maintained on a regular basis
- work organisation, such as job rotation, to ensure adequate staff numbers are available to meet work demands and reduce shift length
- task-specific training to ensure workers are trained in their specific work, such as using tools and mechanical aids
- use of personal protective equipment (PPE), such as anti-vibration gloves, to reduce the exposure to vibration, or shock absorbent shoes for work on hard (concrete) floors[5] [6]
- return to work programs appropriate to individual fitness levels after extended periods of leave.

Administrative controls are best used as **part** of a comprehensive control strategy, or used in the interim while longer term design controls are being developed.

Training

Training is an important administrative control and workers should be trained in safe methods of work and use of mechanical aids. To implement an effective manual task risk management program, workers must be able to identify hazardous manual tasks and be aware of the aspects of manual tasks that increase injury risks.

The evidence shows that manual task training on its own is not an effective risk control strategy and should never be relied on as the only control strategy. Research across a range of industries demonstrates that manual task training is not effective in changing uninjured workers long-term behaviour.

Appropriate training

Training should include:

- safe methods of work (e.g. provide all workers with training following the implementation of new safe operating procedures)
- the correct use of mechanical lifting aids, trolleys and how to perform preventative maintenance
- manual tasks risk assessment including information about the risk factors
- the general principles of handling.

5 Lifting belts worn when manually handling heavy loads are not considered effective PPE as they have not been shown to offer protection against the risk of back injury.

6 If PPE is used, especially gloves and respiratory protection, consideration must be given to the fact that PPE can adversely impact on the task demands by increasing the muscular effort to hold items or result in awkward postures due to restricted head/neck movement or vision.

Further information on controls can be obtained from the Queensland *Manual Tasks Code of Practice 2000* and the *National Code of Practice for the Prevention of Musculoskeletal Disorders from Performing Manual Tasks at Work* (2007).

Case studies

The case studies in Appendix 2 of the handbook demonstrate the application of the PErforM risk assessment tool. While the case studies may not represent the wide range of high risk manual tasks performed in industry, it will assist in illustrating how PErforM can be used. Case study 1—*Vibrating needle sub-grade compaction* was provided by Civdec Construction as part of the PECivCon project.

Appendix 1: PErforM risk assessment tool

Worksheet 1 – Manual tasks risk assessment form

PErforM – Participative ergonomics for manual tasks

Manual tasks risk assessment form

Date and workplace	
Date:	Workplace:

Risk assessors
Work unit/team:
Positions:
Names:

Task description
Name of task:
Why was this task selected:
Location where task occurs:
Who performs the task:
General description:
Postures:
Forceful / muscular exertions:
Repetition and duration:
Tools or equipment used:
Work/task organisation and environment:

Worksheet 2—Risk factor assessment

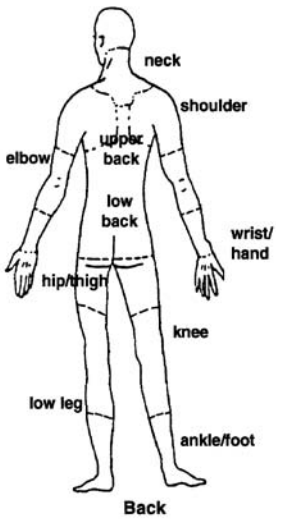
1. Indicate on the body chart which area(s) of the body you feel are affected by the task.
2. If more than one body part is affected, you may shade the different body parts in different colours. If so, use the matching colour when scoring the risk factors (e.g. red for arms on the body and score sheet, blue for low back on the body and score sheet).
3. Give each risk factor a score out of five. One (1) is when the risk factor is not present and five (5) is when the risk factor is the most severe level they have experienced.

