MONASH University
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MANUAL HANDLING RISK ASSESSMENT IN MANUFACTURING INDUSTRIES

- A FOCUS ON WOMEN

(AN EVALUATION OF THE MANUAL HANDLING RISK ASSESSMENT CHECKSHEETS)

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Manual handling risk assessment in manufacturing industries - a focus on women.
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Abstract:

Manual handling tasks are responsible for a large proportion of work-related injuries and long-term health problems amongst workers, particularly women, in manufacturing industries. Manufacturing industries (especially the food and metals assembly sectors) are employing a large proportion of women entering the workforce.

In Victoria (with similar Federal requirements) the manual handling regulations and the two associated codes of practice (for manual handling; for occupational overuse syndrome) require all workplaces to carry out a three phase process of risk identification, risk assessment and control of identified manual handling risks.

This project's aim was to examine the effectiveness of the prescribed processes and tools for carrying out manual handling risk assessments in the workplace.

Methodology included a literature review; detailed risk assessments carried by company staff at a total of 21 workstations in 5 companies (3 involved in food processing; 2 involved with autocomponent assembly); validation of the process of risk identification by the use of subjective means and the objective biomechanical tool RULA.

The major findings were that though the prescribed risk assessment process was somewhat cumbersome, the process did result in suitable identification of manual handling hazards. For manufacturing tasks, it was found that the Manual Handling (Occupational Overuse Syndrome) Code of Practice was most relevant to the assessed manual handling tasks. The study highlighted that unless suitable management support was in place, risk assessments would remain a low level activity and ad-hoc process.

Recommendations include simplification of the codes of practice and checksheets; upgrading of company injury data systems to be oriented towards injury prevention not just cost control; increasing the use and awareness of the codes of practice in industry. Recommendations for additional research include the need to assess the actual compliance of industry with these Regulations and risk assessments and a need for longer term studies to evaluate the overall impact of the manual handling regulations approach in reducing injury frequency and severity.

Key Words:

manual handling, tasks, injuries, occupational overuse syndrome, risk assessment, control strategies, code of practice

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PHOTOGRAPHS

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Finally, but by no means least, particular thanks go to both workers and management at the participating workplaces and the members of their workplace steering committees.

For reasons of confidentiality, the companies are not named in this document.

DISCLAIMER

The risk assessment issues and control strategies for each of the participating companies presented in this report were determined by the respective workplace project teams as part of the risk assessment exercises for this project. They should therefore only be considered as background information to be used in further discussion and consultation with the appropriate staff, management and health and safety representatives.

EXECUTIVE SUMMARY

Manual handling injuries are a major contributor to occupational injuries and work-related claims. For example, in Victoria, over the period 1987-1991, some 46% of workers' compensation claims were associated with manual handling. Due to this high incidence, Federal and State based legislation and regulations requiring industry to implement risk assessment and control activities to reduce manual handling injuries have been implemented. In Victoria, the manual handling regulations and the two associated codes of practice (for manual handling; for occupational overuse syndrome) require all workplaces to carry out a three phase process of risk identification, assessment and control of identified manual handling risks. Manufacturing industries, by their very nature, are a major contributor to manual handling injuries (they contribute 29% of all work-related claims). Women workers within such industries have been identified as having incidence rates of up to 4.6 times that of their male peers. There has been little work carried out evaluating the effectiveness of these manual handling risk control programs in manufacturing industry.

I. AIMS

- To assess the effectiveness of the processes associated with risk assessments in manufacturing industries as required by the Victorian Occupational Health and Safety (Manual Handling) Regulations (1988) and the two Victorian codes of practice (Manual Handling Code of Practice and the Code of Practice for Manual Handling (Occupational Overuse Syndrome)).
- To assess the applicability of the risk assessment checksheets provided in the codes of practice to food processing and autocomponent assembly tasks.
- To validate the manual handling risks of some of the tasks identified through the risk assessment checksheets.
- To compare the risk assessment checksheet results and determine the extent of transferability of approaches to manual handling solutions across the food processing and autocomponent assembly manufacturing sectors.
- To review the extent to which preventive approaches identified in an earlier pilot project in one of the participating companies had been implemented and performed over time.

The focus for this project was largely on the health and safety of women workers in manufacturing companies that employ a large number of women. Manufacturing industries in the food processing and autocomponent assembly sectors typically employ a large number of women involved in manual handling tasks.

II. METHOD

The research team combined engineering, ergonomic and epidemiological approaches to ensure that a comprehensive identification and understanding of issues was achieved. Ethics committee approval for the project was obtained from the Monash University Standing Committee on Ethics in Research on Humans.

The five participating companies were selected on the basis of their: being major manufacturing industries; having a significant female workforce; recognising manual handling injuries recognised as a major concern; being interested in participating in the project; having union and staff support. Three of the companies were from the food processing sector and the other two were concerned with autocomponent assembly. One of the food companies had previously participated in the Food Union's "Management of manual handling hazards in the food industry" project

The main project steps included:

- Establishing a workplace steering committee with representatives from employees, management, and union groups;
- Examination of workplace injury reports and conduct of interviews with workers to identify at-risk work environments/tasks
- Provision of training to the workplace steering committee and/or nominated company personnel in the use of risk assessment and identification checksheets;
- Application of the risk assessment checksheets by company personnel to 3-4 job tasks and assessment of the results by the research team.;
- Assist the workplace steering committees to develop solutions and control strategies for the identified risks
- Obtaining of feedback some 6-8 months after the above process had been completed to determine the extent to which a) control solutions had been implemented and b) participation in the project had been able to influence company risk identification, assessment and control practices.

The findings of the risk assessment checksheets were validated by both subjective and objective approaches. The subjective approaches included firstly comparison of the checksheet findings with the injury statistics. Secondly, the workplace team's risk assessments were compared with the risk assessments of one of the very experienced ergonomists on the research team.

A more objective validation of the risk assessment checksheet was obtained by applying an appropriate biomechanical assessment tool to certain tasks. From a systematic evaluation it was found that the Rapid Upper Limb Assessment (RULA) method best met the requirements of the project. In all, 13 tasks from 3 companies were chosen by the study ergonomist for the RULA assessments.

III. LITERATURE REVIEW

Manual handling tasks are defined as "any activity requiring the use of force exerted by a person to lift, lower, push, pull, carry or otherwise move or restrain any animate or inanimate object". Manual handling also encompasses tasks involving repetitive or forceful movements and the maintenance of constrained or awkward postures, which can result in occupational overuse syndrome. Occupational overuse syndrome is a collective term for a range of conditions characterised by discomfort or persistent pain in muscles, tendons and other soft tissues, with or without physical manifestations.

Data from workers' compensation claims in Western Australia shows the major factors leading to manual handling injuries are lifting (62% of male cases; 58% for females), handling with no lifting (35% of males, 32% of females) and repetitive movements (3% of males, 10% of females). Data from NSW indicated that 56% of female workers' compensation claims were due to activities involving overexertion, physical stress, lifting or carrying, compared with 41% of male claims. In Victoria, over an eight year period, a total of 18,199 claims were made by women in the manufacturing industry; sprains and strains accounted for 86% of the injuries to women, repetitive strain injury 9% and other musculo-skeletal injuries 1%. Amongst women, 46% of injuries were to the shoulder/arm, 27% to the back, 9% to the neck and 8% to the hand.

Risk factors for manual handling injuries cover a wide spectrum and include direct factors relating to the object (load, dimensions, load distribution and stability) and factors relating to the task (frequency/duration, distance moved, workplace geometry/layout, task complexity). It is important to recognise that poor design of manual handling activities also exposes workers indirectly to serious injury. Examples include injuries arising from slips and falls or load shifts in tasks involving carrying or moving loads.

Studies have identified that women have an increased risk of manual handling injuries. This arises both from the frequency of women workers in manufacturing industry carrying out repetitive tasks and a lack of consideration and understanding of the different ergonomic needs of females (versus males) by the largely male designers and management. Issues of gender, culture, socioeconomic status, educational discrimination and lack of power, add to this increasing risk exposure amongst women workers.

The legislative requirements for prevention of manual handling injuries result in a three-pronged approach of risk identification, assessment and control. Guidance is provided in the codes of practice for the process and method for carrying out these three activities. For risk identification and assessment, the process is one of using the checksheets to evaluate the task, largely qualitatively, using a series of questions with a yes/no type answer. One of the prerequisites is suitable training of staff to be able to carry out the assessments. Other and more rigorous methods include detailed ergonomic assessments which attempt to match the task and machine design to that of the particular operator. Biomechanical approaches draw on an understanding of the effects of various movements and postures on the musculo-skeletal system, with a particular focus on the stresses and strains. This results, for example, in systems such as RULA which provides a quantitative risk assessment.

There have been few studies examining the validity of the checksheet approach used in the codes of practice. From the three studies reviewed, conclusions were that checklists required full organisational support to be effective; that there was significant inconsistency in their use by non ergonomists - whether they were quantitative or not; company injury recording systems were quite inadequate for use in prevention and needed upgrading; and considerable impact could be achieved through relatively simple workplace design changes would also lead to a more efficient and streamlined work process.

Control strategies involve the systematic application of the well-known hierarchy for risk reduction and both ergonomic and engineering principles of good design. However the most effective development of control measures includes the use of functional analysis systems techniques (based on Value Engineering methods), for task analysis and creative redesign. Systems techniques recognise that the task under review is just one part of a process system, which may, itself, be part of an even larger system.

IV. RESULTS

(I) Company injury records

Of the five companies, only one had computerised injury data. For the others data extraction was cumbersome and by hand from individual case records such as first aid books, accident investigation reports or workers' injury compensation forms. Manual handling injury rates on certain production lines were found to be over 60%. Typical injuries, depending on the respective company and task included: musculo-skeletal/soft tissue injuries involving the back, neck, shoulder or forearm with treatment often referred to the company physiotherapist. A high proportion of cuts and lacerations was also associated with manual handling. Typically the injury data, even if computerised, was found to be unsuited to injury prevention activities in terms of its structure, content and ease of analysis. The record keeping systems appeared to be more oriented to fulfilling costing and accountancy functions.

(ii) Summary of the assessed manual handling risks

The most frequently assessed manual handling risks were associated with poor posture, namely fixed workstation heights, poor wrist position and tasks requiring unsupported arm positions. The assessed workstations were mainly staffed by women. The prominence of posture-related risk factors is noteworthy since workstations are typically designed (by males) for an average male worker. The lack of possible adjustment or reorientation of work areas becomes more of a problem for women, and this may explain, in part, the frequency with which posture-related manual handling risks were identified.

The risk assessments also highlighted the problem for new employees or those returning from leave being required to work at full work pace without a period of re-adjustment. Production imperatives may explain why this factor is so common across the industries.

The major risks associated with manual handling tasks identified in this project, suggests that similar problems, such as attention to posture, are of importance to both the food processing and autocomponent assembly sectors. Furthermore, control strategies from one sector, could well be translated to the other. Generally, the most common risks identified in the assessments are not complex and can be addressed by sound ergonomic and system design principles. Experiences from other companies indicate that control of these risks can be both effective and low cost.

(iii) Summary of the control strategies

For the short term, administrative controls and training were the favoured options. In the medium term redesign and mechanical aids were prominent. In the long term, elimination of the task and redesign were the most commonly suggested control strategies.

Task elimination appeared to be a preferred long term option considered by the workplace project teams from companies 1 and 2 (autocomponent assembly). On the other hand, the three food processing company teams looked at redesign as a feasible long term option. It was also noted that training was identified as a medium term solution for the food processing assessments (companies 3, 4, 5), but not by the autocomponent assembly company teams.

These differences may reflect the particular company environment or culture regarding control of occupational health and safety (OH&S) issues. Alternatively, they may also highlight real differences between food processing and autocomponent assembly industries in terms of the perceived possibilities for automation (task elimination).

In terms of the controls implemented by the companies, these have generally been short term (as expected considering the time frame of the project), but also have included medium and long term controls. These have included redesign; mechanical aids; and administrative. However training has not been implemented widely by the companies, despite its prominence as a suggested control option.

(iv) Validation of the checksheet assessments: comparison with RULA

The results using the occupational overuse syndrome code of practice risk assessment checks were found to correlate well with the RULA assessments. For the six assessed tasks, the RULA assessment scores ranged from 'immediate change is required' to 'action may be required' - with the two risk assessment methods identified the same risk areas as problems. It can therefore be reasonably concluded that the risk assessment checksheet is an effective tool for identifying these risks. Although RULA only assesses upper limb manual handling risks, it could be a useful adjunct as it provides a risk rating scale for prioritising attention to the assessed risks.

(v) Observations on the risk identification and assessment processes and checksheets

An important finding from the project was that the risk assessment checksheets can be used by most company staff to identify the major manual handling risks and determine some appropriate control strategies. However, there were many difficulties in using the checksheets that could act as major barriers in their being implemented in a systematic way within normal company practice. The question then arises whether a much simplified, yet effective, checksheet could be developed.. It may be better for the checksheets to be developed from an applied injury prevention perspective, rather than one based on meeting regulations only. This means that the steps leading to injury should be defined in functional terms so that a better form can be developed.

With respect to the suggested control strategies, these often reflected the current action culture within each company, rather than the optimal solution to each problem. For example, in one of the companies, the post-injury culture was to train-out the inappropriate actions. It became apparent that there was a need to provide the companies with external support in developing a complete range of control strategies. This was due to the limited view that the workplace project teams had about the current range of control solutions available. More exposure to the approaches used by other companies, resources such as the HSO's Share manual, and use of external consultants would be an obvious way to achieve this.

Many of the issues raised in the notes attached to the risk assessment component of the code also assisted the determination of a range of practicable control strategies. In a few instances, the strategies developed using the issue-specific risk control form were fragmented. Because they addressed the specific risks singly , the resulting control strategies may not have been workable as a total solution.

(vi) Review of preventive approaches identified in an earlier pilot project

It was reported that little, if anything, had been implemented since the earlier project. It appeared that the major reason for this was the fact that the employee regarded as the major (internal) driver for the OH&S involvement at the time of the earlier project had left the company. This had essentially left the company without a dedicated person to drive the necessary action and none of his successors had taken aboard the OH&S aspects as their particular area. The apparent lack of continuity in management taking a lead role in driving OH&S processes within the company has been a major barrier. It was observed, however, that staff involved in the earlier project were able to utilise this experience and were able to act as team leaders and help guide their co-workers through the risk assessment processes. This observation suggests that ongoing reinforcement of manual handling risk assessment processes is needed.

(vii) The role of company policy in risk assessments

It was observed that the undertaking of risk assessments and consequent implementation of control strategies is a complex process requiring staff training; management input and external expertise; regular activity to maintain proficiency; suitable budget, time and priority allocation. It is apparent that it is only with full management support, allocation of resources and priority setting, that risk assessments can be realistically and effectively part of workplace activities. It is worth noting that of the five companies involved in this project, management had changed in three of them over the duration of the project. The challenge is to maintain this type of OH&S program through these changes.

V. CONCLUSIONS

(i) Risk assessments using the codes of practice

The overall conclusion from this project is that use of the risk assessment checksheets, as provided in the codes of practice, do, in the main, lead to the identification of suitable control strategies. Both the subjective and objective validations (using RULA) indicated that risk assessments using the checksheet process, do adequately identify manual handling at-risk tasks.

The study clearly identified that the risk identification, assessment and control process would be more streamlined if the two manual handling codes were combined as a single document and considerably simplified. The current process is an unnecessarily cumbersome task and mitigates against widespread or regular application. Experience from this project, as well as other studies, suggests that few companies have ongoing programs for manual handling risk assessment and control.

The most important benefit of the risk assessments was found not to lie predominantly in the rigorous ergonomic assessments themselves but in the actual process of review of the work function. The formal procedures of the codes of practice act to provide a catalyst and structure for looking at how jobs can be improved. A natural consequence of risk assessments is that reducing manual handling tasks and improving them ergonomically, leads to more efficient production process.

All assessment processes, including use of checksheets, should be viewed as part of an overview risk assessment and control strategy and not in isolation. They will not survive unless there is a clear support mechanism within the company. This support needs to include identification of a driver, more personnel trained in the use of the checksheets and ownership of OH&S at all levels.

The current checksheets do not provide a system of determining the size of the risk, ie there is no way of prioritising the necessary control efforts. It would seem that the capacity to prioritise risk would certainly be advantageous.

(ii) Workplace design and layout

In many of the assessed tasks, there appeared to be inadequate consideration given to ergonomic design. In a number of situations, it was as if the operator was considered to be a very flexible tool that is able to bridge the gaps in the production process. These gaps were possibly created as a result of inadequate attention being given to the OH&S aspects of the production system design in the first place. Priority seems to be given towards production imperatives without due regard for human factors or ergonomic design.

(iii) Role of management

One of the major barriers to implementing control strategies and risk assessment processes is the lack of long-term management in many companies. Management policy and commitment to OH&S are paramount for implementing any effective manual handling injury prevention and risk control strategy. Management needs to ensure allocation of dedicated time and resources for employees to complete the processes.

Without a clear and well-communicated management commitment, implementation of risk assessments and control strategies remain ad-hoc activities, with the likelihood of marginal gains and no continuity.

In this regard there appears to be a lack of leverage available to encourage management to carry out risk assessments and then commit to, and implement, practicable control strategies for identified problems. Indeed, factors such as change of company ownership through takeovers, staff departures and redundancies often leave OH&S programs in limbo, with no continuity or drivers to keep the process going.

VI. RECOMMENDATIONS

(I) Improvements to the codes of practice

- A plain language statement promoting the two codes and their applicability to different situations needs to be written.
- The target audience for the checksheets needs to be re-evaluated and to include shop floor staff, who currently have difficulties with them.
- Consideration should be given to the development of a priority system to be built into the regulations to help management and others to determine which tasks they should tackle first.

- The two volumes could be incorporated into one booklet that covers manual handling issues.
- There needs to be a flow chart that clearly shows the links between each of the stages in the risk identification, assessment and control process.
- The current inclusion of reference points in the assessment checksheets to the identification checklist appears to be somewhat redundant given that the aim of the risk identification is to quickly and simply determine if a hazard or risk may be present. These reference points may be better attached to the assessment checksheet questions themselves.
- The risk identification and assessment sections of the code documentation should be more clearly defined using some distinguishing formatting, colours or under-printing of headings.
- The literacy requirements of the checksheets should be reviewed and simplified ensuring that the level is well within the abilities of most shop floor personnel.
- A number of questions in the risk assessment checksheet need to be reconsidered to remove duplication of questions and required responses in the risk identification and assessment components.

(ii) Increase awareness and use of risk assessment tools for occupational overuse syndrome

- Companies need to be made more aware of the relevance of the code of practice for manual handling (occupational overuse syndrome), rather than just the manual handling code.

(iii) Develop effective implementation strategies and evaluate compliance

- Companies need to identify a clear driver, from within, to ensure that the risk assessment has a high priority and is adopted as standard company policy.
- A strong commitment to OH&S needs to be instituted as company policy so that it continues even when a key driver of the process leaves that company.

(iv) Upgrade workplace injury data systems for prevention

- Record keeping in companies needs to improve if it is to provide the necessary information to guide injury prevention activities.
- Assist industry to develop and incorporate workplace injury recording systems that are geared for injury prevention programs, not simply satisfying accounting type requirements.
- Companies should consider computerising their injury statistics to help facilitate the extraction of data for injury prevention purposes at a later stage. These systems need to be designed to address accounting as well as injury prevention needs.

(v) Promote attention to health and safety issues as a productivity issue

- It should be clearly demonstrated to companies that productivity gains are obtained by attention to OH&S matters. Promotion of best practice models would be useful.
- Companies should change their purchasing criteria so that the benefits of maximising OH&S costs/savings are given full consideration.

(vi) Further research

- An assessment of the inter-rater reliability of the risk assessment checksheets both within and across companies and industries.
- A detailed examination of how the codes of practice are being used in a broader sense in more companies and in other manufacturing sectors.
- A longitudinal study over some years to assess whether current risk assessment procedures really do lead to a reduction in the frequency and severity of injuries

1. INTRODUCTION

Manual handling injuries are likely to have occurred since man's earliest times. Formal documentation and analysis, however, did not occur until the 17th century with the work of Ramazzini (1964) on work-related upper limb disorders.

Manual handling injuries continue to be well known and conspicuous contributors to occupational injuries and work-related injury compensation claims in Australia. In Victoria, for example, during 1987-1991, 46% of all claims for work-related compensation was associated with manual handling. The manufacturing industry, with 29% of all claims, has been identified as the major contributor in this area (Victorian Occupational Health and Safety Authority (VicOHSA, 1994)). Manual handling tasks are responsible for many occupational injuries and long-term health problems amongst manufacturing industry workers. Such injuries result in loss of productivity and increased costs including higher medical expenses and disability payments for injured workers.

The source of manual handling injuries lies in the myriad of repetitive tasks assigned to workers in production processes as well as the less frequent overexertion tasks associated with materials movement. Manual handling injuries are therefore associated with the overuse or overexertion of specific body parts. In the occupational setting, relevant hazards include forceful exertion, rapid and repetitive movements, extreme postures, mechanical stress concentrations, static overload and vibration.

In view of the major impact of manual handling injuries on occupational health and safety (OH&S), prevention of these injuries is a major focus of both state and national agencies. The major strategy promoted to reduce the incidence of manual handling injuries is through state-based legislation. This includes a requirement for employers to assess and control risks arising from manual handling activities in the workplace. The Victorian Manual Handling Regulations, the Manual Handling Code of Practice (VicOHSA, 1988) and the Code of Practice for Manual Handling (Occupational Overuse Syndrome) (VicOHSA, 1992) provide detailed guidance on risk identification, assessment and control of manual handling risks in the workplace. The codes of practice provide checksheets to assist in the identification and assessment of manual handling risks. This Victorian manual handling legislation has formed the basis of the national standard and codes of practice for manual handling and their associated checksheets.

Prevention of workplace injuries requires identifying sites and tasks that place employees at increased risk of injury and supporting efforts to develop safer work environments. Protecting employees from manual handling injuries poses two challenges: i) identifying work-related hazards and ii) instituting appropriate modifications of workstations, tools, work organisation and tasks.

Experience from Sweden suggests that women may become increasingly at risk of manual handling injuries. In that country, 85% of women work and many have been exposed to traditional industrial work (steel, mechanical manufacturing, paper, wood, etc) since the 1960s (Larsson, 1993). Available data for South Australia, has shown that both the incidence and frequency of manual handling injuries are higher in women than in men (Gun, 1990). The incidence rate varied according to occupation but women employed as trades persons, process workers and labourers had a manual handling injury rate 4.6 times that of their male peers.

There is a general lack of information about, and studies of the validity of the processes for examining manual handling injuries, particularly amongst women. This is particularly true for methods of risk assessment for manual handling injuries.

The aim of this project is to assess the practicality and application of the risk assessment checksheets provided by the Victorian manual handling codes of practice in a number of manufacturing companies that employ a large number of women.

This report has four main sections:

i) a literature review to provide an overview of manual handling injuries, their causes and prevention;

ii) an evaluation of the risk assessment checksheets provided by the Victorian codes of practice. This involved manual handling risk assessment by employees at two companies in the autocomponent assembly sector and three companies involved in food processing. In these five companies, a total of 21 workstations was assessed;

iii) a comparison of manual handling risk assessments using the code of practice checksheets with an independent biomechanical assessment tool, the rapid upper limb assessment (RULA) method, for 12 specific work tasks;

iv) detailed conclusions about current risk assessment checksheets and processes and recommendations for improvements.

This report sets out a detailed presentation of the risk assessments and comparisons of the checksheet results with the RULA assessment method. It also provides a detailed discussion of the checksheet findings and risk assessment processes. Recommendations for improvements to the whole process both in terms of efficiency and implementation across industry are also provided.

2. LITERATURE REVIEW

This chapter presents a review of recent international literature and local data sources to obtain insight into the typical causes and outcomes of manual handling injuries. It also includes a review of reports of preventive strategies based on implemented manual handling risk assessments. A review of the tools useful for risk assessments and their evaluations is also given.

2.1 MANUAL HANDLING INJURIES

The National Standard for Manual Handling (National Occupational Health and Safety Commission (NOHSC), 1990) defines manual handling tasks to be "any activity requiring the use of force exerted by a person to lift, lower, push, pull, carry or otherwise move or restrain any animate or inanimate object". It was recognised that the National Code of Practice for Manual Handling tended to focus on the majority of tasks leading to manual handling injuries, namely those involving heavy loads and low repetitions. The National Code of Practice for the Prevention of Occupational Overuse Syndrome (NOHSC, 1994) was therefore developed to address tasks involving repetitive or forceful movements and the maintenance of constrained or awkward postures. The national code of practice for the prevention of occupational overuse syndrome (NOHSC, 1994) defines "occupational overuse syndrome, also known as repetitive strain injury (RSI), is a collective term for a range of conditions characterised by discomfort or persistent pain in muscles, tendons and other soft tissues, with or without physical manifestations". Under Victorian legislation, the manual handling code of practice was initially released in 1988 (VicOHSA, 1988). This was later supplemented in 1992 with the Code of Practice for Manual Handling (Occupational Overuse Syndrome) (VicOHSA, 1992).

Repetition manual handling injuries are often referred to by other terms including occupational overuse syndrome injuries, repetitive strain injuries, cumulative trauma disorders, upper limb disorders and repetitive motion injuries. However, some of these terms are of limited applicability because not all manual handling tasks are repetitive or restricted to only a single body region, such as the back or upper limb.

Repetition type manual handling injuries are usually caused by a build-up of microtraumas from mechanical stresses through repetitive actions (Johnson, 1993). The soft tissues and joints of the body, including the discs, bones, ligaments, nerves and muscles, are particularly susceptible to these stresses. Repetitive or sudden physical loading is the cause of occupational overuse syndrome injuries. The affected sites are usually the tendon, tendon sheath or muscle-tendon junction, although pinched nerves may result in the same way (Turunen, 1994). Another theory of the cause of manual handling injuries is thought to be insufficient time between episodes of heavy usage for the body to repair itself (Frederick, 1992).

Injuries resulting from the performance of repetitive tasks account for more than 50% of all occupational illness in the United States (Rempel et al., 1992). Indeed, the United States Occupational Health and Safety Administration (USOHSA) attributed the recent rapid increases in the occurrence of manual handling injuries to "changes in process and technology" which result in employee ergonomic risk factors such as high task repetition (USOHSA, 1990). Similar problems have been reported from most industrialised countries since the 2nd World War (Stone, 1987).

According to the NOHSC, 90% of work-related injuries related to musculo-skeletal diseases, such as occupational overuse syndrome (NOHSC, 1990). Data for NSW during 1989-90 indicated that 56% of female workers' compensation claims in that state were due to activities involving overexertion, physical stress, lifting or carrying compared with 41% of male claims (Worksafe Australia, 1993).

During the period July 1991 to June 1993, Victorian statistics provided by the Victorian WorkCover Authority reported that 28,217 females filed WorkCare claims (compensation and rehabilitation scheme for injured and disabled workers), which accounted for 25% of all claims. Victorian figures according to manufacturing sector showed that women from the food and beverages sector comprised 28% of all manufacturing injury claims in 1992/93. (Victorian WorkCover Authority, 1993). In total 18,199 claims were made by women over the eight year period 1985/86-1992/93 employed in the manufacturing industry in Victoria. Sprains and strains accounted for 86% of the injuries to women, RSI 9% and other musculo-skeletal injuries 1%. This compared to 83% sprains and strains, 3% RSI and 1% other musculo-skeletal injuries for men. Amongst women, 46% of injuries were to the shoulder-arm, 27% to the back, 9% neck and 8% hand.

During the financial year 1992/93, manual handling injuries accounted for 30% of all occupational injury and disease in Western Australia (White, 1994). The average amount of time lost from work due to manual handling injuries was greater for women (average of 29.7 working days) than for men (22.3 working days). The major factors leading to manual handling injuries were lifting (62% of male cases compared with 58% of females), handling without lifting (35% of males versus 32% of females) and repetitive movements (3% of males versus 10% of females).

Available data for South Australia, has shown that the incidence and frequency (the number of cases per hours worked) of manual handling injuries are higher in women than in men (Gun, 1990). In 1985-86 the incidence rate ratio (women versus men) was 1.9 whereas the frequency rate ratio showed even greater differences (rate ratio, 2.5). The incidence rate varied according to occupation but women employed as trades persons, process workers and labourers had a manual handling injury rate 4.6 times that of their male peers. Furthermore, this particular group of women had a 35-fold greater risk compared with the occupational category with the lowest risk for women.

Incidence rates amongst women workers in South Australia, 1985-86, according to industry were very high in parts of the manufacturing sector (Gun, 1990). Basic metal manufacturing (16.7/1000 person-years), manufacturing of transport equipment (16.2/1000 person-years) and the food and beverages (7.4/1000 person-years) sectors exhibited higher than average incidence rates for women employed in manufacturing industries (Gun, 1990).

Data published by Worksafe Australia on the occupational health and safety of women workers in Australia between 1991 and 1992 found that one-third of the female work force was engaged in part-time or casual employment (Worksafe, 1994). Although women had a lower incidence and frequency rate of injury than men, women required more time off work as a result of injuries. The injuries were more likely to be musculo-skeletal (63%) and the back was involved in 10% more cases than men. In addition, body stressing was the mechanism of injury causation in almost half the cases for women compared with only one third of men. Injuries incurred by women were predominantly due to repetitive movement with low muscle loading, whereas injuries to men were mainly due to lifting, carrying or putting down objects.

It should be stressed that the increased risk of manual handling injuries in women is not because they have a greater susceptibility to these injuries (Mathews, 1993). Rather it is the gender stereotyping of jobs that is the more likely explanation.

2.2 MANUAL HANDLING RISK FACTORS

In 1975, Chaffin and Ayoub identified two broad categories of factors that contribute to manual handling hazards:

Factors relating to the object being handled:

Load:	mass, force requirements, mass moment of inertia
Dimensions:	size and shape of the load
Load distribution:	location of the unit load centre of gravity
Load stability:	constancy of the load

Factors relating to the task:

Frequency/duration/pace:	time dimensions of the handling task
Distance moved	
Workplace geometry:	spatial properties of the task
Complexity of the task:	demands of the task

Johnson (1993) argued that activities such as repetitive gripping, twisting, reaching and moving, reduced recovery time and environmental factors such as vibration and cold are also manual handling risk factors. Like Armstrong et al. (1987), she argues that manual handling risk factors may enhance each other so that the risk of injury is even higher when more than one of these risk factors is combined.

The national code of practice for manual handling (NOHSC, 1990) requires the assessment of manual handling risks to take the following factors into account:

a) actions and movements
b) workplace and workstation layout
c) working posture and position
d) duration and frequency of manual handling
e) location of loads and distances moved
f) weights and forces
g) characteristics of loads and equipment
h) work organisation
i) work environment
j) skills and experience
k) age
l) clothing
m) special needs (temporary or permanent)
n) any other factors considered relevant by the employer, the employees or their representative(s) on health and safety issues.

The factors that apply more specifically to occupational overuse syndrome in manufacturing industries are (NOHSC, 1994):

Work systems: organisation and design

- work patterns
- bonus and incentive schemes
- supervision
- task variation/work pauses
- work adjustment periods

Workplaces: organisation and design

- working position
- work surface height
- visual requirements

work layout
workloads
displays and controls
work tools
physical work environment

Training and eduction

types of programs
target groups

Johnson (1993) has discussed a number of major factors associated with cumulative trauma disorders, particularly of the hand. These include repetition of the task, the posture of the upper extremity when using tools, environmental control of both vibration and cold and tool design. Regarding inappropriate tool design, the hand and upper extremity can become very vulnerable to injury. The major factors contributing to this are handle size, handle shape, texture, length, ease of preparation, shock absorption and weight (Johnson, 1993).

In a broader context, it is important to recognise that poor design of manual handling activities also exposes workers to serious injury risks other than those usually directly associated with manual handling. Examples include injuries arising from slips and falls or load shifts in tasks involving carrying or moving loads. For example, in a study carried out for the Victorian WorkCover Authority some 50% of injuries amongst transport workers related to "overexertion - lifting & slip, fall from vehicle" (Rechnitzer et al., 1995). The following set of brief narratives from the claims material serves to illustrate the point:

"slipped and fell from truck, falling on head causing fractured skull"
"fell off top of truck spreading out tarp, shoulder, arm, head injury"
"slippery floor of truck, fell, breaking right ankle"
"back strain while lifting pipes"
"hernia - I was lifting a 20 litre drum of diesel fuel out the back of truck"
"shoulder strain whilst unloading containers"
"loading empty pallets on truck, slipped and sprained ankle"
"rope hitch let go when securing tray- ruptured disc in back"

This study involved detailed site visits to 40 establishments involved with transport operation. The purpose was to ascertain the underlying causal factors associated with the injuries identified in the WorkCover claims data. For transport, it became clear that the main issues relating to manual handling and slips and falls from vehicles were:

- current truck design makes very little provision for aiding loading and unloading, which is typically manual with no mechanical aids.
- there is a lack of adequate provision at dispatch and receiving points in companies to aid loading/unloading vehicles.
- containerised loads need to be typically loaded and unloaded manually as individual items.
- personnel access provisions to the truck cab and load areas are typically very poorly designed, inadequate and foster slips and falls from vehicle.

