SAFER Industries

Ergonomic Hazard Management

AUDIT TOOL USER GUIDE

For the Meat Industry in South Australia

Meat Industry

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Table of Contents

About This Project

This document is one of four, which have been developed by David Nery (Ergonomist, Nery Ergonomic Services) in collaboration with the SA Meat Industry OHS Committee. The full range of documents developed in this project are:

- An ergonomic hazard audit tool specifically adapted for meat processing tasks
- A user guide of how to use the audit tool
- An industry report which provides a series of 20 case studies of ergonomic interventions in the meat industry in South Australia
- A bibliography of relevant readings for ergonomics in the meat industry

For more information about the documents that have been produced in this project please contact the following people or visit the SAfer Industries - Meat Industry website: **www.workcover.sa.gov.au/safer**

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Introduction

Injury statistics and other sources have identified manual handling and occupational overuse syndrome related injuries as some of the most frequent and severe injuries in the meat industry in South Australia.

This handbook is focused on providing an audit tool to identify, assess and control these hazards in the meat industry in South Australia.

This handbook is intended for use by occupational health and safety personnel and others who have the responsibility for the identification, assessment and control of manual handling related hazards within meat works.

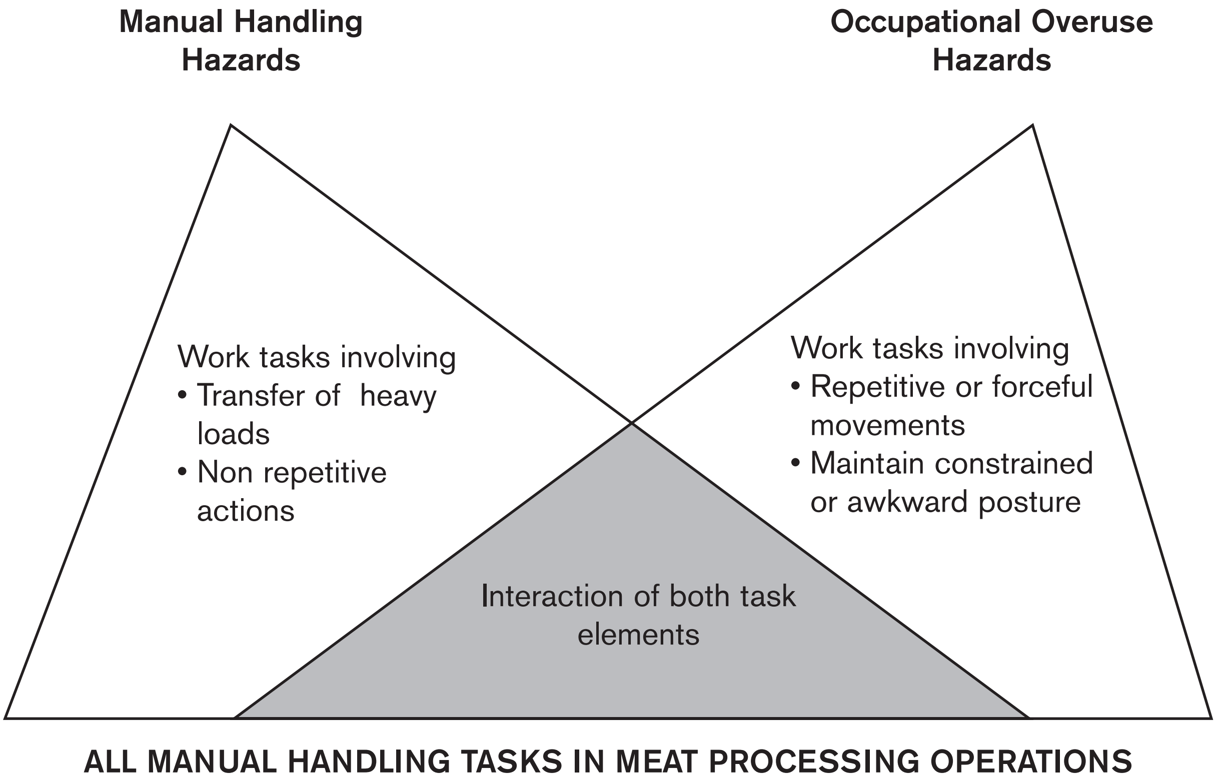
What is Manual Handling?

Manual handling means *"an activity requiring the use of force exerted by a person to lift, lower, push, pull, carry or otherwise move, hold or restrain any person, animal object or thing"* (Code of Practice for Manual Handling, 1990, page 1).

In terms of tasks in the meat industry, this translates to a whole range of activities including cutting, static muscle load in work postures, repetitive movements, pushing bins, lifting and throwing product etc....

The audit tool described in this handbook is designed specifically for the meat processing industry. Therefore, the scope of factors examined covers not only typical "manual handling" hazards but those related to Occupational Overuse Syndrome injuries. Within this handbook the term "Ergonomic Hazards" will be used to collectively describe both manual handling and occupational overuse syndrome hazards.

Figure 1 illustrates the interrelationship between manual handling and occupational overuse related issues in work tasks.



Legal Requirements for Manual Handling Assessments

The Occupational Health, Safety and Welfare Regulations (1995) state that *"An employer must ensure that any manual handling that is likely to be a risk to health and safety is identified and assessed… The employer must take such steps as are reasonably practicable to control the risk."* (page 89-90).

This booklet and enclosed checklist are designed to meet this legal requirement by providing a practical guide for the management of manual handling hazards in the meat industry.

Ergonomic Audits

The key to effectively managing ergonomic hazards (like many other hazards) is to analyse the hazards and their causes and then systematically control these hazards. This hazard management process consists of the following 4 main stages:

1. Risk identification
2. Risk assessment
3. Risk control
4. Monitor and evaluate

This booklet summarises this process and provides some useful reference material to assist you to use the ergonomic audit document in Appendix A.

Manual Handling Audit Process

The key to effectively managing manual handling related hazards is to complete a risk assessment of the work tasks. The assessment of manual handling hazards is a legal requirement in the Occupational Health, Safety and Welfare Regulations (Section 2.9.3, 1995)

The process that needs to be followed is summarised in Table 1.

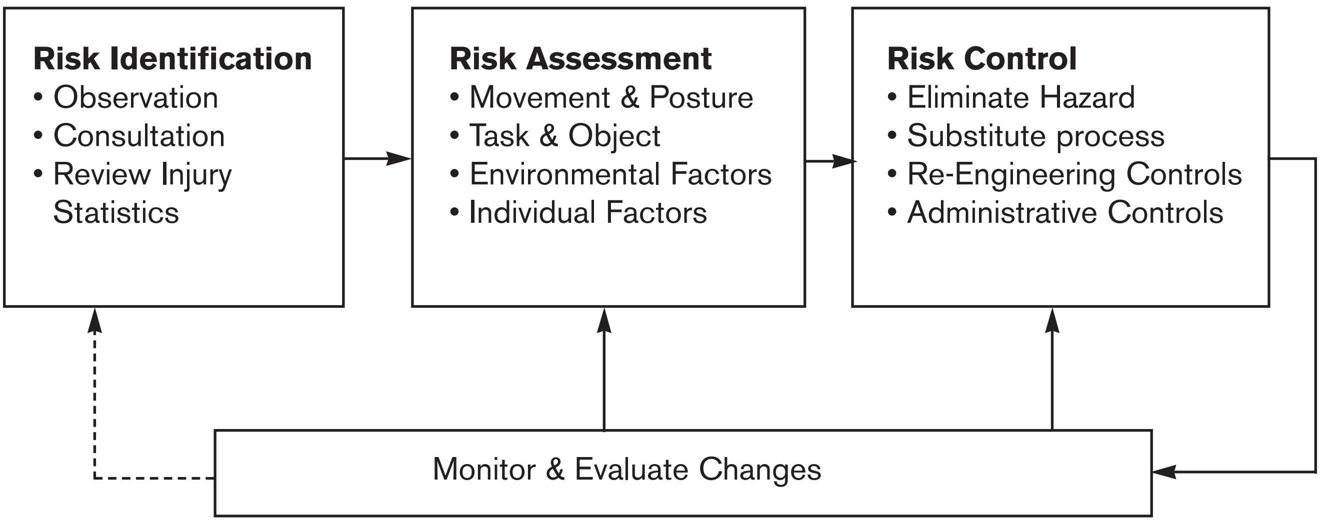


Table 1: An Ergonomic Hazard Management Process

How to Undertake An Ergonomic Audit at your Site

The stages of the process are outlined in Table 1 on page 4. The form in Appendix A is the assessment tool that has been developed to complete this process.

The process involves the same 4 steps described in the previous section. That is:

- Step 1: Risk Identification
- Step 2: Risk Assessment
- Step 3: Risk Control
- Step 4: Monitor & Evaluate

Step 1 Risk Identification

Filling out the Risk Identification Stage of the Assessment Tool

The front cover of the audit tool requires information about the task, injury and claims history associated with the assessed task. This allows for some historical information about the level of risk of this task to be presented.

Consultation with others involved in the task (eg. safety reps, people who have done the task) will provide further background information.

Work Example: Identification of Work Hazards. Repetitive Throwing of Product

Figure 2: Boning room task.
(photo courtesy of Tataria Meat Company)

Step 2: Risk Assessment

This stage involves an assessment of the risks for the hazards that have been identified in stage 1. This requires the task assessors to nominate the level of risk for each hazard that was assessed in step 1.

Assessing the level of risk is a combination of the probability the event will occur, which is affected by how often the task is undertaken (likelihood) and the extent of harm to people should the event occur (consequences).

Work Example:
Assessment of risk - A combination of risk severity and number of times the task is performed. That is, the more people who perform a hazardous task the greater the risk.

Figure 3: A boning room operation before the room was re-designed. (photo courtesy of George Chapman)

Filling out the Risk Assessment Stage of the Assessment Tool

Filling out the risk assessment section of the audit tool requires you to complete the following steps:

- Assess the level of risk from 0 - 5 for each of the assessment items
- Describe assessment of the main hazards associated with the task
- Determine the overall risk rating for the task. This is the highest risk rating given to any of the factors (e.g. If all factors are rated at a level of 2 but one factor [e.g. repetition] is rated 5, the overall risk rating for the task is 5.)
- One 'yes' answer in the personal factors section (Section E) is equivilant to an overall risk rating of 5
- Once you progress to assessing a number of tasks, you will be in a position to prioritise tasks based on how many high hazard ratings are scored per task
- NB: Any aspect of any task that is rated 4 or above needs prompt or immediate attention

- The key for interpreting the risk ratings in terms of the priority of action is as follows:

  - 0 rating = Very low priority, fix within 12 month plan
  - 1 rating = Low priority, fix within 3 month plan
  - 2 rating = Medium priority, fix within 1 month plan
  - 3 rating = High priority, fix within 2 week plan
  - 4 rating = Very high priority, fix within 1 week plan
  - 5 rating = Acute priority, fix by the end of the day

Step 3: Risk Control

Overview of the risk control stage

The risk control hierarchy is the approach commonly used to develop safe methods of work.

The risk control hierarchy for the management of manual handling hazards consists of the following elements:

- **Eliminating or minimising manual handling hazards**
  This includes elimination, substitution and re-engineering risk control options

• **Reducing fatigue through work reorganisation**
This includes the layout, management and scheduling of work options

• **Raising awareness and improving knowledge and skills**
This includes selection, training and supervision of work tasks

Filling Out the Risk Control Checklist and Action Plan Stage of the Assessment Tool

This audit tool provides some space on the back page for people to "tick" one or more risk control options. There is also some space for people to list the risk control options that have been selected.

This information is used as the basis for the development and implementation of risk control options. Remember that elimination, substitution and re-engineering options are the best because they get rid of the hazards. While personal protective equipment (PPE) and training are vital elements of a safety system, they do not get rid of the hazard; they simply assist the individual to cope with the hazard. In some cases training and PPE are the only reasonable options available, but where possible re-engineering the hazard out of the work process is more effective.

Summary of the Risk Control Options

This section provides more detail about the risk control options. Examples are also provided about the how these options have been applied in meat processing scenarios.

1. Eliminating or Minimising Manual Handling Hazards

This is the most effective approach as the hazard is either eliminated or minimized through engineering re-design of the process.

The checklist requires a "yes" if an option is available and some space on the form to determine what the strategy might be.

Examples would include:

- Reviewing if the task is necessary at all?
- Can another method be used?
- Developing mechanical aids (eg.using conveyors rather than dump bins)

Example 1: Eliminating Manual Handling Hazards by Design - Head lifting Task

One example of a demanding manual handling task, is lifting the animal's head between the main chain and a head chain

Figure 4: Carrying a 45 kg head between the main chain and head chain. (photo courtesy of Agpro)

Figure 5: Trying to lift the head onto the head chain. (photo courtesy of Agpro)

Figure 6: A head lifting machine that eliminates lifting the head. (photo courtesy of South Burnett Meat Works)

2. Reducing Fatigue through Work Reorganisation

This will involve a review of the work organisation to reduce double handling, balance work rates/rest schedules which can if not well managed increase the risk of fatigue and injury.

Example 2: Task Rotation (Between Boning & Slicing Tasks)

The key to reducing physical fatigue with task rotation is to move between tasks that involve different muscle actions (e.g. Boning versus slicing). In meat processing operations it is difficult to get enormous variation in body movements because of the repetitive and similar nature of many tasks. However, some form of rotation is critical given this repetitive and non-varied nature of many tasks.

Some examples of task rotation include:

- Boning versus slicing tasks
- Standing versus sitting tasks
- High effort slaughter tasks (e.g. "punching out sheep") versus working with air tools
- High exertion muscular force (e.g. lifting pig or cattle heads) versus a task with low levels of lifting (e.g. working in the knocking box)

These are just some examples of task rotation. Rotating between tasks on a more frequent basis (e.g. 2 - 4 hourly) can also provide often badly needed variation to repetitive tasks.

Figure 7: Head cut up table. (photo courtesy of George Chapman)

Figure 8: Slicing Task. (photo courtesy of George Chapman)

Figure 7 illustrates a cut up table that requires forceful repetitive upper limb movements. Figure 8 illustrates a slicing task that does also involve repetitive movements in the knife hand but the force of the slicing movements is less. This therefore, reduces the total repetitive physical exertion required by operators.

3. Raising Awareness and Improving Knowledge & Skills

Interventions at this level cannot modify the task but can reduce the risk of injury by improving, where possible, the manual handling techniques of people performing the task.

