

Farm injury prevention at the design stage

CULVENOR J, COWLEY S

VIOSH Australia, University of Ballarat

SUMMARY

It is often the case that the greatest opportunity for the control of hazards is at equipment design stage. Designers and manufacturers of equipment are in a position to apply the principles of ergonomics and to use engineering methods to control risk. This paper describes an example of the development of information to support safe design processes. The particular example is equipment designed to assist with sheep shearing and crutching.

Sheep shearing and crutching are jobs that are obviously hazardous in terms of the awkward postures and heavy manual handling. Recently the use of devices to hold sheep in an elevated position while they are crutched have become popular and similar devices are emerging to assist with shearing.

Funded by WorkCover NSW, VIOSH Australia at the University of Ballarat undertook a project to investigate the use of devices generally known as “sheep handlers” used for shearing and crutching. The project aimed to identify common safety issues and from these develop a *Design Guide* that manufacturers could use to integrate ergonomic principles into the equipment, ideally at design stage.

The *Design Guide* has now been distributed to manufacturers. The Design Guide and other information is freely available via the NSW WorkCover web page and further reproduction and distribution by other bodies is encouraged.

INTRODUCTION

Australian workplace safety statutes are underpinned by the hierarchy of control methodology. The hierarchical model indicates that the priority for the minimization of risk should be to control the hazard at the source firstly by elimination if possible and then by engineering means. There is never a better time to incorporate good ergonomic principles and engineering hazard controls into equipment than at the design stage. Designers are therefore important targets for health and safety interventions. A little influence over a small number of equipment designers has the potential to benefit a great many equipment users. Furthermore designers of particular classes of equipment are usually small in number, identifiable and accessible. Therefore it is feasible to target this group to receive information. In contrast, the users of the equipment are usually large in number, difficult to identify and hard to access.

Too often opportunities for targeting designers are missed. Where opportunities are missed, we find that users are placed in a position where they need to make modifications of their own or rely on administrative controls or use personal protective equipment to reduce the risk that has been built in a machine. An example of this has been tractor roll over protection. Manufacturers readily achieved compliance however a great effort has been necessary to retrofit protection to tractors already in use - and there remains more to be done yet.

AIM AND OBJECTIVES

The aim was to *influence designers and manufacturers regarding safe design of farm equipment.*

The objectives were to:

- ❖ select a target area;
- ❖ develop guidelines for design; and
- ❖ distribute the guidelines to designers.

TARGET

The rural industry in Australia has among the highest injury incidence rates. The National Health and Safety Commission (1998) report an incidence rate of 37.2 injuries per 1000 workers (1996-97) versus 22.9 injuries per 1000 workers in all industries combined. In NSW, the incidence rate for injuries in the rural industry was 47.1 injuries per 1000 workers (1996-97) versus 19.4 injuries per 1000 workers in all industries (WorkCover NSW 1999).

Sheep shearers are known to be a group at risk within the agriculture industry. Worksafe Australia (1995) reported that sheep shearers made 150 claims per 1000 workers per year (1992-93) compared with the average of 26 claims for other industries. In 1996-97 claims by NSW sheep shearers combined under Grain, Sheep and Beef Cattle Farming, Sheep Shearing Services and Unspecified Agriculture cost a total of \$10.5M and about ¼ of these injuries were associated with handling a sheep (WorkCover NSW 1999). In addition to addressing the personal costs borne by workers in the industry, it is important that the impact of worker injury on the cost of production be minimized in order for wool to be a competitive product.

In terms of the conventional methods of shearing and crutching, information is available to inform woolgrowers about how to design the shed (AWC 1980; Barber 1983; Barber & Freeman 1986; McEvoy & Simpson 1988; Conroy & Hanrahan 1994). In addition, information specifically focussed on the health and safety aspects of sheep shearing is available (AWU 1993; AAHU 1997), as is a guide to assist shearers in minimising injury through exercise (Williams, et al. 1997). Research has also been undertaken to establish the health and safety impacts of poor design of the conventional shearing shed (Culvenor, et al. 1999a; 1999b; Payne, et al. 1999).

However, even in the best circumstances, the task of shearing sheep remains one of the most strenuous occupations and studies have confirmed that shearing is intensive in terms of its energy demand (Stuart 1991; Webster & Lush 1991). Shearing incorporates nearly all the risk factors highlighted in the National Code of Practice for Manual Handling (NOHSC 1990). Various organizations have pointed to the occupational hazards of shearing with manual handling being one of the most significant hazards faced by a shearer (AWU 1993; HSO 1995).