The issues identified in this example from the transport industry, are also conceptually applicable to internal transport systems for moving products and materials in many manufacturing industries. Thus in terms of risk factors relating to manual handling, these encompass the direct factors relating to loads, postures and frequency as well as the indirect factors associated with good ergonomic design and provision of manual handling aids for performing tasks.

2.3 MANUAL HANDLING INJURIES A PARTICULAR PROBLEM FOR WOMEN?

Figures from the Australian Bureau of Statistics (ABS) for 1990 indicate that women comprised 41% of the labour force, with this figure expected to rise to 50% by the year 2000 (ABS, 1993). Despite these increases in the female workforce, women are still employed in a narrow range of occupations in Australia, such as the health and manufacturing industries. Unfortunately, it is these industries that have been particularly linked to increases in certain types of occupational injuries, including occupational overuse syndrome.

The number of women workers experiencing manual handling injuries is directly related to those occupations and industries that employ large numbers of them. Any strategy for preventing occupational injuries amongst women that is targeted at specific industries is likely to have the most success (NOHSC, 1990). Such an approach has other advantages in that it "lends itself to incorporation of a range of activities, such as standards development, trialing, provision of information, as well as having union and employer mechanisms in place through which such activities can be negotiated and delivered." To this end, the National Approach to Occupational Health and Safety for Women Workers (NOHSC, 1990) is "targeted at industries where a high number of women workers are employed, where injury rates are high, and in areas where Worksafe Australia has a clear national role and has other activities in progress".

The VicOHSA, now the Health and Safety Organisation (HSO), Victoria, produced a brochure entitled "Manual handling: health and safety issues for women workers" to educate women about the 1988 Victorian manual handling regulations (VicOHSA, 1993). The brochure focused on how the manual handling regulations affect women, assessment and control of manual handling, training and education and how pregnancy affects the ability to work.

The 1986 National Agenda for Women focused on non-English-speaking background (NESB) women. It addressed the need for culturally and linguistically appropriate education programs for NESB women, the development of codes of practice on safe manual handling. It also ensured that the needs of women should be taken into account when workplace and occupational restructuring were required (NOHSC, 1990). The Working Women's Centre recently conducted a study to address the issue of higher claim rates for NESB women due to musculo-skeletal injury (McMenamin, 1993). The study focused on 45-54 year old women in the manufacturing sector. Interviews with 106 women found that two-thirds of them had overuse injuries, with 85% located in the upper limbs, neck and spine regions. Only 52% of the women reported their injury at the time of its onset, with this figure falling to 41% for women with occupational overuse syndrome injuries. The main reasons given were fear of dismissal, victimisation, lack of information and vulnerability in the workplace. Return to work was generally not successful due to a number of factors: language barriers, the lack of alternative duties, little awareness of and information regarding support agencies, little access to OH&S information, lack of employer support, fear and distrust of the system, labelling and stereotyping, inadequate retraining options and the impact of the disease on their personal lives.

The Swedish Occupational Injury Information System has reported that women have a lower risk of occupational accidents but a higher risk of occupational diseases, such as occupational overuse syndrome, than men (Lagerlof, 1993). Manufacturing work was the third most risky occupation and musculo-skeletal injuries were the largest category of occupational disease in Sweden (Lagerlof, 1993). This is partially explained by the fact that more women than men are likely to engage in unskilled work. Furthermore, it is the older, immigrant and disabled women who were particularly subject to gender, cultural, socioeconomic and educational discrimination. Women were also more likely to engage in jobs associated with less control and decision making power.

The Swedish data provides some insight into why repetitive and monotonous movements in the workplace are problematic for women. Women are traditionally employed in jobs involving lifting small weights at a fast and monotonous pace such as assembly work (Lagerlof, 1993). Kilbom (1985) claims that if the sum of the small weights was multiplied by the number of times they were lifted, the overall weight lifted per day would be similar to that of men. On average, women's aerobic capacity is approximately 30% lower than men's, muscle strength is two thirds that of men, muscle strength in arms is about half of that of men's and grip force is lower among pregnant women. This may explain the high rate of workplace injury amongst women engaged in repetitive lifting. In addition, organisational factors such as short work cycles, fast work pace, machine determined work pace and no longer carrying out the whole job which would have required the operator to stand up, move around and rotate the tasks, have all contributed to increased occupational injuries for women (Lagerlof, 1993).

Another significant aspect of the design of workplaces and tasks for women operators is the difference between perceived exertion levels and actual levels. Since most of the current workplace and task design decision makers are male, a key issue is the male perception of acceptable levels of exertion for female workers, compared with the actual acceptable levels. Some answers to these issues are provided by the discipline of psychophysics which studies the relationship between sensations (perceptions) and their physical stimuli. Studies by Stevens (1989) on the psychophysical properties of static and dynamic exertion, indicate that perceived exertion is a positively accelerating function of the actual physical level. For example, when the physical level increases by 50%, the average person perceives the exertion as doubling.

From his research Stevens (1989) concluded that "to avoid excessive fatigue and strain it is usually better to work at a low level over relatively long durations than at a high level over short durations". He also provided an everyday example to illustrate the point: "the bag of groceries carried from the supermarket may feel quite manageable on leaving, but as time goes by it produces more and more sense of strain and eventually it may become intolerable. Fearful that that it may become impossible to hold on, the person decides to put the load down to rest. A lighter load it might be possible to carry for all practical purposes indefinitely". From a manual handling viewpoint, Stevens (1989) notes "when the goal is to minimise perceived exertion it may be important to concentrate on the static component, which although it may seem benign at first, may because of its rapid growth rate with time, come to cause great discomfort and limit the amount of work that can be done".

From the work carried out in psychophysics, the consequence of the male-female difference in perceptions of exertion is quite significant, as illustrated in the following brief analysis (Larsson, personal communication). Taking the average female capacity for dynamic muscular work as 70% of the average male capacity, the just right level for men (perceived at about 35% maximum capacity) is too high for females. This means that the just right level for females will be perceived by the average male as about 17% of his maximum capacity and appear too low. Thus a male designing the workplace for females, may well result in exertion levels at twice the just right level for females - with consequent increase in risk of overexertion injuries.

2.4 APPROACHES FOR RISK IDENTIFICATION AND RISK ASSESSMENT

2.4.1 The three stage process of identification, assessment and control

The national standard for manual handling (NOHSC, 1990) requires risk identification, assessment and control of manual handling tasks to be carried out to prevent manual handling injuries. A staged approach is advocated and the national code of practice provides guidance on the following steps:

- identification of risk factors in the workplace likely to cause manual handling injury. This should include analysis of workplace injury records, consultation with employees and direct observation;
- detailed assessment of particular risk factors. (These risk factors have been outlined in Section 2.2 above.);
- principles and examples of control measures to eliminate or reduce risk. This includes attention to job redesign, mechanical handling equipment, training and other administrative controls.

This approach is summarised in Figure 1, which is reproduced, with permission, from the Health and Safety Organisation Victoria, from the document "Manual handling and noise in the poultry industry" (VicOHSA, 1994).

The three-pronged approach of risk identification, assessment and control is easily understood by occupational health and safety practitioners. However, it is not so easily understood by employers and employees and appropriate training needs to be provided to those participating in the risk assessment process. An understanding of what causal factors are relevant to manual handling injuries is crucial before starting the risk identification phase. The use of the checksheets provided in the code, or modified versions of them that comply with the regulations, is to be encouraged.

This staged approach was the basis of the "Management of manual handling hazards in the food industry" project conducted by the Food Unions' Health and Safety Centre (Food Unions' Health and Safety Centre, 1992). This project developed a booklet and video about manual handling hazards in the food industry as a result of trial projects undertaken with three large companies and was funded by Worksafe Australia. The launch of these materials in September 1992 offered a significant opportunity for other companies to learn about successful strategies that have actually been adopted by these three major food companies.

The Food Unions' project developed a management plan for implementing a preventive strategy for major hazards in food manufacturing industries. The plan was developed within workplaces thereby increasing its significance and practical use. The plan also recognised the large number of women currently working in these industries (as well as the potential large increase in their numbers) and the OH&S issues they are likely to continue to face unless preventive actions are taken.

The VicOHSA reported a statewide manual handling program in the food and beverage manufacturing industry in Victoria (VicOHSA, 1993). This program assisted many organisations in the food and beverage manufacturing sector to implement a systematic approach to manual handling. As noted by VicOHSA, different industries would benefit from sharing their knowledge and experience of manual handling problems. Furthermore, many of the problems identified in foods and beverage manufacturers are not specific to these industries as solutions identified can be translated to other industries with manual handling concerns.

A study of Australia's 100 largest manufacturing companies found that at least 45% of the 46 responders, had not established any procedure or standard for assessing risks associated with manual materials handling tasks (Low and Holtz, 1993). The authors of this study concluded that "organisations should be provided with a more definitive approach to identifying hazards and instituting organisational structures, dictated by legislation, to effectively manage hazards in the workplace".

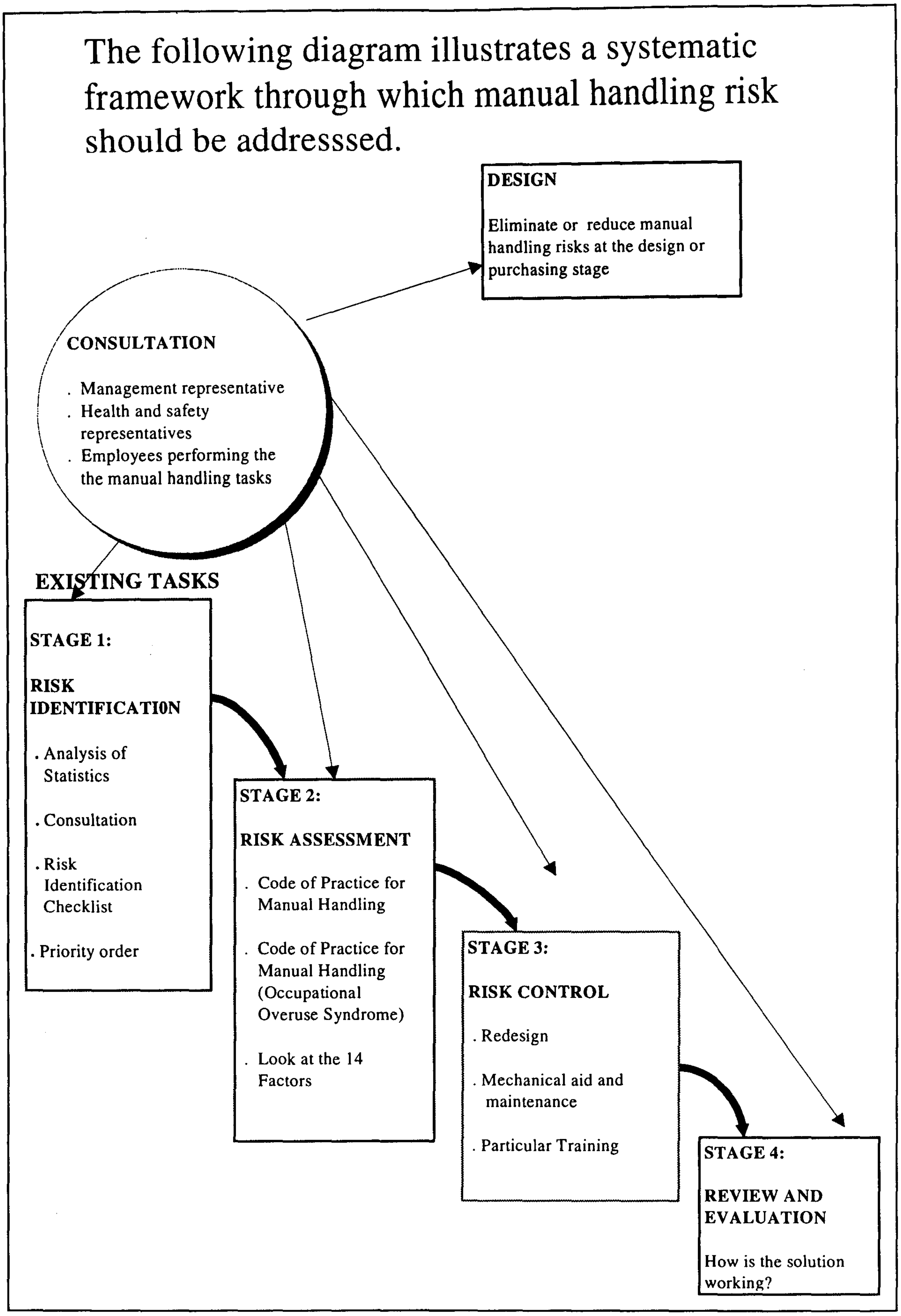


Figure 1: The three stage approach to controlling manual handling injuries

(Reproduced from the document "Manual handling and noise in the poultry industry" (VicOHSA, 1994) with the kind permission of the Health and Safety Organisation Victoria)

2.4.2 The ergonomic approach

The ergonomic approach to risk assessment is based on a detailed examination of the interaction of people (ie the workers) with machines, tools and the work methods. Approaches to job evaluation range from traditional work assessment procedures such as time studies (or structured observational techniques), motion studies (detailed descriptions of body actions required to perform an operation) and predetermined time systems (eg experimental study approach) to more sophisticated biomechanical methods (Keyserling and Chaffin, 1986). Kilbom (1994) defines the ergonomic approach to be one that fits anthropometry, posture, workstations and work tasks to the identification of poor design for subsequent improvements. She also argues that ergonomic assessments are different to the methods used for musculo-skeletal epidemiology and ergonomic assessments of exposure are not suitable for the physical exposure estimates required by epidemiological studies. Nevertheless, direct measurements of postures, etc are very valuable because they provide a large amount of data with a high degree of precision (Kilbom, 1994).

The ergonomic systems design model requires an analysis of the key characteristics of a job and its component tasks before potential solutions can be identified. It is particularly important that characteristics of the user and the working environment are also considered in the implementation of any successful intervention (Caple, 1993).

2.4.3 Biomechanical assessment methods

Biomechanical methods, like ergonomics, examine the effect of various stresses and strains on the musculo-skeletal system during manual handling activities. A number of biomechanical risk assessment methods have been proposed in the literature. A descriptive catalogue of typical working postures is provided by the Finnish working posture analysis system (Ovako Working posture Analysis System (OWAS)) (Heinsalmi, 1986). This system can be used to analyse work postures in either of two ways. Firstly, the combined posture of the back, arms and legs can be examined for its overall effect on the musculoskeletal system. Alternately the time spent in a given posture for each body part can be considered. Although the OWAS method has been used successfully in the field, application of it to the collection and analysis of data can be long and tedious (Long, 1992). Recently, efforts have been directed to developing a computerised system to streamline this process (Long, 1992).

Another biomechanical assessment method is the Rapid Upper Limb Assessment (RULA) method. RULA records the postures of various body segments associated with upper limb disorders and considers muscle, joint and soft tissue loading effects such as force and muscle use (McAtamney and Corlett, 1991; McAtamney and Corlett, 1993). Thus RULA assesses external load factors and focuses on the following risk factors: the number of movements, static muscle work, force and work postures relative to equipment and furniture. A limitation of RULA, however, is that it is only useful for assessing upper limb movements and is not sensitive to fine finger movements or hand and finger spans and grips. A valuable outcome of the RULA assessment is a risk rating that leads to prioritising of tasks and postures that require further attention.

Chaffin (1992) argues that "it is important to depict human postural requirements (kinematics) of a job well, but it is also important to depict the biomechanical consequences of certain types of exertions relative to worker population capability norms". Considering this principle, the University of Michigan's Centre for Ergonomics has developed both two and three dimensional programs for predicting static strengths (Chaffin and Erig, 1991; Chaffin, 1992). The 3D assessment method has been shown to be particularly useful for both manual evaluations of tasks and simulation of new job designs (Chaffin, 1992).

2.4.4 The validity of risk identification and assessment checksheets

Checksheets are generally promoted as an effective tool for risk assessments, however there are few studies of their validity. The three stage approach of risk identification, assessment and control (described in section 2.4.1) has been incorporated into the manual handling codes of practice. Risk identification checklists and risk assessment checksheets have been developed to aid in these stages.

Boucaut et al. (1994) conducted an evaluation of the risk identification checklist as it applied to manual handling risk amongst firefighters. These authors concluded that "the checklist is unsatisfactory for identifying which tasks most urgently require preventive action". Furthermore, a low inter-rater reliability was found for the risk identification checklist, particularly when individual questions were considered.

Researchers at the British Institute of Occupational Medicine conducted two studies which are particularly pertinent to our study and hence their results are presented here in some detail. The first of these studies involved the development and evaluation of a screening method for manual handling (Graveling et al., 1992). The objective was to devise an approach that could be applied by non-experts to fulfil the (legislative) requirements for manual handling risk assessment with a particular focus on lifting of loads and prevention of back injury. The method involved deriving a series of numerical correction factors to be applied to a basic maximum load (50 kg for mine workers) which cam be lifted under ideal circumstance. These factors took account of the deviation from the ideal of the particular task and hence enabled calculation of the particular permissible load for the task in question. The numerical factors were based on a synthesis of the available biomechanical, psychophysical and metabolic criteria; as well as the research group's own judgment. Separate recording and assessment sheets were used for lifting, holding, or carrying, lowering and pushing and pulling. An evaluation study was conducted to seek answers to the following questions for the assessment tool:

- how consistent are individuals in applying the aid (test-retest)?
- how do these individuals compare with each other?
- how do these assessments compare with the correct (expert) assessment?
- is it possible to provide objective corroboration of the assessments?

Because the work was being carried out in a mine, the researchers used video recordings of tasks to carry out the assessments. For the objective corroboration, the team decided to use intra-abdominal pressure (IPA) as the objective and physical determinant of truncal loadings. The evaluation conclusions were:

- a considerable level of inconsistency was demonstrated by the coal staff in using the aid, both within themselves and when compared with a team of ergonomists;
- assessment of the aid against the more objective IPA indicated a general over-estimation of the risk, consistent with findings for other similar assessment procedures;
- inconsistencies in the published data used to formulate the correction factors, may be reflected in the inconsistency in results obtained from the assessments.

It would appear from this work that the inclusion of quantitative assessment aids in the usual generalised risk assessment procedures, by non-experts, is probably inappropriate and not warranted (Graveling et al., 1992).

The other study carried out by the Institute of Occupational Medicine (Tesh et al., 1992) examined the useability of manual handling guidance. This guidance follows from the European regulations which are similar to Australia's requiring risk assessments and controls for manual handling. The study's aims were:

- to establish how easily the risk assessment guidance could be used by non-experts. (The guidance was published in 1991 by the Health and Safety Commission alongside that of the regulations);

- to determine the extent of agreement in its application between experts (ergonomists) and non-experts;
- to examine its utility for task other than just lifting;
- to determine whether it is possible to use company sickness and accident data to corroborate the assessment.

The procedure adopted by the study team followed the regulation requirements. At each company, this involved the following:

- a manual handling audit to list all manual handling task undertaken in the company. For the study and its practical purposes, focus was place on those areas identified by company personnel and company injury records on high incidence areas. Interestingly, it was emphasised to the companies that those areas not covered by the study still required full assessment as per the regulations. A company official and the study team's ergonomist did the audit independently and then drew up an agreed list of tasks that warranted assessment;
- the assessments were carried out independently by the company official and ergonomists;
- the risk assessment check covered the four main factors: the task, the load, the environment and the individual capability. A yes/no check system for perceived risk was used;
- following these assessments the company officials and ergonomists compared assessments and also discussed solutions for the assessed risks;
- It was noted that a comprehensive evaluation of the effectiveness of the guidance was not possible in the time frame of the project. However, the sickness and accident records were examined to see if these were sufficiently detailed to allow their use in any analysis that would corroborate the ergonomic assessments of manual handling risk.

The conclusions from the study are listed as they are surprising and interesting echo to many of those from our study:

- organisations need a multi-disciplinary team approach to be effective in reducing manual handling risks;
- there was a need to seel the benefits of the regulations to companies, to counteract the widely held view that the risk assessment process is time consuming, ineffective and expensive. Publication of case studies is seen as being useful in this regard;
- companies clearly indicated that more guidance was required in interpretation of the checklist questions where a value judgment is required;
- a checklist was seen by companies as essential, with many producing their own;
- considerable impact can be achieved by relatively simple design changes, which can also lead to a more efficient and streamlined work process. Design changes in one area are also a catalyst for action in other similar areas;
- it should not be assumed that the provision of lifting aids necessarily solved manual handling problems, as the associated manual handling work in working with these aids caused additional risks to the operator. Thus these tasks should still be part of continuing review and assessment;
- lifting aids need to be well designed and appropriate to the task if they are to be adopted by the employees. Poorly designed lifting aids increase workers' resistance to changes in their own work practices.;
- though the guidance indicates the use of company accident and sickness records for use in risk identification, records normally kept are not adequate for this purpose. Further guidance for companies is required about what data should be collected, recorded, stored and the value of if properly utilised; in summary, a list

of practical and detailed suggestions were given on improving the guidance, which are also worthy of review and consideration the Australian context.

2.5 CONTROL STRATEGIES

Risk control is defined to be the process of eliminating or reducing identified and assessed risk factors. A hierarchy of risk control is stipulated by the national standard for manual handling in sections 5.3 and 5.4 (NOHSC, 1990):

5.3 The employer shall, if manual handling has been assessed as a risk:

a) redesign the manual handling task to eliminate or control the risk factors; and
b) ensure that employees involved in manual handling receive appropriate training, including training in safe manual handling techniques.

5.4 Where redesign is not workable, or as a short term/temporary measure, the employer shall:

a) provide mechanical aids and/or personal protective equipment and/or arrange for team lifting in order to reduce the risk; and/or
b) ensure that employees receive appropriate training in methods of manual handling appropriate for that manual handling task and/or in the correct use of the mechanical aids and/or personal protective equipment and/or team lifting procedures.

A number of studies have looked at methods to assess risk and designing tasks associated with manual handling focussing on the risk of lower back injuries (Snook, 1978; Snook, 1988). Snook (1988) identified three separate approaches that need to be included in any effective program to control back pain in industry: job design or ergonomics, job placement or worker selection and eduction/training. Whilst he acknowledges that an engineering approach to control is probably the most effective long-term strategy, it can only address up to one third of the problem; both job placement and training are essential to the control process for it to have complete success.

Frederick (1992) has summarised some of the proven methods for controlling and reducing exposure to hazards leading to manual handling injuries. These include: i) for repetition: worker rotation, adequate rest periods, increasing the variety of tasks to increase the variety of movements, automation, mechanical aids, decrease of work pace; ii) for forceful exertion: reducing the weight and number of objects to be held, tool redesign, use of power grips, elimination of ill fitting gloves; iii) for mechanical stress concentrations: rounding or padding surfaces, tool redesign; iv) posture: relocating and reorientating work stations, redesigning tools; and v) for vibration: engineering controls, reducing length of exposure. Proper tool design, rotation or work schedules, pacing of work, scheduling and exercise programs are all promoted by Johnson as solutions to manual handling problems (Johnson, 1993).

Job modification is one solution to eliminate or reduce suspected occupational risk factors. Rempel et al (1992) argue that a practical approach comprising the following steps should be adopted: I) identify occupational risk factors important to the cause of the injury; ii) assess the risk factors that can be modified - this should be done by both employees and employers; iii) assess options to modify exposure to the identified risk factors by changing aspects of the work process.

The need for detailed knowledge is directly related to conclusions on redesign, change of layout, change of flow or investment in new tools or equipment. Adjustable seating and arm rests will not solve the problem if the problem stems from an unsuitably designed production system (Söderqvist, 1991).

In its detailed review of manual handling assessment practices in the food and beverage manufacturing sectors, VicOHSA concluded that "industry can implement a preventive manual handling program if they receive specific guidance backed up with ongoing support" (VicOHSA, 1993). Keyserling and Chaffin (1986) conclude "design effort should be multi-disciplinary with inputs from medical personnel, engineers, ergonomists and workers."

In regard to designing workplaces for risk reduction, Seiden's (1984) work on product safety assurance, strongly emphasises a systematic approach and a hierarchical strategy for risk reduction. He lists the four principles of accident prevention, in order of greatest effectiveness and highest priority, as:

Principle 1 *Hazard elimination.* If practical design the hazard out of the product, workplace, job, or facility through engineering means.

Principle 2 *Safety guards and enclosures.* If you cannot eliminate the hazard entirely, enclose or guard it at the source to protect the user.

Principle 3 *Safety warnings and instructions.* If you cannot guard the hazard, warn or instruct users as to the dangers of the product under reasonably foreseeable conditions of service and commerce.

Principle 4 *Protective clothing and administrative controls.* As an interim or temporary safety measure only, until higher order safeguards can be installed, provide the user with personnel protective gear (ie hard hats, safety goggles, ear protectors) or apply administrative controls (ie. job rotation, employee training, medical surveillance programs).

He lists a further five principles that supplement the first four well-known concepts:

Principle 5 derives from the first four: a safety device must not itself be or create a hazard.

Principle 6 states that a product should be made so that, to the extent practical, it takes into account the kinds of mistakes that humans make and the limitations that we all have under reasonable foreseeable condition of service (including both intended use and reasonably foreseeable misuse) for the product.

Principle 7 says that safety should be built into the product or machine at the design stage. It should not be delegated to some down stream owner or user in the product life cycle, such as the ultimate consumer.

Principle 8 tells us that maintenance or maintainability safety, as well as operating safety, should be carefully considered.

Principle 9 is that the 8 principles are controlling even where there is a published safety code or standard. Safety codes and standards are minimums and sometimes a lot less.

2.5.1 A systems perspective in developing control strategies

A system may consist of people or physical parts or both (Ayoub, 1992). An ill-conceived and improperly organised system inevitably leads to inefficient system performance. This inefficiency must be tolerated by its human components, often at great cost, pain and suffering, if the system is to remain operational. Taking Ayoub's point further, in workplaces where inadequate efforts have been directed at good planning and design, it is the humans that must be the most adaptable and flexible resource in bridging the deficiencies in the system design. However, the human resource may also be regarded as the weak link in the sense of consequential exposure to risk and injuries.

Ayoub (1992) describes the elements of a manual materials handling (MMH) system as, consisting of four components: worker, task, tools and equipment and environment. The ergonomic approach focuses on the human-task-environment system. The generally accepted method of minimising MMH injuries is by designing MMH tasks so that the physical, physiological and mental demands are within the physical, physiological and mental capacities of the workforce performing the tasks. Thus task design is dependent on availability of worker capacities for MMH. Ayoub goes onto describe three approaches used to define capacity: biomechanical; physiological and psychophysical - with considerable disagreement amongst the three design approaches. However Ayoub suggests that drawing on the three models does permit the development of comprehensive charts for load versus frequency using the lower limits as permissible values.

One of the more demanding, but in many ways more effective, aspects in the development of control strategies for identified risks is the application of a systems approach. A systems approach recognises that the task under review is just one part of a process system, which itself may be part of an even larger system. Landy & Trumbo (1980) highlight that "an extremely important development in human engineering, was the adoption of the notion of systems." It is only through the detailed analysis and understanding of the system that the particular activity is part of that control strategies can be broadened to include task elimination or replacement with less stressful tasks (type and frequency) and redesign of processes to reduce risk exposure.

However systems analysis, unlike parts analysis, typically requires the use of both management knowledge (eg. the system parameters that determine production line flow rates and how these can be varied) and outside specialist expertise in conducting systems analysis and awareness of available materials handling systems, equipment and processes. It is noteworthy that a methodical approach to systems analysis is not commonplace and techniques such as value engineering (VE) and value analysis may be fruitfully drawn on as a disciplined approach to systems analysis. This method does not analyse an item from a parts standpoint, nor from a materials or manufacturing view but rather from a functional standpoint.

The technique was developed by Larry Miles from General Electric in 1940 and applied to manufacturing during the war years (Dell'Isola, 1982). As a result of the shortage of materials and labor substitutes had to be used, with the VE technique developed through answering the question *what else will do it?*. It draws on an open systems approach (refer Figure 2) and uses creativity techniques to break *mind forged manacles* about how things could be achieved. The basic VE philosophy is *there must be a better way*. The technique uses the total systems approach and considers objectives, functions, resources and creative development of alternate strategies to achieve the minimum life cycle costs. It considers:

- what does it do?
- what does it cost?
- what must it do?
- what else will do it?
- what does this cost?

An essential feature of the VE approach is the recognition of the low cost of changes at the design-development phase of a project and the potential for cost savings compared with the high or prohibited costs of changes as the project is built. This knowledge is applicable to the OH&S area where companies may purchase equipment that is later modified to suit upon receipt at the factory. The consequence is often a severe restriction in what can be modified and hence major compromises in terms of ergonomics. This approach may be in part due to failure of management to recognise the need for or apply professional expertise to the design, procurement and specification of equipment. Dell'Isola (1982) also notes that the traditional planning and design approach tend to compartmentalise various disciplines involved in decision making and result in sub-optimal solutions.

Though the VE approach was developed to identify effective methods for system cost reduction, the approach can also be adapted for use in the development of control strategies to provide benefits with both improved system efficiency and reduced risk exposure. Greve and Wilson (1967) note that true value engineering principles embody the concept that prevention is more desirable than cure. A design concept will cost less to manufacture if it is value engineered from its inception.

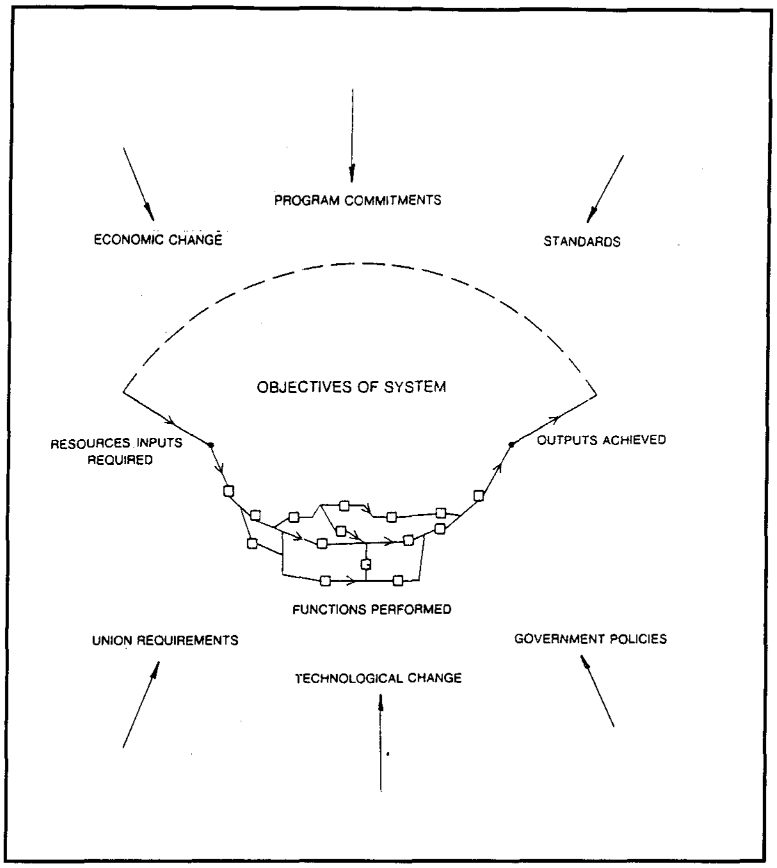


Figure 2: The open systems approach

An example of the application of the systems approach to manual handling control strategies, has been recently reported (Larsson, 1994). This report of a project conducted for Worksafe Australia focussed on OH&S for the staff of the Melbourne City Parks and Gardens. The study found that the main occupational health problems were associated with manual work: the handling of heavy objects, the use of garden and hand tools, strenuous postures, overload to muscles, tendons and joints. One of the authors of this report (GR) was involved in the Melbourne City Parks and Gardens project by helping to analyse and redesign the Fitzroy Gardens nursery, mixing and potting area. One of the major manual handling activities was moving potted plants from the growing areas down to the potting shed, to be potted or repotted and which are then moved back to the growing areas. This activity involved manually carrying the pots to trolleys and involved thousands of movements annually. The usual risk assessment approach would (typically) focus on the separate manual handling activities at the separate areas - the growing area and potting areas. However a systems approach resulted in a suggested solution that would significantly reduce the need to move the pots. This involved the purchase of three mobile potting benches that could be moved to the growing areas, thus eliminating the need to move the thousands of pots to the potting shed.