Example 3: Manual Handling Training

In many cases people have to manual handle cartons and other products in the plant. In this case manual handling training would be required to ensure that when people manual handle they do it in the safest and most practical way. This is not only an effective risk control strategy, it is a legislative requirement. The South Australian Manual Handling Code of Practice (1990) states the following in relation to the requirement for manual handling training :

"The employer must: …ensure that the employees involved in the manual handling task, receive appropriate training, (including training in safe manual handling techniques) and appropriate supervision;" (page 40)

Figure 9: Manual handling cartons in the packing area.
(photo courtesy of Aldinga Table Turkeys)

In figure 9 the operator has to use the following manual handling technique:

- Hold the carton close to her body
- Do not twist her spine
- Keep her spine in a straight (neutral) position
- Get a good grip on the carton
- Plan the lift and test the load

Despite using these safe manual handling techniques other risk control strategies can be used in combination with safe manual handling techniques. This would include the following:

- **Room layout** - keep the pallet close to the scales to reduce the distance over which the carton is to be carried. Review if a conveyor could be used between the scales and the pallet to eliminate lifting

- **Reducing Manual Handling** - Could a scissor lift be put under the pallet (a spring or hydraulic base) so the pallet was always at waist height. That is when the pallet is empty it comes to waist height and then it is lowered under weight as items are stacked on the pallet.

- **Task Rotation** - Rotate people between this lifting task and a more static task (e.g. weighing, packing or wrapping the product). This will provide some variety in terms of movement and muscle load that will reduce fatigue for the operators.

Step 4: Monitor & Evaluate

This stage involves documenting time frames and responsibility for who is going to mange the implementation and evaluation of the risk control strategies that were derived in step 4.

The assessment form provides a spread sheet that requires the following information:

- A list of the hazards and their assessed priority
- Risk control solutions
- Timeframe and responsible person for implementing changes
- Review date

Tips for Good Ergonomic Audits

- **Conducted by a team**, not an individual.
  This provides a cross section of opinions about what hazards exist.

- **Measured against standards**
  Using a checklist, which has been derived from a standard provides a more standard and consistent approach. This gives accurate findings and the levels of risk.

- **Include knowledgeable persons**
  Use safety representatives, operators, engineers or anyone who may have an understanding of the task being assessed (you may show them your results if they cannot all attend the audit)

- **Be specific**
  Where possible, quantify hazards
  Eg. Don't say load is heavy. Measure its weight. Don't say person has to reach a long way, measure it. This provides more detail about the level of risk.

- **Challenge customs and practice**
  People's response to change is sometimes "We have always done it this way," or, "I have never hurt myself on that job, there cannot be a problem." We need to analyse the hazards and manage these and not rely on luck as the main reason for not being injured. If not, one day your luck might run out.

- **When assessing level of risk consider:**
  - the number of people exposed
  - how often they are exposed for
  - any combination of hazards
  - variations in the process (seasonal, different types of meat, meat from the chiller etc...).

Appendix A

Ergonomic Audit Tool - For Meat Processing Tasks

ERGONOMIC HAZARD MANAGEMENT
AUDIT TOOL - MEAT INDUSTRY

STEP 1: RISK IDENTIFICATION CHECKLIST

Company: ....

Department: ....

Assessor: ....

Date: .... Time: ....

INSTRUCTIONS:

* Tick Boxes where applicable
* Spaces allow you to write further information where required
* If you identify jobs where possible risks exist use the risk assessment checklist to further examine those jobs.

Task(s): ....

Task Description: ....

Operator Feedback - Ask people doing the task (or those who have familiarity with the task) what they think the hazards might be? ....

What do the accident, incident or other safety records tell you about the hazards associated with this task? ....

STEP 2: RISK ASSESSMENT

A. REPETITION WHOLE BODY

0	1	2	3	4	5
Idle most of the time; no regular exertions	Consistent, conspicuous pauses or very slow motions	Slow steady exertion/motion, may have frequent pauses	Steady motion/exertion; may have infrequent pauses	Rapid steady motion/exertion, few if any pauses	Very rapid motion/exertion, difficulty keeping up; no pauses

B. FORCE

Hand/fingers

Nothing at all — Comfortable — Greatest imaginable effort

0 1 2 3 4 5

C. GRIP STRESS

Fingers

No grip stress — Comfortable — Maximum Tolerable

0 1 2 3 4 5

Wrist/Palm

0 1 2 3 4 5

D. POSTURE

Wrist Deviation

Neutral — Comfortable — Extreme Range of Motion

0 1 2 3 4 5

Wrist Flex/Ext

0 1 2 3 4 5

Forearms

0 1 2 3 4 5

Elbows

0 1 2 3 4 5

Shoulder

0 1 2 3 4 5

Neck

0 1 2 3 4 5

Back

0 1 2 3 4 5

E. PERSONAL FACTORS

- New employee (under 12 months) or returning from extended leave.
  Yes ☐ No ☐
- Older workers or those with recurrent disabilities
  Yes ☐ No ☐
- Restrictions imposed by personal protective equipment
  Yes ☐ No ☐
- Inadequate skills or experience
  Yes ☐ No ☐
- Inadequate Training
  Yes ☐ No ☐

F. LOAD CHARACTERISTICS

Lifting/Carrying the Load

Easy to move		Comfortable			Greatest Imaginable effort
0	1	2	3	4	5

Push/Pull or Restraining forces

0	1	2	3	4	5

G. WORK ENVIRONMENT / WORK ORGANISATION

Workspace

Does not cause a problem	Inconvenience	Causes extra effort	Hazard for safe work	Will cause major injury	Will cause a fatality
0	1	2	3	4	5

Thermal Comfort

0	1	2	3	4	5

Floor Surface (Wet Tripping / Slipping hazards)

0	1	2	3	4	5

SUMMARISING RISK ASSESSMENT RESULTS

Describe assessment of the main hazards associated with task
(include severity of hazard, how many people exposed to hazard).

....

....

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....

Overall Risk Assessment Rating (Highest rating on any score): ....

STEPS 3 & 4: RISK CONTROL CHECKLIST AND ACTION PLAN

Instructions

Tick boxes where applicable

- A "yes" answer for a question indicates the types of control which might be appropriate.
- Control (solutions) should be developed in consultation with the people who will use them.
- There are several different approaches to reducing risks of handling injuries.

Risk Control Options	**Yes/ No**	**List the Risk Control Option (s)**	**Fix by Date**	**Responsible Person**	**Review Date**
1. Eliminating or Minimising Manual Handling Hazards By:					
(i) Eliminating the task: • Is the task necessary? • Can another method be used?					
(ii) Mechanism or the provision of machines or aids to do the task: • Are there aids or machines which could be used? • Can the aid be made / designed?					
(iii) Eliminating or minimising rehandling: • Can handling be reduced by reorganising, planning, designing?					
2. Reducing Fatigue Through Work Recorganisation By:					
(i) Rescheduling tasks to allow for more consistent effort and fewer periods of high / low demand: • Is the sequence of activities efficient? • Is consideration given to balanced work / rest schedules?					
3. Raising Awareness and Improving Knowledge & Skills By:					
(i) Training & education: Are workers training in safe manual handling?					
(ii) Consultation • Are people undertaking the tasks consulted about the risks associated with their work? • Are workers encouraged to suggested ideas about safer ways to work?					

Table of Contents

Introduction

The introductory section of this report summarises the aims, scope, rationale and for undertaking the audit process. The bulk of the report is case studies outlining the results from the hazard-based assessment of the tasks that were examined.

Background Information

Manual Handling (MMH) and Occupational Overuse (OOS) hazards, hereafter referred to as ergonomic hazards, are significant issues in the Meat Processing Industry nationally and in South Australia. Incident rates of injury/disease in the meat processing sector is approximately 6 times the Australian industry average (WorkSafe, 1995). Approximately 40% of these meat industry incidents relate to sprain and strain injuries.

Observers of and those performing meat processing tasks have long commented that many of the tasks are characterised by highly repetitive movement patterns which use the same muscle groups and require forceful muscle exertions (Grant & Habes, 1997; Moore & Garg, 1994).

Jobs which require repetitive forceful exertions have demonstrated significant increases in the risk of overuse disorders such as tendonitis, tenosynovitis and carpal tunnel syndrome (Silverstein et al, 1987).

The growing use of high speed processing techniques have increased the number of individuals exposed to highly repetitive, intensive hand activities which is thought to have contributed to the increased incidents of OOS disorders (Cook et al, 1998)

For example, in meat processing plants it is not unusual for an employee in a boning room to perform 12,000 or more cutting motions per 8 hour shift (Gjessing, Schoenborn & Cohen, 1994).

Despite this, there is a lack of practical industry specific information in several areas including industry specific hazard audit tools and industry case studies which highlight the process and outcomes for a hazard management approach of sprain / strain issues for all areas within the meat processing industry sector.

Aims & Objectives of this Project

Specifically, this project has achieved the following:

- Prepared an industry report which consists of 20 case studies highlighting the identification, assessment and control of ergonomic hazards in the meat processing industry (this document)
- Developed an industry specific ergonomic hazard audit tool and user guide
- Prepared a bibliography of readings that provide information about the identification, assessment and control of ergonomic hazards in the meat processing industry sector.

Scope Of The Assessment

This industry report has covered meat processing operations in the following areas:

- Beef Processor
- Poultry Processor
- Sheep Processor
- Pork Processor

Table 1 below summarises the reference documents used in this audit program.

Table 1: Reference Documents Used in This Audit Program

Reference Documents	Abbreviation
Australian Standard 4024.1. Safe Guarding of Machinery (1996)	AS4024.1
Consolidated Occupational Health, Safety & Welfare Regulations (1995)	OHS Regs, 1995
Manual Handling Code of Practice (1990)	MHCP, 1990
Joseph (1989) Ergonomic Considerations and Job Design in Upper Extremity Disorders. Journal of Occupational Medicine (USA), Vol 4 (No. 3) pp 547 - 557	Joseph (1989)
Geniady A, M, Delgado E & Bustos T (1995). Active microbreak effects on muscular comfort ratings in meat packing plants. Ergonomics, Vol 38, No 2: 326 - 336	Geniady et al (1995)
Hsiang S, Mc Gorry R & Bezverkhny (1997) The use of Taguchi's Methods for the evaluation of knife design. Ergonomics, Vol 40, No 4; 476 - 490	Hsiang et al (1997)
Upper extremity disorders in a pork processing plant: Relationships between job risk factors	Moore et al (1997)
Australian Standard 1657 (1992). Elevated Platforms, Walkways and Stairs	AS 1657

Legislative Requirements

This audit program for the assessed tasks satisfies legislative requirements for the identification, assessment and control of hazards within the organisation.

This meets the following legislative requirement:

> *"An **employer** must, in relation to the implementation of these regulations, ensure that appropriate steps are taken to identify all reasonably foreseeable **hazards** arising from work which may affect the health or safety of **employees** or other persons at the **workplace...** If a hazard is identified... an employer must ensure that an assessment is made of the **risks** associated with the **hazard...***
>
> *An **employer** must, on the basis of **risk assessment** under Regulation 1.3.2, ensure that any **risks** to health or safety arising out of the work eliminated or, where that is not reasonably practicable, **minimised**" (Section 1.3.2, pages 49-50)*

The above mentioned requirements have been fulfilled through undertaking a hazard-based assessment of the abovementioned tasks.

The hazard assessment methodology was consistent with the hazard management approach in the South Australian Consolidated Occupational Health, Safety and Welfare Regulations (1995).

Hazard Priorities

The hazards that have been identified have been prioritised according to the level of risk for each hazard. This is in accordance with the hazard assessment process outlined in the SA Consolidated Occupational Health, Safety and Welfare Regulations (1995).

The following priority waiting system is used in the assessment of hazards:

- **High Level Hazard**

  Hazards of this priority are in breach of the legislative minimum standards for whatever aspect of work is being examined and the hazard needs to be controlled immediately.

  Timeframe for the control of the hazard - Immediate

- **Medium Level Hazard**

  Hazards at this level of priority are above the minimum level of safety according to minimum legislative requirements but below what is recommended as far as optimum safe work performance is concerned. Therefore, implementing risk control strategies for this aspect of the work will result in an improvement of an existing work process.

  Timeframe for the control of the hazard - 3 – 6 months

- **Low Level Hazard**

  The aspect of work appears to be reasonable and to a high level of safety. However, implementation of the recommended risk control strategy for this hazard will possibly improve the level of safety towards a best practice level of work for the particular work operation, which is being assessed. No immediate risk of injury, risk control strategy should be factored into a work plan.

  Timeframe for the control of the hazard - 12 months

Results and Recommendations

This section of the report summarises the identification and assessment of hazards at the participating sites which are benchmarked against appropriate safety standards. Furthermore, there are recommendations for risk control strategies that need to be implemented to control the identified hazards.

Case Study Number 1: Sorting Task, Boning Room

Organisation: George Chapman Pty Ltd

Table 2 : This Table Summarises The Results Of The Audit For The "Old" Configuration Of The Sorting Task		
Identified Factor	**Examples Of Assessed Factors***	**Is Factor Within Safe Limits?**
1- Posture & Movement*		
• Repetitive exertions	Number of movement per cycle	Yes
• Shoulder movements	Above shoulder height	Yes
	Reaching down and behind	Yes
• Forearm movements	Inward or outward rotation with a bent wrist	Yes
• Wrist movements	Palmer extension or full extension	Yes
• General Manual Handling	Movements & posture during task	**No**
2- Tool Design & Use*		
• General design & Use	Handle, storage, weight & shape	Yes
• Blade	Sharp	Yes
3- Workstation Design*		
• Access	Steps, space, handle, floor surfaces & drainage	**No**
• Layout	Space to move, reach tools, reach wash and product	**No**
4- Task Variety*		
• Rotation between tasks	At least 2 hourly rotations on repetitive tasks	**No**
• Training	Induction & ongoing training	Yes
5- Environment*		
• Thermal	Air temperature & air flow	Yes
• Lighting	Adequate for work tasks	Yes
6- Individual Factors*		
• New employee	Training, skills & supervision	Yes
• Returning from break	Training, skills & supervision	Yes
• Pre-existing injury	Capability, limits of injury & task demands	Yes

* The assessed factors have been derived from the reference documents listed in table 1 (page 3)

The Old Sorting Method

The results of the assessment are summarised in table 2. This section of the report provides a summary of the hazards associated with each aspect of the task that was highlighted in table 2.