Risk factors

Exertion				
1 No effort	2	3 Moderate force and speed	4	5 Maximum force or speed
Awkward posture				
1 All postures neutral	2	3 Moderately uncomfortable	4	5 Very uncomfortable
Vibration				
1 None	2	3 Moderate	4	5 Extreme
Duration				
1 < 10 minutes	2 10–30 min	3 30 min–1 hr	4 1–2 hrs	5 > 2 hrs
Repetition				
1 No repetition	2	3 cycle time < 30 s	4	5 cycle time < 10 s

Body map

Body part



Risk controls

Design control options:

(eliminate, substitute, engineer)

Administrative control options:

Completing the PErforM risk assessment tool

Worksheet 1 – Manual tasks risk assessment form

The first stage of the risk assessment tool involves thinking about the task and breaking it down to identify any significant risk factors. It is also useful for recording brief notes on particular aspects of the task as described in the table below:

Task description	
Name of task:	Workers report something is wrong, after an incident or injury, making a change to process.
Why was this task selected:	
Location where task occurs:	
Who performs the task:	
General description:	This does not need to be a workplace procedure. It is intended to be a general overview.
Postures:	Consider each joint in the body and how far it is from a neutral comfortable position. It is the joints that are at extreme positions that need particular focus. Static/fixed postures also need to be considered.
Forceful/muscular exertions:	Remember the force is relative to the body part, i.e. small muscle groups in the hand are able to handle a smaller force compared to large trunk and shoulder muscles. Note the effect the task has on people performing it; Are they bracing their bodies or is their breathing affected? These signs may suggest over exertion. Jarring and hammering type tasks are considered in this section and should not be confused with mechanical vibration.
Repetition and duration:	Repetition means making the same type of movements over and over. The work cycle is the time taken to perform the task once without interruption. Duration is the exposure to the task without a break. Note the cycle times and durations. Greater than one hour exposure to risk factors, such as awkward postures or vibration without a break, is considered to have increased risk. Note whether the tasks performed before and after the task place similar demands on the muscles and joints, or whether the postures are different.
Tools or equipment used:	Note the tools and equipment handled, including; weights, equipment specifications and maintenance/condition of tools and grips. Are tools designed for the job? Is vibration present?
Work/task organisation and environment:	Some examples to consider: • Does the layout impact on the worker's posture? i.e. location of equipment and heights, distances of furniture/materials, etc. • Are staffing levels adequate? consider factors such as; schedules, pace, availability of assistive equipment; housekeeping and the comfort of the work environment.

Worksheet 2 – Risk factor assessment

The second stage of the risk assessment tool involves:

- identifying the body areas affected by the task
- assessing the risk factors
- recording recommendations for risk controls.

Body map

The body map prompts the assessor to think about any areas of the body that may be affected by the tasks (e.g. those areas that become tired, sore or uncomfortable).