In summary, control strategies involve the systematic application of the well-known hierarchy for risk reduction, ergonomic and engineering principles of good design. However the most effective development of control measures includes the use of functional analysis systems techniques for task analysis and creative redesign, a powerful, but currently under-utilised tool.

3. AIMS

The broad aim of this study was to assess the effectiveness of risk identification and assessment tools in activities for preventing workplace manual handling injuries.

When the project was initially conceived the specific aims were stated as:

1. To monitor the injury reduction and safety improvement progress of a large food manufacturing company that participated in the Food Union's Health and Safety Centre's Pilot Project. This will include an assessment of how the management and preventive strategy implemented as a result of that pilot project has performed over time and the extent to which it has reduced the number and types of various manual handling injuries. If appropriate, the risk assessment procedure currently used by the company will be evaluated and aspects of it redesigned to address the particular needs of this workplace.
2. To extend the experiences and knowledge gained from the pilot study by applying the risk assessment tools to 2-3 other food manufacturing companies of varying size and with their own specific problems. The generality of the assessment procedures used in larger companies and the need for specific applications of it will be trialed.
3. To compare the experience of workers involved in manual handling tasks in food industries with others in the metals manufacturing industries. This will establish whether the broad guidelines developed for manual handling tasks in the food industry have wider application to another industry sector which experiences similar types of injuries.
4. To compare injury rates following the implementation of the strategy in various industry sectors with work-related accident trends as monitored by an external source. This will allow injury trends to be attributed to the strategy implementation rather than to other factors such as secular trends in overall injury rates.

Throughout the project, the focus has largely been on women's health and safety in manufacturing industries where many of the women's tasks involve manual handling. However, tasks involving men have not been excluded from this project.

Once the project began and more formal discussions were held with company management and advice received from the project advisory committee, it became necessary to refine and redefine some of these objectives to the following:

1. To assess the effectiveness of the processes associated with risk assessments in manufacturing industries as required by the Victorian Occupational Health and Safety (Manual Handling) Regulations (1988) and the two Victorian codes of practice (Manual Handling Code of Practice and the Code of Practice for Manual Handling (Occupational Overuse Syndrome).
2. To assess the applicability of the risk assessment checksheets provided in the codes of practice to food processing and autocomponent assembly tasks.
3. To validate the manual handling risks of tasks identified through the risk assessment checksheets.
4. To compare the risk assessment checksheets results and determine the extent of transferability of approaches to manual handling solutions, across the food processing and autocomponent assembly manufacturing sectors.
5. To review the extent to which preventive approaches identified in an earlier pilot project in one of the participating companies had been implemented and performed over time.

4. METHODS

Attention to manual handling injuries requires a multi-disciplinary approach. The research team combined engineering, ergonomic and epidemiological approaches to help ensure that a comprehensive identification and understanding of issues was achieved. The methodology adopted by the project team in working with the participating companies was based on the systematic framework for addressing manual handling risk described in the literature review.

4.1 CONSULTATION AND IDENTIFICATION OF COMPANIES

Following consultation with company management and the relevant unions, five suitable companies were identified and agreed to participate in the study. A plain language statement was provided to all companies to inform them about the project and to explain how they could benefit from participating in it. Three of the participating companies represented the food manufacturing sector and the remainder were concerned with autocomponent assembly. One of the food companies had previously participated in the Food Union's "Management of manual handling hazards in the food industry" project.

The companies were considered to be suitable for participating in the project because:

- manual handling injuries were recognised as a major concern, particularly amongst the women these companies employ;
- many of the jobs that the women employees performed involve manual handling tasks;
- women comprise a large proportion of the workforce of these companies;
- company management agreed to participate in the study;
- there was support from the unions and other staff representatives to participate in the study.

Site visits to each of the participating companies were arranged and interaction with both staff and their work supervisors established. Within each participating company, workplace steering committees were established to liaise directly with the research team. The workplace steering committees included representatives of management, health and safety officers, production managers or engineers, union representatives and shop floor staff. In some instances, the workplace steering committees were based on existing OH&S committees. Because the project had a focus on women, most of the workplace steering committee members were women.

The following project stages were agreed to with each company:

- establish a workplace steering committee with representatives from employer, management, health and safety, industry, union and other appropriate groups;
- examine workplace injury reports and conduct interviews with health and safety representatives, supervisors and workers to identify work environments that need to undergo detailed risk assessments;
- provide training to the workplace steering committee and/or nominated company personnel in the use of risk assessment and identification checksheets. This would include shop floor training in the application of the risk assessment checksheets to 1-2 workstations;
- application of the risk assessment checksheets by company personnel to a further 3-4 job tasks. The research team to reassess the use of the risk assessment checksheets by company staff and to assist the workplace steering committees translate the risk assessment findings to risk control strategies;

- liaison with the workplace steering committee to develop short, medium and long-term solutions to the identified manual handling problems and to identify recommendations for the design and implementation of control strategies;
- obtain feedback 6-8 months after the above process had been completed to determine the extent to which a) control solutions had been implemented and b) participation in the project had been able to influence company risk identification, assessment and control practices.

Ethics committee approval for the project was obtained from the Monash University Standing Committee on Ethics in Research on Humans. A plain language statement explaining the project to the workers was prepared and distributed by the workplace steering committees.

Those steps integral to the project's overall objectives of examining risk assessment practices are described in more detail below.

4.2 EXAMINATION OF INJURY RECORDS

Workplace injury records were examined to identify where and for what particular tasks, manual handling injuries occurred in each company. In particular, the injury records were examined with respect to the following information for each injured person:

- workplace area where the injury occurred;
- occupation and/or task undertaken by the injured person;
- body part injured;
- basic demographics of the injured person (eg gender, age, ethnic background, etc);
- nature of the injury (eg sprain, strain, etc);
- type of incident or activity leading to the injury.

The sources and quality of injury records examined varied from company to company. Sources included, where available, work injury record books, computer generated summaries, accident report forms, WorkCover claims forms and first aid books. Some companies restricted access to only certain types of injury records, eg monthly accounting summaries.

Based on an examination of both workplace injury records and discussions with the workplace steering committees, 3-4 major jobs or tasks in each workplace were identified for targeted risk assessments.

4.3 RISK ASSESSMENT PROCEDURES USED

The risk assessment procedures used in this project were the checksheets provided by the Victorian Code of Practice for Manual Handling (VicOHSA, 1988) and the Victorian Code of Practice for Manual Handling (Occupational Overuse Syndrome) (VicOHSA, 1992). A copy of the risk assessment checksheets provided with these codes of practice is given in Appendices 1 and 2. These Victorian regulations and codes of practice are consistent with their national counterparts, though some of the specific details are different.

This decision was based on the fact that the companies were all Victorian and therefore governed by the Victorian regulations. It was also considered that there would be some advantage in using these code of practice checksheets since other Victorian companies were using the same guidelines and procedures and there would therefore be some degree of uniformity and familiarity with the tools across industry. Furthermore, it is stipulated that the codes of practice (and the accompanying checksheets) "should be followed, unless there is another solution which achieves the same result, or a better solution" (VicOHSA, 1988). It was considered outside the scope and project time frame to develop new risk assessment tools and show that they met the above requirement.

It was found that the Code of Practice for Manual Handling (Occupational Overuse Syndrome) (VicOHSA, 1992) was generally more appropriate for the tasks evaluated in this project because of the type of manual handling problems identified. It is recognised that some of the typical job tasks covered by the manual handling code of practice (VicOHSA, 1988) (eg those associated with an increased risk of back injury) are also identified by the Code of Practice for Manual Handling (Occupational Overuse Syndrome) (VicOHSA, 1992) so use of the latter did not neglect to cover that range of problems. Moreover, the national code of practice for the prevention of occupational overuse syndrome states "if in doubt, begin with the national code of practice for the prevention of occupational overuse syndrome" (NOHSC, 1994).

Evaluation of the effectiveness of the risk assessment checksheets as provided in the two manual handling codes of practice is the focus of this report. The process of risk assessment was worked through with each of the participating companies. This included liaison with staff nominated by each company, specific training of these staff in the risk identification and assessment procedures as outlined in the Victorian codes of practice and leaving the companies to work through these processes on a number of additional tasks.

The completed checksheets were reviewed by the research team to assess the accuracy of the information recorded on them. The extent to which the risk assessment results led to the determination of practicable control strategies was also reviewed.

Across all companies, a total of 21 tasks was assessed by the code of practice risk assessment checksheets. For all but one company, 4 separate tasks were assessed; at the other company 5 tasks were assessed.

4.4 TRAINING OF STAFF

Training was provided to staff representatives in the rationale for, and the use of, the risk assessment checksheets in the relevant codes of practice. The aim of the training was to provide the participants with a basic level of knowledge about the risk identification checklist and the risk assessment checksheet, the three stage process of risk identification, assessment and control and some simple causes of manual handling injuries.

Each company selected its representatives to receive this training. Some, but not all trainees, were members of the workplace steering committees. Hereafter, the group of trainees who carried out the risk assessments are referred to as the workplace project teams.

For company 1 (autocomponent assembly), eight people were involved in the training session, of which all but 2 were women. The trainees represented management (1), union (1), health and safety (1 officer and 2 reps) and 3 shop floor staff from nominated production areas.

The training for company 2 (autocomponent assembly) was provided to seven participants representing management (2), health and safety (1), engineering (2), union delegate (1) and 2 shop floor workers. Four of the seven trainees were women.

The training session at company 3 (food processing) involved seven people, including 2 men. The trainees were from management (1), health and safety (1 officer, 1 rep), supervisor (1) and 3 women off the lines.

Training at company 4 (food processing) involved 8 people, including 7 women and represented health and safety (2 elected reps, 2 nurses), supervisors/team leaders (2) and 2 shop floor workers.

At company 5 (food processing), five people were involved in the training including the factory manager, the production manager, the health and safety rep and supervisors from 2 work areas. Of these, 3 were women.

At each company, all participants were provided with a basic introductory training program, of about 30 minutes. This was kept as simple as possible, to enable the participants to complete the documentation independently.

The training included both a lecture style format and practical shop floor experience in completing the risk identification checklist and risk assessment checksheet. Discussion was also held with both supervisors and workers to determine the extent to which these checksheets had been used in the past to identify new hazards over time and suitable preventive measures.

The items covered in the training included:

- an overall summary of the project;
- an explanation of what manual handling is;
- explanation about the risk identification and assessment checksheets and the regulations and codes of practice from which they originated;
- the three stage process of risk identification, assessment and control and how this leads to the development of practicable control strategies;
- an overview of the causes of manual handling injuries, through static, dynamic and traumatic loads and forces;
- the suitable zones of movement for frequent, non-frequent and heavy tasks;
- the importance of vision in fine motor tasks;
- the acceptable frequency of task performance;
- the risk control priorities as outlined in the codes of practice.

The training sessions also focussed on the strengths and weaknesses of the risk assessment checksheet, how and why to use the checksheets and both management and engineering control systems.

The training was supported by working through the three checklists (risk identification, risk assessment and risk control) for one identified example from the factory floor. The participants were then requested to form teams of at least two people and repeat the process for another nominated task. At the end of the two applied sessions, an overview of the suggested control strategies was conducted. The aim of this was to ensure that the information obtained was according to the legislative requirements (ie that the control strategies developed were practicable and according to the hierarchy of control as specified in the regulations).

4.5 VALIDATION OF THE RISK ASSESSMENT FINDINGS

The findings of the risk assessment checksheets were validated by both subjective and objective approaches.

4.5.1 Subjective approaches

The risk identification checklist and risk assessment checksheet findings were cross checked with the injury statistics to confirm that they were identifying the same sorts of problems. The observations and extensive ergonomic experience of one of the members of the project team (RH) were used as a further subjective assessment of the extent to which use of the risk assessment checksheets by the workplace project teams correctly identified problems and solutions.

As discussed previously, one of the major focuses of the training session was on using the risk assessment checksheets as a lead to the identification of control strategies. If the checksheets used in the risk identification, assessment and control processes led to implemented outcomes, then it can be concluded that they were successful. Of course, a long term examination of injury trends would be needed to confirm this. To assess the extent to which identified control strategies had been implemented, a follow-up questionnaire was sent to the companies some 6-8 months after the risk assessment process to ascertain what controls, if any, had been implemented. The questionnaire was sent to the workplace steering committee nominee who was the major point of contact with the research team. The questionnaire also asked whether the companies had modified their risk identification or assessment procedures during that time. A copy of this questionnaire is given in Appendix 3.

4.5.2 Comparison of biomechanical assessment methods

A more objective validation of the risk assessment checksheet was obtained by applying an appropriate biomechanical assessment tool to certain tasks. In determining the appropriate tool, a review was conducted of the suitability of three existing biomechanical assessment methods for their applicability to this project: the Ovako Working posture Analysing System (OWAS), the University of Michigan 3D Statics Strength Prediction Program™ (3D UMSSPP™) and the Rapid Upper Limb Assessment (RULA) method. The underlying assumption in this review was that the most suitable biomechanical assessment method would be applied to production line jobs in food processing and autocomponent assembly industries and therefore needed to be able to asses the important characteristics of these jobs, namely:

- the workers are generally seated but may also stand for some of the time;
- the work involves high repetition of a limited number of tasks. It is cyclic and predictable and typical of general manufacturing process work;
- the work generally involves low force exertion by the worker.

Any suitable biomechanical assessment method must also be useable within the context and circumstances of the tasks and jobs assessed in this project and therefore should also be able to:

- identify and assess risks associated with posture;
- identify and assess risks associated with specific arm and wrist postures;
- identify and assess risks associated with duration of a posture;
- identify and assess risks associated with frequency of a movement;
- identify and assess risks associated with applied forces and loads;
- identify and assess risks associated with frequency and duration of force and load;
- provide a meaningful evaluation of the effects of any workplace interventions.

Furthermore, it should be:

- valid;
- reliable;
- easy to learn and use;
- require only readily available equipment;
- be acceptable for use in the workplace, that is not interrupt normal work flow and practices;
- reasonable cost.

Table 1 presents an assessment of the degree to which each of the OWAS, 3D UMSSPP™ and RULA assessment methods meets the above criteria. The table was prepared by Ross Armstrong, as consultant to the project team and is based on published (Chaffin and Anderson, 1984; Kant et al, 1990; Long, 1992; Louhevaara and Suurnäkki, 1992; McAtamney and Corlett, 1993) and unpublished (Addison, 1992; Masterton, 1993; Sigismondi, 1994) literature, his experience and knowledge of the methods and the knowledge and experience of his co-workers.

It is clear from Table 1 that the RULA method best met the requirements of the project and it was recommended that this should be the biomechanical method adopted to validate the checksheet findings.

Table 1: Comparison of the OWAS, 3D UMSSPP™ and RULA biomechanical assessment methods

A "√" indicates that the method does assess the task component or has the stated property, "X" that it does not assess the task component nor the stated property and "?" that it may or may not assess the task component or have the stated property depending upon the context.

Task component to be assessed or desired property of the assessment method	OWAS	3D UMSSPP™	RULA
seated and/or standing work	X standing work only	X standing work only	√
repetitive work	√	X takes no account of the number of work actions	√
low force exertion	√	? results likely to be inconclusive	√
posture	√	√	√
arm/wrist posture	X only gross arm posture	X no wrist	√
duration of a posture	√	X	√
frequency of movement	√	X	√
applied force/load	√	√	√
frequency and duration of force	√	X	√
evaluation of interventions	√	√	√
validity	√	√	√
reliability	√	√	√
ease of learning and use	√	? depends on computer skills	√
equipment requirement	√ pencil and paper and video or still camera	? requires IBM486 with maths co-processor and graphics package and video or still camera	√ pencil and paper and video or still camera
acceptable in workplace	√	√	√
cost	$0	$1000+	$0

Note this table was prepared by Ross Armstrong in his role as consultant to members of the project team.

4.5.3 RULA

A validation of some of the issues identified by the risk assessments checksheets in three companies was conducted by comparing the checksheet results with RULA assessments of the same set of tasks. This direct comparison involved 6 specific tasks; 3 of these involved autocomponent assembly and the remainder involved food processing.

RULA was used to validate that the results obtained by non-ergonomists using the occupational overuse syndrome risk assessment checksheets were adequate and practical in identifying the key manual handling risks and possible solutions.

In all, 13 tasks from 3 companies were chosen by the study ergonomist for the RULA assessments. These included the 6 tasks that were involved in the direct comparison with the checksheets. The assessed tasks were chosen on the basis that i) they were associated with a number of yes results in the identification checklist, indicating the need for further assessment; and ii) all had a number of yes responses in the assessment checksheet, indicating that a risk was present.

All the RULA assessments were performed on video recordings of each task. Video recording of at least 2 full motion cycles from the front and back and 2 cycles from the side, for each task. The video taping was done whilst the worker performed their job under normal conditions. The videoing did not affect the workers' performance or productivity. Confidentiality of the video recordings was assured to the companies and the workers being videotaped and were only viewed by the study team.

The project ergonomist identified particular tasks on the video to be assessed by RULA and recorded the starting time. The assessed task usually consisted of a couple of seconds to a few minutes duration. Freeze framing of the most important movements or postures associated with manual handling risk was used to complete the task.

Training of the project team in the use of the RULA scoring system was provided by Ross Armstrong of LaTrobe University. A copy of the scoring procedure used in the RULA assessments is given in Appendix 4.

4.5.4 Limitations of the validation of the risk assessment checksheets

It is useful to raise some of the limitations in the validation approach used in this project, as these limitations are issues that may need to be considered in any future large scale validations of workplace OH&S programs.

Firstly, injury trends could not be examined over time, particularly after the implementation of control strategies. This was because the risk assessment process and implementation of control strategies by the companies, if at all, took much longer than expected. The time frame of the project meant that there was no time left to monitor the injury trends. Control strategies need to have been implemented for some time before their influence on injury rates can be determined. This meant that only broad correlations of the checksheet results with the RULA assessments could be achieved. The short project time frame precluded the opportunity of validating the checksheet results with injury reductions.

Another prerequisite for realistic monitoring of injury trends, is the availability of accurate and comprehensive baseline injury data. However, due to the limitations of the data systems in some workplaces, trend monitoring would not have been feasible.

The RULA assessments were only performed on a small number of tasks or sub-tasks associated with each job. An assessment of each of the individual tasks would need to be made before an assessment of the full job was made. Validations would also need to be performed in a larger number of instances.

It is important to note that RULA does not address all of the factors in the checksheet provided by the Code of Practice for Manual Handling (Occupational Overuse Syndrome)

(VicOHSA, 1992). The only items that are directly comparable are items (refer to Appendix 2):

A: Layout of workplace	A1, A2, A3
B: Posture:	B2, B3, B4, B7, B8, B9, B10
C: Duration and frequency	C4, C5
D: Force applied	D1

The remaining checksheet questions obtain information about other factors that cannot be assessed by RULA. Thus validation of the checksheets with RULA only applies to those items or task components that can be assessed by both techniques.

This project has not attempted to address the issue of inter-rater reliability of the checksheets. This is something that should be assessed in a future study. Risk assessments completed by staff should be compared amongst each other and also against a gold standard assessment provided by an experienced ergonomist.

It was also beyond the scope of this project to assess the usefulness of the risk assessment checksheets for assessing factors such as the cumulative nature of the onset of manual handling conditions or the spill over effects from other tasks.

4.6 CONTROL STRATEGIES

All workplace project teams were instructed in the hierarchy of risk control strategies outlined in the occupational overuse syndrome code of practice, as detailed on pages 47-48 of the code.

Following the risk assessments, the identified risks (ie those with a yes response) were detailed on risk control forms. Participants were asked to determine suitable strategies for each identified risk according to the hierarchy of control. These were documented according to the proposed time period for implementation, that is short, medium or long term.

Two variations of the control forms were used:

1. The risk control sheet and risk control plan as outlined in the occupational overuse syndrome code of practice. This was used at two sites to develop strategies for 4 tasks.
2. An issue specific checksheet was developed specifically for this project (refer Appendix 4) by the two project agronomists (RH and DC). This required the participants to detail three ranges of control strategies (short term, medium term and long term) according to the hierarchy of control strategies, as per the code. This form of checksheet was used to describe the specific strategies needed to control each assessed risk in more detail.

In both cases a summary plan was developed in consultation with the workplace project teams to discuss the practicality of the strategies and expand, if necessary the range of controls considered. This plan was presented back to the respective workplace steering committees for consideration for implementation

5. RESULTS AND DISCUSSION

5.1 COMPANY INJURY STATISTICS

At each company, injury records were examined to assist in the risk identification stage. Each company maintained injury records, as required by the regulations, but the extent to which these could be readily accessed for data useful for injury prevention purposes varied from company to company. Some companies limited our access to certain aspects or types of injury records.

Besides other sources such as a first aid book, only one company had a fully computerised injury record system. Although, the computerised system was limited in some of the injury prevention detail it provided, it was easier to obtain information from this company than from any other. This is because computerised records are preferable for data retrieval purposes.

The following sections give a broad summary of the injury data from each company.

5.1.1 Company 1 (Autocomponent assembly)

A first aid book was maintained by the first aid officer and a separate injury/accident/incident report form completed for each case. The first aid attendant completed the first section of this report form and recorded details about the person, time of injury, body part, nature and extent of injury, treatment given and cause of injury. Part B of this report is completed by the supervisor and obtains more specific information about the job the person was doing at the time of injury and associated factors such as use of safety equipment, adherence to accepted work procedure and hazards contributing to the injury. This injury data is reported at a monthly safety meeting and the safety officer reports this information back to the engineering department.

An annual report of the injury statistics for 1994 written by the company physiotherapist and ergonomist was provided to the researchers. This report showed that manual handling demands and work pace were the dominant issues relating to injury, many leading to manual handling injuries. When examined according to factory sections, the areas with the highest numbers of injuries at the main factory were from three major production areas - two of these were targeted in this project. When injury rates were calculated as the number of new injuries as a proportion of the total numbers of employees in each section, these areas were also found to be the most problematic. For example, each of the production lines in one particular area was found to have injury rates of more than 60%. Two tasks from lines in this area were included in the risk assessments in this project.

For all injuries combined, the most commonly injured body parts were the hand followed by the back, neck, shoulder and forearm (more than one body region was often injured). These were the cases referred to the physiotherapist and consisted mainly of musculo-skeletal and soft tissue injuries.

5.1.2 Company 2 (Autocomponent assembly)

At this company the first aid officer maintained a detailed first aid book. This recorded details of the age and gender of the injured worker, shift worked (day, night), body part injured, nature of the injury or illness, cause of injury, treatment given and the action or disposal at the end of treatment. The cause of injury information is recorded as a text narrative description and included reports such as "employee stated that she was aching from using her muscles working (complaint - aching neck back and shoulder)" and "employee stated that she lifted a bin of parts and felt a terrible pain after (complaint - lower back pain)".

Over the period January to October 1994 the most common injury treated by a first aider involved pain, strain, aching or bruising (46% of cases) followed by cuts/lacerations (24%). In many cases, more than one injured body part was reported. The most commonly injured body regions were neck/shoulder (21% of cases), arm (19%) and hand, including fingers (15%). Many of the finger injuries were cuts and lacerations due to the nature of the assembly work involving metal items. Two production lines, in particular, were chosen for the risk assessments in this project because they were associated with 23% and 10% of all injuries.

The formal injury statistics maintained by the company were the claims lodged with WorkCover. Over the period July 1991 to August 1994, the majority (41%) of lodged claims were associated with strain, carpal tunnel syndrome or tendinitis/RSI. The neck and shoulder were involved in 25% of cases and the arm/hand in 32%.

5.1.3 Company 3 (Food processing)

Although this company maintained files of injury records, the research team were not able to have access to them. The following information about manual handling injuries for the period October 1993 to December 1994 was provided by the company OH&S staff.

During this period, almost one third (30%) of the injuries at this company was manual handling. Of these, 28% occurred in one single area of the company's production area and this was selected for the focus of the project. In this particular area, 38% of all the reported injuries were manual handling. Sixty per cent of the manual handling injuries in this area were amongst women.

Strain was the most common type of injury and the most frequently injured body regions were the neck, back, arm, elbow and shoulder.

5.1.4 Company 4 (Food processing)

At this company, medical centre attendance reports are completed for every injury or illness treated by the company nurse. This report includes details of the bodily location of the injury, the nature of injury and the department section to which the employee belongs. It does not contain information about the treatment given or the severity of the injury - this information is stored with personnel records.

This company also maintained a computerised data system of its injury records for workers' compensation purposes. Its major purpose is to give the number and cost of workers' compensation claims for all lost time injuries (those that resulted in more than 1 shift lost work time). Generally the information is not used at the local level but rather to give a summary of claims across all areas. A number of important injury details are available from this database as pre-coded fields, however. These include the activity at the time of injury (eg. lifting, pushing, packing, etc), the injury factor (eg. repetitive action, hazardous arrangement, unsafe posture, etc), injury agency (eg. reaching/stretching, lifting carrying, hand held manual tools, etc) and the nature and severity of the injuries. Unfortunately, being linked to workers' injury compensation claims, there are threshold limits, such as a minimum of one lost work day, before cases were recorded in the database and the more minor injuries were excluded.

Considering the injury profiles from this database for 1993 and the proportion of women employed, it was decided to focus on 2 of the company's production areas for this project. In the first area, involving packing of food items, all injuries were manual handling. The majority (80%) of injuries were to the arm or hand and 60% were sprains or strains. Repetitive actions accounted for 20% of all injuries, pushing/pulling for 20% and 40% were caused by being struck by an object. A hazardous environment was considered to be the major factor in 40% of cases and faulty method (ie work technique) the factor in a further 40%.

The other work area considered involved handling and cutting food items. Manual handling accounted for 82% of the injuries in this area. Injuries to the arm or hand accounted for 38% of all injuries and neck or shoulder injuries accounted for a further 13%. Sprains/strains were the most frequent type of injury, accounting for 56% of cases. Repetitive actions accounted for about one third (32%) of all injuries in this area whereas reaching/stretching, hand held tools and lifting/carrying each accounted for 13% of injuries. The major factors involved in the injuries were faulty methods (32% of all cases) and inadequate training (25%).

At about the time of that the research project was being undertaken at this company, one of the staff members conducted a survey of some of the process workers in the areas targeted by the workplace steering committee. This survey obtained information from the workers about their general demographic profile, their attitudes towards training techniques and the physical effect the work had on them. The results of this survey were made available to the research team.

Of the 95 responses to this survey, 71% were from female employees. The majority of respondents were aged over 30 years of age and had been born in English speaking countries. Of the women responders, 62% had worked in their present position for less than three years and half for less than one year. More than 80% of the women were satisfied with the training they had received for their current job but many (over 55%) reported low job satisfaction.

Just over half of the female respondents understood the term manual handling. Of those who reported that manual handling tasks caused them some discomfort, 45% attributed this to lifting activities, 20% to hanging of food items, 15% to continuous standing and 10% to each of pulling/pushing and repetitive movements. Only 6% of the female respondents reported that they never felt pain or discomfort associated with their work. Of those who had experienced some discomfort, about half said that it had had a negative effect on their quality of life.

5.1.5 Company 5 (Food processing)

This company kept a copy of its WorkCover claims as its injury records. During 1993, 44% of these claims were due to cuts to thumbs during manual handling tasks. A further 33% of injury claims was for pain associated with strains in the back or arm. All back injuries were due to lifting.

Accident investigation reports were also completed for a number of the injuries during 1993. Information obtained included the type of injury, nature, body part, the object equipment or substance inflicting the injury, a short description of how the injury occurred. Typical scenarios were "turning and cutting food item in hand, complained of pain in back of left hand" and "lifting boxes above normal height".

Just one-half (55%) of the injuries reported on the accident investigation reports were sprains or strains. Of these, half involved the hand/wrist and the others were to the back/shoulder.

5.1.6 General comments about the injury data collections

Only one company had computerised its injury data for workers' compensation purposes. This had some limitations for the extraction of data for injury prevention purposes, however, because the relevant information about each individual injury case could not be obtained - it was essentially an accounting database. Thus it was possible to obtain information, for example, about the total numbers of sprains or strains and the numbers of injuries according to body region. However, it was not possible to cross-link this information to determine, for example what proportion of upper arm injuries were strains. The non-relational nature of many computerised databases can therefore be a major limitation, from an injury prevention perspective.

Another problem with an accountancy-driven approach to injury record keeping, can be that the records are classified according to budgetary units (necessary for company accounting purposes). Little, if any, information is recorded about the jobs and tasks that lead to the injuries. The major implication of this is that the injury data is only available for tasks and jobs grouped according to accounting constraints rather than the similarity of the jobs or tasks performed. The latter is preferred for injury prevention purposes. For example, the budgetary unit may cover one whole section (often geographically defined or relating to the production of a single type of item) of a factory floor. However, this section would typically cover employees involved in many different tasks and jobs, of which only a proportion would be manual handling. This makes it difficult to extract information pertinent to manual handling tasks.

Injury data for the companies without computerisation needed to be extracted by hand from individual case records such as first aid books, accident investigation reports or workers' injury compensation forms. This was a long, painstaking process but some information could be obtained from these sources.

In the end, the quality of the injury data obtained from the companies without a computerised system was little different to that from the company with the computer records. The major difference was in the effort needed to be spent in extracting the relevant information. If it was such a major effort for the research team to extract this data, it must also be hard for the companies. This suggests that the data collections maintained by the companies are not being used for injury prevention purposes or for injury audits but merely for meeting the requirements of the regulations. It would seem that a more pro-active use of injury data for prevention purposes is an activity that should be promoted.

Some companies had injury recording systems that collected a short narrative text description of the event leading to the injury. These narrative descriptions of injuries have been shown to be valuable for injury purposes in other settings (Rechnitzer & Larsson, 1992; Waller and Clemmer, 1993) and should be also encouraged in the occupational setting. The effective use of narrative text is given in the proposed new European standard of recording occupational injury and disease (Heidenström, 1982; Larsson, 1990; Eurostat, 1992; Jørgensen, 1994), which is based on the New Zealand ACC coding system, adopted and further developed in Sweden, Norway and Denmark. This breaks down the narrative of the accident process into activity, mechanism and contact and poses three questions on the claims/recording form:

- what were you (the victim) doing?
- what went wrong?
- how was the injury inflicted?

The answers to these questions are recorded as verbs (activities, actions) and nouns (agencies, exposures) and can be stored in coded form, as open language verbs and nouns, or as free text descriptions with highlighted keywords. In this system, up to three different external agencies can be coded; eg. standing on ladder, hit thumb with hammer, fell to the ground. This approach helps provide the detail required for focusing the data collection system and data itself on information required for effective injury prevention activities.

It is worth noting that whilst all companies complied with the regulations by maintaining injury records, the injury records were not able to be readily used for injury prevention purposes. This suggests that clearer guidance in how to optimally collect, record and use injury data for injury prevention purposes should be provided in the codes of practice.

5.2 SUMMARY OF SITE VISITS AND RISK ASSESSMENTS

This section summarises the findings from the risk assessment checksheets for 21 tasks at the five companies. Details of the particular problems assessed and identified by the risk identification and assessment checksheets are presented, together with photographs of the particular workstations assessed. Short, medium and long term control strategies developed by the workplace project teams are also provided.

5.2.1 COMPANY 1 (Autocomponent assembly)

Company 1 was involved in autocomponent assembly. Four workstations were assessed. Two of the workstations involved the operator taking parts out of a bin and placing them onto a workbench or revolving table; a third involved a packing line with the operator folding the top of each box on a moving conveyor; with the fourth involving repetition cutting using hand scissors.

5.2.1.1 Issue 1: Putting pots on a table

This task involved the operator taking pots from a bin and placing them on a revolving table for the next phase of production (Photo 1).

Photo 1: Putting pots on a table

The problems assessed included:

- twisting of the body to place the pots on the table

- the workstation height did not allow for variations in operator height
- the upper arms are unsupported away from the body
- a full span grip was needed to grasp the pot
- there is a lack of trained skilled staff

Control strategies identified by two project teams were:

Short term strategies:

- reconsider the current layout to bring the bin closer to the work area
- increase job rotations to every 1/2 hour
- train workers in better operation procedures such as no twisting, changing pots between hands, etc.

Medium term strategies:

- redesign layout so that the bin and the table are closer
- develop different heights or adjustable stands for different height workers
- review the line speed to match workers' capabilities rather than production quotas
- allow time for new staff to gradually build up to full speed
- determine the feasibility of automatic feed-on systems

Long term strategies:

- develop technology to auto-feed the pots on to the table, possibly by a continuous feed from previous operation

5.2.1.2 Issue 2: Folding cardboard boxes

The activity assessed was part of the product packing line and requires the operator to fold the top of a cardboard box (Photo 2).

