Checking the checklist:
The effect of training on the application and effectiveness of checklist-based risk assessments

Final Report

Undertaken on behalf of

Institution of Occupational Safety and Health

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Abstract

This report details a programme of research undertaken on behalf of IOSH and intended to investigate the critical factors which control the effectiveness of checklist-based risk assessments. Through five research phases, partner companies from UK manufacturing industries provided case examples of current practice and a resource of participants to conduct user trials.

An extensive literature review revealed that previous research had focussed on the effectiveness and reliability of checklists in risk assessment. However, very little research had been conducted in assessing the effectiveness of the actual design of checklists and the level of accompanying training that is required to ensure they are used correctly.

A questionnaire survey of 88 companies of more than five employees revealed the state of current practice and a wide diversity of resources and application of safety practices. From these companies 15 were selected to undertake an in-depth walk through involving a site inspection, interviews with Health and Safety professionals and an audit of the health and safety practices.

From the audited companies four were selected to take part in user trials involving the provision and evaluation of control checklists and accompanying training. This provided a large data set which could be scrutinised to identify the effective features of checklists and the benefits training may offer.

The results reveal a complex picture with numerous confounding influences. Specific features of checklists and training offer benefits in some circumstances and limitations in others. A lack of clear patterns suggests that the high degree of variability in companies and staff make prescriptive solutions unreliable as safety interventions.

Recommendations are made for assessing the content of checklists but reservations remain over the effectiveness of a single solution for use in any specific company.

Executive Summary

This report details the work and findings of an extensive research program exploring the impact of training on the use of checklist based risk assessments and the design and features which affect the usability of checklists to undertake effective risk assessments in the UK.

The work is set against a backdrop where risk assessment is the keystone of workplace safety. It is primarily a legal requirement and is inevitably the first tool that health and safety practitioners reach for when establishing safe working practices. Its ubiquitous nature has meant that there is a strong demand for ready-made resources which can be easily accessed and completed. This has been endorsed by the current ethos of involving all workers in the risk assessment process. This has resulted in the evolution of simple checklist based tools which allow the user to work through a workplace activity and which should flag factors which may raise the level of risk to unacceptable levels. Because of the diversity of users these tools are often simplistic if aimed at generic use, which reduces their precision. More specific tools have been developed for targeted user groups, such as enforcement agencies, which assume a greater degree of understanding on the part of the user and are hence more detailed and complex. Unsurprisingly, these tools often migrate into the industrial sector where they may be used inappropriately.

Whilst the use of checklist based tools has been scrutinised the design features of the checklist have not. Similarly, the role of training in enhancing the efficiency and longevity of checklists has not been studied, largely due to the simple appeal of the checklist products. This research evaluates how effective the various checklist design features are and the impact training has on supporting the checklist in use. In particular, the study looks at the ability of different strata of the workforce and their ability to use a checklist based risk assessment in conjunction with training to recognise risk factors and then to identify appropriate interventions.

The correct identification of interventions has historically been a shortcoming of the risk assessment process, which normally only highlights the presence of a particular range of risk factors.

The study took the form of five major components spanning a period of two years. The first of these was an extensive literature review. This established the current state of knowledge regarding risk assessment and associated training. It revealed that there is significant knowledge about the use of checklists in risk assessment but not about their design. Similarly, the use of training in workplace safety is well documented, but the role of training in supporting and enhancing the use of checklist based risk assessments was largely unexplored. These findings were important given the widespread use of checklist tools and the range of training resources available. This review also identified the main checklist based tools that are available at this time.

The second phase of the study involved a wide survey of current practice in the workplace. After significant efforts to overcome industry reluctance, three hundred and eighty one companies were surveyed by questionnaire to assess their current attitudes and approaches to risk assessment and safety management. Eighty eight companies responded provided a wide cross section of views and approaches. These companies were also requested to provide examples of the risk assessment tools that they currently use so that these could be further scrutinised. This revealed that companies are largely relying on a limited number of risk assessment tools, the majority of which were not necessarily intended for this purpose. It also revealed wide range of errors in approach, ignorance in understanding and difficulties in practice when considering safety in the workplace.