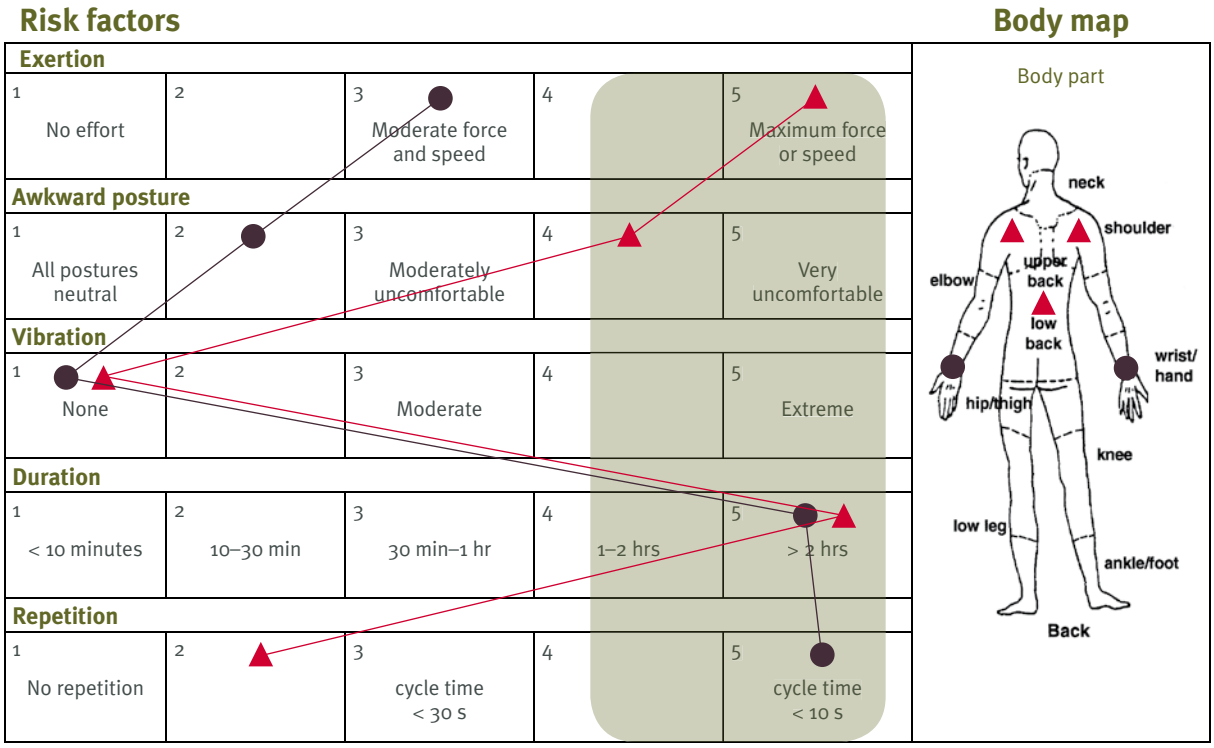
Risk factor assessment

The risk factor section located to the left of the body map requires the group to rate the level of severity of each risk factor for each affected body region on a 1 to 5 scale. A score of 1 is given when the risk factor is not present, and a score of 5 is given when the risk factor is the most severe it could be. The selected rankings should be circled to provide a clear profile of the task. The most significant risk factors can then be easily identified.

When assessing each risk factor, the group should consider the following:

- **Exertion**—Whether the task requires the worker to use maximum force. If the worker is able to continue working at the same level once the task is completed, then they have probably not been exerting maximum force. However, if the worker is left exhausted and has a significantly reduced capacity to exert any force after completing the task, it is quite possible that the worker exerted maximum force during the task.
- **Posture**—Observe the worker's posture and give a ranking out of five for comfort of posture. The group may also consider whether there are postures that could be even more extreme or uncomfortable.
- **Vibration**—When assessing vibration, the group should consider how extreme the vibration is. Whole body vibration contributes to increased injury, particularly in the back, neck and legs. Hand/arm vibration is primarily a risk factor for the arms, hands and shoulders.
- **Duration**—The typical length of time that the task is performed repeatedly without any rest break or substantial interruption by any other task.
- **Repetition—Rated 1** if a task is performed once only without repetition it scores a one (no repetition). Tasks performed repetitively are then ranked according to the length of the cycle time.

Example body map and risk factor assessment



In the example above, the red triangles have been used to indicate the level of risk on each of the five risk factors for the **lower back and shoulders**. The black dots indicate the risk of musculoskeletal injury to the **wrists**. By joining these dots, the risk profile of each body part assessed can be seen clearly.

All dots within the shaded green section are factors that need new control strategies to lower risk. In this example, control measures should particularly focus on:

- the duration of the task
- the force and posture associated with the back and shoulders
- the repetitive actions of the wrist.

The PErforM risk assessment tool can also be used after the controls have been implemented to determine if the level of risk has been decreased for the relevant risk factors and if the new control measures have been effective.

Risk controls

Recommendations for controls should be recorded in the final section of Worksheet 2. Consider both design and administrative controls.

Appendix 2: Case studies

The following case studies demonstrate the application of the PErforM risk assessment tool. While the case studies may not represent the wide range of high risk manual tasks performed in industry, it is hoped that they will assist in illustrating how PErforM can be used. Case study 1– *Vibrating needle sub-grade compaction* was provided by Civdec as part of the PECivCon project.