The problems assessed were:

- reach to the work area was greater than optimal and the upper limbs were unsupported for a lot of the time
- the work was performed in an awkward posture
- the speed of operation was not matched to skill of the operator
- new staff were required to work at full production rates

Short term strategies:

- educate employees about problems associated with over-reaching and change posture on a regular basis, ie take posture breaks
- allow extra staff to relieve production pressure on line
- train the trainers to allow new workers to build up to full speed, possibly using the buddy system

Medium term strategies:

- redesign the conveyor to determine optimal height and allow workers to get closer to the objects
- investigate automatic packing operations to eliminate the task

Long term strategies:

* automate the packing line

Photo 2: Folding the top of a box

5.2.1.3 Issue 3: Cutting with hand scissors

The repetitious activity assessed in this workstation required the operator to cut into specified lengths, using hand scissors (Photo 3).

The problems assessed were:

* reach to the work zone was greater than optimal and upper limbs were unsupported for a lot of the time
* the workstation did not allow for variations in operator height
* the speed of operation was not matched to the operators' ability
* the handles on the scissors required awkward wrist and hand positions
* the size and nature of the paper to be cut required awkward wrist positions
* repetitive work
* a lack of available staff during normal operation

Short term strategies:

- provide adjustable height chairs for different operator heights
- sharpen scissors on a regular basis and investigate and trial designs with ergonomic handles and longer blades
- narrow the edge of the bench to bring the work closer to the operator
- begin the cutting job on the afternoon shift to make up for production shortfalls
- allow the cut paper to control the machine speed
- train more staff to act as backup and rotate staff

Medium term strategies:

- increase the training of personnel to have greater possibilities of multiskilling and rotation
- provide adjustable height workstations, to match different workers' sizes
- investigate automatic sheers and paper grippers and spreaders

Long term strategies:

- automate cutting systems

Photo 3: Cutting with hand scissors

5.2.1.4 Issue 4: Removing objects from bin and putting on table

In this task, the operator removed bundles of loose metal objects from a bin and placed them on a work bench (Photo 4).

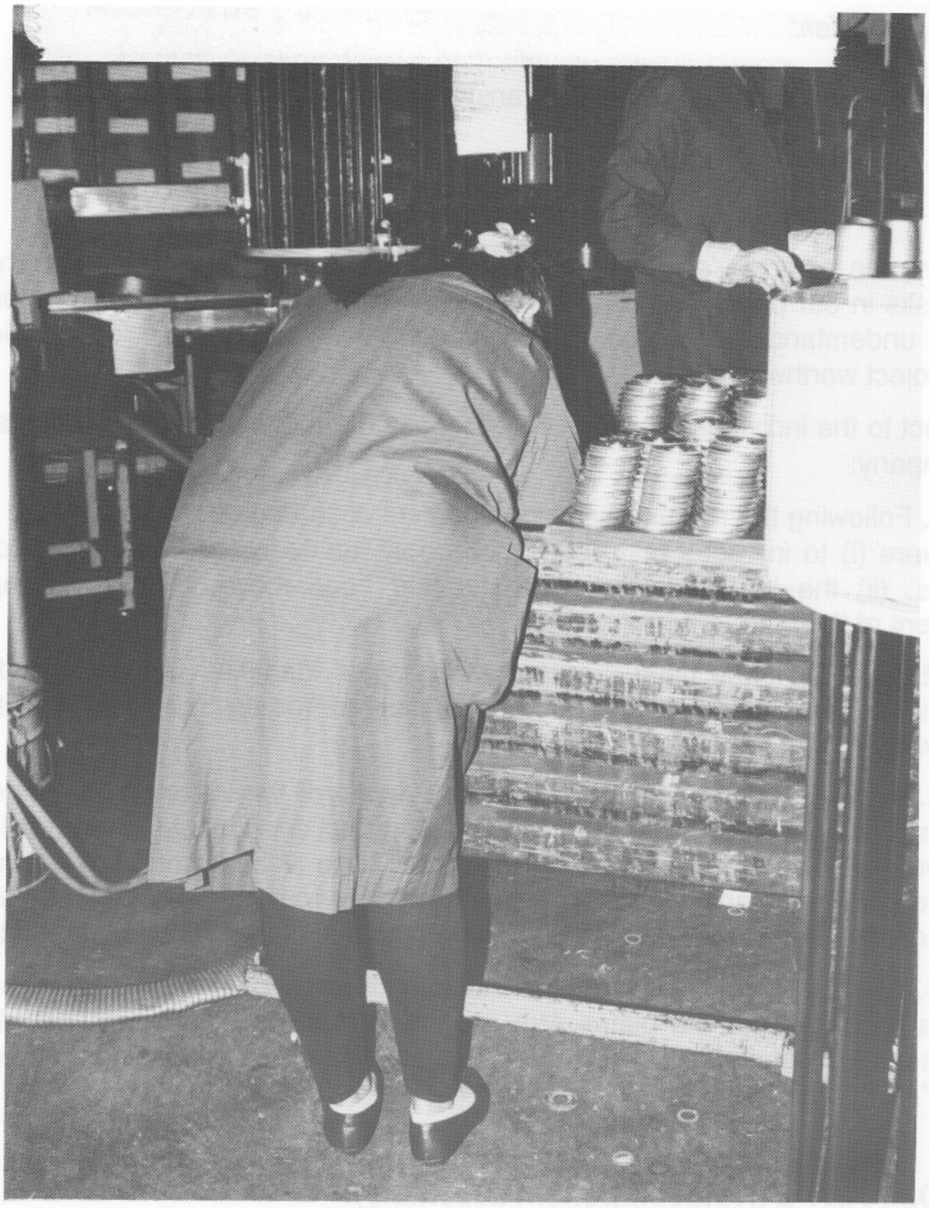


Photo 4: Removing objects from bins

The problems assessed were:

- reaching into the bins required repeated bending twisting and lifting
- the workstation height did not allow for variations in operator height
- the speed of operation was not matched to skill of the operator
- there was a return to full pace after an extended period off work

Short term strategies:

- raise the height and reduce the depth of the bin
- instigate adequate job rotation schedules for all employees performing this task
- investigate a light weight tool to bring plates closer to the operator

Medium term strategies:

- design scissor lifters and a shallower bin
- rotating lifters for bins
- investigate other systems to transfer the materials, including costs and benefits

Long term strategies:

- implement automated product transfer systems

5.2.1.5 Results of the follow-up survey

In summary, the company's response was: "We, as a group, were aware of the manual handling risks in our plant. The risk identification, risk assessment and control procedures helped us understand the seriousness of our problem, making our contribution to the Monash project worthwhile".

With respect to the individual workstations assessed the following responses were provided by the company:

- **Issue 1.** Following the risk assessments and control strategies suggested, the measures taken were (i) to increase task rotation with half-hourly instead of the previous hourly rotations; (ii) the bin containing the pots had been moved slightly to improve the movement of the operator.
- **Issue 2.** The company used the control strategies identified from the study, but no changes had been made since they were considered "too costly and not feasible in light of a new process being introduced".
- **Issue 3.** In this case, the company was "fully aware of the issue and were considering control strategies for the task. An alternative to normal scissors has been provided to the operators - Fiskass Softouch Scissors. These have a cushion grip to eliminate the pressure on thumbs and the spring opens after every cut relieving the operator of extra hand motion and pressure. This task will be automated in the not too distant future."
- **Issue 4.** "One solution of using Jumbo Vacuum Lifters will not work on the plates due to the size and shape of the plates. We are still working (special operations & projects) towards a successful alternative that will be suitable for the task seeing that the space is limited."

5.2.2 COMPANY 2 (Autocomponent assembly)

Company 2 was involved in autocomponent assembly. Four work stations were assessed by the workplace project team: three of the workstations involved the operator in a repetitive production process assembling small parts; the fourth involved lifting of component bins into storage racks.

5.2.2.1 Issue 1: Greasing of small object

This activity involved the operator removing a small object from a bin and reaching over to a greasing nipple that is then activated by pressing a trigger (Photo 5).

The problems assessed were:

- reach to the greasing machine was greater than arms length
- the whole set-up was designed for left handed operation
- a large force was needed to squeeze trigger
- an awkward wrist position was needed to grasp the object

Photo 5: Greasing of small object

A number of control strategies were suggested by the workplace project team.

Short term strategies:

- reconsider the current workstation layout to bring the greasing machine closer to the operator
- increase rotations of operators
- bring the bin closer to operator

Medium term strategies:

- redesign the greasing machine to require a better hand position to operate
- make the operation suitable; for either hand operation
- redesign the trigger mechanism for easier operation
- change the bin type for easier access to parts

Long term strategies:

- eliminate the requirement for this task

5.2.2.2 Issue 2: Putting disc on bracket

In this task, the operator takes a small disc from a bin, rests it on a supporting bracket and, using the thumbs, presses another part onto the disc (Photo 6)

The problems assessed were:

- force and precision are needed to complete the task. The object is difficult to grasp and force is needed when pressing the other part into place
- the task is performed in a confined space
- an awkward posture of the wrist is needed to do the job

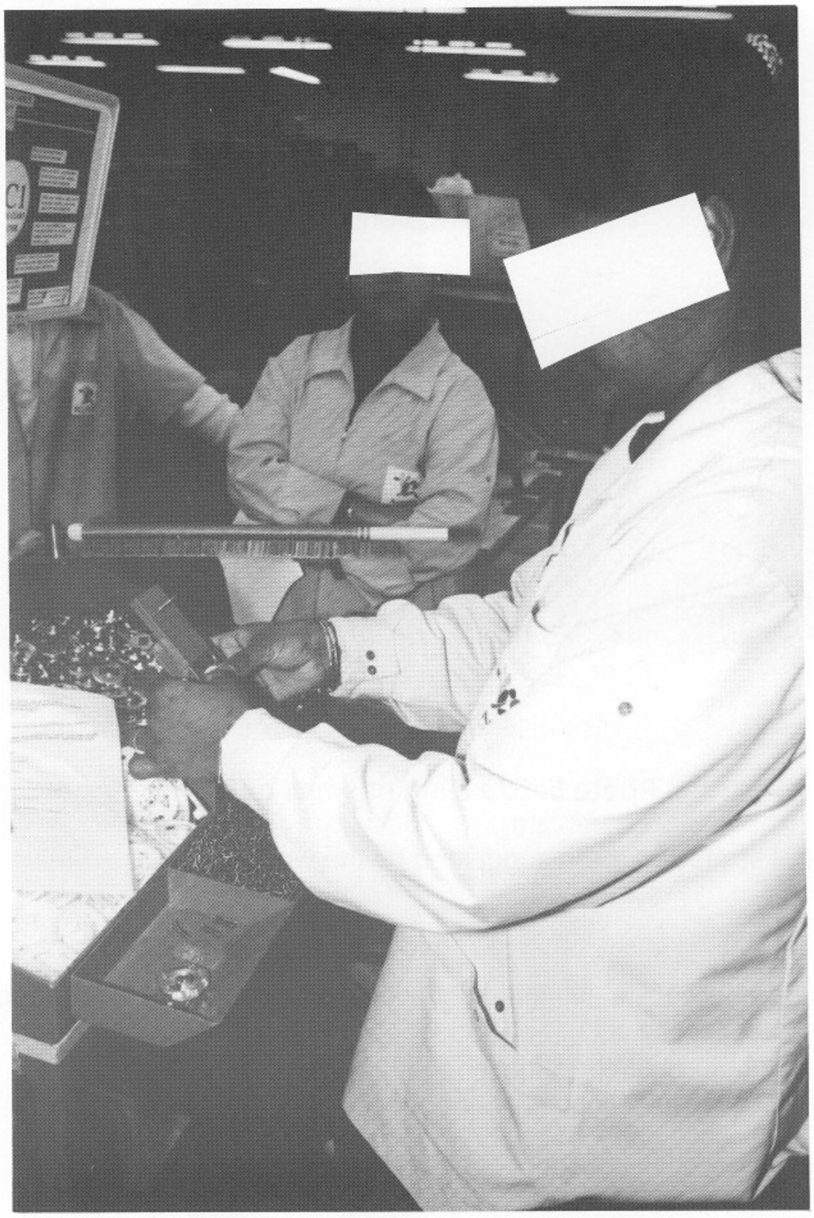


Photo 6: Putting disc on bracket

Short term strategies:

- change the angle of the assembly head to either flat or variable
- increase rotations of the operators, from 2 hourly to 1 hourly
- educate the operators in the use of the workstation, including chair adjustments and good postures

Medium term strategies:

- investigate alternate assembly methods
- investigate automation possibilities

Long term strategies:

- eliminate the task requirement, through automation

5.2.2.3 Issue 3: Lifting cases from the floor to a rack

Parts for the production line are kept in plastic cases, which are placed in racks near the operators. The task assessed in this issue is the lifting of the cases from the floor and placing them in the racks (Photo 7).

Photo 7: Lifting cases from floor to rack

The problems assessed were:

- inadequate and confined space for handling of the cases
- fixed working heights for both the cases and on the stand
- the reach to the top of the stand was excessive and required stretching

Short term strategies:

- training in correct methods of manual handling
- assess the job requirements to change the layout of the stand
- assess the requirements for an adjustable, spring-loaded pallet stand

Medium term strategies:

- redesign the workstation layout to allow more room for operation and loading of stand
- lower the height of the stand
- provide a spring-loaded pallet stand to present cases at a optimal height for the operator

Long term strategies:

- none suggested

5.2.2.4 Issue 4: Assembly task

In this task, the operator reeled a belt onto a small drum (Photo 8)

The problems assessed were:

- the lack of task variety
- fixed height benches and position of operation controls
- the positioning and requirement to operate the foot pedal involves single leg weight bearing

Short term strategies:

- provide training and instruct operators on correct and best methods of operation
- increase the rotation of operators through this and other tasks
- use stands or mats to make the height optimal for each operator

Medium term strategies:

- re-examine layout of the workstations for this and other tasks to optimise process design
- provide alternative methods of activation to the foot pedal (ie hand)
- make benches adjustable and train operators on their correct use
- Investigate options for semi-automation or job redesign

Long term strategies:

- eliminate the requirement for this task

5.2.2.5 Results of the follow-up survey

The general comments made by the company were: " ....manual handling procedures incorporated into the day to day routine of operation. From this study a better awareness of the requirements of legislation and individual operator needs. Further ergonomic training has since been undertaken within the company to develop current personnel skills."

With respect to the individual workstations assessed the response was:

- **Issue 1.** All stages were considered as helpful with the suggested control measures implemented - relocated the machine closer to the operator, with regular rotation of operators through the tasks.

- **Issue 2.** All stages were considered helpful, with the following changes made: modification of the fixtures used, relocation of parts closer to the operator.

- **Issues 3.** All stages were noted as helpful with solutions implemented: changed layout of stand and introduction of alternative containers.

- **Issue 4.** All stages were considered helpful, with the changes implemented, consisting modified foot pedal; relocation of parts for easier access.

Photo 8: Assembly task

5.2.3 COMPANY 3 (Food processing)

In this company, four workstations were assessed by the workplace project team. The workstations involved the operator and moving or packing of various small food items from a conveyor line into various cartons. The following sections are a summary of the control strategies determined by the workplace project team.

5.2.3.1 Issue 1: Packing food items

In this task, the operator sat alongside a conveyor line with her back towards the flow of product along the line. The food items were swept by the operator across the line to in front of them and then packed into cardboard boxes (photo not available).

The problems assessed were:

- the boxes were not in easy reach
- the food items come from behind requiring twisting of the neck and back to view the oncoming objects
- the food items are lifted with one hand
- the workstation heights are fixed
- repetitive wrist movements are required when packing to turn over the food items
- the work is machine paced
- relief is not always available
- extra people are needed during peak times
- no training for new operators

Short term strategies:

- request that boxes are delivered closer to the operator
- obtain new chairs that are adjustable and footstools if required
- place dividers between each layer of food items so that there is no need to twist the wrists to turn the objects over
- set the machine computers so that each side gets the same quantity of food items to pack
- have staff available for relief

Medium term strategies:

- change line layout to provide boxes in closer proximity
- look at alternative belt designs (eg. a snake shape design) to ease viewing the oncoming objects and make it easier to pack
- make the line smaller or thinner
- provide staff with training

Long term strategies:

- develop technology to automate the packing of the food items

5.2.3.2 Issue 2: Quality inspection of food item

In this task, the operator sits perpendicular to a wide conveyor line, inspects the food products and removes the faulty ones.

The problems assessed were:

- frequent reaching beyond 30 cm (about once per minute)
- conveyor height fixed
- repeated force necessary to "hold back"
- work pace is machine controlled
- no training in correct manual handling or in task requirements

Short term strategies:

- put guides on the conveyor to bring the product closer to the operator
- allow extra staff to relieve production pressure on line
- train the operators in manual handling and on correct operating procedures
- have a table with baskets to hold product

Medium term strategies:

- redesign the conveyor to determine the optimal height and allow workers to get closer to the objects and sit in good postures
- install controls or switches so that the operators have some control over machine pace
- train staff

Long term strategies:

- make the line adjustable to accommodate all sized operators
- make the line speed operator controlled
- install collection points to regulate product flow ie. one at a time

5.2.3.3 Issue 3: Packing small food items

In this task, the operator assists a vacuum lifter transfer small food items into boxes (Photo 9).

The problems assessed were:

- the chairs do not have backrests
- there is no adjustment possible in the working height
- asymmetrical lifting and twisting of the body is required
- there are long periods of repetitive work
- the floor surfaces are slippery
- the thermal environment is not well controlled
- there is a need to restrain and hold objects in place

Short term strategies:

- provide adjustable height chairs with back supports
- provide matting to stop slips on the floor
- ensure the trays are full

Medium term strategies:

- redesign the machine
- fix the air conditioning unit

Long term strategies:

- make the machine adjustable to suit individual operators' needs
- slow down the pace of the machine

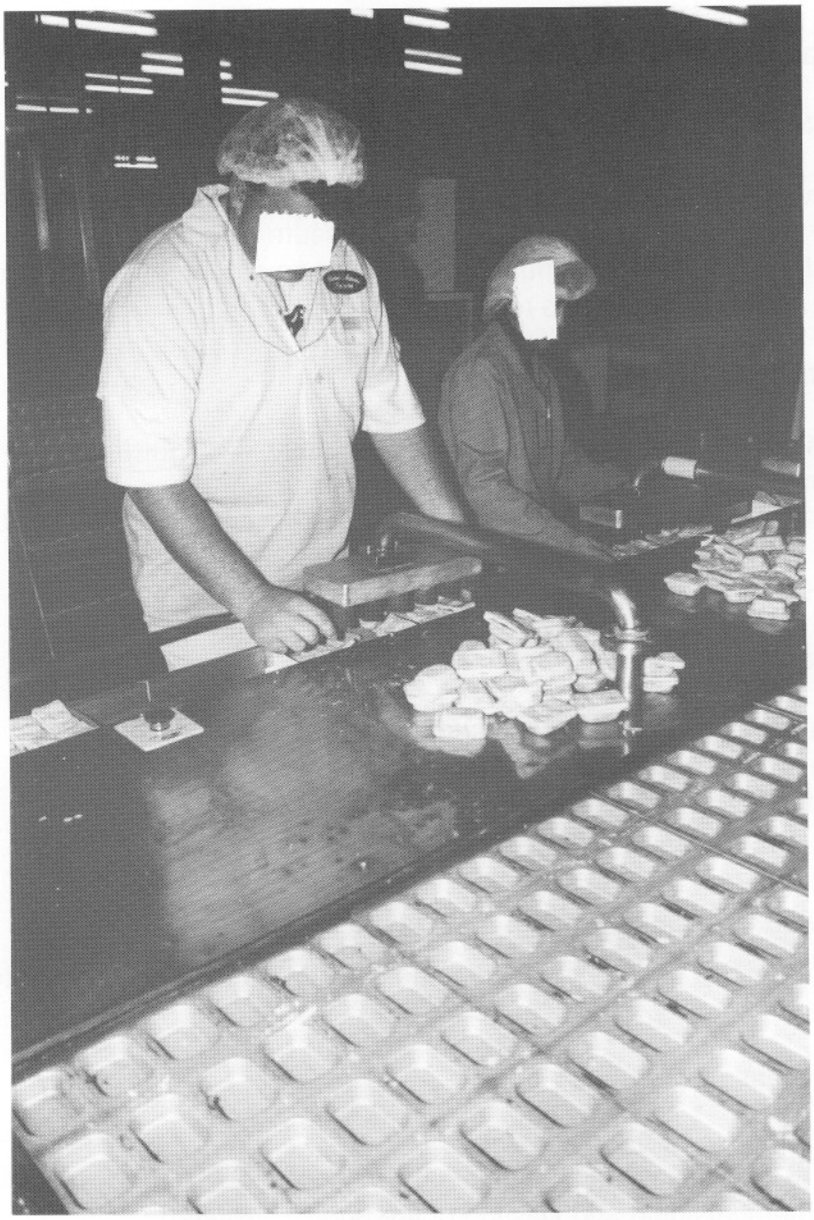


Photo 9: Operators assisting vacuum lifting of small food items into boxes

5.2.3.4 Issue 4: Packing and box handling

This issue consisted of two main tasks: packing of small food items into a box, which itself is then packed into a larger cardboard box. this larger box is formed from pressed flat sheet.

The problems assessed were:

- the chairs have inadequate back support
- the work height did not allow for operators to sit with knees under the line
- access to the other side of the belt is difficult and there is a need to cross over the belt
- heavy handling is required when the boxes do not work (ie. difficult to form the large box from the flat sheet)

- Taping requires manually pushing of boxes through the machine
- the machine operating controls are removed from the immediate operating area

Short term strategies:

- provide more appropriate chairs
- have assistance (from the men) when there is a breakdown in the boxes
- put the belt on an angle so that the boxes run freely

Medium term strategies:

- provide knee space under the line
- investigate options for improving access to the line
- relocate the machine controls closer to the operators

Long term strategies:

- None provided

5.2.2.5 Results of the follow-up survey

Over the period of this project, this company has been sold by the parent company and taken over by another large international group. A number of staff involved in the project have left, including the OH&S officer who was the major driver, leaving no personnel really familiar with the project details to complete the survey.

The company responded, however, by stating that their involvement in the project "has not resulted in any flow on effect in control of manual handling hazards. ... the skills that the women originally developed from the training have now been lost due to lack of follow up and ongoing practice in undertaking assessments".

5.2.4 COMPANY 4 (Food processing)

Five workstations were analysed by the workplace project team using the risk assessment checksheets. Four of the workstations involved production line work with repetitive tasks. One of these involved the operator making repetitive cuts; two involved lifting and placing the food item; a third involved force to remove some items from the larger food item. The remaining workstation involved loading and manual lifting of cartons.

5.2.4.1 Issue 1: Cutting food item

In this task, the operator makes a number of knife cuts to the larger food item to produce smaller pieces (Photos 10 and 11)

The problems assessed were:

- the reach to the work zone was greater than optimal and upper limbs were unsupported for a lot of the time
- the workstation height did not allow for variations in operator height
- the speed of the operation was not matched to skill of the operator
- the handles on the knives were not ergonomic
- there is a return to full pace after an extended period off work

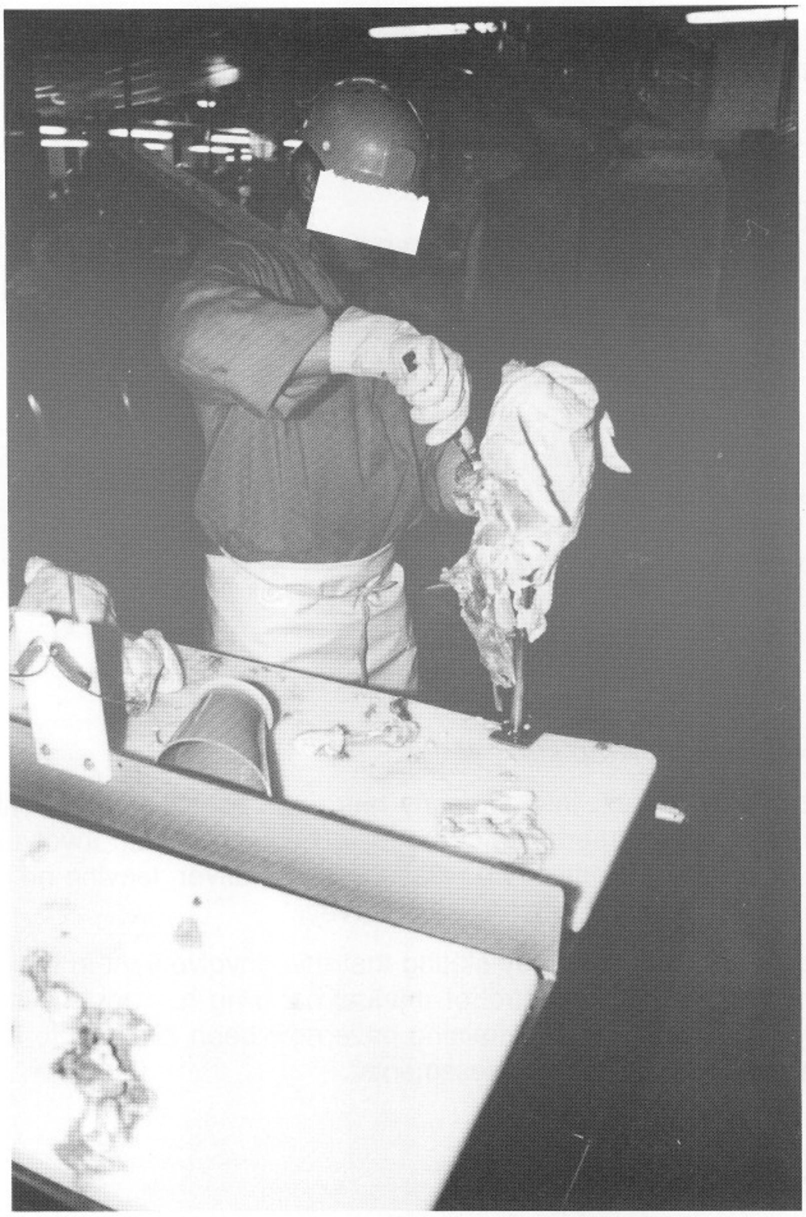


Photo 10: Cutting food item (a)

Short term strategies:

- ensure adequate numbers of variable stands to ensure optimal height
- make available a selection of knives and handle sizes to better suit the operators' requirements
- review the speed of the belt to determine the optimal speed for the operators
- determine a suitable policy to allow those returning to a particular duty, after an extended period off that duty to have a gradual increase in work load to suit their progress
- move the scrap belt to allow better access to the work area

Medium term strategies:

- increase training of personal to have greater possibilities of multiskilling
- instigate additional training to cover issues of good working postures, tool designs and other causes of injuries
- review the heights of the belts to determine optimal height(s)

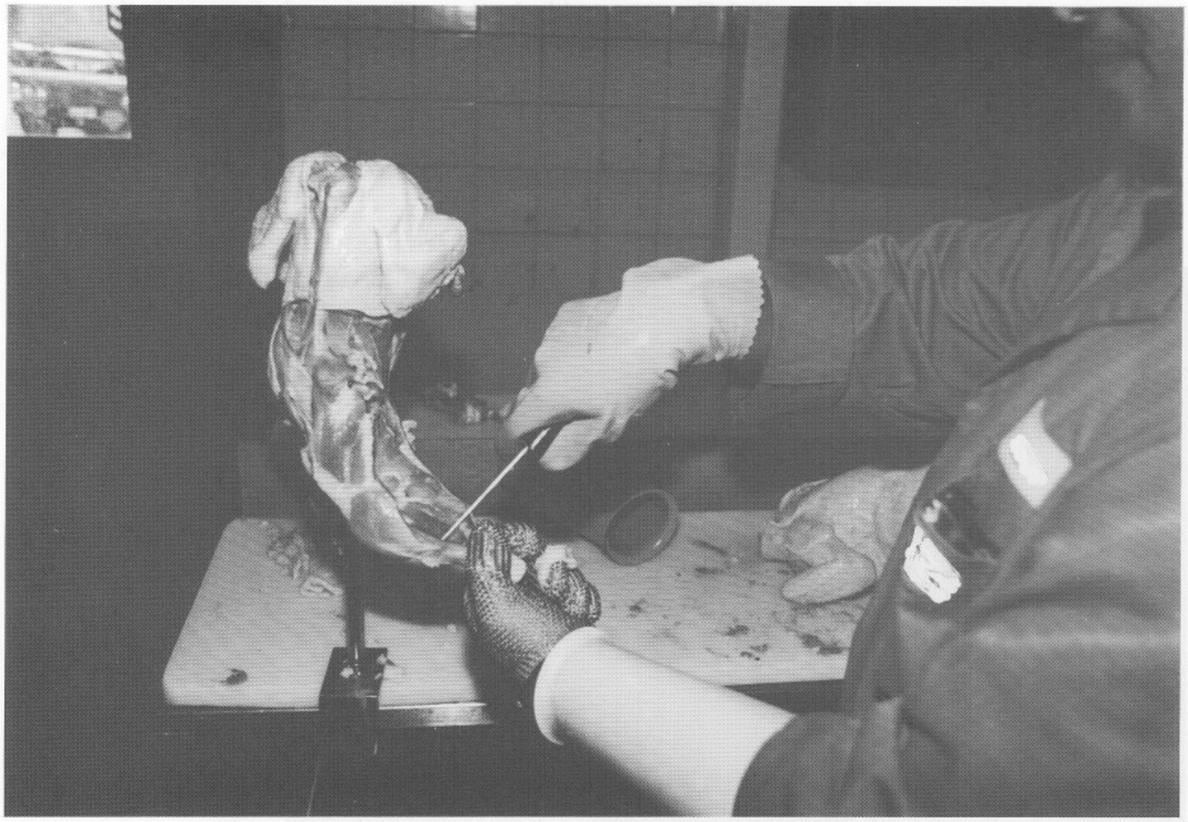


Photo 11: Cutting food item (b)

Long term strategies:

- revise the heights of the belts
- design and custom make a series of knives for different tasks to allow better hand and arm positions.
- increase and change the structure of task rotations taking into account each task requirement

5.2.4.2 *Issue 2: Dispatch palletising*

This task involves various cartons being lifted by an operator from a roller conveyor and placed on various pallets for dispatch (Photo 12).

The problems assessed were:

- to obtain cartons and to place onto pallets required extended reaches, twisting, bending
- there is no variability in work height
- the speed of operation was paced and not matched to skill of the operator
- the task required a non-neutral wrist position
- there is a lack of variety and lack of suitable rotation for new staff
- there is a lack of staff to cover for overtime, peak times and suitable rotation

Short term strategies:

- allow more frequent rotation to reduce overall load and provide task variety
- review the position of belt and pallet to determine optimal layout with current equipment

- train more staff for multiskilling to enable better utilisation during peak times and better rotation
- review staffing levels to determine requirements based upon task levels
- determine a suitable policy to allow those returning to a particular duty, after an extended period off that to have a gradual increase in work load to suit their progress

Photo 12: Dispatch palletising

Medium term strategies:

- investigate redesign of workplace to include pallet lifters for each station and variable height conveyors to enable optimal postures
- instigate additional training to cover issues of good working postures and other causes of injuries
- have overlapping of shifts and utilise greater staff numbers (via multiskilling) to spread load
- regulate work flow based upon staff levels

Long term strategies:

- install redesigned layout including pallet lifters and variable height conveyors
- investigate mechanised palletising systems

5.2.4.3 Issue 3: Hanging food item

The operator lifts the food item off the conveyor belt and hangs it onto moving hanging hooks (Photo 13).

