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Preventing amputations from bandsaws in the red meat industry

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Abstract

Australian abattoirs have historically experienced high injury rates given the reliance on manual labour and high risk equipment such as knives and bandsaws. Whilst injuries relating to knives have reduced significantly with the introduction of cut proof gloves, injuries relating to bandsaws continue. Some meat processors have implemented controls such as guards, training and anti fatigue surveillance, however none of these controls are effective in preventing amputations. The Bladestop safety mechanism has been developed through an exhaustive consultation process with stakeholders including processors, industry regulators, safety professionals and engineers to address this risk. The sociotechnical aspects of technology implementation were considered and utilised in the consultation plan to ensure the maximal acceptance and success of the safety mechanism and systems. The mechanism is currently being installed in 20 red meat processing plants and will be extended to the retail sector in the coming year.

Keywords: Bandsaw, injuries, safety mechanism, consultation

1. Industry Perspective

The Australian red meat industry is a valuable part of Australia's economy and social fabric. The red meat industry generates $A15 billion for the Australian economy and employs over 300,000 people. Meat and Livestock Australia (MLA), the research and development arm of the red meat industry focus research and innovation on identified threats to sustainability in order to maintain a competitive advantage in the global and domestic market.

One of the major threats to the sustainability is the high financial and social costs of workplace injuries. The South Australian Workcover Authority [1] report that in South Australia alone the annual cost of injuries to the community is over $8 million dollars a year. These figures reflect the direct cost of injury however indirect costs such as loss of productivity and skilled labour, training and replacement costs of temporary and permanent employees and the loss of function and subsequent quality of life of injured employees are difficult to capture. With the skills shortage currently being experienced in Australia, this places greater pressure on the sustainability of the industry given the impact that this has on the retention and recruitment of skilled employees. High turnover rates and inability to attract and retain staff are dramatically affected by the industry's image as a safe place to work.

1.1 Bandsaws

Bandsaws are used in most red meat processing plants with a greater proportion found in sheep processing. Currently all bone is either cut with a hand tool saw or a band saw .The number of bandsaws in processing plants range from one to up to 20 in a boning room. They are used for a variety of tasks from breaking up the whole carcass into portions to tipping the ends of the ribs.

1.1.1 Current risk control

Bandsaw risks are well known in the industry with

both the frequency but also the consequences of injuries rating the risk as high with most meat processors. One small sheep processor alone in a five year period reported 6 amputations and 20 lacerations requiring surgery and stitches.

Unfortunately most people who experience an injury on a bandsaw suffer some form of amputation, ranging from the tip of a digit to the whole digit. There is currently no failsafe solution to prevent amputations on bandsaws within the Australian meat processing sector or the world, as MLA are aware. In the past the industry has introduced many controls such as guarding, training and anti fatigue measures all with limited success, bandsaw injuries continue to be reported.

2. Developing the Bladestop safety mechanism

When searching for effective solutions to industry risks, MLA often look to other industries such as mining or the timber industry for innovative risk controls. It was the timber industry that prompted the current research following the discovery of a control that reduced injuries relating to circular saws. An American company called Saw Stop had developed an innovative approach to reducing the dangerous aspects of saws in the wood industry. Whilst the concept was transferable, the actual technology required further development to be applied to the meat industry.

The concept for the Sawstop system revolves around the human body having a large capacitive coupling that is drastically different to wood and therefore can easily be sensed when the finger comes in contact with the saw blade. This is not the case in the meat industry as a human finger and a carcass have very similar capacitive coupling. The sensing technology therefore needed to be developed to ensure a reliable operation for the meat industry.

After this initial discovery of the Sawstop concept, MLA discussed the concept with a number of commercialisers and research suppliers until one company was identified and contracted to progress the concept further and develop it to suit meat processing.

2.1. The technology

The Bladestop system has three integral components; the sensing systems (see Fig. 1), the firing and mechanical mechanism (see Fig. 2) and the operating smarts.

Fig. 1: The sensing system

Fig. 2: The firing and mechanical mechanism

The sensing system enables the saw to sense the difference between a piece of meat and a person's hand. An arm or wrist band is worn by the operator which applies a small voltage (under 5 volts, which has been approved by the Standards Australia) to the operator and verifies that the voltage is present. By doing this once the person comes in contact with the blade and the non conductive gloves have been penetrated, the system then triggers.

The blade is then cut mechanically once the computer processor has determined that a person has come in contact with the blade. The blade is

mechanically cut 10 milliseconds from the time that the person touched the blade. The Bladestop mechanism mechanically shears the bandsaw blade and grips above the cut to stop further travel. This causes the blade in the cabinet to lose contact with the fly wheel which is still travelling at great speeds after the motor has stopped.