Case study 1 – Vibrating needle sub-grade compaction

PErforM — Participative Ergonomics for Manual Tasks

Manual tasks risk assessment form

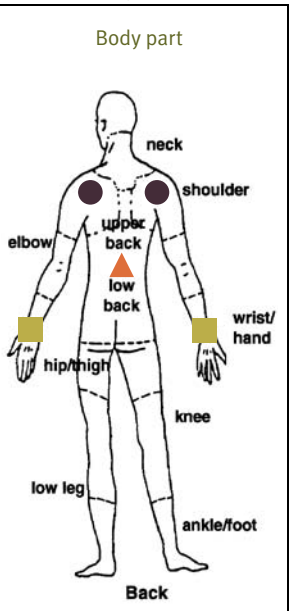
Date and workplace	
Date: 14/10/05	Workplace: Civdec (Port of Brisbane)
Risk assessors	
Work unit/team:	Earthworks crew
Positions:	Labourers, leading hands
Names:	
Task description	
Name of task:	Sand sub-grade compaction of trenches and manholes with vibrating needle.
Why was this task selected:	The natural material at the Port of Brisbane is white sand, which therefore requires particular attention to achieve the required density and compaction for the construction of pavements. In particular, the compaction of the sand sub-grade within trenches or around manholes is an important part of ensuring the integrity of pavements. To achieve the required compaction, the sand is required to be flooded and vibrated. The current method to achieve this is to use a needle vibrator, which is a slow and labour intensive task. This task is very demanding on the body, in particular the back, hands and forearms.
Location where task occurs:	Sand sub-grade compaction.
Who performs the task:	Earthworks/pavements construction labourers.
General description:	Once sand has been backfilled within trenches or around manholes within a pavement, it is flooded with water to become liquefied. At this point a vibrating needle (commonly used to compact concrete) is placed into the sand and retrieved. This process removes any voids within the sand and compacts it accordingly. The process of placing the vibrating needle and retrieving it is usually required about three to five times per square metre. The sand is also usually compacted in 0.5m thick layers.
Postures:	Due to the process of constantly retrieving the vibrating needle from the sand, the lower back and shoulders take a lot of strain. The back is required to be bent over numerous times during the process, and the shoulders are used to physically retrieve the needle.
Forceful exertions:	A strong grip is required to retrieve the needle from the sand. Also the vibrations caused from the vibrating needle are carried through the hands, wrists and forearms each time the needle is retrieved. This results in muscular fatigue setting in reasonably quickly within these body parts.
Repetition and duration:	Needle retrieving approximately 1 in 30 seconds, duration of task is approximately 1 hour depending on size of area to be compacted.
Tools or equipment used:	Labourer, vibrating needle, drive motor, water.
Work/task organisation and environment:	Conditions that make this task awkward and uncomfortable are the wet sand, the vibration of the needle, and the repetitiveness and physical effort needed to retrieve the needle from the sand.

Risk factor assessment

Risk factors

	1	2	3	4	5
Exertion	No effort		Moderate force and speed		Maximum force or speed
Awkward posture	All postures neutral		Moderately uncomfortable		Very uncomfortable
Vibration	None		Moderate		Extreme
Duration	< 10 minutes	10–30 min	30 min–1 hr	1–2 hrs	> 2 hrs
Repetition	No repetition		cycle time < 30 s		cycle time < 10 s

Body map



Risk controls

Design control options:

- Look into the manufacture of a series of vibrating needles on a beam that can be hitched to a backhoe. This will allow the backhoe to compact the sand (with the use of the vibrating needles) using mechanical power, not physical power. Additionally, this would also improve efficiency by speeding up the time taken to perform the sub-grade compaction.