SHEEP HANDLING EQUIPMENT TO ASSIST WITH SHEARING AND CRUTCHING

Two aspects of shearing and crutching that make the job hazardous are the catching and dragging of the sheep and the fully-flexed posture that the shearer adopts while doing the work. The catching and dragging of sheep is particularly problematic when crutching because many more sheep are caught and dragged per day.

Equipment that holds the sheep off the floor while crutching is performed has become popular over recent years. Such equipment removes the need for the shearer to adopt a fully-flexed posture. Furthermore, sheep are delivered to these units in races in a way that aims to remove the problems associated with the catch and drag from the traditional "catching pen".

Although there seem to be no data about the number of sheep crutched in cradles versus "over the boards", we can say with some certainty that sheep handling equipment is in reasonably common use and has therefore changed the job for many people working in the industry. Devices to assist with shearing are not so well developed and are only emerging at the moment but may be significant influences in the near future.

The crutching systems range from single operator units installed inside shearing sheds to multiple operator mobile units. The mobile units are popular for crutching sheep "in-field" especially in the pastoral areas of New South Wales, South Australia and Western Australia. In some instances, usually where the sheep are a long distance from shearing shed facilities, the mobile crutching units are used for shearing.

It was considered prudent to conduct an assessment of the likely safety impact of the new technologies, to note common hazards that may exist, and then develop guidance material that could be used by designers and manufacturers of the equipment.

DEVELOPING THE DESIGN INFORMATION FOR DESIGNERS AND MANUFACTURERS

Representatives of the wool harvesting industry were consulted to establish the range of equipment that exists or is emerging. Thirty-three individuals and representatives of bodies involved in the wool industry were contacted (State and National Farmer's Federations; Australian Workers' Union; Shearing and Rural Workers' Union; Shearing Contractors Association of Australia; Wool Mark Company). This consultation was used to identify equipment and its location and to gauge of the range of hazards associated with the use of this equipment.

Twenty-eight crutching and seven shearing systems were reviewed in various locations throughout Australia. The equipment was observed in use where possible and operators were consulted. Where equipment was not in use, the equipment was examined and the owner/operator were consulted regarding its operation and health and safety issues. An assessment was made, based on the ergonomic issues of the interface between the operator and the machine, the occupational hygiene issues, and work organisation issues. Checklists on manual handling (NOHSC 1990), occupational overuse syndrome (NOHSC 1996) and plant (HSOV undated) were used. Manual handling issues in particular were analyzed by a researcher with clinical physiotherapy experience and the working postures associated with some machines were analyzed using biomechanical modeling using the University of Michigan 3D Static Strength Prediction Program [reported by Culvenor and Williams (1999)].

The review of the equipment indicated that, in general, the new systems for shearing and crutching have the potential to expose operators to less risk of manual handling injury than the conventional methods. Generally it was noted that the sheep handling equipment offer benefits including: reduced bending; no catching or dragging of sheep; and many utilize an automatic handpiece switch. There are a number of disadvantages associated with the new technologies, some of which can be generalized to most equipment:

- ❖ the tendency for equipment to require operators to semi-stoop;
- ❖ the use of handpieces close to metal objects which could lead to comb breakage and/or handpiece lock-up;
- ❖ the use of handpieces close to the face and upper body;
- ❖ problems with bending to feed sheep into the unit; and
- ❖ the lack of restraint of sheep legs that may result in the legs striking the handpiece or face/upper body.

Similarly, there would seem to be opportunities for new technology to positively impact on the OHS issues associated with shearing. However, the development of shearing technology is less well advanced and would seem to face much greater hurdles. In this light, any further development of equipment to assist with shearing in a way that includes consideration of OHS is to be encouraged.

DISSEMINATION OF THE DESIGN MATERIALS

A *Design Guide* has been developed to assist designers and manufacturers of sheep handling equipment (see the contents of the *Design Guide* in Appendix A). The *Design Guide* contains a set of checklists for equipment design and operation that were also produced as a separate document. A catalogue of the equipment reviewed was produced without prejudice to aid the purchasing decisions (the catalogue also contains the checklists).