The third component, the computer smarts allow Bladestop to interact and service the needs of the operator. The processor does not allow the saw to run until it knows that the operator has the wrist band on. Functions such as prevention of triggering when the motor is not running are designed to eliminate false triggers. The easy setup and recocking mechanism allows the operator to reset the mechanism with ease enabling limited down time. Dual processors for redundancy and shelf checking have been installed to allow for an extra level of inbuilt reliability.

3. The consultation process

Whilst the development of the technology is paramount to the project success, equally important is the consultative approach of the project development to ensure the acceptance and success of the technology. Consultation with industry stakeholders was seen as key to the success of this research project. MLA have supported a number of technology projects in the past, on paper all appearing to have great benefit to the meat industry. Unfortunately the implementation of some of this technology has been flawed and the technology has failed.

MLA recognises that it is not just the kind of technology implemented that will ensure a positive impact, but rather how the technology is implemented. Implementation should not be confused with installation of technology for it involves a change in companies and high levels of consultation. This approach often deemed a sociotechnical systems (STS) approach aims to optimise both the technical and social effectiveness of the new process. Considering this approach allows researchers and commercialisers to maximize the potential of technology whilst minimizing their inherent weaknesses such as reliability. Failure to do this can severely limit the impact and success of the technology to the business.

There were two main reasons for the high level of consultation; past experience of technology failing due to lack of STS approach, as well as the high level of variability of processes that the technology was being applied. The safety mechanism is designed to be retrofitted to bandsaws and given the variation in models of bandsaw, tasks performed and actions performed in the industry, it was important to involve as many processors as possible in the design stage.

With this concept in mind, in the very early stages of this research project, the technology manager and the people issues (processing) manager worked together to plan both the technical and the organisational needs of the project. When considering the type and level of consultation that would be required to ensure success the team drew on the experience and knowledge of many within the meat industry as well as experts from the academic arena.

3.1. Establish the need

With any technology it is important that the people who are to invest in the technology and who are directly impacted by the technology see the need. It was important to interview and ask the processors about high risk tasks and this was done through a number of forums, projects, mail outs and meetings. Every processor reported that they considered the bandsaw a high risk task that they would like to control. As well as this anecdotal evidence, injury data was collected to identify the impact of bandsaw injuries on workers compensation premiums and production in order to quantify the financial benefits of an effective bandsaw control.

3.2. Processor commitment

It was important from the outset to engage meat processors in this project. Many of the processors have been in the industry for a long time and have become sceptical about technology given some have had a negative experience in the past.

Communicating with the red meat industry has its difficulties given the widespread and often remote distribution of abattoirs and the sheer number of processors. MLA took every opportunity to show early footage of the Sawstop to determine interest in the concept and determine the need for a similar concept that could apply to the red meat industry.

The video footage of the Sawstop concept was shown at every forum including committee meetings, OHS conferences and network meetings. The Sawstop video footage was also mailed out to every meat processor in Australia and a fax back form was attached to gauge the level of interest in the industry. Overwhelmingly, the response was positive and the processors conveyed their commitment to the research from an early stage.

3.3. Sociotechnical approach

Nadin, S.J., Waterson, P.E. & Parker, S.K. [2] highlight that there are many tools available to assist in designing or re-designing jobs. Clegg, C. W., Coleman, P., Hornby, P., Maclaren, R., Robson, J., Carey, N., & Symon, G [3] agree, but state that there are not many methods and techniques available for designing jobs that incorporate the psychological and organisational consequences of design decisions. Instead, most job design tools tend to focus on technology while ignoring the social costs.

Many tools have been developed to overcome these technical biases including a scenarios-based tool outlined Clegg et. al. [3]. In line with STS design principles, this particular scenarios based tool is intended to incorporate high levels of involvement including front line employees, management, and technical experts. The scenarios tool is designed to be used in a workshop environment and is used to explore requirements for new technology. Whilst this tool was not used directly, the concept was adopted and a similar methodology adopted.

3.2.1. Workshops

Every meat processor in Australia was invited to attend a workshop not only view the latest development in the technology but most importantly to give invaluable feedback on the working prototype. The workshop was designed not only to show case the technology developments but also to implement the sociotechnical concepts and identify potential barriers to the implementation of the technology.

Representatives from 14 red meat processors, including CEOs, production managers, occupational health and safety officers, human resource managers and boning room employees attended the workshop held at the factory of the company developing Bladestop. A presentation by the developers outlined the process they had undertaken from the initial concept in the timber industry to the developments that had occurred to suit the meat industry environment. Footage of the trials of the early development of Bladestop were shown to highlight the process and the effectiveness in the braking mechanism (see Fig.4). This was followed by an extensive consultation period in which processors discussed potential barriers as well make recommendations for the improvement of the system. The processors were then able to view the early working prototypes of the Bladestop technology and interact with the mechanics of the technology (see Fig. 5).