In the third phase of the work, fifteen companies were selected from those of the eighty eight who indicated that they would be willing to participate further. Walk through audits were then conducted at these companies in conjunction with the Health and Safety manager. These took the form of semi structured interviews conducted partly in an office based setting and partly on the shop floor whilst observing the working practices.

They scrutinised the procedures and systems used, the reasons and justifications for those systems and the work activities they were trying to address. These visits further illuminated the range of issues which impact on the implementation of good safety practice. One of the main recurrent issues was the diversity of workers and the problem in ensuring safety information was effectively communicated. Also apparent were the problems in identifying and implementing interventions when risk factors had been raised. A consistent message was the lack of commitment (often financial) at boardroom level to support a ‘safety first’ corporate policy.

Phase four of the work contained the main bulk of the trials undertaken with representatives from four companies drawn from the fifteen organisations with which audits had been undertaken. These four companies were matched in terms of training approaches, structure, size and work tasks to allow cross comparison. Line managers, line leaders and line workers all contributed to the trials providing different perspectives on the content. A questionnaire survey of the participants established the current attitudes and approaches. Two risk assessment checklists were developed to scrutinise upper limb risk factors associated with repetitive activity. These were based on popular intervention tools, with one having a more detailed analytical approach whilst the other was in the form of a ‘traffic light’ assessment. These were presented to eight groups of workers either with or without training, which was provided by an IOSH accredited trainer.

The results allowed comparison between the groups of trained and untrained users for each of the two checklists. By using the checklists to review videotaped activities it was possible to evaluate how the different worker groups viewed the nature and level of risk and whether appropriate interventions could be identified. The opinions of the participants were validated against an expert panel of ergonomists and health and safety professionals who separately reviewed the taped activities, allowing ‘success’ rates to be established.

The final phase of the work took the form of a longitudinal study intended to establish whether training had any lasting effect on the attitudes and knowledge of the participants and to assess whether any changes to working practices had occurred as a function of participating in the study. This phase involved revisiting the organisations and the participants and repeating the questionnaire survey conducted in stage four. Furthermore a walk through interview was undertaken with the Health and Safety manager to explore any changes, benefits or problems that had been revealed following the previous phases.

The main findings of the work were complex and correlated. It was clear that it is possible to identify good and bad design features in checklist based risk assessments and hence optimise design for better performance. However, the features that were most effective differed according to the worker group undertaking the risk assessment. Clearly, where organisations are encouraged to involve all workers in this process this is problematic. Similarly, it can be seen that training is effective in enhancing the identification of risk factors and in identifying interventions. However, the effectiveness of the training depends on how the content matches the trainees abilities, and mixed groups are not particularly effective.

More importantly, other factors were identified as greater obstacles to effective safety management through the use of risk assessment tools. Primary amongst these was the motivation of the participants. It was clear that those individuals who were interested in, and motivated by, being part of the safety management process (as opposed to those who were ‘drafted’ or used it as an opportunity to avoid their routine duties) were much more receptive to training and were more adept at using any of the tools.

The report concludes with the provision of a range of best practice suggestions for developing and using checklist based risk assessments as well as training resources. However, it is noted that there are serious barriers to the use of these tools being effective.

These include language and cultural obstacles, lack of financial motivation at executive level, the need for bespoke resources for the various strata of workers and the predisposition to rely on risk assessment alone to provide adequate levels of occupational safety.

Recommendations are made for greater outsourcing of risk management activities as well as greater education into the wider principles of safety and risk perception. By necessity this may preclude direct involvement of all types of worker in the process, although there remains a role for all workers in furnishing appropriate information. It remains that the identification and management of risks in the workplace is not a simple problem and the expectation that simple tools and basic training can solve it is flawed.