Figure 1: Sorting product at the end of the belt

The main hazards that were identified with this task were:

- Lack of postural support offered by the chair (crate)
- Operator could not keep up with product on conveyor so errors in grading product may occur
- Many combinations of product to be sorted so many bins required (this created congestion for other people on the line and for general access & egress)
- Over reaching & high speed repetitive work
- No adjustment in the workstation to accommodate different sized operators
- Poor visibility of the product (because it was going so fast)

The New Sorting Method

Figure 2 illustrates the results of the audit and re-design process.

Figure 2: Sorting work task

This design has the following ergonomic design features:

- The rotating table is adjustable in height to accommodate different height operators
- The table makes the task (to some extent) self-paced so the rate of work can be more controlled by the operator. This has safety advantages for reducing sustained high rates of work and quality advantages for correct sorting of the product.
- The changes in layout allow for some of the product to be sorted before it gets to this workstation so this can reduce the load placed on this operator.
- Standing position improves work posture at this workstation
- Reorganisation of the sorting process means there are fewer bins to sort into which reduces congestion and improves access and egress.
- Improvements in boning room layout have allowed sorting to be done away from main circulation area which has reduced congestion and access / egress in this area.

Case Study Number 2: De-Rinder Machine, Boning Room

Organisation: George Chapman Pty Ltd

Table 3 : This Table Summarises The Results Of The Audit For The "Old" Configuration Of The Sorting Task		
Identified Factor	**Examples Of Assessed Factors***	**Is Factor Within Safe Limits?**
1- Posture & Movement*		
• Repetitive exertions	Number of movement per cycle	**No**
• Shoulder movements	Above shoulder height	Yes
	Reaching down and behind	Yes
• Forearm movements	Inward or outward rotation with a bent wrist	Yes
• Wrist movements	Palmer Flexion /dorsi flexion/ulnar or radial deviation	Yes
• General Manual Handling	Movements & posture during task	**No**
2- Tool Design & Use*		
• General design & Use	Handle, storage, weight & shape	Yes
• Blade	Sharp	Yes
3- Workstation Design*		
• Access	Steps, space, handle, floor surfaces & drainage	**No**
• Layout	Space to move, reach tools, reach wash and product	**No**
4- Task Variety*		
• Rotation between tasks	At least 2 hourly rotations on repetitive tasks	**No**
• Training	Induction & ongoing training	Yes
5- Environment*		
• Thermal	Air temperature & air flow	Yes
• Lighting	Adequate for work tasks	Yes
6- Individual Factors*		
• New employee	Training, skills & supervision	Yes
• Returning from break	Training, skills & supervision	Yes
• Pre-existing injury	Capability, limits of injury & task demands	Yes

* The assessed factors have been derived from the reference documents listed in table 1 (page 3)

The Old De-Rinder Machine Layout

The results of the assessment are summarised in table 3. This section of the report provides a summary of the hazards associated with each aspect of the task that was highlighted in table 3.

Figure 3: De-Rinder machine at 90 degrees to the belt

The hazards that were identified with this task were:

- Machine at 90 degrees to the belt so product has to be lifted onto and off the belt to be fed to the machine. This introduces unnecessary manual handling.
- This manual handling is repetitive (at least one lift per minute) and can increase if the product has to be fed through the machine twice.

The New De-Rinder Machine Layout

Figure 4 illustrates the new position of the de-rinder machine.

Figure 4: The de-rinder machine running parallel to the belt.

This design has the following ergonomic design features:

- Having the de-rinder machine running parallel to the belt means that there is less lifting to get the product onto the machine.
- The product is easily transferred back to the belt since the end of the de-rinder machine is right next to the belt.

Case Study Number 3: Boning Room Layout – Boning & Slicing Tasks

Organisation: George Chapman Pty Ltd

Table 4 : This Table Summarises The Results Of The Audit For The "Old" Configuration Of The Workplace Layout		
Identified Factor	**Examples Of Assessed Factors***	**Is Factor Within Safe Limits?**
1- Posture & Movement*		
• Repetitive exertions	Number of movement per cycle	**No**
• Shoulder movements	Above shoulder height	Yes
	Reaching down and behind	Yes
• Forearm movements	Inward or outward rotation with a bent wrist	**No**
• Wrist movements	Palmer Flexion /dorsi flexion/ulnar or radial deviation	Yes
• General Manual Handling	Movements & posture during task	**No**
2- Tool Design & Use*		
• General design & Use	Handle, storage, weight & shape	Yes
• Blade	Sharp	Yes
3- Workstation Design*		
• Access	Steps, space, handle, floor surfaces & drainage	**No**
• Layout	Space to move, reach tools, reach wash and product	**No**
4- Task Variety*		
• Rotation between tasks	At least 2 hourly rotations on repetitive tasks	**No**
• Training	Induction & ongoing training	Yes
5- Environment*		
• Thermal	Air temperature & air flow	Yes
• Lighting	Adequate for work tasks	Yes
6- Individual Factors*		
• New employee	Training, skills & supervision	Yes
• Returning from break	Training, skills & supervision	Yes
• Pre-existing injury	Capability, limits of injury & task demands	Yes

* * The assessed factors have been derived from the reference documents listed in table 1 (page 3)

The Old Boning Room Layout

The results of the assessment are summarised in table 4. This section of the report provides a summary of the hazards associated with each aspect of the task that was highlighted in table 4.

Figure 5: Workplace Layout: Boning Room

The main hazards that were identified with this task were:

- The layout of the room meant people would have to "throw" the product between the cut up table and the belt. This occurred with every unit, so it was a frequent task. The product was also heavy (approximately 10 – 12 kg).

  Other tasks required this throwing of the product. Boners would have to "throw" the product over the belt to slicers. This meant interruptions in work for those people to move when the product was thrown. This also created additional manual handling for those people who had to throw the product.

- Additional manual handling was also required for the people to bend and twist when throwing "off cuts" into the dump bins. This over reliance on dump bins also created access problems and a lack of space in the boning room.

The New Boning Room Layout

Figures 6 & 7 illustrate workstations in the new boning room.

Figure 6: Boning workstation on the main belt

Figure 7: Collecting product for sorting from the end of the return belt

This design has the following ergonomic design features:

- There is a return belt above the main belt. This return belt is where the off cuts are placed. This eliminates the bending and twisting to throw product into dump bins behind the boner.

- There is reduced double handling of the product as it is put on the belt and sorted once by one operator. This centralises the sorting process, which reduces the number of dump bins that are required. This improves access around the belt (as there are less dump bins) improves general access and egress around the room. It also eliminates the need for the boners to throw product over the belt or behind themselves to the dump bins.

- The musculoskeletal strain of the boning task is further reduced by rotation of people through boning and slicing tasks. This provides relief from the repetitive and more forceful movement patterns of boning by providing people with the opportunity of doing some slicing tasks.

Case Study Number 4: Removing the Rib Set

Organisation: George Chapman Pty Ltd

Table 4 : This Table Summarises The Results Of The Audit For The "Old" Configuration Of The Workplace Layout		
Identified Factor	**Examples Of Assessed Factors***	**Is Factor Within Safe Limits?**
1- Posture & Movement*		
• Repetitive exertions	Number of movement per cycle	**No**
• Shoulder movements	Above shoulder height	**No**
	Reaching down and behind	Yes
• Forearm movements	Inward or outward rotation with a bent wrist	**No**
• Wrist movements	Palmer Flexion /dorsi flexion/ulnar or radial deviation	**No**
• General Manual Handling	Movements & posture during task	**No**
2- Tool Design & Use*		
• General design & Use	Handle, storage, weight & shape	**No**
• Blade	Sharp	Yes
3- Workstation Design*		
• Access	Steps, space, handle, floor surfaces & drainage	**No**
• Layout	Space to move, reach tools, reach wash and product	Yes
4- Task Variety*		
• Rotation between tasks	At least 2 hourly rotations on repetitive tasks	**No**
• Training	Induction & ongoing training	Yes
5- Environment*		
• Thermal	Air temperature & air flow	Yes
• Lighting	Adequate for work tasks	Yes
6- Individual Factors*		
• New employee	Training, skills & supervision	Yes
• Returning from break	Training, skills & supervision	Yes
• Pre-existing injury	Capability, limits of injury & task demands	Yes

* * The assessed factors have been derived from the reference documents listed in table 1 (page 3)

Removing the Rib Set – Old Method

The results of the assessment are summarised in table 5. This section of the report provides a summary of the hazards associated with each aspect of the task that was highlighted in table 5.

Figure 8: Trimming around the rib set with a knife

Figure 9: Using a string to pull the rib away from the meat. Arm only part way through action. Elbow comes up to arm pit height at end of movement

The main hazards that were identified with this task were:

- The meat had to be pre-trimmed away from the rib (refer to figure 8). This required extensive deviation of the wrist with the knife hand.

- Using the string to pull the meat from the rib (refer to figure 9) requires significant grip on the tool handle. There is also a “jarring” effect when pulling the string, because it would not always slide easily down the rib.

- There is significant strain placed on muscle and tendon structures around the wrist, forearm, elbow and shoulder of the arm pulling the string.

- The task is continuous and the lack of task rotation adds to the accumulated fatigue associated with the task.

The new method for pulling out the rib set

Figures 10 & 11 illustrate the new method for pulling out the rib set.

Figure10: The hand tool used for pulling out the rib set

Figure 11: Wrist in a neutral position when using the tool to pull out the rib set

This hand held tool has the following ergonomic benefits for this task:

- **Improved Wrist Position**
  The wrist of the hand holding the tool is in a neutral position that means there is a reduced risk of injury to the muscles and tendons in this area compared to if the wrist was highly deviated.

- **Reduced Double Handling**
  The pre trimming around the rib with the knife (refer to figure 9) is eliminated as the new tool has a blade so only one movement across the rib is required. This eliminates much of the double handling that the old system required where the knife and the string were required.

- **Reduced Effort During the task**
  The aperture of the blade is set for the widest part of the rib. This means when the blade is pulled through the thinner 80% of the rib the blade slides very easily as it is cutting through meat. This significantly reduces the pulling effort required to pull the blade along the rib.

- **Reduced Muscular Strain and Shoulder Strain**
  The handle design means the elbow can be kept close to the body and not elevated high and away from the body during the pulling action. The low elbow position during pulling (refer to figure 11) reduces strain on the arms and shoulder compared to the high elbow position for the old method of performing this task (refer to figure 9).

- **Improved Job Design**
  The new job design allows for task rotation. This reduces the fatigue associated with the repetitive movement patterns associated with performing the same task for prolonged periods of time.

- **NB:** In addition to the ergonomic benefits the end-product quality and yield were improved due to the closer cutting edge of the tool.

Case Study Number 5: Machine Guarding

Organisation: George Chapman Pty Ltd

Machine guarding around belts is a critical design issue. There are Australian standards for machine guarding generally and for the guarding of conveyors. The general requirements for Guarding are specified in Australian Standard 4024.1 (1996). It states ;

> ***"that every projection such as a set screw, bolt or key on a exposed moving part of machinery should be sunk, shrouded or otherwise effectively guarded " (page 49)***

The AS 4024.1 requires a hazard assessment of the plant design and its use to be carried out so that any guarding hazards can be identified, assessed and controlled. Chapman's did this with their new conveyors that were being used in the boning room. Figure 12 illustrates the conveyors that are being used.

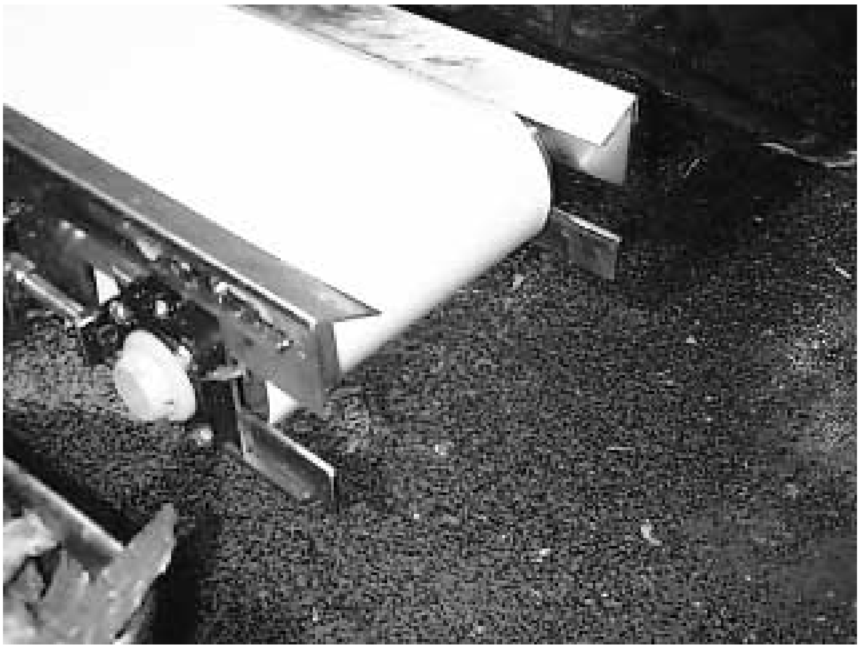

Figure 12: The belt conveyors used in the new boning room design

This conveyor has the following safety benefits:

- **Rotating Spindles Covered**
  The yellow capping on the end of the conveyor covers the spindle on the end of the conveyor. This eliminates any risk of entrapment.
- **End of the Belt is Covered**
  The powered roller on the end of the belt is covered with the extended side of the belt that eliminates any risk of entrapment by end of the roller or the belt.
- **Improved Manual Handling**
  People reported they felt comfortable about standing closer to the guarded conveyor without a risk of entanglement. This reduces the risk of overreaching and manual handling related injury.

Case Study Number 6: Job Rotation

Organisation: George Chapman Pty Ltd

Good design from a safety perspective requires more than just achieving good results in the physical design. The management of the job is critical to ensure that the safety of the work is optimised. One of the commonly used strategies to vary the muscle loads that people are exposed to in a task, is to rotate people between work tasks. This is particularly important in boning room tasks because of the repetitive nature of the work people do. That is, if a particular task requires a limited number of muscles to produce highly repetitive movements or maintain a fixed work posture those muscles and tendons may become fatigued which may lead to injury.