The problems assessed were:

- reach to the work zone was greater than optimal and upper limbs were unsupported for a most of the time
- the workstation height did not allow for variations in operator height
- only standing posture is possible
- inadequate trained staff to cover peak times, adequate rotation or staff relief
- inadequate training
- the task involves a fast pace and repetitive work with awkward grips
- cold working environment

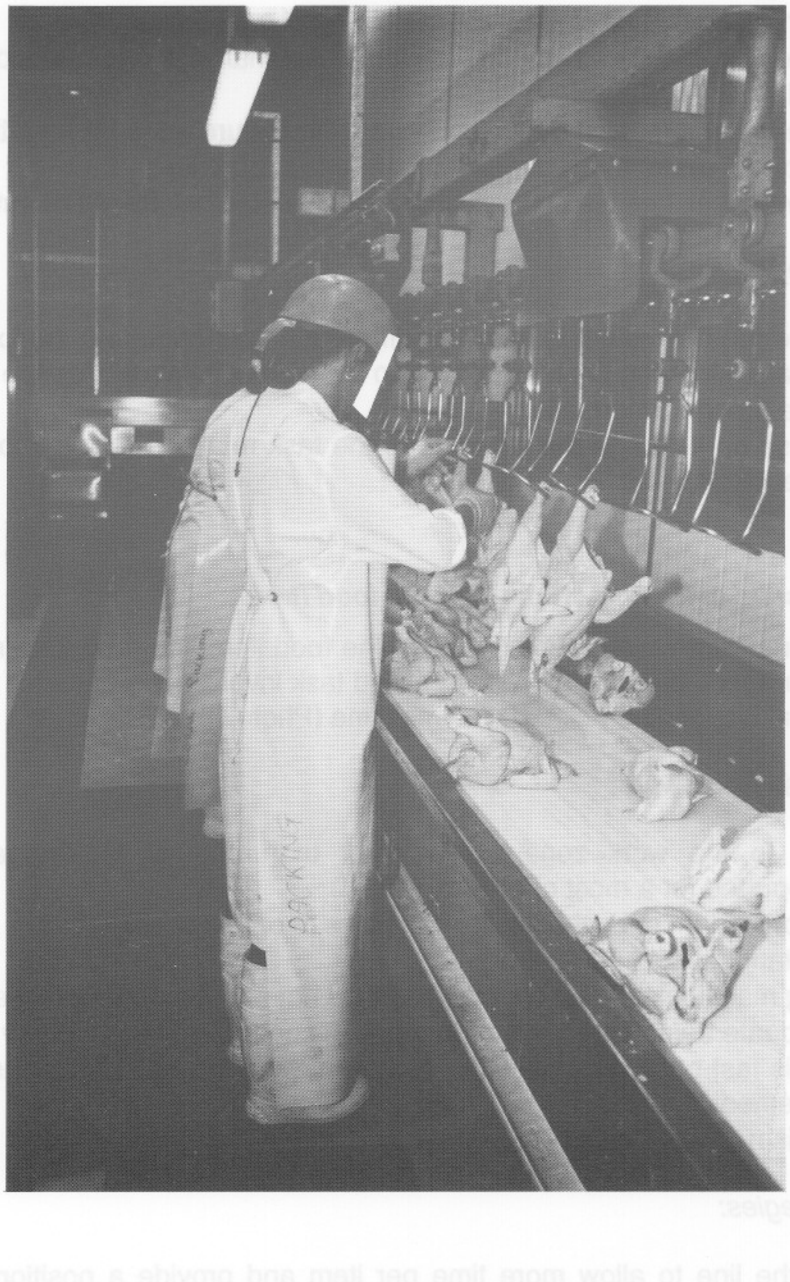


Photo 13: Re-hanging

Short term strategies:

- provide extended platforms or select operators of appropriate height to ensure optimal height and reduced reaches
- provide anti-fatigue matting to reduce the fatigue from standing
- review the speed of the belt to determine the optimal speed for the operators

- allow more frequent rotation
- provide more training to cover issues of good working postures, causes of injuries
- increase the number of trained staff to allow more frequent rotation and to cover periods of increase workload
- provide a spare fill in person to assist slower, or relieve, staff during toilet breaks, etc.
- determine a suitable policy to allow those returning to a particular duty, after an extended period off to have a gradual increase in work load to suit their progress

Medium term strategies:

- train more staff to have greater possibilities of multiskilling
- provide ongoing training to reinforce optimal working positions are used especially for wrists
- devise better supervised rotation systems to ensure adequate rotation sequences and correct return to full duties after absences from task
- review the belt heights and possibilities of variable belt height or automation

Long term strategies:

- change the belt height to allow for different height operators. (ie fixed variable or adjustable) to bring the food items into optimal repetitive work zone
- update trainers' information
- increase and change the structure of the task rotations taking into account each task requirement

5.2.4.4 Issue 4: Pulling off parts of the food item

Following machine removal of internal parts of the food item, the food item moves along a vertical conveyor past the operator. The assessed task involves the operator pulling out any remaining internal bits not extracted by the machine (Photo 14).

The problems assessed were:

- reach to the work zone was greater than optimal and upper limbs were unsupported for a most of the time
- the work height did not allow for variations in operator height
- only standing posture allowed
- slitting machine and pull out machines did not adequately work on all item sizes
- inadequate trained staff to perform the task correctly and efficiently
- there is fast pace and repetitive work with awkward grips and considerable force requirements
- there is no availability for slower workers

Short term strategies:

- slow the line to allow more time per item and provide a position for a second operator
- allow more frequent rotation
- increase the number of staff trained to allow more frequent rotation and to cover periods of increase workload
- leave gaps in line to allow workers to catch up, or to take a micro pause

Medium term strategies:

- train more staff to have greater possibilities of multiskilling and better duties rotation
- improve maintenance to ensure machinery is correctly adjusted to cover a variety of item sizes, reducing the need to touch every item
- allow a second operator position on the pulling out duties, to decrease individual work load, allow for relief operation, allow routine and frequent postural breaks, provide training, allow re-adjustment at less than full pace

Long term strategies:

- ensure that the machinery is intelligent enough to correctly determine the slit and pull strength necessary for all item sizes and minimise the numbers of items that need to be handled
- introduce less physical duty that can include a sit and/or stand option
- multiskilling to ensure wide ranging rotations

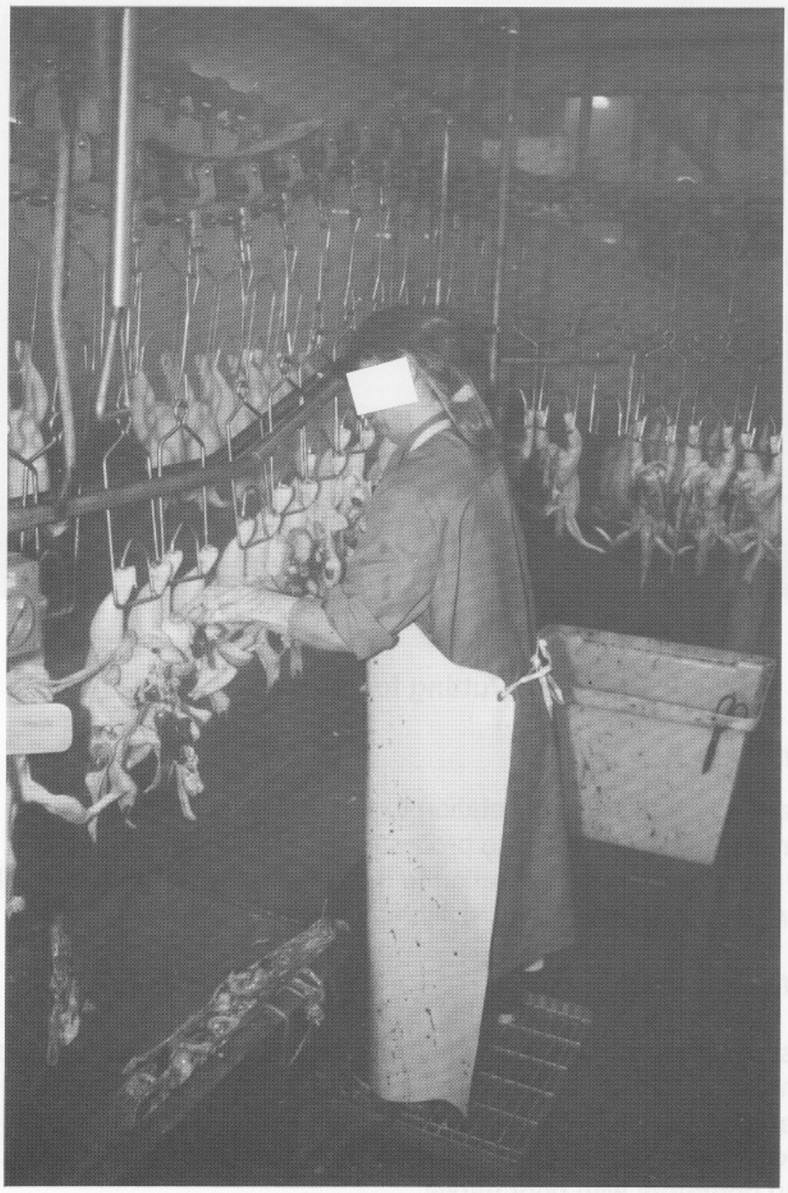


Photo 14: Pulling off parts of the food item

5.2.4.5 Issue 5: Putting food item on holder

In this task, the operator takes the food item from a storage bin and lifts then places it onto a vertical holder on a conveyor (Photo 15).

The problems assessed were:

- the layout of workplace requires frequent handling and twisting and bending of the trunk
- the grips and wrist movements are awkward
- the force required to grip produces discomfort
- there are work organisation difficulties with inadequate trained staff to cope with overtime demands, adequate rotation and multiskilling

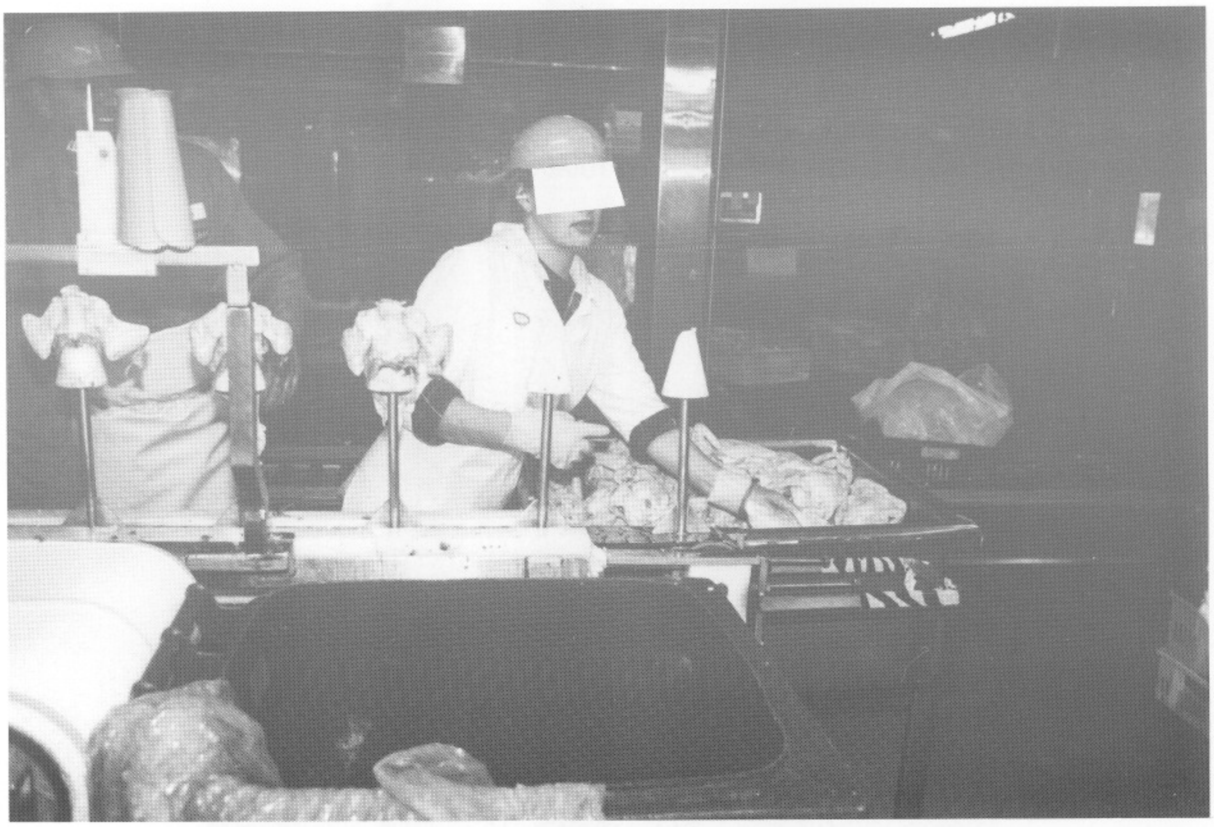


Photo 15: Putting food item on holder

Short term strategies:

- increase the frequency of rotation to every 30 minutes
- commence a pause exercise program
- allow a variable speed operation to match workers ability, especially when starting
- train more staff to have multiskilling and better rotation

Medium term strategies:

- redesign the stands to allow more room and to be of an appropriate adjustable height
- management should correct the time and speed of item drops to coordinate with breaks
- retrain operators with poor habits
- match the production to staff levels and ability

- train more operators and multi-skill those currently working there to allow for better rotation

Long term strategies:

- redesign the layout of the machine to reduce poor posture requirements such as reaches, the need to bend or make twists, etc.
- introduce variable machine speeds
- introduce two crews to enable better rotation and job sharing arrangements

5.2.4.6 Results of the follow-up survey

The company reported that "the greatest benefit came from the focus on manual handling issues and the development of a system to record the issues and maintain the focus."

With respect to the individual workstations assessed the response was:

- Issue 1. The project helped to identify specific risks relating to tools with changes made to size of knife handles and also staff rotation.
- Issue 2. Though the project helped to identify and assess the risks, it was not considered helpful in identifying control strategies in this area. This area is considered to be difficult and costly to improve.
- Issue 3. Changes were made as a direct result of the project with increased frequency of job rotation and increased staffing levels for peak periods.
- Issue 4. Shorter rotation times on this task (half hourly) were introduced.
- Issue 5. Though the study helped to identify risks, it did not help to identify appropriate control strategies in this area and no changes have been implemented.

In response to the workplace project team's risk assessments and suggested control strategies, the company's management was concerned that a number of the suggestions were not necessarily realistic. They also believed that they appeared to ignore or not recognise measures that had, in fact, been taken by management. It must be emphasised that the proposed solutions from any risk assessment are just the starting point for the detailed determination of practicable solutions. These solutions need to be more fully developed with both management and staff involvement.

For example, the suggestion that the "handles on the knives were not ergonomic" was made by the workplace project team. However, management pointed out that a great deal of effort had been expended on trying to find the best available boning knives. Moreover, the knives used by the company were the same as those used by their largest peer in the USA. The view of management in this case was that training of the operators in the correct use of the knives was really the issue and not the knives themselves. In other cases, where the workplace project team considered that the speed of the line was an issue, it was pointed out by management that this line was slower than any other in Australia.

This discussion highlights the importance of appropriate management participation in risk assessments and, of course, the development of solutions. The concern is, however, that management in many organisations may find reasons why suggestions are not workable rather than allowing themselves to be open to exploring new approaches. In this regard, it is noteworthy that solutions to problems identified in the risk assessments are often better examined and solved at the systems level (eg. the speed of production lines). A systems analysis generally needs to be overseen by management and production management and in consultation with employees. Factors such as speed, work, ergonomics, etc need to be assessed and controlled in consultation, assisted where necessary by appropriate professional disciplines such as engineering or others.

5.2.5 COMPANY 5 (Food processing)

Company 5 was a food processing company that was also involved in some packing activities. Four workstations were analysed by the workplace project team. All involved repetitive tasks: one involved selection and placing of items on a conveyor; one involved heavy cutting of food items; two involved the fine cutting and shaping of food items.

5.2.5.1 Issue 1: Selecting and placing items

Items are selected by the operators from storage bins and placed on a conveyor line for packing (Photos 16 and 17).

Photo 16: Selecting and placing items (a)

Photo 17: Selecting and placing items (b)

The workplace project teams identified the following strategies:

Short term strategies:

- rotate the staff through other jobs more frequently (including non standing tasks)
- trial work mats and platforms to make height better for all staff
- make the task speed adjustable (by trained first operator) to that of least skill operator
- increase the pool of available skilled staff through recruitment & transfer from other areas
- negotiate with suppliers and customers to have better lead times to meet orders
- rotate returning and new staff through a range of other duties

Medium term strategies:

- determine optimal height of machine and make necessary adjustments
- ensure skilled pool of staff remains
- set up a committee to examine and make recommendations on return to work strategies and policy
- develop policies for suppliers with adequate lead times, etc.

Long term strategies:

- redesign the incoming goods table to deliver goods closer to the employees
- install an adjustable platform for employees to stand on
- investigate possibilities for total or partial automation
- develop adequate training and employment policies
- implement policies for staff returning to work

- implement policies for suppliers.

5.2.5.2 Issue 2: Cutting food item

This task involved cutting a food item into small pieces and trimming these pieces by hand using a small knife (Photo 18).

Photo 18: Cutting food item

The problems assessed were:

- set table height, not adjustable to workers height
- no established method to attain neutral wrist working position
- not enough trained staff
- a lack of re-adjustment time when returning from leave, etc.

Control strategies suggested by the workplace project team were:

Short term strategies:

- match employees to correct table height
- train staff in good working postures and techniques to work better
- train more staff to do this job
- adjust the production requirements to allow for staff returning to work after absences. Develop policies re: returning to work

Medium term strategies:

- maintain training in good working postures and techniques

- create a pool of skilled staff

Long term strategies:

- provide adjustable workstations for all areas
- trial and purchase ergonomic and customised knives
- maintain pool of skilled staff

5.2.5.3 Issue 3: Turning food item

In this task, small sections of food items are shaped individually by hand using a small knife. This involves rotating the food item and cutting off curved slices (Photo 19).

Photo 19: Turning food item

The problems assessed were:

- wrist position when turning not neutral
- lack of variety in work.
- repetitive grip and movement of knife can cause localised discomfort
- not enough trained staff for production and relief
- inadequate time to meet production requirements
- lack of re-adjustment time when returning from leave, etc.

The workplace project team identified the following:

Short term strategies:

- rotate the staff through other duties more frequently

- train staff in good working postures and better work techniques
- train more staff
- adopt a policy to better match orders to production abilities
- set lower production requirements

Medium term strategies:

- train new staff in good working postures and techniques
- create a pool of skilled staff
- purchase new knives with softer and broader handles
- produce a training manual
- relocate the cutting machine to allow for better maintenance

Long term strategies:

- engage a consultant to design, obtain and train operators in correct knife use
- ensure the cutting machine operates daily, rather than always relying on manual labour
- maintain training for pool of skilled staff

5.2.5.4 Issue 4: Chopping

In this task, the operator cuts whole food items into big slices, which are then cut into small segments. **(Photo 20)**

The problems assessed were:

- set table height which is not adjustable to workers height
- considerable pressure or force on the upper body is required to cut the item
- not enough trained staff

The workplace project teams suggested the following control strategies:

Short term strategies:

- match employees to correct table height
- sharpen knives regularly
- train more staff
- adjust the production requirements to allow for staff returning to work after absences. Develop policies re: returning to work

Medium term strategies:

- trial other cutting methods eg bandsaw, more suitable knives
- use adjustable work tables to better match height to workers
- investigate process mechanisation

Long term strategies:

- investigate and develop markets for product offcuts due to mechanisation
- develop and investigate, the trial and purchase of a mechanised cutting process

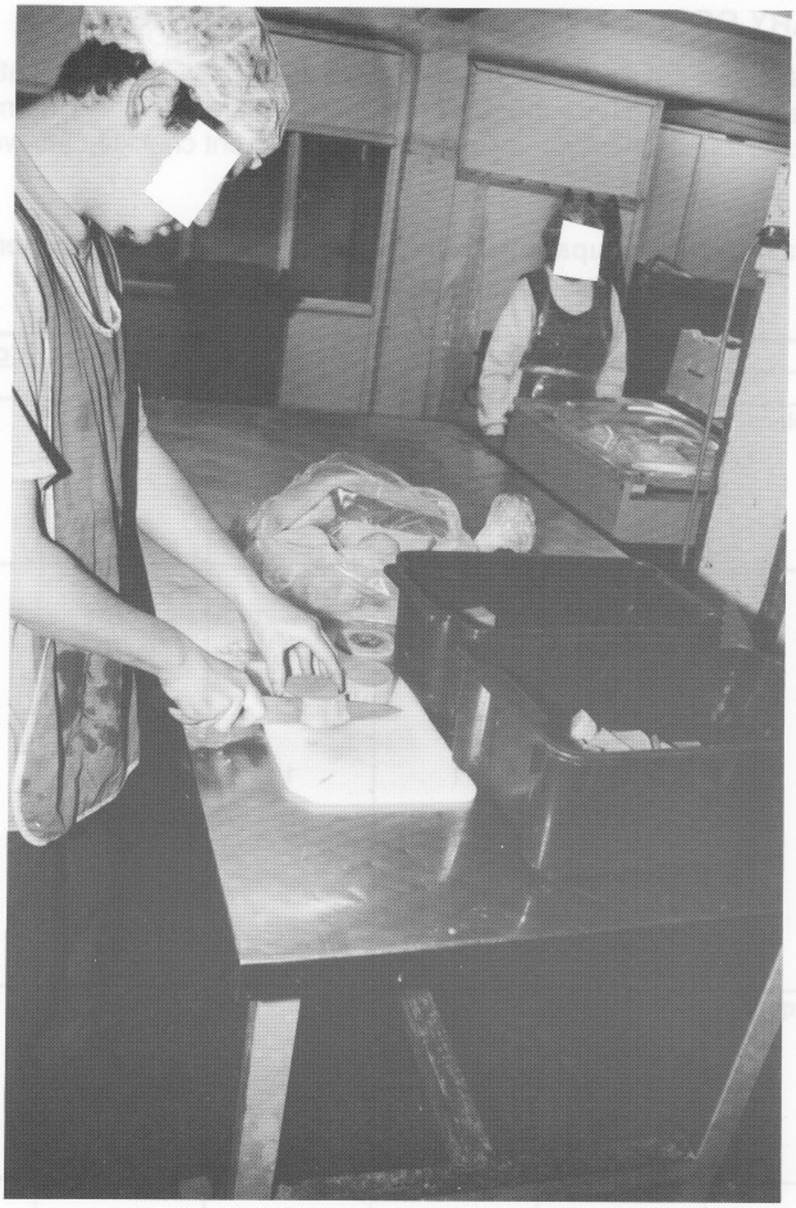


Photo 20: Chopping

5.2.5.5 Results of the follow-up survey

The company's overall response was "due to the change in management we have had insufficient time to assess new procedures".

With respect to the individual workstations assessed the response was:

- Issue 1. The study helped in risk assessment but not in risk control and no changes made.
- Issue 2. The change noted was 'using correct knives".
- Issue 3. The study helped to assess risks in this area with changes not yet implemented as "we are still looking at new knives".
- Issue 4. Though the study helped in each of the areas of risk identification assessment and control, no changes had yet been made because of a "change of management, lack of understanding".

5.3 SUMMARY OF THE ASSESSED MANUAL HANDLING RISKS

The previous section detailed the problems assessed by the occupational overuse syndrome risk assessment checksheet. The following table (Table 2) summarises these results for the tasks for which fully completed risk assessment checksheets were available.

Table 2: Summary of the occupational overuse syndrome risk assessment checksheet results across all companies

Checksheet item	Company 1 (auto)	Company 2 (auto)	Company 3 (food)	Company 4 (food)	Company 5 (food)	Total
A. Layout of workplace						
A1	1	1	1	3	1	7
A2	2	1	1	4	1	9
A3				2		2
A4		1				1
B Posture						
B1	4	3	2	3	4	16
B2	3	1		4	3	11
B3	4		2	4		10
B4	1			1		2
B5	3	1		2		6
B6	2	1	1	2		6
B7						
B8	2	1	2	3		8
B9	1					1
B10	1			1	1	3
B11	3			2		5
B12	2	1		2		5
C Duration and frequency						
C1			1	3	1	5
C2	4		2	4	1	11
C3			1			1
C4						
C5	2		1	1		4
D Force applied						
D1	3	1	1	4	1	10
D2	4		2	2	2	10
E Work organisation						
E1	2	1	2	2	3	10
E2		1	1	2	1	5
E3	3			2	3	8
E4	2			2	3	7
F Skill and Experience						
F1	2		1	2	3	8
F2	4		2	4	4	14
Total number of risk assessments	**4**	**4**	**2**	**4**	**4**	**18**

For each company's risk assessment checksheets, the number of times a yes response (ie an identified risk factor) was recorded against each of the checksheet items was determined. This is shown in Table 2. For example, in all of the tasks assessed in company 1, a yes response was given to checksheet item B1.

The last column in Table 2 gives the total number of yes responses to each checksheet item across all companies. Examination of this column shows that the identified risks with the highest frequency were, in order:

- **B1** working heights fixed and not adjustable to match employees (the most frequent of all factors identified, found in 16/18 assessments)
- **F2** new employees or those returning from leave are required to work at the regular pace or level without readjustment to the workload (14/18 assessments)
- **B2** work is performed with wrists not in neutral position (11/18 assessments)
- **C2** task demands are such that employee lacks control over pace of the work (11/18 assessments)
- **B3** most work performed with upper arm in unsupported position away from body (10/18 assessments)
- **D1** employee experiences discomfort when required to apply force repetitively or continuously (10/18 assessments)
- **D2** employee is required to repetitively use grip spans that cause discomfort (10/18 assessments)
- **E1** there is inadequate staff to meet work demands (10/8 assessments)

Each of the assessed manual handling risks listed above were recorded for at least half of the tasks assessed in this project. The most frequently assessed issue was associated with posture, ie B1, namely fixed workstation heights. The other postural risks B2 and B3 were also frequently assessed as being important. This is a noteworthy observation since attention to posture represents a basic ergonomic prerequisite of workstation design. This result suggests, therefore, that there may have been insufficient application of ergonomic principles to workstation design in these industries.

As stated in the methods, the risk assessments involved workstations that were mainly staffed by women. It is therefore worth noting the prominence of posture-related risk factors highlighted in the manual handling risk assessments. Since workstations are typically designed (by males) for an average male worker, the lack of possible adjustment or reorientation of work areas becomes more of a problem for women. This may explain, in part, the frequency with which posture-related manual handling risks were identified.

Another important issue frequently highlighted in the risk assessment checksheets was F2: new employees or those returning from leave being required to work at full work pace without a period of re-adjustment. Production imperatives may explain why this factor is so common across the industries. Clearly this is another area that could be readily addressed and due consideration given to gradually re-introducing staff to full production levels.

Table 2 highlights the major risks associated with manual handling tasks in both the autocomponent assembly and food processing industries considered in this project. It suggests that similar problems, such as attention to posture, are of importance to both industry sectors and that control strategies from one sector, if they exist, could well be translated to the other. However, it should be remembered that manual handling risk cannot be managed as a single issue and all other risks present also need to be considered. Generally, the most common risks identified in Table 2 are not complex and can be addressed by sound ergonomic and system design principles. Control strategies implemented in other companies have demonstrated that controlling these sorts of risks can be both effective and low cost.

5.3.1 Summary and characterisation of the control strategies

A summary of the control strategies presented for each company in Section 5.2 is given in Table 3. The strategies are presented according to the hierarchy of control and the suggested time frame for each company. The control strategies implemented by the companies within 4-6 months of the risk assessments are identified in Table 4 (see shaded sections in Table 4).

Table 3: The range of identified control strategies for the 21 assessed tasks

	Short term	Medium term	Long term
Eliminate task	0	1	9
Redesign	11	17	11
Mechanical aids	12	13	6
Administrative	20	10	6
Training	16	11	5

The main observations about the control strategies from Tables 3 and 4 are:

- for the short term, (perhaps not surprisingly) administrative controls and training were the favoured option. In the medium term redesign and mechanical aids were prominent;
- for the long term eliminate task and redesign were the most frequent suggestions for control strategies;
- task elimination appeared to be a preferred long term option considered by the study teams from companies 1 and 2 (autocomponent assembly). The three food processing companies, on the other hand, considered redesign to be a feasible long term option. Training was identified as a medium term solution for the food processing sector (companies 3, 4, 5), but not by the autocomponent assembly company teams. These differences may reflect the particular company environment or culture regarding control of OH&S issues. Alternatively, they may also highlight real differences between food processing and other manufacturing in terms of perceived possibilities for automation (task elimination);
- in terms of the controls implemented by the companies during the 4-6 months since the assessments (refer shaded items in Table 4), these have generally been short term (as would be expected considering the time frame). However, they have also included implementation of some medium and long term controls such as redesign, mechanical aids and administrative controls. Training had not been implemented by any of the companies, despite the frequency with which it was suggested as a control option.

5.4 THE RULA RISK ASSESSMENTS

The RULA method was used at three of the companies for twelve selected sample tasks to validate the risks identified by the occupational overuse syndrome risk assessment checksheets. The following sections describe the results of these assessments and the final RULA scores for the assessed tasks. The procedure for obtaining the RULA scores is summarised in Appendix 3. A comparison of the RULA results with the checksheet assessments is summarised at the end of this section. For each assessment, a picture of the task under review and the RULA score sheet are provided.

Table 4: Summary of control strategy options identified for the five companies, in terms of the hierarchy of control and likely implementation time frame. The shaded areas in this table correspond to the control strategies that have been implemented by the companies at the time of the follow-up survey

		Total number of controls in each category	Company 1 (auto)				Company 2 (auto)				Company 3 (auto)				Company 4 (food)					Company 5 (food)			
	Issue No.	21 issues	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	5	1	2	3	4
Short Term	Eliminate task	0																					
	Redesign	11	X		X	X	**X**	**X**	**X**		X	X		X	X	X							
	Mechanical aids	12			**X**	X				X	X	X	X	X	**X**		X			X	X		X
	Administrative	20	**X**	X	X	X	**X**	X		X	X	X	X	X	X	**X**	X	**X**	X	X	X	X	X
	Training	16	X	X	X			X	X	X	X	X			X	X	X		X	X	X	X	X
Medium Term	Eliminate task	1						X															
	Redesign	17	**X**	X	X		X		X	**X**	X	X	X	X	X	X	X	X		X		X	X
	Mechanical aids	13	X		X	X	X		X	X	X			X		X			X	X		X	X
	Administrative	10	X		X							X			X	X	X		X	X	X	X	
	Training	11								X	X	X			X	X	X	X	X	X	X	X	
Long term	Eliminate task	9	X	X	**X**	X	X	X		X	X												X
	Redesign	11									X	X	X		X	X	X	X	X	X	X	X	
	Mechanical aids	6										X			X	X				X	**X**	X	
	Administrative	6											X		**X**		X	X	X	X			
	Training	5															X	X		X	X	X	

5.4.1 Company 1 (Autocomponent assembly)

For the purpose of the RULA assessments, the task was split into two main components: (i) right hand picks up the item from the bin, passes it to the left hand and lubricates it; and (ii) transfer of object from lubricant pad onto machine.

(I)Task: right hand picks up the object from the bin, passes to the left hand and lubricates it

Photo 21: Picking of object from bin and transferral to other hand

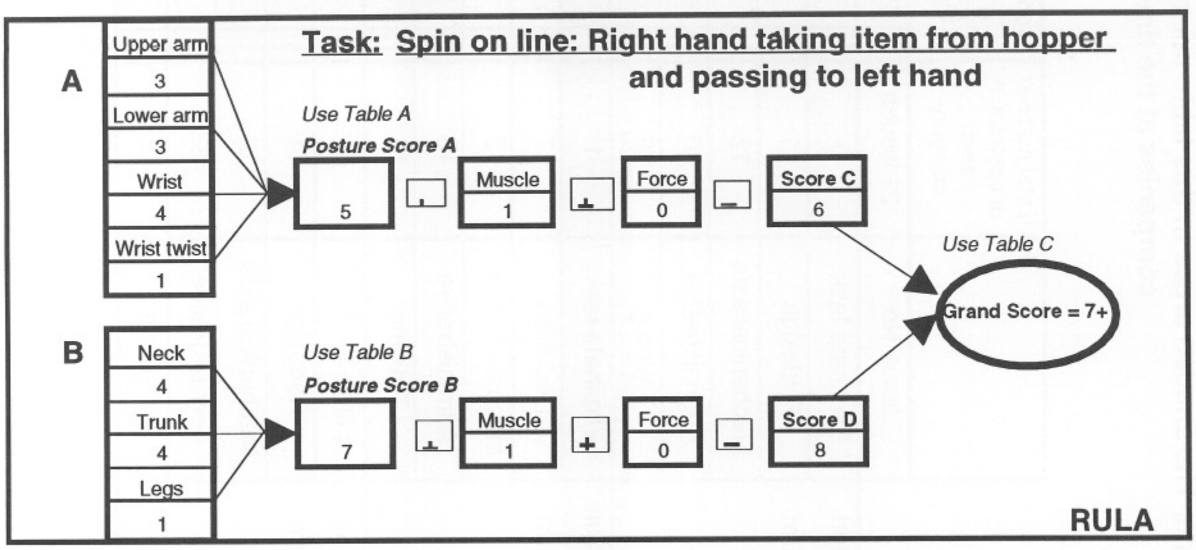


Figure 3: RULA assessment of picking of object from bin and transferral to other hand

This RULA grand score of 7 corresponds to RULA action level 4 and indicates that further investigation and change are required now.

The occupational overuse syndrome code risk assessment for the task identified four factors with a yes response:

- A2 - layout of workplace -results in excessive twisting and bending.
- B2- work is performed where the wrists are not kept in a neutral position.