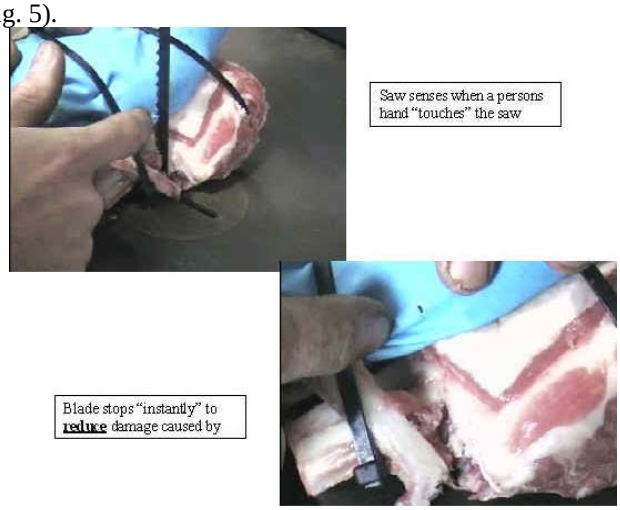

Fig. 4: Footage of Bladestop trials

Fig. 5: Workshop participants view working

prototype

What was most important about the timing of this workshop was that it occurred at a relatively early stage in the development of the system, so that recommendations could be taken and board and changes made. A number of issues were identified as potential barriers or advantages and these were all documented. Some issues discussed included; the activation for the braking method, where it would be, how the operator would interact and activate the mechanism. Initially a footpedal design was discussed however following the workshop many issues were raised including; the operators need to move away from the saw for short periods and therefore the need to leave the footplate, ergonomic issues of the footplates being placed adjacent to each other when most operators need to move and change their foot position. Discussions then led to the concept of a bungy cord being placed either on the arm or the leg. Other issues discussed were:

- The issue of 5 volts running throughout the operator
- Safety considerations if other parts of the body came into contact with the saw or the table and what guarding would be required
- Quality and design of non conductive gloves
- Sensitivity of the technology, if too sensitive and always breaking the blade this affects productivity, if not sensitive enough will lead to a serious injury
- Maintenance and installation considerations, needs to be operator maintained and therefore they must be very involved in the installation process

Many recommendations for the designers were made in the workshop, most of which were addressed and have been implemented. As well as the people who attended the workshop having input, it was suggested that all plants that are involved with the project return to site and show the video footage of the technology and get feedback from operators. This was undertaken by a number of sites and further feedback gained.

3.4 Consultation with regulators

As well as consulting with the processors, it was also important to consult with the regulators to ensure that the technology was supported by the State based Workcover Authorities. Meetings were held with representatives from MLA, the commercialiser and the regulator body. The main issue raised in this meeting was that at the time the device was not titled a safety device yet people would rely on it as a safety device. It was recommended that the work be undertaken to attain accreditation to either AS/NZ 61508 functional safety for programmable electrical equipment or AS/NZ 4024 categories of reliability. Extensive work was undertaken to achieve this.

4. Site implementation

Following the technical changes made on the basis of the extensive consultation process the Bladestop system was ready to be implemented on site. MLA invited 20 processors to be involved in the implementation phase which ensured that one bandsaw on site would be retrofitted with the technology.

Prior to the technology being installed the first milestone of the project ensures the continuing consultation process and measurement of impact. Prior to installation each processor must undertake a site based workshop to explore any concerns or issues associated with the implementation of the Bladestop on site. The processor must also provide a three year history of frequency and cost of injuries associated with the bandsaws on site. This will enable MLA to measure the financial and social impact of the technology.

Following the implementation into the meat processing industry it is envisioned that the technology will be made commercially available to every processor as well as those in the retail sector.

Acknowledgements

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References

[1] South Australian Workcover Authority. Workplace safety brochure. (1998)

[2] Nadin, S.J., Waterson, P.E. & Parker, S.K. (2001). Participation in job redesign: An evaluation of the use of a sociotechnical tool and its impact. *Human Factors and Ergonomics in Manufacturing*, 11, 53-69

[3] Clegg, C. W., Coleman, P., Hornby, P., Maclaren, R., Robson, J., Carey, N., & Symon, G. (1996). Tools to incorporate some psychological and organisational issues during development of computer based systems. *Ergonomics, 39*, 482-511.