The best form of job rotation is where people move through tasks that require different muscles to be used differently. For example, a task that requires more forces in the movements (eg. Boning) versus a task that requires less force (eg.Slicing) is one method of job rotation. Another is rotating between heavier boning tasks (eg working on the cut up table or lifting the animal heads) to working on boning tasks on the belt where the lifting loads are lighter.

The more varied the tasks are the more variety the muscles will have and therefore the risk of injury will decrease. The barriers to this system in the meat industry have been the tally system and other industrial-based issues.

A good job rotation program can have value not only in reducing the risk of musculoskeletal injury, but it can make the overall job more interesting. Science and common sense have shown that improvements in job satisfaction can lead to more ownership of the work process, reduced staff turnover and improvements in the quality of the work people can produce. The improvements in safety in this sort of environment are also well documented.

Figure 13: Heavier manual handling required on the cut up table compared to other tasks in the boning room

Figure 14: Lighter slicing tasks. Rotating between this task and heavier boning tasks can reduce the overall muscle load that is accumulated during the shift

Case Study Number 7: Hose Attachment

Organisation: George Chapman Pty Ltd

Washing down work areas is an everyday occurrence in meat processing operations. Using hot water is a necessary requirement in many cases for the hygiene requirements of cleaning.

Having just a cut off section on the end of the hose means that people often get burned with the hot water. There is also a metal "wrap" around the end of the hose that heats up with the hot water running under it and eventually this metal burns the hands of the operators holding the hose. In addition, people use their thumb to create extra water pressure, that over time can lead to soreness to the muscles and tendons in the hand / wrist area.

Figure 15 illustrates a hose attachment that is used by Chapman's over the end of the hose. The cylindrical shape allows the hose to be held with a power grip for downward application when washing the floor. But, the grip can also be changed to hold the hose in an elevated position for washing down equipment (refer to figure 16) which is a safer grip than just holding the hose (refer to figure 17). This is because there is less risk of getting burned and the larger "grip" on the hose with the attachment can reduce the muscular action for the grip so the risk of overuse injury can be reduced.

Figure 15: Attachment on the end of the hose. Provides a more comfortable grip on the hose and keeps the hand away from the hot water, and hot metal edge on the hose

Figure 16:Hosing down equipment above shoulder height

Figure 17: The old hose design (with no cover). Metal elements of the hose end heat up and burn the operators hand

Case Study Number 8: Working at Elevated Heights

Organisation: Aldinga Table Turkeys

Working at elevated heights to retrieve stored items on racking, or to conduct general maintenance or installations, is a common activity within meat processing operations.

AS 1657 (titled; Fixed Platforms, Walkways and Landings, 1992) provides the guidelines for the design and use of equipment being used for this purpose. The design of ladders is not only critical for ensuring that people get up to an elevated working height, but, they are able to work safely when they are there. If people are lifting items into and out of storage or reaching and working, there may be additional hazards of balance and manual handling to consider in the design of the ladder system they are using.

The ladder in figures 18 and 19 is used at the Aldinga Table Turkeys site.

Figure 18: Standing on the top of the ladder

Figure 19: Moving the ladder

Recommendations

The ladder system in figures 18 & 19 has the following safety benefits:

Stable Base
The platform at the top of the steps provides a stable base for standing and loading items into and out of storage.

Hand Railings
The platform has well designed railings (ie correct height and running all the way around). They are also painted for easy visual identification.

Step Design
The steps have the correct ratio for height and angle. This is important to ensure people do not trip which is common when the horizontal part of the step (called the "going") overlaps.

The steps also have a good grip which is critical since the floors and worker's boots are often wet. If there is some food product on the sole of a persons boot, this may further increase the risk of slipping on the step.

Portability of the Unit
Figure 19 illustrates how easy it is to move the unit. The wheel means that the weight of the unit does not have to be lifted so the manual handling associated with the task is significantly reduced.

Case Study Number 9: Workstation & Job Design, Boning Room

Organisation: Aldinga Table Turkeys

Table 6 : This Table Summarises The Results Of The Audit For The Manual Handling Identification Results		
Identified Factor	**Examples Of Assessed Factors***	**Is Factor Within Safe Limits?**
1- Posture & Movement*		
• Repetitive exertions	Number of movement per cycle	Yes
• Shoulder movements	Above shoulder height	Yes
	Reaching down and behind	Yes
• Forearm movements	Inward or outward rotation with a bent wrist	Yes
• Wrist movements	Palmer extension or full extension	Yes
• General Manual Handling	Movements & posture during task	**No**
2- Tool Design & Use*		
• General design & Use	Handle, storage, weight & shape	Yes
• Blade	Sharp	Yes
3- Workstation Design*		
• Access	Steps, space, handle, floor surfaces & drainage	**No**
• Layout	Space to move, reach tools, reach wash and product	**No**
4- Task Variety*		
• Rotation between tasks	At least 2 hourly rotations on repetitive tasks	Yes
• Training	Induction & ongoing training	Yes
5- Environment*		
• Thermal	Air temperature & air flow	Yes
• Lighting	Adequate for work tasks	Yes
6- Individual Factors*		
• New employee	Training, skills & supervision	Yes
• Returning from break	Training, skills & supervision	Yes
• Pre-existing injury	Capability, limits of injury & task demands	Yes

* * The assessed factors have been derived from the reference documents listed in table 1 (page 3)

Workstation & Job Design – Boning Room

The results of the assessment are summarised in table 6. This section of the report provides a summary of the hazards associated with each aspect of the task that was highlighted in table 6.

Figure 20: High cuts which are required on the carcass

Figure 21: Using the "stab" grip when cutting the carcass

Figure 22: Pulling part of the carcass (left hand) and cutting with the knife (right) hand

Recommendations – Boning Task

(1) Task Rotation (High priority Recommendation)

Rotate people as frequently as is practical through this work task. The current system of half-day rotations between boning and slaughter tasks, combined with rotations within the boning room does provide significant variation for the work tasks that people perform.

(2) Manual Handling Training (Medium Priority)

The Code of Practice for Manual Handling (1990) states the following in relation to people undertaking manual handling at work:

> ***"The employer must:***
> ***ensure that employees involved in the manual handling task receive appropriate training, (including training in safe manual handling techniques) and appropriate supervision" (page 40)***

The boning task does require a significant amount of repetitive arm movement, both with the knife and gripping motions with the non knife hand (eg refer to figures 20-22) and lifting some cartons (figure 23)

Figure 23: Lifting the full cartons onto the conveyor

(3) Change workstation Layout (Medium Priority)
When the carton is full it has to be lifted from the floor to the conveyor. The carton weighs approximately 20 kg and is lifted approximately 8 – 10 times per day per boner (refer to figure 23).

If the box was mounted at the height of the conveyor it could be pushed directly onto the conveyor. This would eliminate the manual lifting of the container during this task.

(4) Knife Sharpening (High priority Recommendation)
Training in knife sharpening (especially for new employees) needs to continue. Reductions in the sharpness of knives has been demonstrated as contributing to the increase in muscular effort whilst using the knife and contributes to an increase in the risk of cuts when using the knife.

Figure 24: Sharpening a knife in the boning / slicing area

(5) Matting (Medium Priority Recommendation)

The OHS Regulations (1995) state the following in relat :

"[it should be] of low thermal conductivity; and designed to give reasonable relief from the hard surface" (page 66)

The matting in figure 25 is a good design but it is worn on some of the workstations and needs to be replaced.

Figure 25: Matting on the floor of the boning area

Case Study Number 10: Slicing Workstation, Boning Room

Organisation: Aldinga Table Turkeys

Table 7 : This Table Summarises The Results Of The Audit For The Manual Handling Identification Results		
Identified Factor	**Examples Of Assessed Factors***	**Is Factor Within Safe Limits?**
1- Posture & Movement*		
• Repetitive exertions	Number of movement per cycle	Yes
• Shoulder movements	Above shoulder height	Yes
	Reaching down and behind	Yes
• Forearm movements	Inward or outward rotation with a bent wrist	Yes
• Wrist movements	Palmer extension or full extension	Yes
• General Manual Handling	Movements & posture during task	**No**
2- Tool Design & Use*		
• General design & Use	Handle, storage, weight & shape	Yes
• Blade	Sharp	Yes
3- Workstation Design*		
• Access	Steps, space, handle, floor surfaces & drainage	Yes
• Layout	Space to move, reach tools, reach wash and product	Yes
4- Task Variety*		
• Rotation between tasks	At least 2 hourly rotations on repetitive tasks	Yes
• Training	Induction & ongoing training	Yes
5- Environment*		
• Thermal	Air temperature & air flow	Yes
• Lighting	Adequate for work tasks	Yes
6- Individual Factors*		
• New employee	Training, skills & supervision	Yes
• Returning from break	Training, skills & supervision	Yes
• Pre-existing injury	Capability, limits of injury & task demands	Yes

* The assessed factors have been derived from the reference documents listed in table 1 (page 3)

Slicing Workstation – Boning Room

The results of the assessment are summarised in table 7. This section of the report provides a summary of the hazards associated with each aspect of the task that was highlighted in table 7.

Figure 26: Slicing workstation

Figure 27: Slicing workstation

Recommendations – Slicing Workstation

(1) Workstation Design – Working Height (High priority Recommendation)

The height of the bench is 1100mm. This is higher than the "standard" packing or boning workbench height. The reason for this is the slicing work task uses less forceful cutting movements and there are more fine slicing movements in the task. The greater the precision of the task the higher the bench height needs to be. This height is at the high end of the scale for this precision task. Some form of platform or floor height change may be required for very short operators, but the bench height is suitable for the current users.

(2) Workstation Design – Storage (High Priority Recommendation)

There is the provision for the meat cuts to be stored in a carton that is on the bench. This eliminates bending to a carton if it were on the floor. It also eliminates any shoulder strain that might occur if the arms had to be elevated repetitively to throw items into a carton on the bench top.

(3) Task Rotation (High Priority Recommendation)

Rotate people as frequently as is practical through this work task. The current system of half-day rotations between boning and slaughter tasks, combined with rotations within the boning room does provide significant variation for the work tasks that people perform.

(4) Manual Handling Training (Medium Priority)

The Code of Practice for Manual Handling (1990) states the following in relation to people undertaking manual handling at work:

> ***"The employer must:***
> ***Ensure that employees involved in the manual handling task receive appropriate training, (including training in safe manual handling techniques) and appropriate supervision" (page 40)***

The boning task does require a significant amount of repetitive arm movement, and lifting cartons so it is important that these movements are performed in the safest possible way. On-going training and reinforcement is required achieve and sustain these safe manual handling techniques.

(5) Work Flow (High Priority Recommendation)

There are many cartons on the floor around the slicing workstation. As the work accumulates it would be preferable to have the cartons stored between mid-thigh to chest height to reduce bending during the lifting. If this is not practical then particular care through training and supervision should occur to ensure the lifting techniques of people lifting from ground heights is performed in the safest possible way.

(4) Knife Sharpening (High priority Recommendation)

Training in knife sharpening (especially for new employees) needs to continue. Reductions in the sharpness of knives has been demonstrated as contributing to the increase muscular effort whilst using the knife and contributes to an increase in the risk of cuts when using the knife. This would assist with reducing manual effort when trimming the carcass.

Figure 28: Sharpening a knife in the boning / slicing area

Case Study Number 11: Mincing Workstation, Boning Room

Organisation: Aldinga Table Turkeys

Table 8 : This Table Summarises The Results Of The Audit For The Manual Handling Identification Results		
Identified Factor	**Examples Of Assessed Factors***	**Is Factor Within Safe Limits?**
1- Posture & Movement*		
• Repetitive exertions	Number of movement per cycle	Yes
• Shoulder movements	Above shoulder height	Yes
	Reaching down and behind	Yes
• Forearm movements	Inward or outward rotation with a bent wrist	Yes
• Wrist movements	Palmer extension or full extension	Yes
• General Manual Handling	Movements & posture during task	**No**
2- Tool Design & Use*		
• General design & Use	Handle, storage, weight & shape	Yes
• Blade	Sharp	Yes
3- Workstation Design*		
• Access	Steps, space, handle, floor surfaces & drainage	Yes
• Layout	Space to move, reach tools, reach wash and product	Yes
4- Task Variety*		
• Rotation between tasks	At least 2 hourly rotations on repetitive tasks	Yes
• Training	Induction & ongoing training	Yes
5- Environment*		
• Thermal	Air temperature & air flow	Yes
• Lighting	Adequate for work tasks	Yes
6- Individual Factors*		
• New employee	Training, skills & supervision	Yes
• Returning from break	Training, skills & supervision	Yes
• Pre-existing injury	Capability, limits of injury & task demands	Yes

* The assessed factors have been derived from the reference documents listed in table 1 (page 3)

Mincing Workstation – Boning Room

The results of the assessment are summarised in table 8. This section of the report provides a summary of the hazards associated with each aspect of the task that was highlighted in table 8.

Figure 29: Lifting cartons of mince

Recommendations – Mincing Workstation

(1) Workstation Design – Scales (High priority Recommendation)

All cartons of mince are weighed. This involves lifting the mince from ground height (refer to 29) and carrying them to the other side of the boning room. There is a lot of unnecessary double handling when there is a build up of cartons.

The mince machine should, if possible, be modified to have some scales where the carton is being filled. This would eliminate the lifting of the carton to the scales and all of the double handling currently being undertaken.

If this modification is not possible, then a second set of scales close to the mince machine should be made available to reduce the distances over which the cartons have to be lifted.

(2) Task Rotation (High Priority Recommendation)
Rotate people as frequently as is practical through this work task. The current system of half-day rotations between boning and slaughter tasks, combined with rotations within the boning room does provide significant variation for the work tasks that people perform.

(3) Manual Handling Training (Medium Priority)
The Code of Practice for Manual Handling (1990) states the following in relation to people undertaking manual handling at work:

> ***"The employer must:***
> ***Ensure that employees involved in the manual handling task receive appropriate training, (including training in safe manual handling techniques) and appropriate supervision" (page 40)***

Working on the mincing workstation does require some repetitive arm movement, and lifting cartons so it is important that these movements are performed in the safest possible way. The ongoing training that is provided to staff does assist them with their manual handling skills and this training and supervision needs to continue.

(4) Machine Guarding (High priority Recommendation)
People need to be trained, instructed and supervised to keep their hands out from under the guard and away from any risk of entanglement with moving parts.