- B3 - most of the work is performed with the upper arms in an unsupported position away from the body.
- B10 - the task requires body to be held in a fixed position casing discomfort - standing all day.

Thus the overall view of the task obtained using the occupational overuse syndrome code risk assessment is of a task which is ergonomically unsound and in need of significant improvement to reduce the injury risk. This assessment agrees well with the high rating obtained from RULA, which indicates a task in need of immediate improvement.

(ii) Task: transfer of object from lubricant pad to machine

Photo 22: Transfer of object from lubricant pad to machine

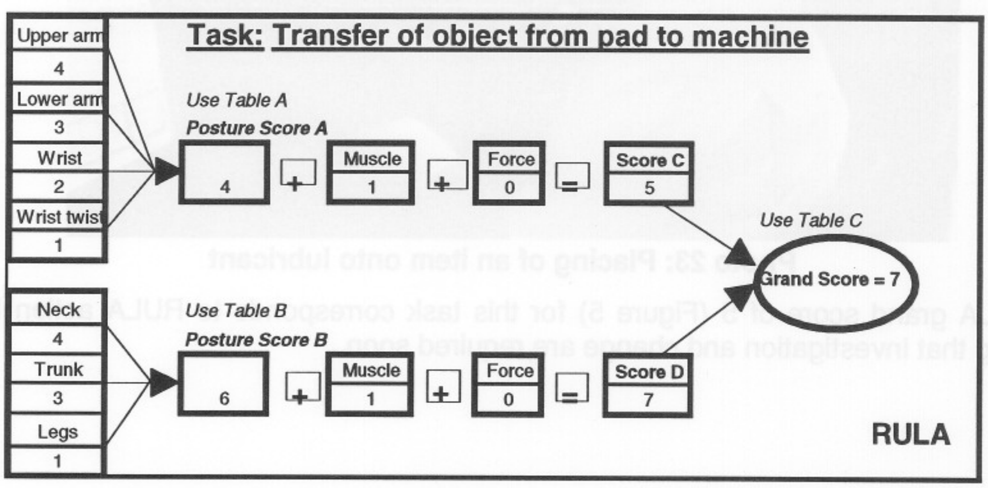


Figure 4: RULA assessment of transfer of object from lubricant pad to machine

This RULA grand score of 7 corresponds to RULA action level 4 and indicates that further investigation and change are required now.

The occupational overuse syndrome code risk assessment for the task identified three factors with a yes response:

- A2 - layout of workplace - results in excessive twisting and bending.
- B3 - most of the work is performed with the upper arms in an unsupported position away from the body.
- B10 - the task requires body to be held in a fixed position casing discomfort - standing all day.

The overall view of the task obtained using the occupational overuse syndrome risk assessment is of a task that is in need of improvement to reduce the injury risk. This conforms well with the high rating obtained from the RULA assessment.

Taken together, the results for both components of this task indicate that a risk, with high priority is present. Furthermore, the occupational overuse syndrome code risk assessment conforms well with the RULA rating for this task.

5.4.2 Company 2 (Autocomponent assembly)

At this company, one task involving the placing of an item onto lubricant was evaluated by RULA.

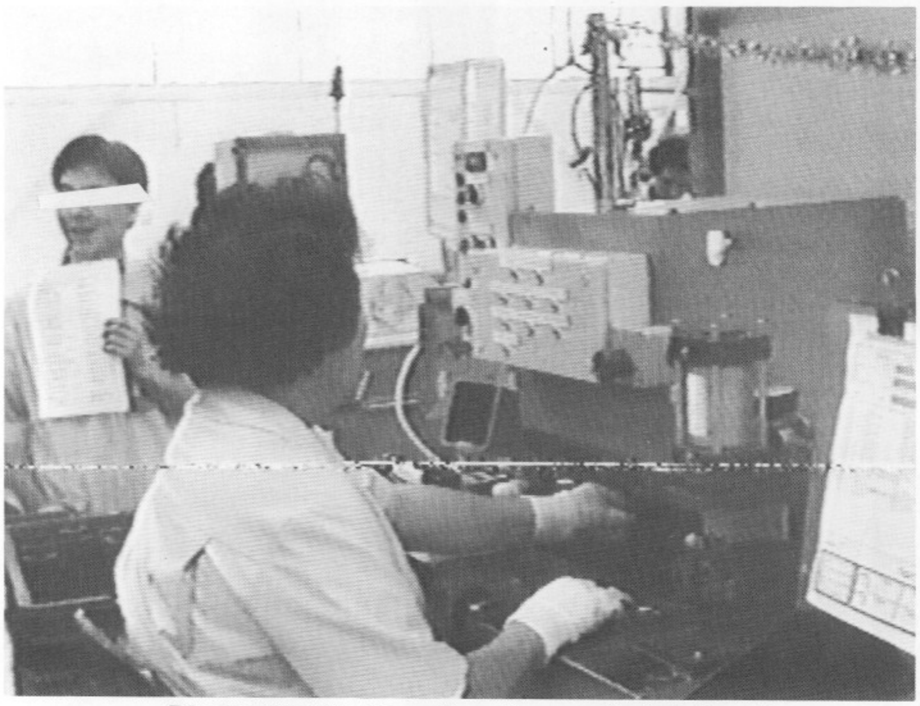


Photo 23: Placing of an item onto lubricant

The RULA grand score of 5 (Figure 5) for this task corresponds to RULA action level 3, indicating that investigation and change are required soon.

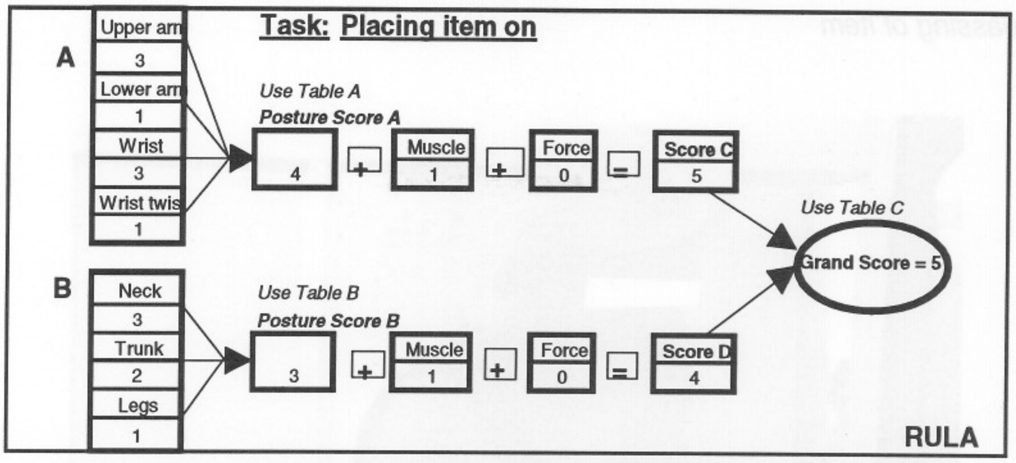


Figure 5: RULA assessment of placing of an item onto lubricant

The occupational overuse syndrome code risk assessment for the task identified five factors with a yes response:

- A1 - frequently handled objects are positioned beyond easy reach
- A2 - layout of workplace - results in excessive twisting and bending.
- A4 - displays are difficult to read from the person's usual work position
- B2- work is performed where the wrists are not kept in a neutral position.
- B8 - the employee works continuously more than 30 cm away from the body for more than 1 minute without rest.
- D1 - discomfort is experienced by the employee when required to apply force repetitively

Thus the overall view of the task obtained using the occupational overuse syndrome code risk assessment is of a task which is in need of improvement to reduce the injury risk. This assessment agrees with the rating obtained from RULA, which indicates a task in need of improvement *soon*.

Interestingly, however, this task gave a lower RULA rating than the previous two tasks (Section 5.4.1), yet registered a higher number of yes responses on the occupational overuse syndrome code risk assessments than the previous two tasks. This observation helps illustrate the point that the there is not necessarily a direct correlation between the number of yes responses and the risk priority or severity.

5.4.3 Company 5 (Food processing)

At this company, two major jobs were assessed by RULA. The first involved turning and cutting of a food item and the other involved cutting with an ergonomic knife.

5.4.3.1 Turning of hard food item

For the purposes of the RULA assessment, the task was divided into its constituent activities as follows: (i) passing of item (ii) chopping of item (iii) turning of item with left hand and (iv) turning of item with right hand. The RULA assessment and a photographic description of each of these individual task components are presented below.

(l) passing of item

Photo 24: Passing of item

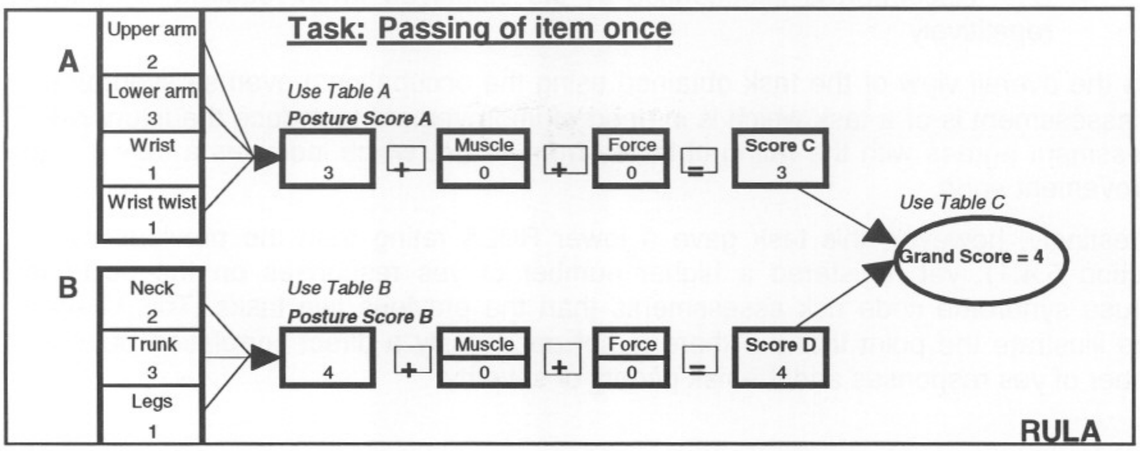


Figure 6: RULA assessment of passing of food item

The grand score of 4 in Figure 6 corresponds to RULA action Level 2, indicating that further investigation is needed and changes may be required.

(ii) *chopping item*

Photo 25: Chopping item

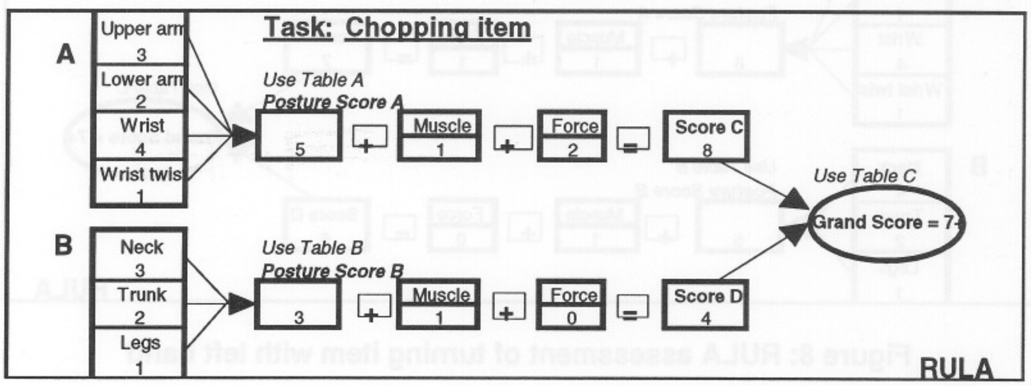


Figure 7: RULA assessment of chopping item

This RULA grand score of 7 (Figure 7) corresponds to an action level 4 and indicates that further investigation and change are required now.

(iii)	*turning item with left hand*

Photo 26: Turning item with left hand

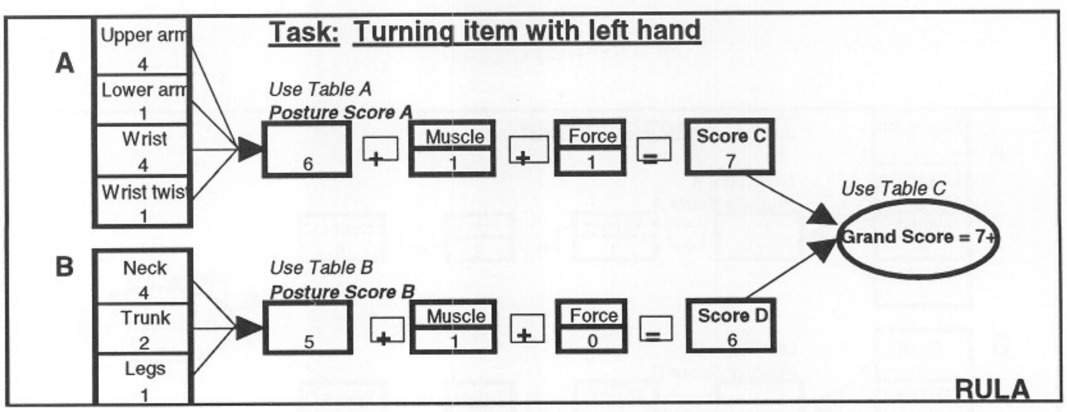


Figure 8: RULA assessment of turning item with left hand

This RULA grand score of 7 (Figure 8) corresponds to action level 4 and indicates that further investigation and change are required now.

(iv) turning item with right hand

Refer to Photo 26.

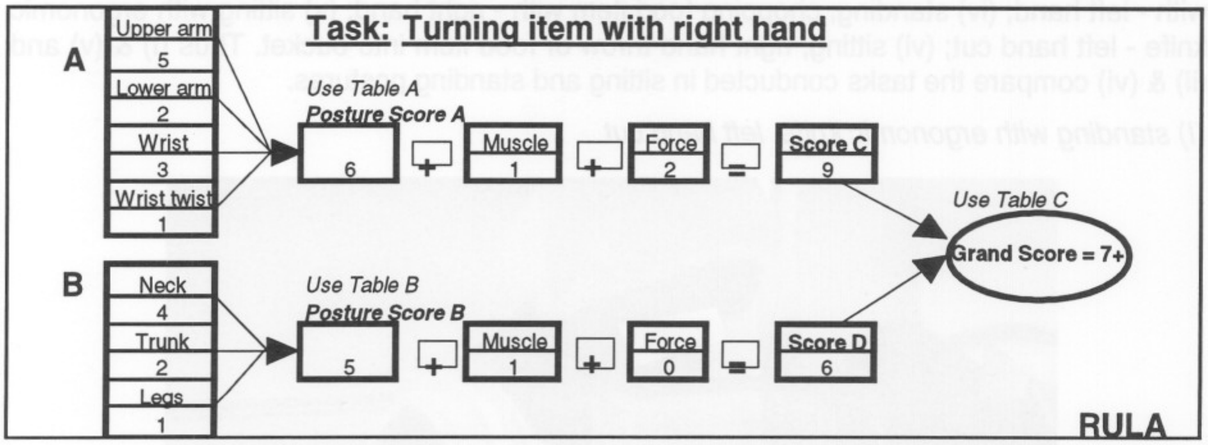


Figure 9: RULA assessment of turning item with right hand

The RULA grand score of 7 (Figure 9) corresponds to action level 4, indicating that further investigation and change are required now.

In summary, the RULA assessments of this whole task provide three scores of 7 and one of 4, which indicate that the task should be investigated as a matter of priority.

In comparison, the risk assessments carried out to the occupational overuse syndrome code for the whole task (Table 3) identified three factors with a yes response:

- A2 - layout of workplace - results in excessive twisting and bending.
- B2- work is performed where the wrists are not kept in a neutral position.
- D1 - discomfort is experienced by the employee when required to apply force repetitively

Thus the overall view of the task obtained using the occupational overuse syndrome risk assessment is of a task that is in need of improvement to reduce the injury risk. This agrees well with the ratings obtained for each of the four elements of the task assessed by RULA.

5.4.3.2 Cutting food item

The RULA assessment of this particular task involved assessing the performance of a task using an ergonomic knife used by a woman on a rehabilitation program. The task was divided into the following activities: (i) standing with ergonomic knife - left hand cut; (ii) standing and right hand throw of food item into bucket; (iii) standing, chopping food item with - left hand; (iv) standing, chopping food item with - right hand; (v) sitting with ergonomic knife - left hand cut; (vi) sitting, right hand throw of food item into bucket. Thus (I) & (v) and (ii) & (vi) compare the tasks conducted in sitting and standing postures.

(I) standing with ergonomic knife, left hand cut

Photo 27: Cutting with ergonomic knife, standing

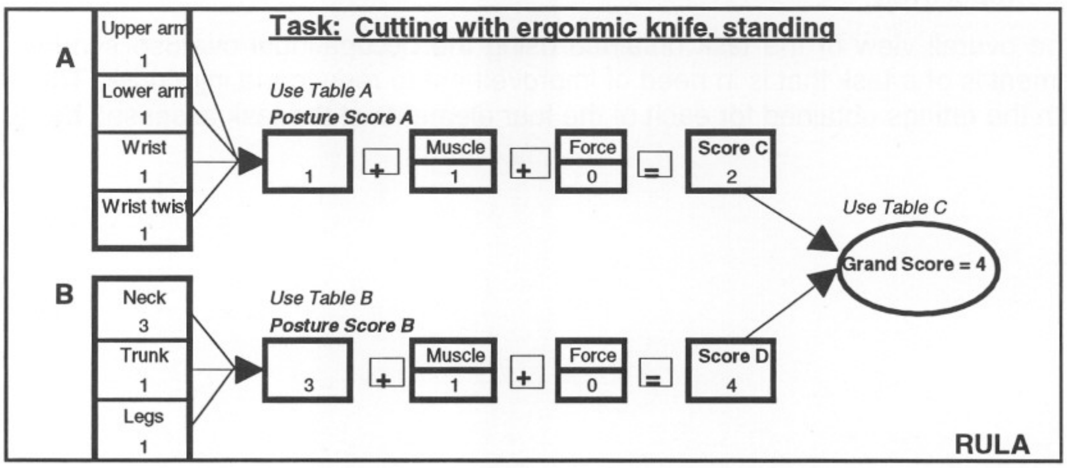


Figure 10: RULA assessment of cutting with ergonomic knife, standing

The grand score of 4 (Figure 10) indicates that further investigation of this activity is needed and changes may be required. This compares with the code risk assessment (task 5A in Table 3) which identified one yes response:

- A2 - layout of workplace - results in excessive twisting and bending.

The assessment from the occupational overuse syndrome code clearly indicates a need for improvement to reduce the injury risk. However, it provides no measure of injury risk severity. In contrast, the RULA score indicates a low priority for attention.

(ii) standing, right hand throw of food item into bucket

Photo 28: Right hand throw of food item into bucket

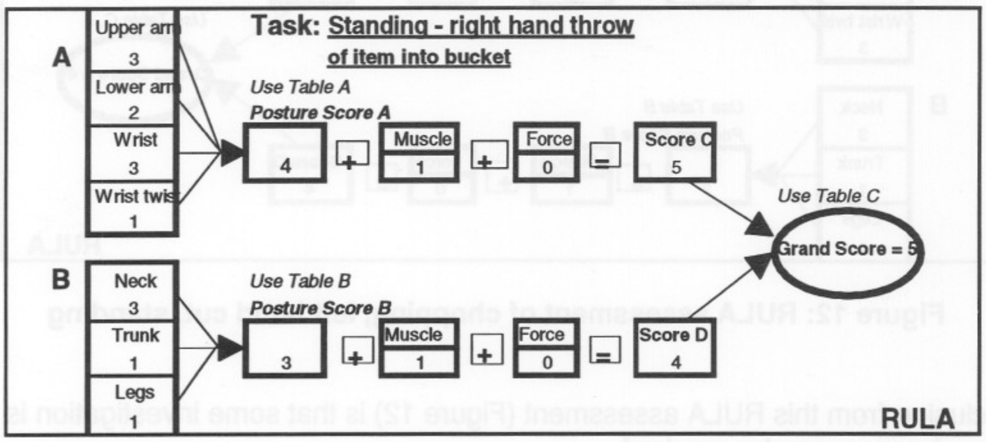


Figure 11: RULA assessment of right hand throw of food item into bucket

This RULA grand score of 5 (Figure 11) indicates that both investigation and changes are needed soon to this task. The corresponding occupational overuse syndrome code risk assessment for the task (Table 3, task 5B) identified two factors with a yes response:

- A2 - layout of workplace - results in excessive twisting and bending.
- B2- work is performed where the wrists are not kept in a neutral position.

Thus the overall view of the task obtained using the occupational overuse syndrome risk assessment is that of a task which is in need of improvement to reduce the injury risk. This assessment agrees with the rating obtained from RULA, which indicates a task in need of improvement soon.

(iii) standing, chopping - left hand grab

Photo 29: Chopping, left hand cut, standing

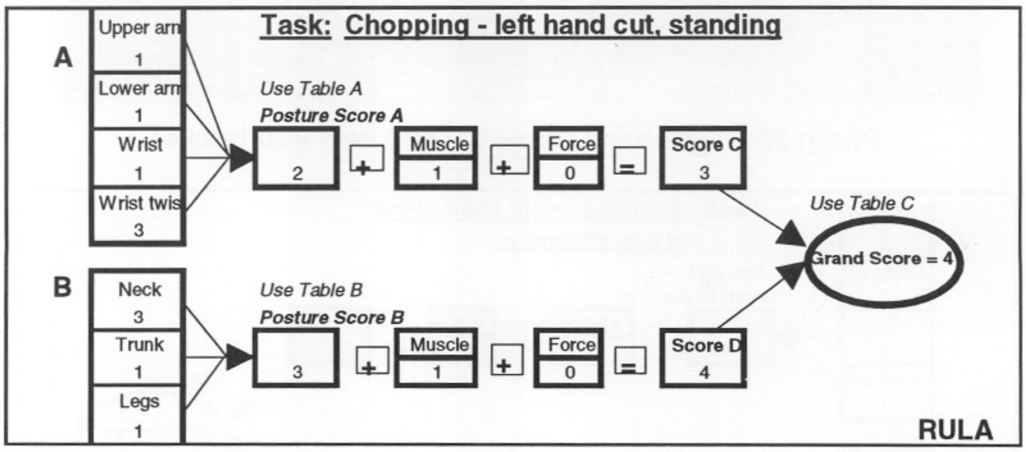


Figure 12: RULA assessment of chopping, left hand cut, standing

The conclusion from this RULA assessment (Figure 12) is that some investigation is needed and some changes may be required.

(iv) standing, chopping - right hand

For this task refer to Photo 29.

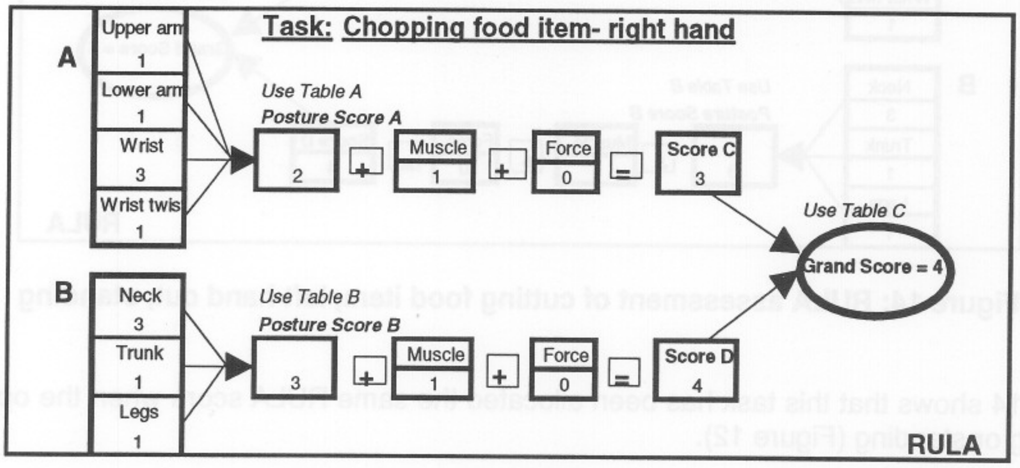


Figure 13: RULA assessment of chopping food item with right hand

As with the previous assessment for the same task using the left hand, the RULA score of 4 indicates that this task needs further investigation and changes may be required.

(v) sitting with ergonomic knife, left hand cut

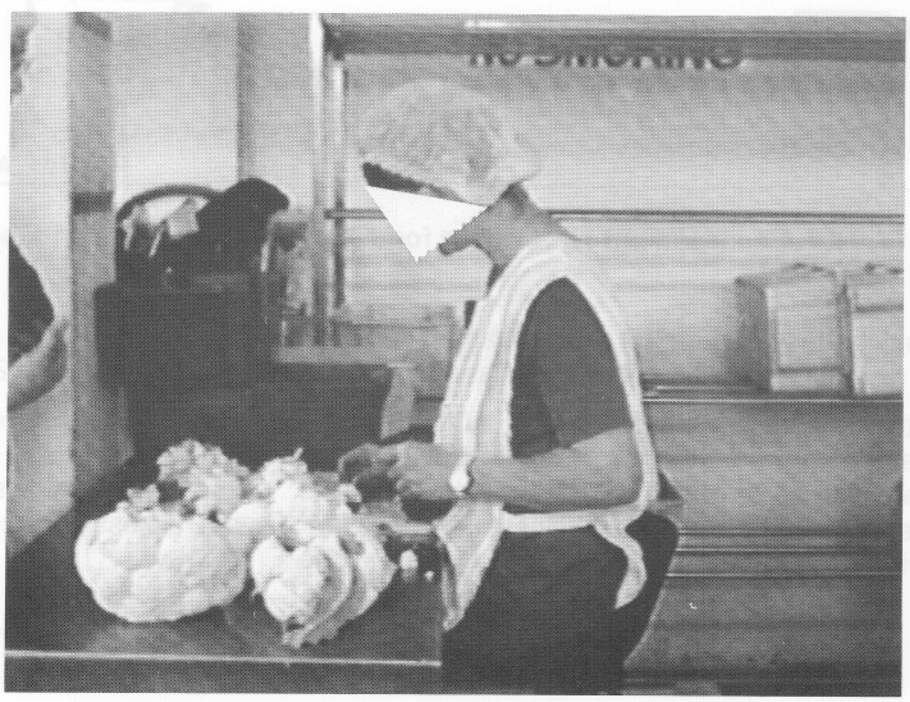


Photo 30: Cutting food item, left hand cut, sitting

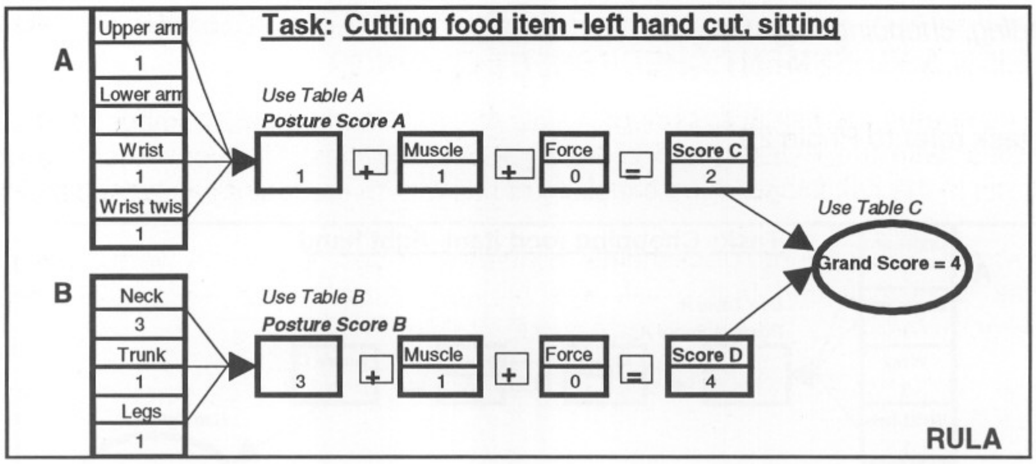


Figure 14: RULA assessment of cutting food item, left hand cut, standing

Figure 14 shows that this task has been allocated the same RULA score when the operator is sitting or standing (Figure 12).

(v) sitting, right hand throw of item into bucket

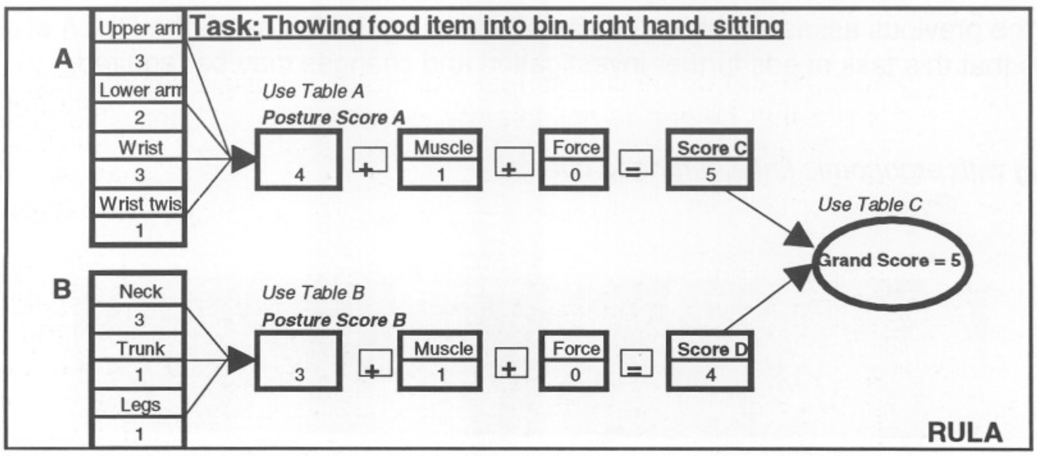


Figure 15: RULA assessment of throwing food item into bin, right hand, sitting

Like the previous task, Figure 15 shows that this task receives the same RULA score and action level whether or not the operator is standing (Figure 15) or sitting (Figure 12).

Taken together, these comparisons show that there was no assessable difference between sitting or standing postures for this particular task. For the tasks with equivalent occupational overuse syndrome code risk assessments, as noted, these assessments corresponded well with the RULA evaluations. However, the risk assessment checksheet did not provide a measure of priority or risk severity rating.

5.5 SUMMARY OF THE COMPARISON OF THE RULA RESULTS WITH THE RISK ASSESSMENT CHECKSHEET FINDINGS

Table 5 compares the risk assessment results for the 5 main tasks (composed of a total of 12 activities) with the RULA grand score for these activities. The comparison is only with those items in the risk assessment checksheet relevant to the factors assessed by RULA.

Using the risk assessment checksheets, a number of yes responses were highlighted for each task. This indicated that a risk was present and required controlling. These risks related predominantly to the following checksheet risks:

- A2: layout of workplace results in excessive twisting and bending of the neck, shoulders or upper body;
- B2: wrist position not neutral;
- B3: most work performed with the upper arms in an unsupported position away from the body
- B10: parts of body held in fixed position causing discomfort.

The occupational overuse syndrome checksheet results correlated well with the RULA assessments. In three of the six assessed tasks, the RULA score corresponded to an action level 4, indicating that the problem is of such priority that change is required now. Two of the assessed tasks had an action level 3 on the RULA score indicating that change to these tasks is required soon. In the remaining case, an action level of 2 was obtained and this suggests that action may be required for this task.

A comparison of the checksheet and RULA risk assessments indicates that RULA provided a scale that helped to validate the risk assessment checksheet findings. Furthermore, the two risk assessment methods have identified the same risk areas as problems. It can therefore be reasonably concluded that the checksheet in the manual handling (occupational overuse syndrome) codes is an effective tool for identifying these risks.

A by-product of the use of RULA for these assessments, was observation of a number of its limitations as a sole assessment method. Firstly, it was somewhat limited in its scope in that it could not specifically assess the fine details of actions of the hand, finger/hand spread, fine finger movements or certain wrist movements that were features of many of the tasks assessed in this project. Secondly, it was difficult to determine the application of force in specific instances (eg cutting hard food items; pulling to remove specific components). From the viewpoint of the regulations, RULA does not address all of the factors included in the risk assessment checksheet, such as work layout, environment, employee age, etc. This suggests that the RULA assessment method could produce false negative results if these factors are not assessed.

Although RULA does not assess all of the manual handling risks (nor was it intended to) required by the regulations, it should not be discounted as a useful adjunct to the risk assessment checksheets procedures. One of its major values is in providing a risk rating scale for prioritising attention to the assessed risks. An alternative approach may be to consider incorporating some scale or risk rating into the risk assessment checksheets.