There are two targets for the materials:

1. *Designers/manufacturers*. Designers and manufactures are the key target in order to influence the safety of equipment at the design stage. Therefore copies of the design guide have been distributed to identified manufacturers.
2. *Users*. Users of the equipment are also important however users are a much larger population and are not readily identified. To give this group access, the materials are available on the NSW WorkCover web page.

Bodies that have been identified as having members/constituents with an interest in the information, will be sent a single hard copy of the materials as an example. These bodies will be encouraged to promote the materials to their members and will be able to offer access to the documents by advising their members of the location on the NSW WorkCover web page or they will be able to download, print and distribute the documents in hard copy format.

This paper and presentation is part of the effort to advise the farm safety community of the materials.

Users of the *Design Guide*, *Equipment Catalogue* and *Checklists* are encouraged to return a survey, included in the documents, to evaluate their usefulness and identify improvements that can be made for future editions.

CONCLUSION

The conclusion of the project is that sheep handling equipment makes a positive contribution to safety in the crutching of sheep. While the equipment reduces some of the greatest risks of the traditional method of crutching, namely the catching and dragging of sheep and the fully flexed posture, there are a number of improvements that could be made to the equipment. These are noted in the design guide that should be utilized by manufacturers. In the case of shearing, the handlers are less well developed but there would appear to be similar opportunities for their use to improve safety.

In any work it is important that the hazards of new equipment and work processes be identified, the associated risks assessed and control measures applied. This is equally true of shearing and crutching where the introduction of new methods should be accompanied by a consideration of any new hazards such that problems can be addressed at an early stage.

This project has identified a class of equipment being used in a hazardous industry, identified common issues with the use of that equipment, and developed information to assist designers and manufacturers to improve that equipment. We believe that this model could be transferred to other areas of concern in agriculture. Some of these are listed in recommendation 2 below.

RECOMMENDATIONS

1. That bodies with an interest in farm safety advise their members/constituents of the *Design Guide*, *Equipment Catalogue* and *Checklists* and their availability and location.
2. That OHS issues associated with other classes of agricultural plant (e.g. grain handling and storage equipment; power take-off driven equipment; hydraulic systems; tractors; etc) be addressed by adopting a model as follows:
 - ❖ identify a class of plant that is hazardous;
 - ❖ identify the range of models/types of this plant in manufacture/use;
 - ❖ undertake a risk assessment by inspecting the plant in use;
 - ❖ develop guidance material for manufacturers of the plant;
 - ❖ promote guidance material to manufacturers; and
 - ❖ promote purchasing guidelines and information about operation to users.
3. That OHS regulatory authorities incorporate the above recommendations into their strategic plans.