Figure 30: Mincer guard.

Case Study Number 12: Packing Area

Organisation: Aldinga Table Turkeys

Table 9 : This Table Summarises The Results Of The Audit For The Manual Handling Identification Results		
Identified Factor	**Examples Of Assessed Factors**[*]	**Is Factor Within Safe Limits?**
1- Posture & Movement*		
• Repetitive exertions	Number of movement per cycle	Yes
• Shoulder movements	Above shoulder height	Yes
	Reaching down and behind	Yes
• Forearm movements	Inward or outward rotation with a bent wrist	Yes
• Wrist movements	Palmer extension or full extension	Yes
• General Manual Handling	Movements & posture during task	**No**
2- Tool Design & Use*		
• General design & Use	Handle, storage, weight & shape	Yes
• Blade	Sharp	Yes
3- Workstation Design*		
• Access	Steps, space, handle, floor surfaces & drainage	Yes
• Layout	Space to move, reach tools, reach wash and product	Yes
4- Task Variety*		
• Rotation between tasks	At least 2 hourly rotations on repetitive tasks	Yes
• Training	Induction & ongoing training	Yes
5- Environment*		
• Thermal	Air temperature & air flow	Yes
• Lighting	Adequate for work tasks	Yes
6- Individual Factors*		
• New employee	Training, skills & supervision	Yes
• Returning from break	Training, skills & supervision	Yes
• Pre-existing injury	Capability, limits of injury & task demands	Yes

[*] The assessed factors have been derived from the reference documents listed in table 1 (page 3)

The Packing Area

The results of the assessment are summarised in table 9. This section of the report provides a summary of the hazards associated with each aspect of the task that was highlighted in table 9.

Good design from a safety perspective requires more than just achieving good results in the physical design. The management of the job is critical to ensure that the safety of the work is optimised. One of the commonly used strategies to vary the muscle loads that people are exposed to in a task, is to rotate people between work tasks. This is particularly important in packing room tasks because of the repetitive nature of the work people do. That is, if a particular task requires a limited number of muscles to produce highly repetitive movements or maintain a fixed work posture, those muscles and tendons may become fatigued which may lead to injury.

Job Rotation in the Packing Area

The best form of job rotation is where people move through tasks that require different muscles to be used differently. For example, a task that requires greater range of movement (eg wrapping) versus a task that requires more dexterity (packing) is one method of job rotation. These tasks are illustrated in figure 31.

Figure 31: The packing / wrapping workstation

Rotation on either side of the bench also allows for rotation for left and right movements. That is, if the wrapper leans to their left to put the final product down when she is on one side of the bench she will lean in the other direction to perform the same task on the other side of the bench.

Rotating between heavier manual handling tasks (eg moving boxes) can provide some relief from static muscle load. The lifting technique illustrated in figure 32 is poor. That is, the person should be bending the legs, keeping their spine straight and holding the load close to their body. The majority of peoples manual handling techniques on the site are very good. The training and supervision of work tasks needs to continue to modify the few instances where the manual handling techniques could be improved.

Figure 32: Lifting cartons onto a pallet

Manual Handling Training (Medium Priority)

The Code of Practice for Manual Handling (1990) states the following in relation to people undertaking manual handling at work:

> ***"The employer must:***
> ***Ensure that employees involved in the manual handling task receive appropriate training, (including training in safe manual handling techniques) and appropriate supervision" (page 40)***

The boning task does require a significant amount of repetitive arm movement, and does lifting cartons, so it is important that these movements are performed in the safest possible way.

Case Study Number 13: Machine Guarding – Band Saw

Organisation: Tatiara Meat Company

Machine guarding around bandsaw machines. The general requirements for Guarding are specified in Australian Standard 4024.1 (1996 – Titled – Safeguarding of Machinery – General principles). It states:

> ***"Where it is impractical to prevent access to the dangerous parts because they are unavoidably exposed during use, eg the cutters on milling machines and the cutters of woodwork machine, the use of an adjustable guard may be permissible in conjunction with other closely supervised conditions e.g. sound floor, good lighting and adequate training of the operator" (page 76)***

The AS 4024.1 requires a hazards assessment of the plant design and its use to be carried out so that any guarding hazards can be identified, assessed and controlled.

Figure 33: Pushing the carcass through the bandsaw requires the arms to travel past the blade up to the elbow of the operator

Hazards Associated with the Design and / or Use of the Bandsaw

- **Use Adjustment Guard on the Blade**
  An adjustable guard is fitted to this machine and is used by operators. As a general rule the guard is adjusted approximately 7.5 cm above the top of the carcass. This is to provide enough clearance for the carcass on slightly different angles and to provide enough vision of the carcass and blade during the cutting process

- **Personal Protective Equipment**
  A mesh glove is not practical as a form of protection because the glove would become entangled with the blade on contact, which would draw the person into the blade.

- **Rate of Work**
  This is essentially a paced task. That is the operator has to keep up with the people supplying the carcass to them. If the person cannot keep up they could make mistakes that may lead to injury (e.g. a new employee or someone who is not experienced in this task). At this site new employees are provided with a reduced rate of work so they can develop their skills on this job before being required to work at the "normal" rate of work for the room.

Figure 34: Using the bandsaw to cut the carcass

- **Stability on the floor**
  At the time of the assessment this was reasonable. Anti fatigue matting can be used in some situations but it should not create secondary manual handling problems when moving the matting during cleaning or hygiene problems when working at the workstation. A dry floor is essential ie. Housekeeping for stabiltiy is essential during this task.

- **Lighting**
  The lighting for this task was reasonable. It is essential to have good lighting because of the close proximity of the hands to the exposed moving blade.

Recommendations – Changes in the Design & Use of the Bandsaw

- **Adjustable Guard on the Bandsaw (Medium Priority Recommendation)**

Continue with adjusting the guard on the blade. This will result in only the required amount of the bandsaw blade being exposed. This is of particular significance for the following reasons:

- The operator moves at high speed,
- Very close to the blade,
- No protection in terms of gloves or forearms shields and
- Moves next to the blade on a very frequent basis (at least 60 times per minute)

- **Training (Medium Priority Recommendation)**

People need extensive training on the safety of how to use the saw and how to process the product safely through the machine. This includes keeping the hands as far as is practical from the blade.

People need to be trained on the safe use of the equipment and the hazards pointed out to people in the training. There should be a safe work procedure for the use of the machine with the hazards associated with the use of the machine fully explained in this document (this should be the case with all machines).

The training records and safe work procedures need to be readily available.

3. Supervision (Medium Priority Recommendation)

This is to ensure that people are working at a rate they can do safely. This is a paced task so people have to keep up with the product that they are supplied with. Supervisors in this area need to monitor this to ensure that people are not working at a rate that they cannot keep up with (particularly when they are new to the task and still learning).

Case Study Number 14: Machine Guarding - Conveyors

Organisation: Tatiara Meat Company

Machine guarding around belts is a critical design issue. There are Australian standards for machine guarding generally and for the guarding of conveyors. The general requirements for Guarding are specified in Australian Standard 4024.1 (1996). It states

> ***"that every projection such as a set screw, bolt or key on a exposed moving part of machinery should be sunk, shrouded or otherwise effectively guarded " (page 49)***

The AS 4024.1 requires a hazards assessment of the plant design and its use to be carried out so that any guarding hazards can be identified, assessed and controlled. Some of the belts in the plant are not adequately covered. Figure 35 illustrates the end of a powered roller in the boning room that is exposed. The risk of entrapment is relatively low as there is not someone next to the machine, the roller is rotating slowly and the exposed aperture is not large. However it still needs to be guarded.

Figure 35: End of a powered roller in the boning room that needs to be covered

The exposed rollers on a packing belt have the same problem. That is, the exposed roller on the end of the belt needs to be covered with a solid guard so that there are no exposed moving parts.

Operators will feel more comfortable about standing closer to the guarded conveyor without a risk of entanglement. This reduces the risk of overreaching and manual handling related injury.

Figure 36: Exposed moving parts at the end of a packing belt

Case Study Number 15: Throwing Product Task – Boning Room

Organisation: Tatiara Meat Company

Table 10 : This Table Summarises The Results Of The Audit For The Manual Handling Identification Results		
Identified Factor	**Examples Of Assessed Factors**[*]	**Is Factor Within Safe Limits?**
1- Posture & Movement*		
• Repetitive exertions	Number of movement per cycle	**No**
• Shoulder movements	Above shoulder height	**No**
	Reaching down and behind	Yes
• Forearm movements	Inward or outward rotation with a bent wrist	Yes
• Wrist movements	Palmer extension or full extension	Yes
• General Manual Handling	Movements & posture during task	**No**
2- Tool Design & Use*		
• General design & Use	Handle, storage, weight & shape	Yes
• Blade	Sharp	Yes
3- Workstation Design*		
• Access	Steps, space, handle, floor surfaces & drainage	**No**
• Layout	Space to move, reach tools, reach wash and product	**No**
4- Task Variety*		
• Rotation between tasks	At least 2 hourly rotations on repetitive tasks	**Yes**
• Training	Induction & ongoing training	**Yes**
5- Environment*		
• Thermal	Air temperature & air flow	Yes
• Lighting	Adequate for work tasks	Yes
6- Individual Factors*		
• New employee	Training, skills & supervision	Yes
• Returning from break	Training, skills & supervision	Yes
• Pre-existing injury	Capability, limits of injury & task demands	Yes

[**] The assessed factors have been derived from the reference documents listed in table 1 (page 3)

Throwing The Product Task - Boning Room

The results of the assessment are summarised in table 10. This section of the report provides a summary of the hazards associated with each aspect of the task that was highlighted in table 10.

Figure 37: Manual handling part of the carcass. Throwing it over the conveyor.

Summary of the Assessment

Manual Handling

Throwing part of a carcass that weighs approximately 6 – 8.5 Kg over a belt on a highly frequent basis is a risk of manual handling injury for the person throwing and to a lesser degree the person catching the carcass. To counter this Tatiara ensures this task occurs a maximum of 4 hours per week.

Recommendations – Throwing the Carcass Task

Review Workstation Layout (High priority Recommendation)
Review the layout of the boning room to examine whether this task can be eliminated.

Task Rotation (High priority Recommendation)
Rotate people as frequently as is practical through this work task. This is performed 1.5 hourly rotation between tasks and provides some meaningful change in muscle loads for the work tasks along the chain.

Manual Handling Training (High priority Recommendation)
The Code of Practice for Manual Handling (1990) states the following in relation to people undertaking manual handling at work:

> ***"The employer must:***
> ***ensure that employees involved in the manual handling task receive appropriate training, (including training in safe manual handling techniques) and appropriate supervision" (page 40)***

A 3 hour task specific training session in this area should satisfy this requirement.

Case Study Number 16: "Punching out the Sheep" – Slaughter Floor

Organisation: Tatiara Meat Company

Table 11 : This Table Summarises The Results Of The Audit For The Manual Handling Identification Results		
Identified Factor	**Examples Of Assessed Factors***	**Is Factor Within Safe Limits?**
1- Posture & Movement*		
• Repetitive exertions	Number of movement per cycle	**No**
• Shoulder movements	Above shoulder height	**No**
	Reaching down and behind	**No**
• Forearm movements	Inward or outward rotation with a bent wrist	**No**
• Wrist movements	Palmer extension or full extension	**No**
• General Manual Handling	Movements & posture during task	**No**
2- Tool Design & Use*		
• General design & Use	Handle, storage, weight & shape	Yes
• Blade	Sharp	Yes
3- Workstation Design*		
• Access	Steps, space, handle, floor surfaces & drainage	Yes
• Layout	Space to move, reach tools, reach wash and product	Yes
4- Task Variety*		
• Rotation between tasks	At least 2 hourly rotations on repetitive tasks	**Yes**
• Training	Induction & ongoing training	**Yes**
5- Environment*		
• Thermal	Air temperature & air flow	Yes
• Lighting	Adequate for work tasks	Yes
6- Individual Factors*		
• New employee	Training, skills & supervision	Yes
• Returning from break	Training, skills & supervision	Yes
• Pre-existing injury	Capability, limits of injury & task demands	Yes

* The assessed factors have been derived from the reference documents listed in table 1 (page 3)

Punching Out The Sheep – Slaughter Floor

The results of the assessment are summarised in table 11. This section of the report provides a summary of the hazards associated with each aspect of the task that was highlighted in table 11.

Figure 38: Using the hand to punch the skin away from the carcass

Summary of the Assessment

Manual Handling

There is a lot of bending and twisting of the spine involved in this task as the operator bending down to knee height to complete the task. Depending on the number of people doing the task an operator could perform this task every 1 – 2 minutes.

Occupational Overuse Injury Risk

The grip of the hand when it is being forced inside of the animal can cause significant strain to the muscles and tendons in the hand and wrist area, particularly if the sheep are dry and the operators perform the task on a continuous basis.

Recommendations – Punching Out the Sheep

Task Rotation (High priority Recommendation)
Rotate people as frequently as is practical through this work task. Currently they rotate every 1.5 hours from this task onto other tasks in the slaughter floor. This rotation between tasks provides some meaningful change in muscle loads for the work tasks along the chain.

Recommendations – Punching Out the Sheep cont….

Manual Handling Training (High priority Recommendation)
The Code of Practice for Manual Handling (1990) states the following in relation to people undertaking manual handling at work:

> ***"The employer must:***
> ***ensure that employees involved in the manual handling task receive appropriate training, (including training in safe manual handling techniques) and appropriate supervision" (page 40)***

A 3 hour task specific training session in this area should satisfy this requirement.

Automate or Semi Automate the Task (High Priority Recommendation)

Examine the technological options for automating or semi-automating this process. Technical advice is available from Dr Lewis Atkinson (Meat & Livestock Australia). Even if the automated function could only process the mutton and part of the lamb that would still represent a significant reduction in the amount of times this task has to be performed.

Case Study Number 17: Job Rotation – Slaughter Floor

Organisation: Tatiara Meat Company

Good design from a safety perspective requires more than just achieving good results in the physical design. The management of the job is critical to ensure that the safety of the work is optimised. One of the commonly used strategies to vary the muscle loads that people are exposed to in a task, is to rotate people between work tasks. This is particularly important in slaughter floor tasks because of the repetitive nature of the work people do. That is, if a particular task requires a limited number of muscles to produce highly repetitive movements or maintain a fixed work posture, those muscles and tendons may become fatigued which may lead to injury.