Administrative control options:

- Provide more vibration equipment for additional labourers to perform the task, which would therefore reduce the duration of the task if only one labourer performed the task.
- Minimise number of trenches by 'trench sharing of conduits'.
- Train additional labourers to perform the task and allow job rotation.

Supporting photos

Vibrating needles

Case study 2 – Stacking pallets

PErforM – Participative ergonomics for manual tasks

Manual tasks risk assessment form

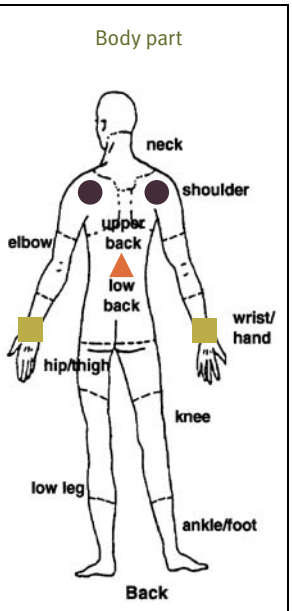
Date and workplace	
Date: 17/02/09	Workplace: Packing shed
Risk assessors	
Work Unit/team:	Packers
Positions:	Labourers, supervisors
Names:	
Task description	
Name of task:	Stacking pallets with boxes of tomatoes.
Why was this task selected:	Workers reported this task was difficult and complained of discomfort to the back, elbows and hands. It is performed most days and often involves a whole shift's work.
Location where task occurs:	At the end of the sorting conveyor near the load out area.
Who performs the task:	Usually two male workers. This task is considered by management to be too heavy for female workers and workers short in stature as they are unable to reach the top layers of a fully loaded pallet.
General description:	Palletising is the end task on the packing line. The worker has to carry the boxed tomatoes from the end of the conveyor and stack them onto a pallet to about shoulder height. The worker has to work around the pallet.
Postures:	Bending over while putting the boxes down on the pallet. Twisting when carrying boxes around obstructions such as empty and full pallets. Stretching to reach the top layers of boxes on the pallet.
Forceful/muscular exertions:	Force required in the back and upper body when carrying full boxes weighing 12 kg each. High gripping force of the hands and wrists and force on the forearm muscles when carrying boxes.
Repetition and duration:	This task is often performed all day and for two hours or more before a break is taken. Work pace is dictated by the speed of the packing line. Generally slow to medium pace. Short breaks taken while boxes are being filled.
Tools or equipment used:	Nil.
Work task organisation and environment:	Work usually commences by 7 am. Morning smoko 9:30 am (20 min) and lunch 12 pm (30 min). Usually finished by 4 pm. Sometimes have afternoon smoko at 2:30 pm for 10 min. Heights of pallets are dictated by customers. Zincalume shed with some ceiling insulation and fans. Hot in summer.

Risk factor assessment

Risk factors

	1	2	3	4	5
Exertion	No effort		Moderate force and speed		Maximum force or speed
Awkward posture	All postures neutral		Moderately uncomfortable		Very uncomfortable
Vibration	None		Moderate		Extreme
Duration	< 10 minutes	10–30 min	30 min–1 hr	1–2 hrs	> 2 hrs
Repetition	No repetition		cycle time < 30 s		cycle time < 10 s

Body map



Risk controls

Design control options:

- Investigate automating the task.
- Install spring-loaded pallet turntable to allow the stacking task to be done at waist height and turn the pallet to stack from one direction.
- Investigate recessing a height adjustable pallet turntable into the floor to keep the task at waist height.
- Plan the layout of this area and give consideration to issues such as space, handling of product, access to pallets.
- Use a platform structure around the pallet with a pallet on a mechanical lifting system (e.g. a forklift).

Administrative control options:

- Negotiate with clients and/or transport companies regarding the configuration of pallets (e.g. to reduce the height, do half/split pallets).
- Implement a good housekeeping policy (i.e. clear walkways, maintain floor surfaces, remove produce and other items from floors and clean up spills immediately).
- Rotate the job among workers.
- Allow frequent rest breaks e.g. five minutes each hour.