REFERENCES

- Australian Agricultural Health Unit 1997, *Guidance Notes for the Sheep and Wool Industries, Number 22 Woolshed Safety*, AAHU, Moree, NSW.
- Australian Wool Corporation 1980, *Wool Harvesting Notes: Shearing Sheds*, AWC [parts of this loose-leaf document are dated up to 1983].
- Australian Workers' Union (Vic.) 1993, *Code of Practice for the Shearing Industry (Health, Safety & Welfare Standards)*, AWU, Carlton South, Victoria.
- Barber, A. 1983, *Shearing Shed Design*, Primary Industries South Australia, Murray Bridge.
- Barber, A.A. & Freeman, R.B. 1986, *Design of Shearing Sheds and Sheep Yards*, Inkata, Melbourne.
- Bentley, R. 1993, *Managing shearing to improve productivity and reduce injury*, South Australian Farmers Federation.
- Conroy, F. & Hanrahan, P. 1994, *Sheepyard and Shearing Shed Design*, Agmedia, East Melbourne.
- Culvenor, J. & Williams, R. 1999, 'Biomechanical Analysis of the use of Sheep Handling Devices to assist with Shearing and Crutching', Submitted to *Applied Ergonomics*.
- Culvenor, J., Harvey, J., Cowley, S., Lawrance, M., Payne, W., Stuart, D. Williams, R. 1999a, 'Determination of the Force Required to Drag Sheep over Various Surfaces', Submitted to *Applied Ergonomics*.
- Culvenor, J., Harvey, J., Williams, R., Cowley, S., Lawrance, M., Payne, W. & Stuart, D. 1999b, 'Biomechanical Analysis of Releasing a Sheep following Conventional Shearing', Submitted to *Applied Ergonomics*.
- Health and Safety Organisation Victoria n.d *Plant Hazard Checklist*, HSOV, Melbourne.
- Health and Safety Organisation, Victoria 1995, *The Sheep Shearing Project*, HSO, Melbourne.
- McEvoy, R.I. & Simpson, I.H. 1988, *Australian Shearing Shed Design*, NSW Rural Industry Training Committee Ltd.
- National Occupational Health and Safety Commission 1990, *National Standard for Manual Handling and National Code of Practice for Manual Handling*, AGPS, Canberra.
- National Occupational Health and Safety Commission, 1998, *Compendium of Workers' Compensation Statistics, Australia, 1996-97*, AusInfo, Canberra, available www.worksafe.gov.au.
- National Occupational Health and Safety Commission 1996, *Guidance Note for the Prevention of Occupational Overuse Syndrome in the Manufacturing Industry* [NOHSC:3015(1996)], AGPS, Canberra.
- Payne, W.R., Culvenor, J., Lawrance, M., Cowley, S., Stuart, D., Harvey, J. & Williams, R. 1999, 'Reducing the Energy Cost and Likelihood of Back Injury During Sheep Shearing by Altering the Path of Sheep Drag', submitted to *Applied Ergonomics*.
- Stuart, D. 1991, 'The Physical Demands of Sheepshearing – with Particular Reference to the Physical Fitness of Shearers', *Farmsafe 88: Papers and Proceedings of the Farmsafe 88 Conference*, University of New England, AGPS, Canberra, pp. 419-427.
- Webster, M.E.D. & Lush, D.P. 1991, 'The Effect of Shearing and Crutching', *Farmsafe 88: Papers and Proceedings of the Farmsafe 88 Conference*, University of New England, AGPS, Canberra, pp. 449-453.
- Williams, R., Lawrance, M & Pryor, J. 1997, *The Australian Rules of Shearing: An exercise guide for shearers*, Department of Human Services, Grampians Region, Victoria.
- WorkCover NSW 1999, *Industry Reference Groups, Rural: Industry Profile 1996/97*, WorkCover NSW, Sydney.
- Worksafe Australia 1995, *Occupational Health and Safety Performance Overviews, Selected Industries: Issue No. 9 Agriculture and Services to Agriculture Industries*, by B. Cole & G. Foley, AGPS, Canberra.

APPENDIX A: TABLE OF CONTENTS FROM DESIGN GUIDE

PREFACE

ACKNOWLEDGEMENTS

CONTENTS

1. INTRODUCTION: PRIORITY INJURY PREVENTION
2. OPTIMUM EQUIPMENT DESIGN GUIDELINES
 - 2.1 GENERAL
 - 2.2 CHECKLISTS FOR DESIGN
3. OPERATOR/MACHINE/SHEEP INTERFACE ISSUES
 - 3.1 MANUAL HANDLING
 - 3.1.1 General
 - 3.1.2 Working Reach
 - 3.1.3 Working Height
 - 3.1.4 Loading Sheep
 - 3.1.5 Obtaining the Handpiece
 - 3.1.6 Encouraging Sheep to Enter Handler
 - 3.1.7 Cradle System Design
 - 3.2 OCCUPATIONAL OVERUSE SYNDROME
 - 3.3 PLANT
4. WORK ENVIRONMENT AND WORK ORGANISATION FACTORS
 - 4.1 WORK ENVIRONMENT ISSUES
 - 4.1.1 Hot Climate
 - 4.1.2 Cold Climate
 - 4.1.3 Airborne Contaminants
 - 4.1.4 Noise
 - 4.1.5 Lighting
 - 4.1.6 Chemicals
 - 4.2 WORK ORGANISATION ISSUES
 - 4.2.1 Consultation
 - 4.2.2 Pacing and Work Rhythm
 - 4.2.3 Job Design
 - 4.2.4 Hours of Work
5. CONCLUSION
6. REFERENCES AND POTENTIAL READING
7. APPENDICES: ORGANISATIONAL CONTACT INFORMATION
 - 7.1 HEALTH ADVICE
 - 7.2 EMPLOYER ORGANIZATIONS
 - 7.3 EMPLOYEE ASSOCIATIONS
 - 7.4 SAFETY ADVICE & OHS INSPECTORATE
 - 7.5 OCCUPATIONAL HEALTH AND SAFETY INFORMATION RESOURCES
 - 7.6 STANDARDS AUSTRALIA

DESIGN GUIDE, CHECKLISTS & CATALOGUE SURVEY