Job Rotation in the Slaughter Floor

The best form of job rotation is where people move through tasks that require different muscles to be used differently. For example, a task that requires more forces in the movements (eg. “punching our the sheep”) versus a task that requires less repetitive force (eg. Operating air tools).

The more varied the tasks are, means the more variety the muscles will have and therefore the risk of injury will decrease. The barriers to this system in the meat industry have been the tally system and other industrial-based issues.

There should be a structured job rotation program where people move through the different tasks. It should not be left to the individuals to organise without management support or it may not happen. Boning rooms such as Chapman’s (SA) and Greens (WA) have a job rotation program in their boning rooms and it works well in terms of reduction in physical stresses and job satisfaction for people.

A good job rotation program can have value not only in reducing the risk of musculoskeletal injury, but it can make the overall job more interesting. Science and common sense have shown that improvements in job satisfaction can lead to more ownership of the work process, reduced staff turnover and improvements in the quality of the work people can produce. The improvements in safety in this sort of environment are also well documented.

Job Rotation in the Slaughter Floor

Some of the tasks in the slaughter floor are very demanding (eg punching out the sheep – refer to figure 39) where other tasks do not put the same strain on the upper limbs (eg knife work – refer to figure 40). Continue to rotate every 1.5 hours which is an effective strategy for reducing the risk of overuse related injuries.

Figure 39: Punching out the sheep is a very demanding task on the lower back and upper limbs

Figure 40: Using an air knife on the slaughter floor

Case Study Number 18: Legging Task – Slaughter Floor

Organisation: Abdilla Meats Pty Ltd

Table 12 : This Table Summarises The Results Of The Audit For The Legging Task Identification Results		
Identified Factor	**Examples Of Assessed Factors***	**Is Factor Within Safe Limits?**
1- Posture & Movement*		
• Repetitive exertions	Number of movement per cycle	Yes
• Shoulder movements	Above shoulder height	Yes
	Reaching down and behind	Yes
• Forearm movements	Inward or outward rotation with a bent wrist	Yes
• Wrist movements	Palmer extension or full extension	**No**
• General Manual Handling	Movements & posture during task	**No**
2- Tool Design & Use*		
• General design & Use	Handle, storage, weight & shape	Yes
• Blade	Sharp	Yes
3- Workstation Design*		
• Access	Steps, space, handle, floor surfaces & drainage	Yes
• Layout	Space to move, reach tools, reach wash and product	**No**
4- Task Variety*		
• Rotation between tasks	At least 2 hourly rotations on repetitive tasks	Yes
• Training	Induction & ongoing training	**No**
5- Environment*		
• Thermal	Air temperature & air flow	Yes
• Lighting	Adequate for work tasks	Yes
6- Individual Factors*		
• New employee	Training, skills & supervision	Yes
• Returning from break	Training, skills & supervision	Yes
• Pre-existing injury	Capability, limits of injury & task demands	Yes

*The assessed factors have been derived from the reference documents listed in table 1 (page 3)

Legging Task – Slaughter Floor

The results of the assessment are summarised in table 12. This section of the report provides a summary of the hazards associated with each aspect of the task that was highlighted in table 12.

Figure 41: Using the knife during the legging task

Figure 42: Cutting the animal during the legging task

Wrist Movements

The manual handling of this task is repetitive in terms of the active range of movement for the cuts being produced for this task. There is between 30 – 50 degrees of spinal flexion for approximately 30 seconds which is 80 % of the cycle time.

The nature of cutting requires a bent wrist (towards the little finger -Ulnar deviation) with the wrist rolling with the hand bent towards the palm (palmer flexion). This sort of wrist deviation has less risk if the resistance force is low. If the resistance force is high (dry sheep or knife blade not sharp) the risk of injury to the muscles and tendons in the wrist / forearm & elbow increases.

Posture & Movement

The general flexed posture is static and can cause lower back strain if prolonged. The current job rotation system and the legging support chain (hangs under the buttocks – refer to figs. 41 & 42) help to reduce this sustained flexed working posture.

Layout

There is a reach to the animal (refer to figure 42). This is because there is a need to have the animal in front of the platform so the operator has to bend in front of their feet to grasp the animal, but they lean back during much of the cutting.

Recommendations - Legging Task

Task Rotation (High priority Recommendation)
Rotate people as frequently as is practical between work tasks. Ideally 2 hourly rotation between tasks would provide some meaningful change in muscle loads for the work tasks along the chain.

Knife Sharpening (High priority Recommendation)
Training in knife sharpening (especially for new employees) needs to continue. Reductions in the sharpness of knives has been demonstrated as contributing to the increase muscular effort whilst using the knife and contributes to an increase in the risk of cuts when using the knife.

Manual Handling Training (High priority Recommendation)
The Code of Practice for Manual Handling (1990) states the following in relation to people undertaking manual handling at work:

> ***"The employer must:***
> ***ensure that employees involved in the manual handling task receive appropriate training, (including training in safe manual handling techniques) and appropriate supervision" (page 40)***

A 3 hour task specific training session in this area should satisfy this requirement.

Work Layout (Medium Priority Recommendation – as required)
The platform illustrated in figures 41 & 42 appeared adequate in terms of size for the operators. However, **if** more people were involved in the slaughtering task the current platform may need to be extended to the left of the operator in figure 43. This is so that people working with a knife are not standing on the side of the platform.

Case Study Number 19: Slaughter Floor Platform

Organisation: Abdilla Meats Pty Ltd

The current slaughter floor platform is illustrated in figure 43. The design criteria for platforms is determined by Australian Standard 1657 (1992 – titled -Fixed Platforms, walkways stairways and ladders – Design, construction and installation)

Figure 43: Slaughter Floor Platform

The current design has the following design problems:

- No kick board on the front edge of the platform
- Split level platform requires a step handrail arrangement for the movement between levels

Recommendations – Slaughter Floor Platform

Figure 44 below illustrates a slaughter floor platform. It has a kick board on the front, side access with a ladder (with handrail) and enough depth on the platform to allow people to walk past each other.

Figure 44: A slaughter floor platform (photo courtesy of Greens Meats, WA)

Design Criteria for the Platform

General Safety
Whatever the design it must conform to the requirements of AS 1657 (1992).

Access & Egress
The steps up to the platform need to conform to AS 1657 (1992). The dimensions, and handrail requirements are summarised in AS 1657 (1992). If the change of level in the split platform is more than 300 mm a step and handrail will need to be fitted, again meeting the design requirements summarised in AS 1657 (1992)..

Movement on the platform
If people are crossing past each other on the platform, then the reasons for this have to be discussed in terms of operational requirements to minimise this, since people are walking with knives in their hands.

The Occupational Health, Safety & Welfare Regulations (1995) state the following in relation to the provision of space for movement:

> ***"If work must occur in the passage or space [where people walk] for egress must be at least 600mm wide. That is, the space behind the people working on the chain needs to be 600mm wide " (page 55)***

Surface of the platform

The surface of the platform needs to be free from any tripping hazards (eg.poor matting) with adequate drainage, maintenance and cleaning so there are no tripping or slipping hazards.

Case Study Number 20: Head Lifting Task, Slaughter Floor

Organisation: Agpro Operations Pty Ltd

Table 13 : This Table Summarises The Results Of The Audit For The Manual Handling Identification Results		
Identified Factor	**Examples Of Assessed Factors***	**Is Factor Within Safe Limits?**
1- Posture & Movement*		
• Repetitive exertions	Number of movement per cycle	**No**
• Shoulder movements	Above shoulder height	**No**
	Reaching down and behind	**No**
• Forearm movements	Inward or outward rotation with a bent wrist	**No**
• Wrist movements	Palmer extension or full extension	**No**
• General Manual Handling	Movements & posture during task	**No**
2- Tool Design & Use*		
• General design & Use	Handle, storage, weight & shape	Yes
• Blade	Sharp	Yes
3- Workstation Design*		
• Access	Steps, space, handle, floor surfaces & drainage	**No**
• Layout	Space to move, reach tools, reach wash and product	**No**
4- Task Variety*		
• Rotation between tasks	At least 2 hourly rotations on repetitive tasks	**No**
• Training	Induction & ongoing training	**No**
5- Environment*		
• Thermal	Air temperature & air flow	Yes
• Lighting	Adequate for work tasks	Yes
6- Individual Factors*		
• New employee	Training, skills & supervision	Yes
• Returning from break	Training, skills & supervision	Yes
• Pre-existing injury	Capability, limits of injury & task demands	Yes

*The assessed factors have been derived from the reference documents listed in table 1 (page 3)

Head Lifting Task – Slaughter Floor

The results of the assessment are summarised in table 13. This section of the report provides a summary of the hazards associated with each aspect of the task that was highlighted in table 13.

Figure 45: Trimming the head

Summary of the Assessment

There are essentially three main manual handling aspects to this task. They are:

- Lifting the head from the main rail
- Carrying it to the head rail
- Lifting the head onto the head rail

<u>Lifting the head from the main rail and carrying it to the head rail</u>

Lifting the head from the rail can cause manual handling hazards for the following reasons:

Weight
The heads are heavy- bulls heads can weigh in the order of 55kg, other heads can weigh up to 35 – 45 kg.
The lifting is repetitive. Depending on the rate of work, people may lift a head every 2- 3 minutes.

Amount of manual handling
Within the cycle of lifting, 50 – 70 % of the cycle time of the task is spent weight bearing the head. That is, either lifting the head from the rail, carrying it to the head rail or lifting it onto the head rail. So a large proportion of the work task is spent manual handling the head.

Low height of lifting
Bull's heads are not only heavy, but they are lifted from a low height because of the length of the animal hanging on the rail. The head could be about knee height (approximately 500mm) above the ground. Other animals' heads are still about mid thigh height above the ground (approximately 650mm) when they are lifted. This low height increases the risk of manual handling injury because of the amount of bending required to lift the head.

Figure 46: Lifting the head from the main rail

Carrying the heads
The head is carried approximately 5 metres between the two lines. This can impose a significant manual handling load on the person.

Gripping the heads
The manual handling of the head is difficult because there is not always a good grip. Some people grasp the head around the jaw (refer to figure 46). A risk at other sites has been when the head has not been de-skinned, and the operator has to put their fingers in the eye sockets when they are lifting the head. With a heavy bulls head in particular, it places a significant strain on the back, arms and shoulders with this lift.

Trimming the head
Before the head is lifted it is trimmed (refer to figure 45). There is some bending and twisting of the operators spine during this task, particularly with longer animals (as their heads are closer to the ground when they are hung on the rail.

Figure 47: Lifting the head from the main rail to the head rail

Lifting the head onto the rail

This task is illustrated in figure 47. The manual handling hazards for this task in terms of the repetition, weight and loads are the same as described in the previous section.

Lifting the head of the animal requires a lift height of approximately 1500mm (shoulder height). This height combined with the repetition, grip and weight risk factors already discussed, causes a serious risk of lower back, shoulder, and general muscular strain to the trunk and arms of the operator. This task is illustrated in figure 47.

Recommendations – Lifting the Head

Eliminate the Lifting – High Priority Recommendation

Lifting the head can be eliminated by getting a head lifting device. The device illustrated in figure 48 was used at South Burnett Meat works. It hooks under the head and works on an air assisted resistance mechanism which allows the weight of the head to be taken by the hook. It is suspended from overhead and allows the head to be transferred from one line to another with no lifting of the weight of the head.

Figure 48: Head lifting device (figure courtesy of South Burnett Meat Works)

Task Rotation (High priority Recommendation)
Rotate people as frequently as is practical through this work task. Ideally 2 hourly rotation between tasks would provide some meaningful change in muscle loads for the work tasks along the chain.

Manual Handling Training (High priority Recommendation)
The Code of Practice for Manual Handling (1990) states the following in relation to people undertaking manual handling at work:

> ***"The employer must:***
> ***ensure that employees involved in the manual handling task receive appropriate training, (including training in safe manual handling techniques) and appropriate supervision" (page 40)***

A 3 hour task specific training session in this area should satisfy this requirement.

Reference List

[Refer To Bibliography Report For A More Extensive List Of Manual Handling Hazard Management Reference Material]

Australian Standard 1657 (1992). **Elevated Platforms, Walkways & Stairs.** Standards Australia

Australian Standard 4024.1(1996)**Safe Guarding of Machinery.** Standards Australia

Code of Practice for Manual Handling (1990). WorkCover (SA)

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Gjessing, C.C., Schoenborn, T.F., & Cohen, A. (Eds.), (1994), NIOSH. **Participatory ergonomic interventions in meatpacking plants** (DHHS [NIOSH] Publication No.94-1240. Cincinnati, OH: U.S Department of Health & Human Services (DHHS), Centre for Disease Control and Prevention, National Institute for Occupational Safety & Health (NIOSH)

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Table of Contents

Section 1: Introduction

A systemic approach to the management of musculoskeletal injuries has to be taken. This is because there is not one problem for which there is one "quick fix" solution. The complex nature of the interaction of people with their work means the management of hazards covers a range of levels within the risk control hierarchy.

Structure of this Report

This literature review report covers the management of manual handling hazards in the meat processing industry sector. This divides the hazard management strategies into engineering and job design strategies, the relative merits of the two strategies are discussed.

This report contains the following sections:

- Engineering-based hazard management strategies
- Job design-based hazard management strategies (e.g. Job rotation & training)
- Summary of the risk control strategies
- Bibliography of relevant hazard management references

Section 2: Engineering Risk Control Strategies

This section of the literature review summarises the results of engineering risk control strategies for reducing the exposure to musculoskeletal hazards in meat processing plants. Studies from other industry sectors have been included if their results have implications or application to the meat industry in South Australia.

Table 1 provides a summary of the studies in terms of the authors, risk factors examined, control measures and the effects of these control strategies. Tables 1,2 & 3 are adapted from NIOSH, 1995

Within this section of the report the references have been categorised according to the following risk control methods:

Part 1: ***Tool modifications***
Part 2: ***Workstation modifications***

Part 1: Tool Modifications

This part of the report summarises the following:

- Ergonomic hazards associated with tool design and use
- Ergonomic benefits of correct tool orientation, tool dimensions and tool materials

The Problem

Matching the hand to the handle of a tool and then combining these to produce a safe set of movements is a key to reducing musculoskeletal fatigue and injury.

People measure their size for their clothes, shoes, hat, etc. Even at work we adjust safety equipment such as respirators, hats and clothing to meet our comfort, safety and task requirements.