5.6 DISCUSSION OF THE RISK IDENTIFICATION AND ASSESSMENT PROCESSES AND CHECKSHEETS

This section provides a detailed discussion and analysis of the risk assessment checksheets and processes. Although the purpose of this project was to focus on methods of risk assessment, some valuable insights were also gained into the risk identification and risk control processes. These are also presented below.

Table 5: Risk assessment results obtained by two methods: comparison of the checksheet and RULA findings

occupational overuse syndrome risk assessment checksheet item	**Company 1** **Picking up item from bin and passing to other hand**	**Company 1** **Moving item from lubricant pad to machine**	**Company 2** **Placing item onto lubricant**	**Company 5** **Cutting food item – left hand cut, standing**	**Company 5** **Putting food item into bin - right hand**	**Company 5** **Chopping food item**
A. Layout of workplace						
A1			1		1	
A2	1	1	1	1	1	1
A4			1			
B Posture						
B2	1		1			1
B3	1	1				
B4						
B7						
B8			1			
B9						
B10	1	1				
C Duration and frequency						
C4						
C5						
D Force applied						
D1			1			1
RULA grand score	7+ =action level 4: immediate action required	7 =action level 4: immediate action required	5 =action level 3: investigation and changes are required soon	4 =action level 2: further investigation needed & changes may be required	5 =action level 3: investigation and changes are required soon	7 =action level 4: immediate action required

5.6.1 Risk identification

The purpose of risk identification is to identify and place in order of priority, the jobs or tasks that require action to reduce the risk factors for occupation overuse syndrome. In general, the risk identification checklist could be completed by the workplace project teams within about 10 minutes with minimal assistance. This issue is critical if it is to be used to scan a large number of tasks for possible risks and prioritise them.

Overall, one of the recurring difficulties in this project was in getting the workplace project teams to narrow each particular job to its component tasks. It is the individual task level that is required for the risk identifications and assessments. This was a particular problem when a job was made up of a number of interrelated tasks or when the task, itself, was complex.

A review of the completed forms by the research team indicated that a number of false positive results occurred over a range of questions, with very few false negatives. This suggests that the risk identification process is biased appropriately towards the side of caution. False positives tended to occur more frequently with questions associated with qualitative descriptions (such as significant, extreme, optimal, awkward, frequent, cold, etc.) or OH&S jargon terms (such as restricted space, vertical height, etc.)

Some workplace project teams had difficulties with questions that either seemed to be repeated or which asked for information already requested by an earlier question. Questions based on words with similar meaning in standard English usage but, which, in the context of the code, had subtle differences also caused problems. Some examples were the words handling, actions, use, travel and application of force. This was a particular problem when the workplace project team members did not have a good command of English or were not familiar with OH&S jargon.

Once a yes response is recorded on the risk identification checklist, the relevant section in the risk assessment checksheets is required to be completed. However, many workplace project teams found this process of linking these two checksheets to be very confusing and time consuming particularly when both manual handling codes needed to be consulted. The following specific points summarise some of the major reasons leading to this confusion.

- the risk assessment sections referred to by the risk identification process often provide information that is not necessarily relevant to the initial risk identification question being answered. For example, question A9 (do operators perform this task for more than one hour), in the risk identification checklist, refers the user to section 10C in the risk assessment checksheet. However, 10C makes no reference to the figure of 1 hour, which was the basis of question 9;
- for many questions the broad brush approach used in the checklist contained or referred to too much other information, particularly for those with the poor English comprehension skills. Because of this it was found to be very time consuming, particularly if a number of yes responses were recorded. For example, a yes response to question 11 refers to the user to section 7.1.2. from the manual handling code of practice as well as to sections 10 C, D, E and F in the occupational overuse syndrome code;
- there is no consistency or continuity in the layout and numbering of the risk identification and assessment sections in the codes. For example, in the risk identification section C refers to the workplace, whereas section C in the risk assessment section refers to the task and frequency. To add to this confusion, all the risk identification references have a prefix of 10 compared with the risk assessment checksheet sections that are headed by the letters A, B, C, etc. This inconsistency added to the confusion about the linkages between the risk identification and risk assessment processes.

The relevance of having a reference section attached to the risk identification checklist appears to be an attempt to reduce the number of risk assessment sections that need to be cross-referred. However, an evaluation of the risk identifications conducted by the workplace project teams suggested that most people either needed to consult every assessment section, or did so because it was too confusing to determine just which sections were specifically needed. This process appears to be at odds with the opinion that the risk identification checklist is just to provide a quick checklist for determining whether further risk assessment is required. That there is little continuity or consistency between the two sections, as discussed above, would appear to reinforce the separate function of the two sections, in the minds of the users.

Another point is that the risk identification checklist does not include questions on the age of the employees or their skill and experience, although these factors are addressed in the code of practice.

5.6.2 Risk assessment

Completion of the risk assessment checksheet by the workplace project teams was the most time consuming aspect. It also generated the most questions about how to complete the process. Many of the issues discussed in Section 5.6.2 also apply to the risk assessment checksheets. These include:

- the level of English comprehension required;
- the differences in the numbering, both between the risk identification and assessment section as well as between the two codes, ie one uses a numeric and the other an alpha-numeric system;
- The apparent duplication of questions. Many questions appear to be repeated due to subtle differences not often appreciated by those without much OH&S knowledge or with poor English comprehension skills.

Other identified problems with the occupational overuse syndrome risk assessment checksheets and processes included:

- the requirement to jump between the manual handling and occupational overuse syndrome booklets to obtain information relevant to the identified issue. Often the sections referred to had little direct relevance to the issues identified. Furthermore, the formatting differences in two booklets added to the general confusion of the risk assessment process. Obtaining an accurate and complete risk assessment of a task based on the checksheets was therefore a very difficult undertaking for the workplace project teams;
- the similarity in the formats between the risk assessment and identification sections. In a number of instances, the workplace project teams completed two risk identifications of a task rather than a risk assessment. This was thought to be due to a failure to fully understand the risk identification and assessment processes and not just because of the similarity between the formats and the questions. The similarity between some of the questions in the risk identification and assessment checksheets also added to the general confusion, however. The workplace project teams often thought that they had already answered some of the questions previously. On the basis of these observations, it would appear that both checksheets need to be more clearly identifiable and the formatting made more distinct;
- completion of the risk assessment checksheet was easier if the questions were answered using the manual rather than the checksheet guidelines. This was because the introductory paragraphs introduced the manual handling process and provided the context for the subsequent questions. This also applied to the checksheets in the manual handling code. It suggests, therefore, that it is important for the risk assessment documentation not to be too long and to be as objective as possible;
- completion of the risk assessment checksheets was made difficult because of the need to read and re-read large sections of the explanatory text. This was particularly the case when there were a number of yes responses in a section and there is a need to re-read the section with a new frame of reference. Sometimes, different risk identification questions refer the user to the same section of the risk assessment documentation but expect the reader to put a different emphasis on what they read This was especially the case when the review required was subtle. For example, questions 1 and 3 in the risk identification checklist both refer to the same risk assessment section but require different usage of that information to be made.
- many workstations reviewed in this project were typical of the food processing and autocomponent assembly industry. However, some of the checksheet questions had little relevance to these workstations. In other instances, the consequence of the question was lost due to the occasional nature of the task. Some examples are questions that relate to the use of controls, dials or switches. Questions about the position of tools and the places to keep them may have been more relevant to the assessments. It should be recognised in some industries and for some tasks, that seeking information about these sorts of factors are very pertinent to the manual handling risks involved. The often mentioned justification that the checksheet questions are generic and can be adapted to suit the industry is important. However, industry specific targeting of

some of the questions would remove the irrelevant questions and makes the responses more poignant;

- some of the workplace project teams included personnel with poor English comprehension and literacy skills. When these staff were matched with those with better literacy skills, those with the better skills appeared to bias, or dominate, the responses. This was particularly the case when the detail in the risk assessments was explained and the control strategies were determined;
- there are a number of questions that appear to ask for similar information in different sections of the checksheet. This confused the workplace project teams when they tried to distinguish between the questions or they became frustrated at the apparent duplication. For example, the issues assessed in Question 1 Section A, can be assessed again in B 1,4,6,8,9, & 11 and can also be addressed in C4 and C5;
- more accurate detail was recorded on the checksheets using the guiding question format as adopted by the occupational overuse syndrome code rather than the by the open-answer questions approach in the manual handling code. When the open-answer format was completed by the workplace project team, the responses usually only reported one point. They rarely detailed the all the aspects of the task or the full range of manual handling problems associated with it. It is suggested that one format, based on the guided question approach, should be used for the checksheets from both codes;
- the checksheets from the occupational overuse syndrome code were more applicable than those from the manual handling code for the range of task assessed in this project.

5.6.2.1 General comments on the risk assessment checksheets

The discussion in this section provides general comments on the risk assessment checksheets and does not focus on the specifics of particular questions.

- the language of the questions. Presumably these are written in such a way to prompt discussion amongst the employer, health and safety representatives and employees and are not meant to be posed directly to the worker in this form. There is a possibility that in translating these questions to a form that can be asked directly to a worker that some of the original meaning may be lost. In their current form, the question may be posed in such a way that they reflect the asker's biases. It would be helpful for any checksheet not to rely on the asker's interpretation of a question or the context to which it is to be applied;
- it is not clear whether the response that is to be recorded should be the asker's interpretation or view of the situation, just the response of the involved worker, or a combination of both;
- some of the questions are ambiguous in that they are not based on objective statements that can lead to directly quantifiable responses;
- it would be appropriate for some questions to allow a not applicable or not relevant option;
- It is not clear that the risk assessment checksheet should be completed separately for each task within a job. This leads to the question as to whether it is always meaningful to separate out specific tasks or components of a job and consider them in total isolation from all other tasks performed at a given workstation;
- it would be preferable to use a positive rather than a negative orientation for all questions;
- a number of questions included nebulous terms such as excessive, optimal, frequent, awkward, easy reach, vary significantly, etc. These terms are open to subjective interpretation and could cause particular problems for those with poor

English literacy skills. Such terms should either be avoided or clear definitions given;
- it would be useful to allow space for comments or qualifications of responses to be recorded against each question;
- for some questions the yes response only applied for some of the time during the task and, in some cases, only occasionally. It is not clear from the current checklist whether a yes response should only be given if it *always* applies;
- the generic nature of the documents may decrease their relevance in specific situations. This can only be overcome with industry specific documentation, or even company customisation of the tools.

In addition to the above general comments, there were a number of exposure and risk issues that were not adequately covered by the occupational overuse syndrome checksheet. These may be a particular concern if the occupational overuse syndrome code is used in preference to the manual handling code. Moreover, they could be important since users of the national codes are directed, if in doubt, to use the occupational overuse syndrome code. It is intended that the information from the manual handling code is also read, recorded and considered in the assessment. However, the confusion that some of the workplace project team members had in completing the whole process, as described earlier, suggests that this may not be happening. The issues that may be inadequately covered by the occupational overuse syndrome checksheet included:

- the size and space of the work area;
- floor temperature and surfaces;
- the nature and location of the work surfaces;
- the position of tools and places to store them;
- the size of the product or material being handled;
- the temperature of the product or material being handled;
- the texture of the product or material being handled;
- relevant maintenance issues (eg sharpening of knives).

It is recognised that some of these issues are covered in the occupational overuse syndrome risk assessment checksheets in section A: layout of workplace which has direct reference to sections 7.1.2 and 7.1.18 in the manual handling code of practice. However, there is little space devoted to these issues and this may lead to them not being assessed adequately by the users of the checksheet, particularly if the occupational overuse syndrome checksheet is also used. For the types of tasks and jobs considered in this project, attention to the above issues would appear to be crucial to any assessment of manual handling risk.

It has already been reported above that the workplace project teams had considerable difficulty in following the flow of the risk identification, assessment and control process. Once a yes response was obtained it was not always clear to users of the checksheet what the next step in the process is.

5.6.3 Risk control

As a broad statement, the range of control strategies suggested by the workplace project teams, would achieve the required results of eliminating or reducing the assessed risks. This demonstrates that the workplace project team members, many of who had very little experience and training, were able to use the risk assessment checksheets to determine a range of control strategies for the selected tasks. The practicability of these control strategies was subject to further review by each company.

Two types of risk control check forms were evaluated. One sought open-responses based on either the priority hierarchy or time-based approach. The other form was designed to be issue specific and required users to determine a response for each of the issues assessed as a problem. The issue-specific format (Appendix 5) was developed specifically for this project to explore the range of strategies developed from the risk assessment process. This may have influenced the quality of the results because it resulted in a larger number of suggested control strategies, than was provided when the risk control plan was used.

When the risk control plan forms from the code were used, it was found that:

- there was a lack of space provided to describe the assessed problems. This meant that only the main control strategies tended to be recorded and the other, less obvious, contributing factors to the injury risk were neglected. This resulted in usually only one response for each category of strategies;
- there was no continuity or obvious link between the risk assessment checksheets and the risk control plan forms. A review of the completed risk control plan forms from one of the participating companies, for example, showed that the top section used to describe the assessed problem and who did the assessments, etc, was often not completed;
- the workplace project teams often did not understand the relevance of the assessed problems and the factors that contributed to the manual handling hazards in determining suitable control strategies. They were often are too intent in completing the paperwork rather than producing the most practicable control strategy.

The suggested control strategies often reflected the current action culture within each company, rather than the optimal solution to each problem. For example, in one of the companies, the post-injury culture was to train-out the inappropriate actions. Thus many of the suggested control strategies involved investigating the amount of staff training provided and reviewing the trainers' ability to train. This approach tended to put the blame back onto the trainer for their poor training method and this was frequently identified as the cause of the injury.

Each of the workplace project teams tended to suggest mechanisation or automation as a long term control strategy to eliminate the risks associated with the tasks. On review of the feasibility of these as a practicable solution, many had no idea of whether they were truly practicable or even possible. The consequential job loss with this type of technology (ie the priority of OH&S over employment) did not appear to be an issue.

It became obvious in the training overview sessions that there was a need to provide external support in developing a complete range of control strategies. This was due to the limited view that the workplace project teams had about the current range of control solutions available. This could be assisted if the team had more experience in completing these types of documents. More exposure to the approaches used by other companies through cooperative visits, resources such as the HSO's Share manual would be another obvious way to achieve this. The use of external consultants and ergonomists (and other internal resources eg engineers) greatly facilitated expansion in the thinking of the workplace project teams to other possibilities.

Many of the issues raised in the notes attached to the risk assessment component of the code also assisted the determination of a range of practicable control strategies. A number of positive comments about the usefulness of the diagrams provided in the codes for giving examples to help develop ideas were made.

In a few instances, the strategies developed using the issue-specific risk control form were fragmented. Because they addressed the specific risks individually, the resulting control strategies may not have been workable as a total solution.

5.6.4 Simplification of the risk identification, assessment and control process

This project has demonstrated that the risk assessment checksheets can be used by most company staff to identify the major manual handling risks and determine some appropriate control strategies. However, there were many difficulties in using the checksheets that could act as major barriers in their being implemented in a systematic way within normal company practice. The question then arises as to whether a much simplified, yet effective, checksheet could be developed to help facilitate this process.

It appears that the current checksheets, though comprehensive, were developed from the point of view of satisfying the regulations and that their structure was forced to suit these. It may be better for the forms to be developed from an applied injury prevention perspective, rather than one based on meeting regulations only. This means that the steps leading to injury should be defined in functional terms so that a better form can be developed. This could lead to a form that is more meaningful from the users' viewpoint which in turn, could result in more widespread use.

Currently the available checksheets are not able to be widely used to their optimal potential. The issue can be summarised by the following question: can better, simpler documents that still meet the objectives of the regulations and are within the context of the code of practice be produced? This development should not be an examination of the risk identification and assessment checksheets only. Furthermore, it should not be a challenge to the codes of practice.

A change in style to the risk identification and assessment checksheets would be one way to differentiate between the risk identification and assessment components. This would also remove the repeated material and questions from different parts of the checksheets. Qualifying paragraphs would also be useful for extracting the relevant information from of the existing codes.

Moving away from the legalistic requirements, is consideration of the actual total benefits (ie. actual workplace injury prevention) arising from the manual handling codes of practice. This notion is described in part by a variation on the Pareto principle. For example, a checksheet designed to cover 100% of situations but only applied 20% of the time (benefit = 0.2) may not necessarily be better than one that covers 80% of all scenarios but which is applied 50% of the time (benefit = 0.4). Though there is some debate as to the effect of the duty of care perspective on this proposal, it is not a matter of changing the regulations, just the checksheets. The net result would be greater potential for the regulations to be met more often than is currently the case.

5.6.5 Review of preventive approaches identified in an earlier pilot project

One of the companies that participated in this project had already participated in another Worksafe funded pilot project. This pilot project is discussed in the literature review (Section 2.4) and the report was released in 1992. One of the aims of this project was to review the extent to which the preventive approaches identified during the Food Unions' Health and Safety Centre's project had been implemented and performed over time.

Discussion was held with the relevant OH&S and shopfloor staff about progress since the company's involvement in the earlier project. Unfortunately, it was reported that little, if anything, had been implemented since the earlier project. It appeared that the major reason for this was the fact that the employee regarded as the major (internal) driver for the OH&S involvement at the time of the earlier project had left the company. This had essentially left the company without a dedicated person to drive the necessary action. Moreover, none of his successors had taken aboard the OH&S aspects as their particular area. The apparent lack of continuity in management taking a lead role in driving OH&S processes within the company has been a major barrier. For this reason, the company injury statistics were not able to be examined to correlate injury reductions with implementation of control strategies.

Notwithstanding the above comments, the company recognised that it had not addressed sufficiently some of the issues identified in the Food Union's project. For this reason, it was supportive of the project reported here and was keen to participate in it. It was hoped that renewed impetus for preventing manual handling injuries could be stimulated by participation in this project. Unfortunately, the change of other key personnel during this project (the company was taken over in 1995 by an international group) as well as the continuing lack of a clear driver for the process will probably mean that this impetus is not generated.

There was one benefit of participation in the earlier project that we were able to note. Some of the shop floor and supervisory staff involved in the workplace project team for this project, had been involved in the earlier project. When these individuals participated in the training sessions, they were able to grasp the concepts very quickly as this was reinforcement of what they had been taught a couple of years earlier. This meant that they were able to act as team leaders and help guide their co-workers through the risk assessment processes. This observation suggests that ongoing reinforcement of manual handling risk assessment processes is needed. For an injury prevention perspective, however, this would be better achieved by constant use of the checksheets, etc for actual work situations on the shop floor.

5.6.6 The role of company policy in risk assessments

The importance of a company's OH&S policy in facilitating the risk assessment process was considered in this project. Some of the identified issues involved with risk assessments are:

- the complexity of the process. This requires training in the process as well as experience in determining the control strategy for users to become proficient in the correct operation. This study has found that although the participants could describe a fairly complete picture of the risk factors, the determination of suitable control strategies that were lateral in their view required experience both internally within their company and externally in other companies and industries.;
- there is a requirement that companies see the outcome of risk assessments as valuable and act on the recommendations. However, the whole process can be considered to be too difficult if it is just to satisfy the requirement of doing the right thing or fulfilling the consultation requirements of the legislation. This attitude is quickly recognised at the shop floor level, where staff can usually distinguish the effort needed to complete these complex systems;
- risk assessments need to be done regularly by company staff so that a level of proficiency in the process can be maintained. This is also needed to develop a proper understanding of the requirements of the risk assessment process;
- to develop a range of control strategies that are outside the normal company vision requires exposure to outside resources. This is an investment by the company that is not always realised. It is in this area, that translation of successful OH&S experience from one company should be promoted and translated to others;
- employers need to allow the results of risk assessments, (ie the development and implementation of control strategies) to be given both budget and time (staff) so that some of the less developed control strategies can be further expanded and developed;
- management has the overview and knowledge of production parameters and costings;
- management sets the priorities regarding production imperatives and OH&S needs.

From this brief consideration of the risk assessment process it is obvious that it is only with full management support, allocation of resources and priority setting, that risk assessments can be realistically and effectively part of workplace activities.

It is worth noting that of the five companies involved in this project, management had changed in three of them over the duration of the project. This had direct (negative) effects on the extent to which the risk assessment procedures and resulting control strategies could be implemented within these companies.

6. CONCLUSIONS

6.1 RISK ASSESSMENTS USING THE CODES OF PRACTICE

The overall conclusion from this project is that use of the risk assessment checksheets, as provided in the codes of practice, does lead to the identification of suitable control strategies. Significantly, this study has identified that even when users of the checksheets have a low level of proficiency in using them, they will still be guided towards identifying appropriate control strategies. That all workplace project teams were able to complete the checksheets and develop a range of practicable control strategies that accorded with the hierarchy for control, indicates that the checksheets achieve what they are intended to. However, the final proof will be in the scope of control strategies implemented and subsequently evaluated as to their effectiveness in preventing or reducing the severity of injuries.

Another major finding from this study is that the risk identification, assessment and control process would be more streamlined if the two manual handling codes were combined as a single document and considerably simplified. The risk assessment process using the two codes with their different checksheets was found to be an unnecessarily cumbersome task, particularly for use on an ongoing basis in the workplace. In their current format, the risk assessment process and checksheets would not be widely implemented within companies without significant guidance. This raises the question of the extent to which the codes of practice have actually been implemented in industry. Experience from this project, as well as other studies (Low and Holz, 1993), suggests that few companies have ongoing programs for manual handling risk assessment and control. A major reason for this could be that some companies have difficulty with understanding why and when, to use the two codes. It is therefore apparent that the development of one succinct code, with simplified checksheets and procedures would be of considerable advantage to companies. It is also likely that this simplification would lead to more companies regularly performing the risk assessments.

It is important to recognise that completion of the documentation is not an end in itself. Rather it should only focus the attention on determining those factors that are contributing to the risk and to determine practicable control strategies to overcome them.

The most important benefit of the risk assessments was found not to lie predominantly in the rigorous ergonomic assessments themselves but in the actual process of review of the work function. The formal procedures of the codes of practice act to provide a catalyst and structure for looking at how jobs can be improved. A natural consequence of risk assessments is that reducing manual handling tasks, and improving them ergonomically, leads to more efficient production process. Although some of the conducted risk assessments were mediocre, they nevertheless provided some valuable information about the available controls. The risk assessment review presented in this report may provide the most detailed consideration of this process for years. It therefore provides insights for reducing manual handling risks and improving the risk assessment process.

All assessment processes should be viewed as part of an overview risk assessment and control strategy and not in isolation. They will not survive unless there is a clear support mechanism within the company. This support needs to include identification of a driver, more personnel trained in the use of the checksheets and ownership of OH&S at all levels. It is important that core groups are established within each workplace and that at least two people from each work area are trained.

For each of the 21 tasks assessed in this project, there was more than one yes response given in the risk identification checklist, indicating that further assessment was required. Similarly, all tasks were associated with a number of yes responses on the risk assessment checksheets indicating that there was a risk of occupational overuse syndrome present and that a risk control strategy should be developed to eliminate or reduce the risk. To some extent, this result was not unexpected since all tasks reviewed had already been identified as having caused injuries. Unfortunately, the possibility of false positive results indicated on the checksheets due to this could not be assessed. However, a number of the users of the risk assessment checksheets with previous experience in using these documents, commented that it was very difficult to get a job that did not score at least one yes response (in both the risk identification or assessment checksheets). This is one aspect that warrants further investigation.

Another point to consider is that these checksheets do not provide a system of determining the size of the risk, ie there is no way of prioritising the necessary control efforts. However, as the overriding aim is to prevent injury, both the issue of false positive results and the degree of risk may not be a major concern. Nevertheless, it would seem that the capacity to prioritise risk would certainly be advantageous. It is important that any priority rating or scale is sensitive to the legal responsibilities to control all risks assessed, as far as practicable. There may also be worth in such a rating scale giving some weighting to low severity hazards that could be controlled easily and at low cost.

In conclusion, this project has shown that the risk assessment checksheets, as provided in the manual handling codes of practice, are useful for identifying control strategies, despite some of their inherent limitations. It seems sensible at this stage, therefore, to continue with using them as one of the major risk assessment tools. However, greeter compliance and ease of use would be achieved if the format of the two codes and the associated checksheets was reviewed.

6.2 WORKPLACE DESIGN AND LAYOUT

For some of the workstations assessed in this project, inadequate attention appeared to have been given to the needs of the operator to carry out the tasks efficiently, with a low risk of manual handling injuries. In these instances, the operator's work position and space represented a minimal and ergonomically inadequate layout. This suggests that the operator was an appendage to the production process and, at times, even an afterthought. In other situations, the operator was considered (by implication) to be a very flexible tool who was able to bridge the gaps in the production process. These gaps were created as a result of inadequate thought being given to the design of the production system in the first place. There was clearly lack of adequate consideration given to ergonomic design in many cases, with the urgency of production requirements apparently overriding other considerations.

It is important that the manual handling codes of practice risk identification and assessment processes and checksheets are introduced to designers of worksystems from the outset so that they become a required part of the design criterion. The legal requirement on the employer about workplace design sets this in place. If designers and engineers are not given this information from the outset it cannot be used in the design. Ergonomic criteria also need to be documented so that they can be incorporated into the design phase of new plant or in modifications to existing plant. It is not enough to state only that the plant must be safe. Designers need to be given accepted ergonomic criteria to incorporate as part of designing or specifying plant requirements. It should also be recognised that it is far more efficient and effective to incorporate ergonomic requirements at the design phase, rather than wait till the equipment is installed and then determine what can be improved. Unfortunately, many companies use this second best solution of trying to redesign existing systems and plant. A direct consequence of this is a severe limiting of their options, both in the changes that can actually be made and the costs of making such changes.

Though the emphasis so far has been on engineers as designers, it is also apparent that even major companies often do not use professional expertise in planning new layouts and equipment purchases. Whether this arises from the sense of urgency to meet production goals or whether it is historic from the companies' beginnings is not clear, but the consequence can be seen in poorly designed, injury-producing processes. Both managers and plant engineers, need to be trained in the existence and use of the manual handling codes of practice.

In summary, priority seems to be given towards production design rather than human factors or ergonomic design. Management plans should be established to ensure that all designs incorporate ergonomic considerations. This is probably best achieved by specifying , that the designs must comply with the relevant manual handling codes of practice as one of the basic performance criteria.

6.3 ROLE OF MANAGEMENT

One of the major barriers to implementing control strategies and risk assessment processes is the lack of long-term management in many companies. Management policy and commitment to OH&S are paramount for implementing any effective manual handling injury prevention and risk control strategy. Management needs to ensure allocation of dedicated time and resources for employees to complete the processes. The benefits can be seen in terms of reductions in injury as well as productivity improvements.

Without a clear and well-communicated management commitment, implementation of risk assessments and control strategies remain ad-hoc activities, with the likelihood of marginal gains and no continuity. The manual handling codes of practice are certainly important tools to be used for risk assessment and control. It is management, however, that provides the means to drive the process, ensure its ongoing viability and ultimately the extent of its impact on the organisation.

6.4 COMPLIANCE WITH THE LEGISLATIVE REQUIREMENTS TO ASSESS RISK AND USE OF THE MANUAL HANDLING CODES OF PRACTICE

Any risk assessment tool is only effective if it is used (preferably well).The broad question regarding the manual handling codes of practice as tools looks beyond the quality of the risk assessment tool itself, and asks how widely is it used?

As previously noted the codes of practice have a number of features that inhibit their widespread use. However an overriding consideration is the lack of leverage available to encourage management to carry out risk assessments and then commit to and implement practicable control strategies for identified problems. Though there is often a stated commitment to OH&S, there also appeared to be, in some cases, a lack of drive for management to actually act. In other cases, on the other hand, there was a clear commitment to implementing OH&S improvements. Factors such as change of company ownership through takeovers, staff departures and redundancies often leave OH&S programs in limbo, with no continuity or drivers to keep the process going. Hopkins (1995) notes that there is a need for a supporting environment of insurance incentives, government regulations, inspection and enforcement to ensure management's interest and need to attend to OH&S issues.

Besides providing tools that are easy to use, there is a vital need to revisit and invigorate implementation strategies associated with OH&S products. Otherwise we may simply be left with quality products 'sitting on the shelf' with few users. The quality of the product itself should of course not be confused with its success. This can only be measured by output parameters such as the percentage of employers using the item and measurement of injury reductions. Thus ongoing evaluation of any OH&S program, is a major requirement that will ensure a realistic assessment of the effectiveness of any implemented injury prevention strategies.

7. RECOMMENDATIONS

7.1 IMPROVEMENTS TO THE CODES OF PRACTICE FOR MANUAL HANDLING AND OCCUPATIONAL OVERUSE SYNDROME AND THEIR DOCUMENTATION

1. A plain language statement promoting the two codes and their applicability to different situations needs to be written.

2. The target audience for the checksheets provided in the codes of practice needs to be re-evaluated. For example, shop floor staff have difficulty in using them and this suggests that the checksheets may not have developed with them in mind.

3. Consideration should be given to the development of a priority system to be built into the regulations to help management and others to determine which tasks they should tackle first. This could be as a ranking tool accompanying the documentation. The RULA scoring system shows that this is possible.

4. The two volumes could be incorporated into one booklet that covers manual handling issues. Alternatively, two books that have clearly defined situational usage and the reference requirements from each of the manuals should be prepared. For example, the code for the prevention of occupational overuse syndrome could be a complete reference manual in itself.

5. There needs to be a flow chart that clearly shows the links between each of the stages in the risk identification, assessment and control process. This would be useful for determining which of the codes should be used in a particular situation as well as directing the flow for completing the sequential stages of this process.

6. The current inclusion of reference points to the identification checklist appears to be somewhat redundant given that the aim of the risk identification is to quickly and simply determine if a hazard or risk may be present. These reference points may be better attached to the assessment checksheet questions. The current checksheet format works well and can be easily completed in a relatively short time, with little instruction.

7. The risk assessment documentation and checksheet, divided into sections, have no clear links to the risk identification document nor to the reference sections in the manual handling code of practice. Having users only refer to specific risk assessment sections, as guided by the risk identification section, does little to reduce the time to complete the assessment or focus the efforts of its users towards identifying control strategies.

   The risk identification and assessment sections of the code documentation should be more clearly defined using some distinguishing formatting, colours or under-printing of headings. Different formatting that would allow a closer linkage between the questions in the three parts of the code process should be investigated. This would need, of course, to be in line with the regulations. For example, a simpler format in the risk identification phase, directing the user to a block of risk assessment questions that then leads to an identified issue for control would be more useable and assist in the flow of the whole process. This would greatly facilitate the process of identifying control strategies that would control for those specific elements that were assessed to be an important issue.

9. The literacy requirements of the checksheets should be reviewed and simplified ensuring that the level is well within the abilities of most shop floor personnel. This should include improvements to the consistency in terminology and provide a glossary of terms.

10. A number of questions in the current risk assessment checksheet need to be reconsidered to remove any duplication of questions and required responses, between the risk identification and assessment components.

7.2 INCREASE AWARENESS AND USE OF RISK ASSESSMENT TOOLS FOR OCCUPATIONAL OVERUSE SYNDROME

1. Companies need to be made more aware of the relevance of the code of practice for manual handling (occupational overuse syndrome), rather than just the manual handling code, because of its importance in identifying and assessing tasks with a risk of occupational overuse syndrome which are carried out by women to a large extent.
2. Companies should adopt the assessment of occupational overuse syndrome injuries into their gamut of tools for manual handling risk assessment and design criteria. Some companies have been able to customise checksheets for manual handling to suit their specific requirements but often overlook occupational overuse syndrome injuries, which can be more relevant for women.

7.3 DEVELOP EFFECTIVE IMPLEMENTATION STRATEGIES AND EVALUATE COMPLIANCE

1. There is a need to recognise that the simple presentation of products for industry to use under the legislative requirements is quite inadequate for effective implementation. If the objective is widespread industry compliance, then measures incorporating incentives, as well as inspection and enforcement, would appear to be a necessary prerequisite of any effective and realistic strategy.
2. Companies need to identify a clear driver, from within, to ensure that the risk assessment has a high priority and is adopted as standard company policy.
3. A strong commitment to OH&S needs to be instituted as company policy so that it continues even when a key driver of the process leaves that company.

7.4 UPGRADE WORKPLACE INJURY DATA SYSTEMS FOR PREVENTION

1. It is essential that record keeping in companies is improved to provide the necessary information to guide injury prevention activities.
2. Specific guidance on how to optimally collect, record and use injury data for injury prevention purposes needs to be provided with the regulations and the codes of practice.
3. Assist industry to develop and incorporate workplace injury recording systems that are geared for injury prevention programs, not simply satisfying accounting type requirements. Currently most (nearly all!) workplaces have poor injury recording systems, which are typically inadequate for their prime role of clearly identifying risk areas, risk factors and be used for applied prevention activities.
4. Companies should consider computerising their injury statistics to help facilitate the extraction of data for injury prevention purposes at a later stage.
5. Companies should be encouraged, however, to move away from computerised data systems that solely collect information for accounting or auditing purposes. The major limitation of many of these systems is that they are non-relational databases that limit the depth of information needed for prevention purposes that can be obtained.