Supporting photo:

Stacking boxes of tomatoes.

Case study 3 – Pushing a meal trolley

PErforM – Participative Ergonomics for Manual Tasks

Manual tasks risk assessment form

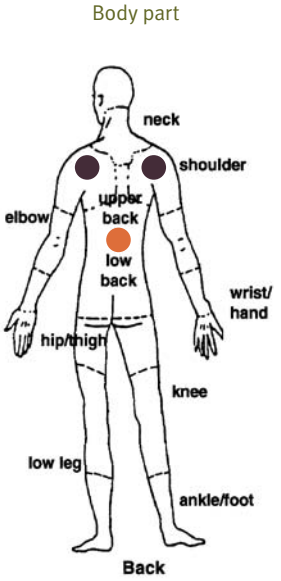
Date and workplace	
Date: 11/11/08	Workplace: Regional hospital
Risk assessors	
Work unit/team:	Hostel staff
Positions:	Operational support officer
Names:	
Task description	
Name of task:	Transporting meal trolley between the kitchen and the hostel.
Why was this task selected?	This task was selected by all staff required to push the meal trolley. Staff reported that a lot of force is required to push and manoeuvre the trolley. High forces are particularly required when pushing the trolley up the long ramp to the kitchen and also through doorways with raised thresholds.
Location where task occurs:	Between the hospital kitchen and the hostel.
Who performs the task:	Hostel staff – service assistants.
General description:	Prior to each meal, the hostel staff retrieve the loaded meal trolley from the hospital kitchen. They return the trolley loaded with the dirty meal trays once the meal is finished.
Postures:	Twisting in the lower back and reaching the arms across the body and to the side when manoeuvring the trolley through doorways.
Forceful/muscular exertions:	Forceful exertions of the arms, trunk and legs are required when pushing the trolley. Additional force is required when pushing the trolley up/down the ramp and jerking of the trolley is required to push the trolley over the doorway thresholds.
Repetition and duration:	The trolley is retrieved for three meals a day and returned following the meal (task is therefore completed six times). Estimated pushing time is 10 minutes.
Tools or equipment used:	Trolley – solid steel construction.
Work/task organisation and environment:	• The trolley is pushed over a range of floor surfaces including carpet, linoleum and concrete. It is also pushed up/down a concrete ramp of approximately 50 m and manoeuvred through doorways with raised thresholds. • Doors have to be manually opened causing increased twisting of the back and one-armed handling of the trolley. • The doorway threshold located at the beginning of the ramp is raised. Increased force is required to push the trolley over the threshold and then up the ramp. • The lunch time trolley is heavier as soup is also carried on the trolley.

Risk factor assessment

Risk factors

	1	2	3	4	5
Exertion	No effort		Moderate force and speed		Maximum force or speed
Awkward posture	All postures neutral		Moderately uncomfortable		Very uncomfortable
Vibration	None		Moderate		Extreme
Duration	< 10 minutes	10–30 min	30 min–1 hr	1–2 hrs	> 2 hrs
Repetition	No repetition		cycle time < 30 s		cycle time < 10 s

Body map



Risk controls

Design control options:

(eliminate, substitute, engineer)

- Explore options for motorising the trolley via a retro-fit of a motor or purchase of a trolley mover. The trolley mover may be able to be used for other needs within the hostel.
- Fit brakes to the trolley to prevent loss of control on the ramp.
- Consider purchase of a lighter weight trolley.
- Install automatic opening doors.
- Modify the door thresholds to a lower profile.

Administrative control options:

- Use two staff to transport the trolley between the kitchen and hostel.
- Task-specific training to ensure best manual handling strategies are in place.
- Rotate task between staff.

Supporting photo:

Pushing trolley through doorway.

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Further information

For general information on manual tasks, please contact Workplace Health and Safety Queensland:

Telephone 1300 369 915

Website www.worksafe.qld.gov.au

Telephone interpreter service 13 14 50

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PN10151 JAG 09/3386