There is an enormous variation in hand size and strength between people, despite this there is not enough practical thought given at the workplace level of how to overcome the problem of "one size does not fit all". That is, how to achieve a comfortable and safe grip on a tool (knife or hook). This is never more critical than in the meat processing industry. An industry that requires the fine body architecture of the hand to produce fine precision cutting movements as well as forceful power grip movements. These movements combined are usually performed at reasonably high speed, with a lack of variety in the movement patterns produced. When these risk factors are present in a job the risk factor for occupational overuse injury increases.

The readings in this section are critical, because they attempt to eliminate many of these risk factors by engineering risk control options to the tools that people use.

This attempt to eliminate the risk through improvements in design is what makes this type of risk control so effective in the management of hazards at work.

Tool Orientation

Several studies demonstrated that by bending the handle or reorienting the blade angle the amount of wrist deviation could be reduced (e.g. Armstrong, et al, 1982). This principal is illustrated in Figure 1.

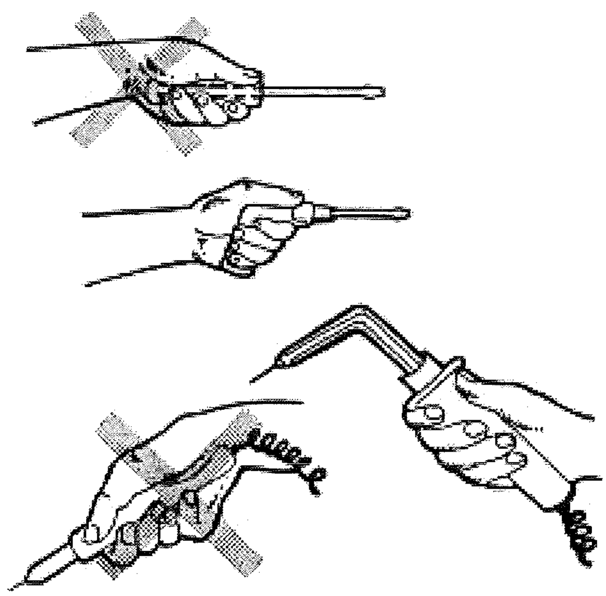

Figure 1: Deviated wrist position caused by design of the tool and its use. Wrist angle better (neutral) with the change in tool design (figures from Anderson, 1990)

Other design principals such as achieving a better "fit" of the handle in the hand can reduce the muscular effort to hold the handle and thus reduce the risk of strain when using the tool (e.g. Little 1987; Johnson 1988).

These issues are a little more complex in many meat industry scenarios because of the multiple orientations of the knife (e.g. Horizontal (vertical cuts) and the variety in grips (eg. Stabbing and slicing grip).

Despite this, these design principles can be applied to varying degrees to improve the orientation of the tool for the user.

Tool Dimensions

The dimensions of the tool are also critical. As Figure 2 illustrates, the longer shaft on the handle can push into the base of the palm. This stress concentration in the base of the palm has been known to contribute to the risk of Carpal Tunnel Syndrome (Dionne, 1995).

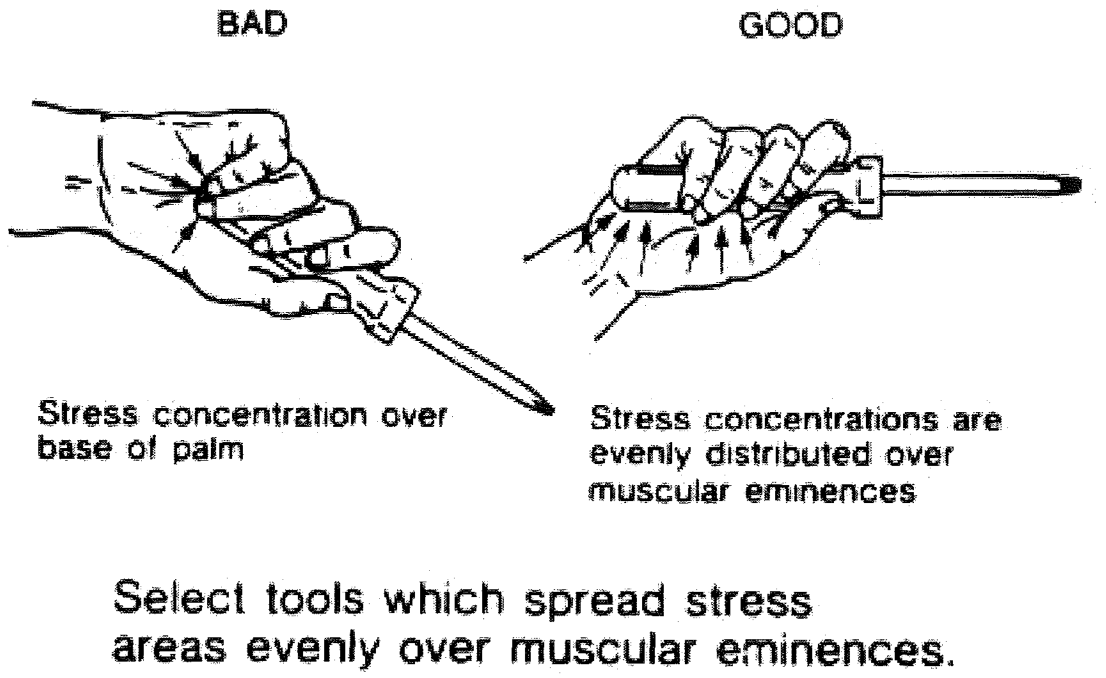

Figure 2: Poor handle design causes additional pressure concentration in the base of the palm of the hand. (NIOSH, 1995).

Tool Materials

The selection of materials for handles is a challenge because of the hygiene and safety requirements.

Some studies have demonstrated that using other tools with a slightly softer handle results in less muscle fatigue in the forearm, when using the tool (e.g. Johnson, 1988; Fellows & Freivalds, 1989). The logic of this is that the handle "moulds" around the hand to some extent, therefore, reducing the muscle effort required to hold the handle.

This has implications not only for the reduction in musculoskeletal effort required to hold the handle, but, this additional 'grip' may reduce run through injuries and affect the control and quality of the work. These specific variables are yet to be tested in the meat industry context, but, they have been shown to be the case for work with Surgeons (Miller et al, 1971, Little, 1987) and to some extent with power tools (Anderson, 1990).

Part 2: Workstation Modifications

Issues surrounding posture, the parameters and dimensions of the workstation within which the people work usually determine movement and manual handling. For example, the height of the rail or table will define the posture and reach required to perform the task.

The literature presented in this section is concerned with developing workstation design changes that improve the posture, movements and general safety of people working at those workstations.

The Problem

"One size does not fit all". Therefore, any workstation design that is evaluated has to be done to accommodate a physically diverse range of users, and variations in the product type and line speed. These are just some of the variables which can affect how optimal the human-machine interface can be.

Modifications to workstations like tools, have to be sensitive to safety, hygiene, task and individual requirements.

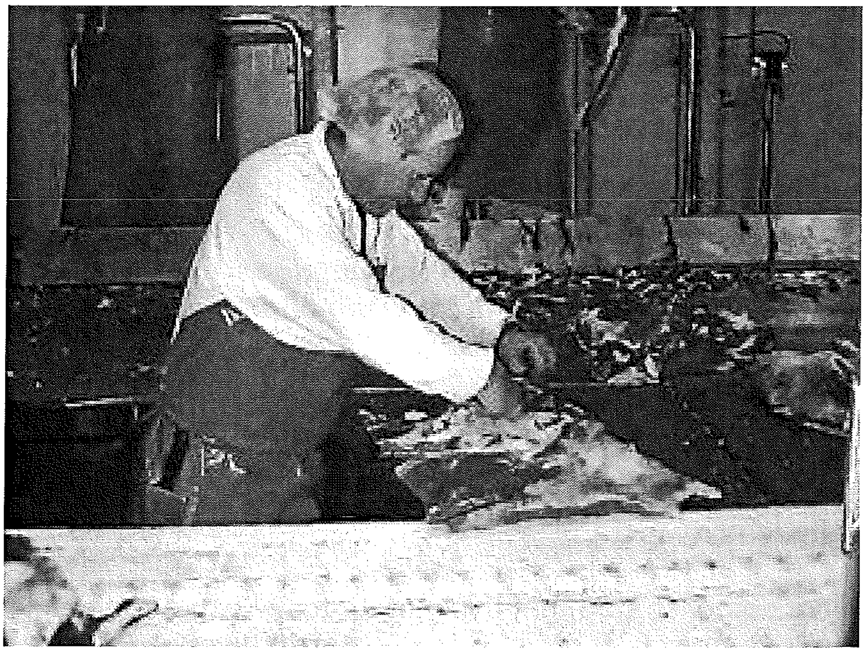

Figure 3: Slicing workstations that are set at different heights. The shape of the table also reduces the reach to the belt (Figure courtesy of Greens Meat Works, WA)

There is a whole range of design factors that can be integrated into meat processing operations. The studies that are discussed only represent some basic examples of the range of workstation design changes.

An example of this would be packing workstations. Basic issues such as having the box run parallel to the belt can reduce overreaching (Luttmann & Jager, 1992). This way the person only reaches over the width of the box (approx. 300mm) rather than the length of the box (approx. 600mm).

One bench height will not fit all but having individual workstations for boning or slicing which are not on the main conveyor (refer to Figure 3) allow some height adjustment (by having different benches set at different heights).

A good design outcome is dependent on having a quality design process.

Responsibilities for Design

In terms of responsibility for designing a safe workplace the code of practice for manual handling (SA, 1990) states:

> ***"Plant, equipment, containers and furniture shall be designed so they can be used safely. It is also desirable to design workplaces, activities and tasks to suit the capacity of the widest range of people.***
>
> ***The employer is required to take account of the safety of each employee, and not simply design a system which might be safe for an 'average' person in the workforce".***
> ***(page 5).***

The specific duties of designers, manufacturers, importers, employers and employees in relation to the design and use of plant is outlined in the Occupational Health, Safety and Welfare (SA) Regulations (Section 3.2, pp118-147).

Another example of ergonomic design interventions is the use of counter balancing tools. This is commonplace for larger tools such as the backing down saw (refer to Figure 6).

Smaller tools/saws that are counterbalanced have also demonstrated significant reductions in neck/shoulder muscle fatigue (Westgaard & Aaras, 1984 & 1985).

Figure 4: Counterbalancing tools can support the tool weight and Reduce muscular fatigue (Figure courtesy of South Burnnett Meat works).

Section 3: Job Rotation Risk Control Strategies

The previous section dealt with engineering risk control solutions. Even if this aspect of the work is optimal (which is rare), additional risks can be controlled through effective safety systems, administrative controls other re-design alternatives. This section of the literature review summarises the safety benefits of the 'non-design' related risk control strategies.

The notion of Job Rotation is often a misused and misunderstood term. Cynics of job rotation say it is like doing 10 mindless tasks rather than 1. In many cases, the term is used inconsistently throughout the literature. The predominant definition is rotating people through a range of tasks within the job.

The literature clearly differentiates between job rotation and job enrichment. The former is doing an increased range of tasks; the latter involves not only doing more tasks, but acquiring more skills.

A job rotation task (e.g. Moving between packing tasks) may reduce musculoskeletal strain (if designed correctly) but it may not make the task more interesting (eg. Just using the same skills but at different workstations). Job enrichment involves not only rotating between tasks, but rotating between different tasks (e.g. Boning & slicing) so people not only have a reduction in the risk of musculoskeletal injury but they learn new skills in different tasks. This makes the job not only safer (i.e. Different muscle loads for different tasks), but also makes the job more diverse in terms of the skills people are using (ie. Boning & Slicing tasks).

Whilst the definition of job rotation as a process is generally well recognised, it is the application of this process for the control of injury risks.

In terms of general safety, it is not the definition or the concept it is how it is applied as a safety risk control strategy.

If the objective is to reduce the risk of overuse related injuries, then the tasks that people rotate between need to involve different muscle groups being used in different ways (e.g. Static verses dynamic work).

Some of the benefits in job rotation strategies include the following:

The literature has demonstrated significant benefits in reducing muscloskeletal injuries by some form of job rotation.

- Rotation between light and heavy manual handling tasks reduce muscle fatigue (Jonsson, 1986)

- Rotation of people between heavy lifting and lighter precision movements reduces muscle fatigue (Lutz & Harsford, 1987)

Job rotation also has benefits as different tasks have different cycle times. Variation in the speed of work can reduce the risk of manual handling and overuse related injuries (Hani et al, 1979).

The old saying "it's not the hours you put in but what you put into the hours" has some truth in relation to the overuse injury. Increasing numbers of micro breaks (ie. Shorter duration, but more frequent) or doing stretch exercises (Lutz & Hainsford, 1987) does reduce the risk of overuse injury.

A muscular break may take the form of a small stretch at the workstation. Generally speaking, the more repetitive and high intensity the task the more these micro breaks are needed to provide some relief from accumulated muscle fatigue.

Some of the broader principles of job rotation include:

- Light precision movements (eg. Slicing) versus heavier muscle loads (boning)

- Sitting -vs- standing tasks

- Static tasks (eg bench top packing high frequency rate) -vs- dynamic tasks (eg pushing bins or general moving of cartons).

- Variation in the muscles that are being used (eg. Packing versus pushing trolleys)

- Manual handling (eg. Load out)

These are just some of the variations that should, where possible, be integrated into the work that people are doing.

The concept of job rotation has enormous value in meat processing plants. The work is repetitive, highly task specialised (eg. Only do boning or slicing) and work at a high rate in a tally-based system. These factors have all contributed to the meat industry having an injury rate 6 times the Australian Industry average.

This information is not new, and over recent times many plants have produced innovative and profound changes to the way job tasks are organised.

In terms of job rotation, some beef boning rooms rotate between the 12 boning tasks on a 2 hourly basis. This provides some variation between more physically demanding tasks and some lighter boning tasks (eg. Greens, WA). Other boning rooms are looking to have job rotation with white meat between boning (higher muscle demand) and slicing (less muscular exertions required).

Designers who have designed beef boning workstations for job rotation have also embraced this concept. In this case a team of people work on a side of beef. The team has boning tasks (on the rail and on the bench) slicing tasks and a packer. People rotate between these work tasks on a 3 hourly basis that can provide significant muscular variation in the work people do. The team concept also allows for tracing the product from the team so this has quality benefits. This concept is used at Stockyards beef processing plant in Queensland.