7.5 PROMOTE ATTENTION TO HEALTH AND SAFETY ISSUES AS A PRODUCTIVITY ISSUE

1. It should be clearly demonstrated to companies that productivity gains are obtained by attention to OH&S matters. Promotion of best practice models would be useful.
2. Companies should change their purchasing criteria so that the benefits of maximising OH&S costs/savings are given full consideration.

7.6 FURTHER RESEARCH

Further research is needed to identify how risk assessment tools can be improved. The study reported here is just a starting point and further studies such as the following are recommended:

1. An assessment of the inter-rater reliability of the risk assessment checksheets both within and across companies and industries.
2. A detailed examination of how the codes of practice are being used in a broader sense in more companies and in other manufacturing sectors.
3. A longitudinal study over some years to assess whether current risk assessment procedures really do lead to a reduction in the frequency and severity of injuries

8. REFERENCES

Addison M. The use of objective and subjective techniques in identifying injury risk in a light repetitive task: a case study. Unpublished project report: CEHF, La Trobe University. 1992.

Armstrong TJ, Fine LJ, Goldstein SA, Lifshitz YR, Silverstein BA. Ergonomics considerations in hand and wrist tendinitis. The Journal of Hand Surgery. 12A (part 2). 1987: 830-837.

Australian Bureau of Statistics. Women in Australia. ABS Catalogue Number 4113.0. 1993.

Ayoub MM. Problems and solutions in manual materials handling: the state of the art. Ergonomics, 1992; 35 (7/8) : 713-728.

Boucaut R, Gun R, Ryan P. An evaluation of the risk identification checklist from the manual handling code of practice. Journal of Occupational Health and Safety 0 Aust NZ. 1994; 10 (3) :205-211.

Caple D and Associates Pty Ltd. Powered handtools: ergonomic guidelines to selection and use in the automotive industry. Melbourne, Australia. 1993

Chaffin DB, Andersson GBJ. Occupational biomechanics (Second Edition). John Wiley and Sons Inc, New York. 1991.

Chaffin DB, Ayoub MM. The problem of manual materials handling. Industrial Engineering. 1975; 7: 24-29.

Chaffin DB, Erig M. Three-dimensional biomechanical static strength prediction model sensitivity to postural and anthropometric inaccuracies. IIE Transactions. 1991; 23 (3) : 215.

Chaffin DB. Biomechanical modeling for simulation of 3D static human exertions. In: Computer applications in ergonomics, occupational safety and health. M Matislo & W Karwowski (Eds). 1992; 1-11.

Dell'Isola AJ. Value engineering in the construction industry. Van Nostrand Reinhold Co. NY. 1982.

EUROSTAT: Commission of the European Communities. Methodology for the Harmonisation of European Occupational Accident Statistics. Luxembourg, 1992.

Food Union's Health and Safety Centre. Management of manual handling hazards in the food industry. September 1992.

Frederick LJ. Cumulative trauma disorders. An overview. AAOHN Journal. 1992; 40(3): 113-116.

Graveling RA, Johnstone J, Symes AM. Development of screening method for manual handling. Report No. TM/92/08. Institute Of Occupational Medicine, Edinburgh. 1992.

Greve JW, Wilson FW. (Eds) Value engineering in manufacturing. American society of tool and manufacturing engineers. Prentice Hall. 1967.

Gun RT. The incidence and distribution of RSI in South Australia 1980-81 to 1986-87. Med J Aust. 1990; 153: 376-380.

Heidenström, PN: Accident recording: the need for a new approach. Accident Compensation Commission Statistics. Wellington, New Zealand. 1982.

Heinsalmi P. Method to measure working posture loads at working sites (OWAS). In: The ergonomics of working postures. Corlett N, Wilson J, Manenica L (Eds). Taylor and Francis, London, 1986. 100-104.

Hopkins A. Making safety work. Getting management commitment to occupational health and safety. Allen and Unwin. New South Wales. 1995

Johnson SL. Ergonomic hand tool design. Hand Clinics. 1993; 9(2): 299-311.

Jørgensen, K: Occupational injury data as a basis for the grading of industrial injury insurance premiums - Denmark and the European Community. In Larsson, TJ & Clayton, A (Eds): Insurance and Prevention; some thoughts on social engineering in relation to externally caused injury and disease. IPSO Factum 46. Folksam Insurance and the Swedish Work Environment Fund, 1994.

Kant J, Notermans JHV, Borm PJA. Observations of working postures in garages using the Ovako Working posture Analysing System (OWAS) and consequent workload reduction recommendations. Ergonomics. 1990; 33 : 209-220.

Keyserling WM, Chaffin DB. Occupational ergonomics - methods to evaluate physical stress on the job. Ann Rev Public Health. 1986; 7: 77-104.

Kilbom Å. Assessment of physical exposure in relation to work-related musculoskeletal disorders - what information can be obtained from systematic observations? Scan J Work Environ Health 1994; 20 special issue: 30-45.

Kilbom Å. 1985. Cited in Lagerlof E. OECD working party on the role of women in the economy, panel of experts on women work and health: National report Sweden. National Institute of Occupational Health, Stockholm. 1993.

Kilken S, Stringer W, Fine L, Sinks T, Tanaka S. National Institute for Occupational Safety and Health (NIOSH) health hazard evaluation report 89-307-2009 (Perdue Farms Inc). Cincinnati, OH. 1990.

Lagerlof E. OECD working party on the role of women in the economy, panel of experts on women work and health: National report Sweden. National Institute of Occupational Health, Stockholm. 1993.

Landy FJ, Trumbo DA. Psychology of work behaviour, Dorsey Press. Illinois. 1980.

Larsson TJ. Local work environment activities in the Melbourne city parks and gardens 1992-1993. IPSO Factum 45, Melbourne. 1994.

Larsson TJ. Permanent medical disability from work-related strain and overuse disease: an indication of the future from Sweden. J Occup Health Safety - Aust NZ. 1993; 9:71-75.

Larsson TJ: Accident information and priorities for injury prevention. Thesis. IPSO Factum 21. Department of Work Science, Royal Institute of Technology. Stockholm. 1990.

Long AF. A computerised system for OWAS field collection and analysis. In: Computer applications in ergonomics, occupational safety and health. Mattila M and Karwowski W (Eds). New York, Elsevier. 1992; 353-358.

Louhevaara V, Suurnäkki T. OWAS: A method for the evaluation of postural loading during work. Helsinki: Institute of Occupational Health. 1992.

Low I, Holz A. Approach to risk reduction in manufacturing firms in Australia. Occup Med 1993; 43: 43-46.

Masterton K. A study of the reliability of RULA and its application in the food processing and packaging industry. Unpublished project report: CEHF, LaTrobe University. 1993.

Mathews J. Health and safety at work. Australian trade union safety representatives handbook. Second Edition. Pluto Press Australia Limited. 1993.

McAtamney L, Corlett EN. Survey method for the investigation of work-related upper limb disorders. Proceedings of the 11th Congress of International Ergonomics Association "Designing for everyone". 1991;141-143.

McAtamney L, Corlett EN. RULA: a survey method for the investigation of work-related upper limb disorders. Appl Ergon 1993; 24(2): 91-99.

McMenamin A. Migrant women and occupational injury - The challenge: A research report on musculo-skeletal injury amongst women on non-English speaking backgrounds. Working Women's Centre: Adelaide. (1993).

National Occupational Health and Safety Commission. A national approach to occupational health and safety for women workers. Australian Government Publishing Service, Canberra, March 1990.

National Occupational Health and Safety Commission. Code of Practice for the Prevention of Occupational Overuse Syndrome. Australian Government Publishing Services, Canberra. February. 1994.

National Occupational Health and Safety Commission. National Standard for Manual Handling and National Code of Practice for Manual Handling. Australian Government Publishing Services, Canberra. February. 1990.

Ramazzini B. Diseases of workers (Wright WC trans.). New York, NY: Hafner Publishing Co. 1964. (Original work published 1700 and 1713)

Rechnitzer G, Larsson T, Mantle B. Ballarat region occupational injury prevention project claims data analysis. MUARC unpublished report. 1995.

Rempel DM, Harrison RJ, Barnhart S. Work-related cumulative trauma disorders of the upper extremity. JAMA. 1992; 267: 838-842.

Seiden M. Product safety engineering for managers. Prentice Hall, New Jersey. 1984.

Sigismondi S. Usability and utility of the University of Michigan 2D and 3D static strength prediction programs. Unpublished project report: CEHF, LaTrobe University. 1994.

Snook SH. Approaches to the control of back pain in industry: job design, job placement and education/training. Professional safety. 1988; 23-31.

Snook SH. The design of manual handling tasks. Ergonomics. 1978; 21(12): 963-985.

Söderqvist A. The development of sorting tasks; ergonomics, organisation and rehabilitation. IPSO Factum 32. IPSO Stockholm. 1991.

Stevens JC. Static and dynamic exertion: a psychophysical similarity and dissimilarity. In: Ljunggren G and Dornic S. (Eds). Psychophysics in action. Springer-Verlag. 1989.

Stone NE. Occupational overuse syndrome in other countries. J Occup Health Safety - Aust NZ. 1987; 3:397-404.

Tesh KM, Symes AM, Graveling RA, Hutchinson PA, Wetherill GZ. Useability of manual handling guidance. Report No. TM/92/11. Institute Of Occupational Medicine, Edinburgh. 1992.

Turunen V. Overuse syndrome - prevention better than cure. Work Health Safety 1994; 16-18.

USOHSA (Occupational Safety and Health Administration). Ergonomics program management guidelines for meatpacking plants. OHSA 3123, Washington, DC. 1990.

Victorian Occupational Health and Safety Commission. Manual Handling Regulations and Ccode of Practice. In effect from 1st February 1988.

Victorian Occupational Health and Safety Commission. Code of Practice Manual Handling (OOS). In effect from 1st January 1992.

Victorian Occupational Health and Safety Authority. Manual Handling: Health and safety issues for women workers. Occupational Health and Safety Authority: Melbourne. 1992

Victorian Occupational Health and Safety Authority. Manual handling in the food and beverage manufacturing industry - Part II. Statewide report. Occupational Health and Safety Commission. July 1993.

Victorian Occupational Health and Safety Authority. A statistical profile of occupational health and safety Victoria, 1994. October 1994.

Victorian Occupational Health and Safety Authority. Manual handling and noise in the poultry processing industry. 1994.

Victorian Workcover Authority. Policy legislation and communications: Manual handling injuries in manufacturing (statistics). Victorian Workcover Authority: Victoria. 1993

Waller JA, Clemmer DI. A scheme for describing injury events. The Journal of Trauma 1993; 35 (6): 909-919.

White CB (Ed). State of the work environment: Manual handling injuries and diseases, Western Australia 1992/93. Department of Occupational Health, Safety and Welfare. Perth, Western Australia. 1994.

Worksafe Australia. Occupational health and safety performance, Australia: Best estimates. Commonwealth of Australia: Canberra. 1993.

Worksafe Australia. Occupational Health and Safety: The experience of women workers, Australia, 1991-92. Australian Government Publication Service. October 1994.

APPENDIX 1: MANUAL HANDLING CODE OF PRACTICE RISK ASSESSMENT CHECKSHEET

Manual Handling Risk Assessment Checksheet.

To be filled out with consultation between Employer, Health and Safety Representative and Employee.

The General Risk Identification Checklist of the Manual Handling Code of Practice should be completed <u>before</u> using this checklist.

Description of Work Location: Date:

Task Workstation:

Assessed by: Employer Position:

Assessed by: Employee(s) Position:

Assessed by: Health & Safety Representative Position:

Have there been any records of injury related to this task at this workplace? ☐ Yes ☐ No

If Yes before proceeding to the Risk Assessment below, review section 6.1– "Analysis of Injury Statistics" page 17 of the Manual Handling Code of Practice.

If No proceed directly to the Risk Assessment below.

Risk Assessment.

(Refer to Section 7 of Code of Practice for guidance.)

Section in Code of Practice.		Is there a risk?
7.1.1 (p.22)	Actions and Movements Involved	☐ Yes ☐ No
7.1.2 (p.23)	Layout of workplace	☐ Yes ☐ No
7.1.3 (p.23)	Posture	☐ Yes ☐ No

Section in Code of Practice.		Is there a risk?
7.1.4 (p.24)	Duration and Frequency of activity	☐ Yes ☐ No
7.1.5 (p.24)	Distance and Time Handled	☐ Yes ☐ No
7.1.6 (p.24)	Force applied	☐ Yes ☐ No
7.1.7 (p.25)	Weight	☐ Yes ☐ No
7.1.8 (p.25)	Nature of Load	☐ Yes ☐ No
7.1.9 (p.26)	Condition of workplace	☐ Yes ☐ No
7.1.10 (p.27)	Work organisation	☐ Yes ☐ No
7.1.11 (p.27)	Age of Employee	☐ Yes ☐ No
7.1.12 (p.27)	Skill and Experience of Employee	☐ Yes ☐ No

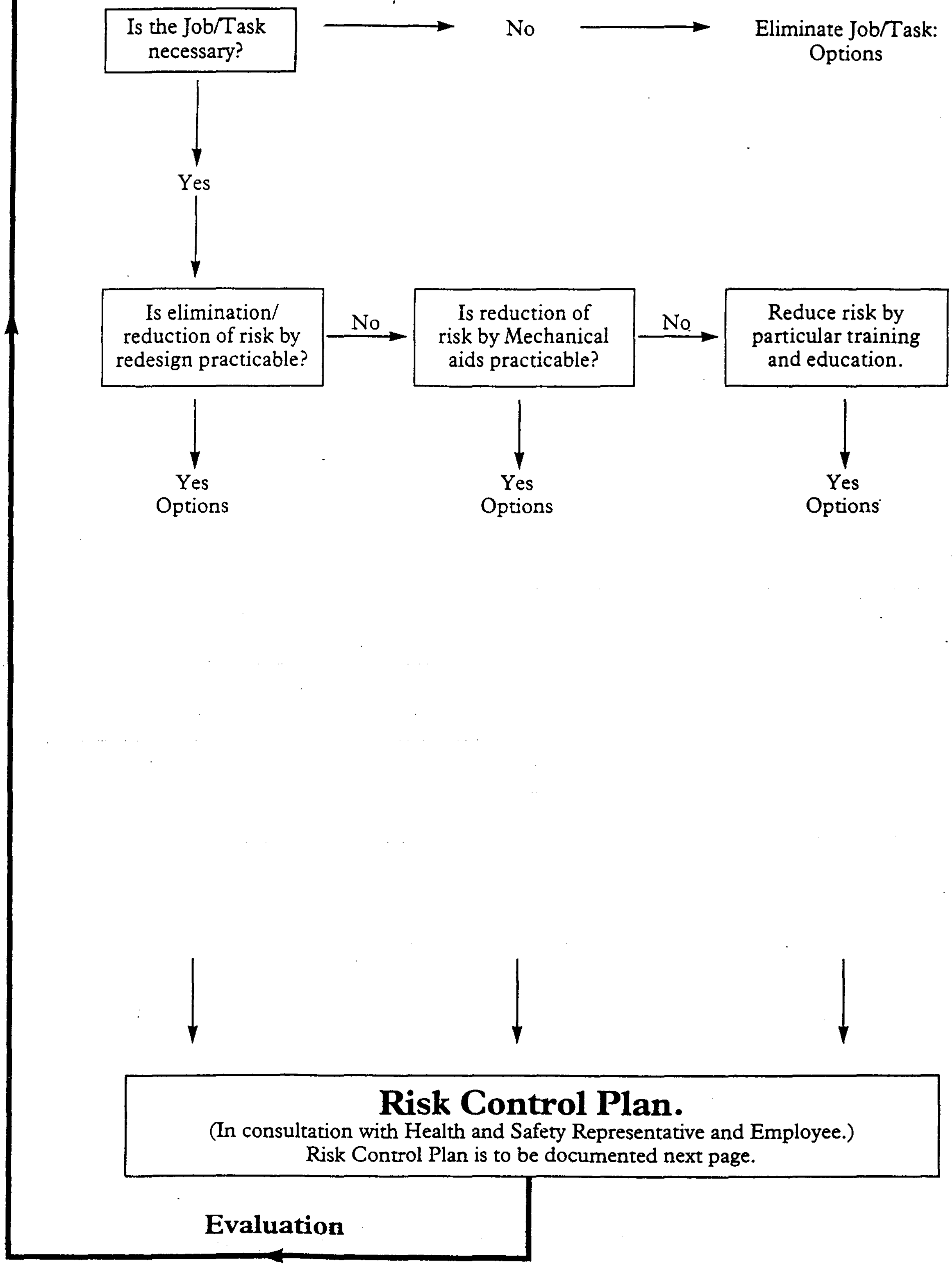
Any other factors/comments:

Risk Control.

Date:

Factors assessed as a risk (from Risk Assessment Checksheet, previous pages).

Refer to section 8 Manual Handling Code of Practice for control options.



Risk Control Plan.

(To be developed in consultation with Health and Safety Representatives and employees.)

Short Term: (Indicate time-frame)

Medium Term: (Indicate time-frame)

Long Term: (Indicate time-frame)

Have all parties been consulted?

No

Yes

Implement Controls.

Evaluation of all solutions.

Risk Identification and Risk Assessment may be repeated to evaluate the appropriateness of this control measure.

DEPARTMENT OF LABOUR

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APPENDIX 2: OCCUPATIONAL OVERUSE SYNDROME CODE OF PRACTICE RISK ASSESSMENT CHECKSHEET

Appendix 2

Occupational Overuse Syndrome

Risk Assessment Checksheet

To be filled out with consultation between Employer, Health and Safety Representative and Employee. This checksheet is to be used in conjunction with Section 10 of the Occupational Overuse Syndrome Code of Practice for guidance.

The Risk Identification Checklist of the Occupational Overuse Syndrome Code of Practice should be completed before using this checksheet.

Description of Work Location Date:

Task Workstation

Assessed by: the employer in consultation with Position

the employee(s) in consultation with Position

the Health and Safety Representative Position

A "Yes" response to any of these questions in the risk assessment section indicates risk of occupational overuse syndrome. In such cases, the Risk Control sections (Sections 11-17) of this Code should be consulted to eliminate or reduce risks.

A Layout of Workplace

The layout of the workstation should not impose sustained, inappropriate and awkward body positions.

1. Are any frequently handled objects, e.g. controls, tools or material, positioned beyond easy reach? ☐Yes ☐No
2. Does the layout of the workplace result in excessive twisting or bending of the neck, shoulders or upper body? ☐Yes ☐No
3. Are controls or keys on tools, equipment or instruments positioned in such a way that they are difficult to grasp or activate? ☐Yes ☐No
4. Are displays difficult to read from the person's usual work position? ☐Yes ☐No

Are there any risks assessed from Section 7.1.1, 7.1.2., 7.1.3., 7.1.8 of the Manual Handling Code?

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B Posture

The design of the task and the workstation should aim to provide comfortable and varied working postures, particularly where there is the need to apply force or to repeat the task continuously or both.

1. Are working heights fixed (that is, not adjustable to match the height and size of the employees to their working height)?
2. Is most work performed where the wrists are not kept in a neutral (natural) position? ☐Yes ☐No

3. Is most work performed with the upper arms in an unsupported position away from the body? ☐Yes ☐No

4. Is the employee required to bend frequently at low working heights to handle objects. ☐Yes ☐No

5. Does the shape, width, length and texture of the tool handle cause discomfort? ☐Yes ☐No

6. Does the work level vary significantly from the optimum level? ☐Yes ☐No

7. If fine assembly or writing tasks are performed for most of the shift, is there a lack of support for the forearm? ☐Yes ☐No

8. Does the employee work continuously more than 30cm away from the body for at least one minute without rest? ☐Yes ☐No

9. Do tasks require an employee to work continuously above shoulder level for at least 30 seconds? ☐Yes ☐No

10. Do tasks require part or all of the body to be held in a fixed position so that it causes discomfort, e.g. standing or sitting all day? ☐Yes ☐No

11. Do tasks require an employee to maintain an awkward position for at least 30 seconds? ☐Yes ☐No

12. If an object is handled, is the object presented to an employee in a position that makes it difficult to grasp or hold? ☐Yes ☐No

Are there any risks assessed from Section 7.1.4., 7.1.5, 7.1.7 of the Manual Handling Code?

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C Duration and frequency of activity

Muscles, when used repeatedly or used to apply force continuously or both, will tire. When muscles tire there is an increased risk of injury.

1. Do the tasks performed in a working day lack variety, e.g. typing for a full day, packaging for a full shift? ☐Yes ☐No

2. Are the task demands such that the employee lacks control over the pace of work? ☐Yes ☐No

3. Is the employee unable to take breaks, e.g. working on a process line without any relief? ☐Yes ☐No

4. Are there any repetitive tasks which requires an employee to work above shoulder and which takes longer than 30 seconds? ☐Yes ☐No

5. Are there any repetitive tasks which require an employee to maintain an unsupported fixed position and which takes longer than 30 seconds? ☐Yes ☐No

Are there any risks assessed from Section 7.1.9 of the Manual Handling Code?

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D Force Applied

The application of force requires muscular effort, e.g. moving, restraining, or holding a posture. Generally, the employee should not be required to exert forces that cause discomfort.

1. Does the employee experience discomfort when required to apply force repetitively or continuously? ☐Yes ☐No

2. Is the employee required to repetitively use grip spans that cause discomfort? ☐Yes ☐No

Are there any risks assessed from Section 7.1.6 and 7.2.2 of the Manual Handling Code?

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E Work Organisation

The work should be organised to avoid having to meet unreasonable deadlines and peak demands which will increase time pressures, reduce control over workflow, and may contribute to risk of occupational overuse syndrome.

1. Is there inadequate staff to meet work demands? ☐Yes ☐No
2. Is regular overtime worked in jobs involving repetitive work? ☐Yes ☐No
3. Is there a lack of appropriate relief staff to cover peak demand or absences? ☐Yes ☐No
4. Is there adequate time to meet targets set? ☐Yes ☐No

Are there any risks assessed from Section 7.1.10 of the Manual Handling Code?

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F Skill and experience

Training and education programs are essential to the success of an occupational overuse syndrome prevention strategy.

1. Is there lack of employees training appropriate to the task? ☐Yes ☐No
2. If the employee is a new staff member, or has recently returned from leave, is the employee expected to perform at the regular pace or level without readjustment to the workload? ☐Yes ☐No

Are there any risks assessed from Section 7.1.12 of the Manual Handling Code?

....

....

....

Risk Control

Date: ☐☐☐☐☐☐

Factors assessed as risk from Risk Assessment Checksheet.

Refer to Sections 11-17 Occupational Overuse Syndrome Code of Practice for control options.

Is the Job/Task necessary? → No → Eliminate Job/Task: Options

↓ Yes

Is elimination/ reducation of risk by redesign practicable? → No → Is reduction of risk by devices or mechanical aids practicable? → No → Reduce risk by particular training and education

Yes Options | Yes Options | Yes Options

↓

Risk Control Plan

(In consultation with Health and Safety Representative and Employee).
Risk Control Plan is to be documented next page.

Evaluation

APPENDIX 3: FOLLOW UP SURVEY QUESTIONNAIRE TO THE PARTICIPATING COMPANIES

COMPANY: ____

Please indicate your responses to the following statements on the scales indicated. A score of "0" indicates you disagree strongly, a score of "5" indicates that you neither agree nor disagree with the statement and a score of "10" indicates you strongly agree.

	Strongly Disagree				Neither Agree or Disagree						Strongly Agree
Participation in the project was of benefit to us	0	1	2	3	4	5	6	7	8	9	10
RISK IDENTIFICATION											
In general, the project helped us to understand **risk identifcation** procedures better	0	1	2	3	4	5	6	7	8	9	10
In general, the project helped us to improve our **risk identifcation** procedures	0	1	2	3	4	5	6	7	8	9	10
RISK ASSESSMENT											
In general, the project helped us to understand **risk assessment** procedures better	0	1	2	3	4	5	6	7	8	9	10
In general, the project helped us to improve our **risk assessment** procedures	0	1	2	3	4	5	6	7	8	9	10
RISK CONTROL											
In general, the project helped us to understand **risk control** procedures better	0	1	2	3	4	5	6	7	8	9	10
In general, the project helped us to improve our **risk control** procedures	0	1	2	3	4	5	6	7	8	9	10

Are there any general comments you would like to make? ____________________

____

____

____

____

____

____

COMPANY: ____

Please answer the following questions for the specific work stations/areas targeted by the project.

Work station area:

Participation in the Monash project helped us to **identify** specific risks in this area.

yes ☐ no ☐ don't know ☐

Please comment: ______________________________

____

____

Participation in the Monash project helped us to **assess** the risks in this area.

yes ☐ no ☐ don't know ☐

Please comment: ______________________________

____

____

Participation in the Monash project helped us to **identify control strategies** in this area.

yes ☐ no ☐ don't know ☐

Please comment: ______________________________

____

____

We have been able to make changes to reduce manual handling risks in this area:

yes ☐ no ☐ don't know ☐

If not, why not? ______________________________

____

____

If Yes, were these changes?

- a direct result of participation in the project ☐
- an indirect result of participation in the project ☐
- not related to participation in the project ☐

Please describe what changes you have made: ______________________________

____

____

____

APPENDIX 4: RULA SCORE SHEET

HOW TO USE RULA

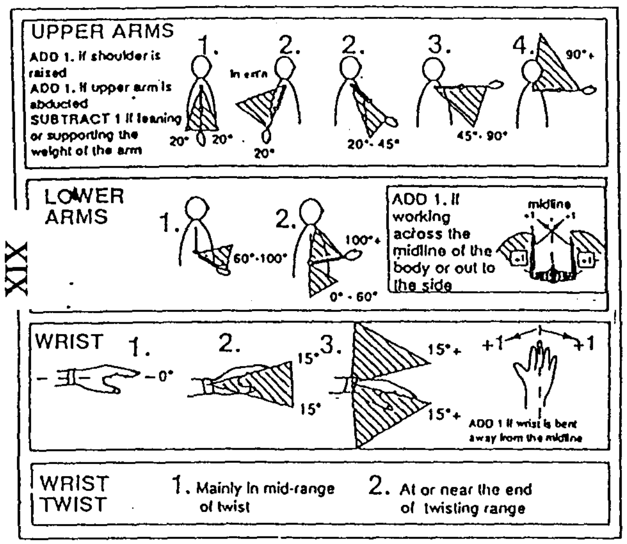
Step 1. Record the posture of each body part in groups A and B using the diagrams of the bodyparts and the score sheet.

Also record the muscle use and force scores for both groups A and B using the tables at the bottom of the diagrams. Record them in the boxes on the score sheet as indicated.

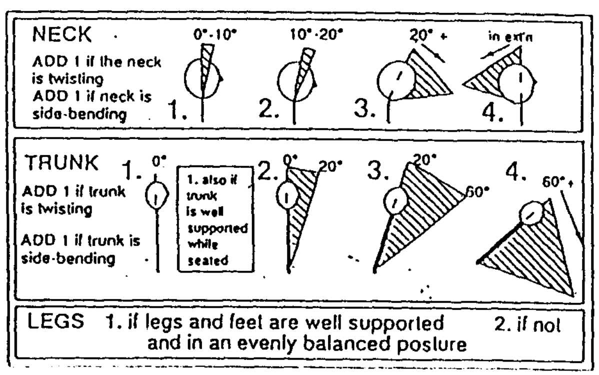
Step 2. Code the posture scores for group A using Table A and group B using Table B. Add the respective muscle use and force scores as shown on the score sheet to get SCORES A and B.

Step 3. Using SCORES A and B look up the Grand Score in Table C. Compare the score to the Action List below.

GROUP A



GROUP B



FORCES OR LOAD SCORE

0.	1.	2.	3.
• No resistance or less than 2kg intermittent load or force	• 2-10kg intermittent load or force	• 2-10kg static load • 2-10kg repeated load or force	• 10kg or more static load • 10kg or more repeated loads or forces. • Shock or forces with a rapid buildup.

MUSCLE USE SCORE

Give a score of 1 if the posture is;

- mainly static, e.g. held for longer than 1 minute
- repeated more than 4 times/minute

RULA SCORE SHEET

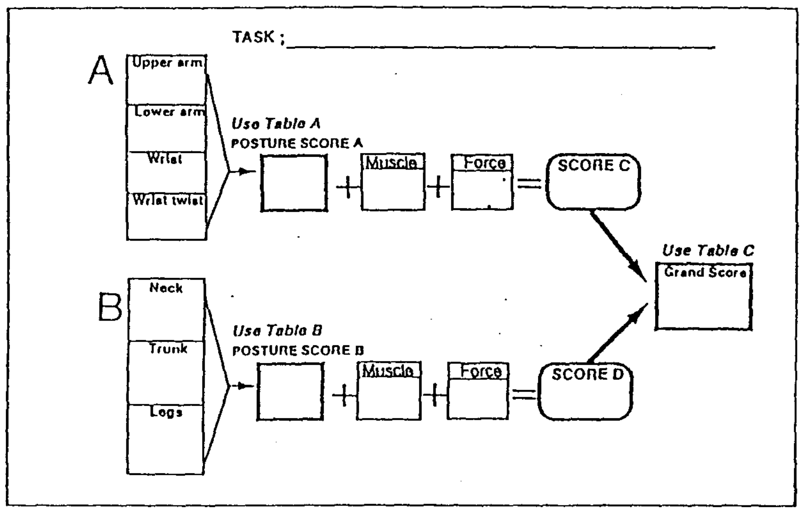


TABLE A Upper Limb Posture Score

UPPER ARM	LOWER ARM	WRIST POSTURE SCORE 1		2		3		4	
		W. TWIST 1	2	W. TWIST 1	2	W. TWIST 1	2	W. TWIST 1	2
1	1	1	2	2	2	2	3	3	3
	2	2	2	2	2	3	3	3	3
	3	2	3	3	3	3	3	4	4
2	1	2	3	3	3	3	4	4	4
	2	3	3	3	3	3	4	4	4
	3	3	4	4	4	4	4	5	5
3	1	3	3	4	4	4	4	5	5
	2	3	4	4	4	4	4	5	5
	3	4	4	4	4	4	5	5	5
4	1	4	4	4	4	4	5	5	5
	2	4	4	4	4	4	5	5	5
	3	4	4	4	5	5	5	6	6
5	1	5	5	5	5	5	6	6	7
	2	5	6	6	6	6	7	7	7
	3	6	6	6	7	7	7	7	8
6	1	7	7	7	7	7	8	8	9
	2	8	8	8	8	8	9	9	9
	3	9	9	9	9	9	9	9	9

SCORE D (NECK,TRUNK,LEG)

SCORE C (UPPER LIMB)	1	2	3	4	5	6	7+
1	1	2	3	3	4	5	6
2	2	2	3	4	4	5	5
3	3	3	3	4	4	5	6
4	3	3	3	4	5	6	6
5	4	4	4	5	6	7	7
6	4	4	5	6	6	7	7
7	5	5	6	6	7	7	7
8	5	5	6	7	7	7	7

TABLE C

Grand Score Table

TABLE B Neck, Trunk, Legs Posture Score

NECK POSTURE SCORE	TRUNK POSTURE SCORE 1 LEGS 1	2	2 LEGS 1	2	3 LEGS 1	2	4 LEGS 1	2	5 LEGS 1	2	6 LEGS 1	2
1	1	3	2	3	3	4	5	5	6	6	7	7
2	2	3	2	3	4	5	5	5	6	7	7	7
3	3	3	3	4	4	5	5	6	6	7	7	7
4	5	5	5	6	6	7	7	7	7	7	8	8
5	7	7	7	7	7	8	8	8	8	8	8	8
6	8	8	8	8	8	8	8	9	9	9	9	9

Source: Mc Atamney and Corlett, 1992.

ACTION LIST

ACTION LEVEL 1. A grand score of 1 or 2 indicates that the posture is acceptable if it is not maintained or repeated over long periods.

ACTION LEVEL 2. A grand score of 3 or 4 indicates further investigation is needed and changes may be required.

ACTION LEVEL 3. A grand score of 5 or 6 indicates investigation and changes are required soon.

ACTION LEVEL 4. A grand score of 7 or more indicates investigation and change is required now.

APPENDIX 5: MODIFIED CHECKSHEET FOR MANUAL HANDLING RISK CONTROL OPTIONS

MANUAL HANDLING RISK CONTROL OPTIONS

TASK: DATE ASSESSED:

ASSESSED BY:

No	ASSESSED PROBLEM	LONG TERM STRATEGY	MEDIUM TERM STRATEGY	SHORT TERM STRATEGY
	IMPLEMENTATION DATE			