All the successful job rotation programs (eg. Lutz & Harsford, 1987) have required significant training for people to do a range of tasks.

This provides not only a safer work environment but it can provide the employer with a more flexible labor force, because people can do a range of tasks.

Section 4: Summary of Risk Control Strategies

This section provides tables that summarise the readings that have been used in the previous sections of this report.

For each of the references in these tables the following summary information is provided:

- The authors of the study
- The type of work task examined
- Relevance of the study to the meat processing industry sector
- The number of workers involved in the study
- The method of intervention
- A summary of the results
- Additional comments about the study

Table 1 summarises the readings related to engineering-based hazard management risk control strategies. These readings are discussed in section 2.

Table 2 summarises the readings related to a variety of hazard management risk control strategies. These readings are discussed in section 3.

Table 3 summarises the readings related to ergonomics training as a form of risk control and are discussed in section 3.

Table 1: Engineering Risk Control References

(section five on page 24 contains a full list of the references that are summarised in table 1)

STUDY & TARGET POPULATION	RELEVANCE TO MEAT INDUSTRY	PROBLEM & RISK FACTOR	CONTROL MEASURE	EFFECT
Miller, Ransohoff and Tichauer (1971) – Surgeons (bayonet forceps)	Assessment protocol of dexterous movements could be used for some hand manipulative tasks in the meat industry	Muscle fatigue during forceps use, frequent errors while passing instruments	Redesigned forceps (increase surface area)	Reduced muscle tension (determined by EMG, fewer passing errors)
Armstrong, Kreutzberg and Foulke (1982) – Poultry cutters (knives)	Assessment process and design outcomes could be used for tools in all aspects of meat industry	Excessive muscle force during poultry cutting tasks	Redesigned knife (reoriented blade, enlarged handle, provided strap for hand)	Reduced grip force during use, reduced forearm muscle fatigue
Knowlton and Gilbert (1983) – Carpenters (hammers)	Information about handle design could be applied to hand tools in the meat industry	Muscle fatigue, wrist deviation during hammering	Bent hammer handle, decreased handle diameter	Less strength decrement after use, reduced ulnar wrist deviation
Habes (1984) – Auto workers	Assessment method of posture could be used to assess meat processing tasks	Back fatigue during embossing tasks	Provided cut out in die (reduce reach distance)	Reduced back muscle fatigue as determined by EMG
Goel and Rim (1987) – Miners (pneumatic chippers)	Assessment results can be used to research same issues in meat industry	Hand-arm vibration	Provided padded gloves	Reduced vibration transmitted to the hand by 23.5 – 45.5%
Wick (1987) – Machine operators in a sandal plant	Results of static postures relates to some tasks on the chain in the meat industry	Pinch grips, wrist deviation, high repetition rates, static loading of legs and back	Provided adjustable chair and bench-mounted armrests, angled press, provided parts bins	Reduced wrist deviation, compressive force on L5/S1 disc (from 85 to 13 lbs)

STUDY & TARGET POPULATION	RELEVANCE TO MEAT INDUSTRY	PROBLEM & RISK FACTOR	CONTROL MEASURE	EFFECT
Little (1987) - Film notchers	Assessment results of repetitive tasks hazards can be applied to the meat industry	Ulnar deviation, high repetition rates, pressure in the palm of the hand imposed by notching tool	Redesigned notching tool (extended, widened and bent handles, reduced squeezing force)	Reduced force from 12-15 to 10 lbs, eliminated ulnar wrist deviation, increased productivity by 15%
Johnson (1988) – Power hand tool users	Assessment protocol can applied to repetitive meat industry tasks	Muscle fatigue, excessive grip force	Added vinyl sleeve and brace to handle	Reduced grip force as determined by EMG
Fellows and Freivalds (1989) - Gardeners (rakes)	Assessment protocol can applied to repetitive meat industry tasks	Blisters, muscle fatigue	Provided foam cover for handle	Reduced muscle tension and fatigue buildup as determined by EMG
Andersson (1990) – Power hand tool users	Issues about vibration can be applied to powered tools in the meat industry	Hand-arm vibration	Provided vibration damping handle	Reduced hand-transmitted vibration by 61-85%
Radwin and Oh (1991) - Trigger-operated power hand tool users	Issues about symptoms & injury can be applied to tasks in the meat industry	Excessive hand exertion and muscle fatigue	Extended trigger	Reduced finger and palmar force during tool operation by 7%
Freudenthal et al. (1991) – Office workers	Issues about symptoms & injury can be applied to tasks in the meat industry	Static loading of back and shoulders during seated tasks	Provided desk with 10 degree incline, adjustable chair and table	Reduced moment of force at L5-S1 by 29%, at C7-T1 by 21%
Powers, Hedge and Martin (1992) – Office workers	Issues about symptoms & injury can be applied to tasks in the meat industry	Wrist deviation during typing tasks	Provided forearm supports and a negative slope keyboard support system	Reduced wrist extension

STUDY & TARGET POPULATION	RELEVANCE TO MEAT INDUSTRY	PROBLEM & RISK FACTOR	CONTROL MEASURE	EFFECT
Erisman and Wick (1992)	Assembly workers	Pinch grips, wrist deviation	Provided new assembly fixture	Eliminated pinch grips, reduced wrist deviations by 65%, reduced cycle time by 50%
Luttmann and Jager (1992)	Weavers	Forearm muscle fatigue	Redesigned workstation (numerous changes)	Reduced fatigue build-up as indicated by EMG, improved quality of product

Table 2: A Range of Ergonomic Risk Control Strategies

(section five on page 24 contains a full list of the references that are summarised in table 2)

STUDY	TYPE OF WORK TASK & NUMBER OF WORKERS	METHOD OF INTERVEN-TION	RELEVANCE TO THE MEAT INDUSTRY	SUMMARY OF RESULTS	ADDITIONAL COMMENTS
Jonsson (1988)	Telephone assembly, manufacturing printed circuit cards, glass blowing, mining work	Job rotation	Task rotation mechanism could be used in the meat industry	Job rotation in light duty tasks not as effective as in dynamic heavy duty tasks	Measured static load in trapezius muscle with EMG
Westgaard and Aaras (1984; 1985)	Production of cable forms 100 workers	Introduced adjustable workstations and fixtures, counterbalanced tools	Examples of design changes to workstations (eg counterbalance tools) could be used in the meat industry	Turnover decreased, musculoskeletal sick leave reduced by 2/3 over 8 year period; productivity increased	Positive results of interventions verified by reductions in trapezius muscle EMG
Itani et al. (1979)	Photographic film rolling workers - 124 total workers in two groups	Reduced work time, increased number of rest breaks	Job design of task rotation & rest breaks for repetitive tasks could be applied to the meat industry	Reduction in cervicobrachial disorder and low back complaints; improved worker health	Post intervention productivity 86% of preintervention levels
Luopajarvi et al. (1982)	Food production packing tasks - 200 workers	Redesigned packing machine	Principles of workstation re-design can be applied to the meat industry	Decreases in neck, elbow, and wrist pain	Not all recommended job changes implemented; workers still complain
McKenzie et al. (1985)	Telecommunications equipment manufacturer - 6600 employees	Redesigned handles on tools & ergonomics training program	Tool design and method of ergonomics training could be adapted for the meat industry	Incidence rate of OOS decreased from 2.2 to .53 cases/200,000 work hours and lost days reduced from 1001 - 129 in 3 years	Data inadequate for rigorous statistical evaluation

STUDY	TYPE OF WORK TASK & NUMBER OF WORKERS	METHOD OF INTERVEN-TION	RELEVANCE TO THE MEAT INDUSTRY	SUMMARY OF RESULTS	ADDITIONAL COMMENTS
Rigdon (Wall Street Journal 1992)	Bakery - 630 employees	Formed union-management CTD committee; work station changes, tool modifications	The process of change (ie committee structure & approach) and the risk control strategies could be adapted to the meat industry	CTS cases dropped from 34 to 13 in 4 years, lost days reduced from 731 to 8	Union advocated more equipment to reduce manual material handling
Lutz and Hansford (1987)	Manufacturer of sutures and wound closure products – More than 1000 people	Introduced adjustable work stations and fixtures,	The risk control examples could be adapted to the meat industry	Reduced medical visits from 76 to 28 per month	Results based on two departments with 33 employees; company enthusiastic about exercise program
Jonsson (1988b)	Telephone assembly, glass blowing, mining work - 25 total workers	Job rotation	Mechanism of job rotation could be applied to the meat industry	Job rotation in light duty tasks not as effective as in dynamic heavy duty tasks	Measured static load in trapezius muscle with EMG
Silverstein et al. (1987)	Investment casting plant - 136 workers	Specific ergonomic changes not mentioned	Task assessment method could be adapted for the meat industry	No relationship between ergonomic changes and prevalence of hand-wrist CTDs	Ergonomic changes did not reduce the risk of studies jobs

STUDY	TYPE OF WORK TASK & NUMBER OF WORKERS	METHOD OF INTERVEN-TION	RELEVANCE TO THE MEAT INDUSTRY	SUMMARY OF RESULTS	ADDITIONAL COMMENTS
Jorgensen et al. (1987)	Airline baggage loaders - 6 males	Introduced a telescopic bin loading system	Methods of task analysis could be applied to the meat industry	Local muscular load on the shoulders and low back reduced	Measured EMG of the trapezius and erector spinae muscles
Geras et al. (unpublished)	Rubber and plastic parts workers - 87 plants of a national company	Ergonomics training; material handling equipment, work station modifications	Method of ergonomics training and some risk control solutions could be adapted to the meat industry	Lost time at two plants reduced from 4.9 and 9.7/200,000 hours to .9 and 2.6, respectively over 4-year period	Key to success has been increased training, awareness of hazards and improved communication between management and workers
LaBar (1992)	Household products manufacturer - 800 workers	Adjustable workstations, Re-designed tools, improved parts	Examples of workstation and tool design could be adapted for the meat industry	Reduced injuries (particularly back by 50%)	Company also has a labor-management safety committee that investigates ergonomics-related complaints
Orgel et al. (1992)	Grocery store - 23 employees	Redesigned checkout workstation	Examples of workstation design and method of training could be adapted for the meat industry	Lower rate of self-reported neck, upper back, and shoulder discomfort.	Study lacked a control group

Table 3: **Selected Studies Demonstrating the Effectiveness of Ergonomics Training**
(section five on page 24 contains a full list of the references that are summarised in table 3)

AUTHORS	TASK (INDUSTRY) & SAMPLE	RELEVANCE TO MEAT INDUSTRY	STUDY DESIGN	MEASURES	RESULTS
Brown et al. (1992)	Varied (Municipal) 74 works back injury history	Training methods could be applied to lifting tasks in meat industry	Before – After 6 wk. Back School Non-equivalent controls	Records study; Lost time, lost time cost, medical cost, total cost	Trained workers had sig. Before-after gains on all measures; fewer injury reports than controls
Orget et al. (1992)	Check-out (Grocery) 23 workers	Assessment checklists could be adapted for meat industry tasks	Before-After; no controls Training was part of ergonomics program	Self-report of discomfort	Ergonomics program resulted in some decrease in medication requirements and recovery days
Dortch & Trombly (1990)	Assembly by hand (Electronics) 18 workers	Assessment methods could be adapted for the meat industry	Before-After Handouts vs. handouts + demonstrations vs. controls	Behaviour observation	Trained groups had reduced traumatizing movements when compared with controls
wGenaidy et al. (1989)	Lifting and carrying (Packaging) 21 workers	Training & assessment methods could be applied to the meat industry	Before-After w/controls 8 Physical training sessions	psychophysical endurance, ratings of perceived exertion	Psychophysical endurance doubled after training, perceived exertion did not change

AUTHORS	TASK (INDUSTRY) & SAMPLE	RELEVANCE TO THE MEAT INDUSTRY	STUDY DESIGN	MEASURES	RESULTS
St-Vincent et al. (1989)	Lifting (Geriatric hospital) 32 orderlies	General training principles could be applied to meat industry	12-18 months After only 12h classroom training	Trained behaviour observers using a behaviour grid	Procedures from training more effectively used
Rosenfeld et al. (1989)	Varied (Pharma-ceutical) 522 workers	Assessment methods could be applied in the meat industry	Before-After Physical training vs social activity	Self-report of perceived workload, efficiency, fatigue	Physical training group had higher perceived workload but lower fatigue post training
Geras et al. (unpublished)	Varied (Auto mfg.) Unknown # plant leaders	Incident data could be used for the meat industry	Before-After Training course + pro-active ergonomics program	Lost time incidence rates	Substantial reductions in incidence rates after program was initiated
Chaffin et al. (1986)	Lifting (Warehouse) 33 material handlers	Assessment tools modified for the meat industry	Before-After 2 4-hour training sessions	Expert analysis of random video-taped lifts	Post-training lifts were better on 2 of 5 criteria
McKenzie et al. (1985)	Varied (Communications mfg.) 6,600 workers	Assessment tools modified for the meat industry	Before-After Training for ergonomics task force professionals only as part of ergo. Program	Repetitive motion incidence rates	Reduced incidence rates corresponded with program implementation
Smith & Smith (1984)	Supervision Textile mfg. 100 supervisors	Checklists modified for meat industry	After only, no controls	Self-reports of attitudes toward ergonomic activities	Substantial support for ergonomics activities

AUTHORS	TASK (INDUSTRY) & SAMPLE	RELEVANCE FOR THE MEAT INDUSTRY	STUDY DESIGN	MEASURES	RESULTS
Dehlin et al. (1981)	Lifting (Geriatric hospital) 45 Females with low back symptoms	Training methods could be used in the meat industry	Before-After Fitness training vs lifting technique training vs controls	Self-reports of perception of work, low-back insufficiency, and determination of physical work capacity	Negligible differences; fitness training resulted in greater perceived need to information and less perceived exertion
Snook et al. (1978)	Lifting (Varied) 192 surveys	Assessment methods could be used in the meat industry	After only Training vs no training	Self-report of insurance reps on their most recent claim	No training effects on injury incidence
Rohmert & Laurig (1977)	Varied (Auto mfg.) 195 workers	Assessment methods could be used in the meat industry	Before-After 4-day training course; no controls	Written questionnaire	Increased correlation between course time devoted to topic and importance rank

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