1 Introduction

This report presents phases one to five of a research project funded by the Institute of Occupational Safety and Health (IOSH). The project investigates the effect of training on the application and effectiveness of checklist-based risk assessments. The research is driven by the need to understand the link between risk identification and risk control. It is hypothesised that this link is forged by the quality of the design of checklists and the correct identification, and implementation of appropriate training in their use.

The project investigates the effectiveness of two different designs of risk assessment checklists for assessing musculoskeletal risks, and measures their performance with and without training by a range of users from within the workplace. The project also investigates the effect of checklist design and training on the longer term outcomes of the identification, implementation and acceptance of interventions to eliminate or reduce the risks of musculoskeletal disorders.

1.1 Project background

Employers are legally required under the Health and Safety at Work Act 1974 to carry out risk assessments in order to ensure, as far as is reasonably practicable, the health and safety of their workforce. Various health and safety bodies such as Health and safety Executive (HSE), National Institute of Occupational Safety and Health (NIOSH), health and safety consultancies and other recognised sources produce a variety of different standard forms of risk assessment aimed at particular issues/tasks to assist employers in performing their legal duties. For example, standard forms of risk assessment are available for manual handling, display screen equipment, work related musculoskeletal disorders, slips, trips and falls etc. These standard risk assessments typically are in a checklist format.

Checklists can provide a quick and effective means of assessing the specific hazards and their attendant risks involved in a given process. They can be used by a range of users and can vary from being stand alone tools (requiring only supportive reading for instruction in their use) to examples where staff may require more formal training. Checklists can also be easily adapted - individual companies often reformat standard checklists to better suit their needs (Neathey et al, 2006; NIOSH 1997). As a result there are a large number of checklist-based risk assessments in use which vary considerably in terms of design, rating systems, means of prioritising risk and the information they provide in terms of taking action, control and feedback. Because there are hundreds of different types of checklist based risk assessment this project focuses on checklists developed to assess work related musculoskeletal disorder risks.

Work related musculoskeletal disorders constitute a large proportion of all reported work related illnesses and in the UK affected over 1 million people in 2005/06. The costs of work related musculoskeletal disorders to the economy and to the individual are high. Estimated costs to UK business in 2005/06 were in excess of £200 million. To assess work related musculoskeletal disorder risks, checklists are the most common type of tool used by companies.

Although the risks for work related musculoskeletal disorder are now well recognised, research has shown that the interventions to prevent or reduce the risks are seldom successfully implemented (Urlings *et al.* 1990, Hendrick 1991, Lawton and Haslam 2000). Similarly, research concerning risk management in general (not restricted to musculoskeletal risk management) has shown that once risk assessments have been completed, and when the risks have been identified, actions required for risk control and risk reduction often fail to be implemented (Neathey 2006, Gadd *et al.* 2003). One of the pitfalls listed in a report by Gadd *et al.* (2003) was the lack of links between hazard identification and risk control. The study noted that risk assessment is often just a paper exercise where the findings are noted but no action is taken as a result.

Critically, there is very little information on whether checklists successfully aid the risk assessment process, going beyond just risk identification to assist in the progression towards appropriate actions being generated and implemented.

This project investigates the obstacles preventing the progression from risk identification (through the use of checklist tools) to implementing risk controls for work related musculoskeletal disorder risks and is driven by the need to understand the link between risk identification and risk control.

1.2 Aims

This project focuses on musculoskeletal risk assessment and aims to:

- Review current working practices in manufacturing industry regarding risk assessment and the implementation of interventions.
- Evaluate a representative sample of checklist-based risk assessments of varying designs.
- Identify design characteristics of risk assessment checklists which are most effective in risk identification and risk control.
- Evaluate whether accompanying training in the use of the selected checklists is beneficial in risk identification and risk control.
- Assess whether benefits from training vary for different designs of checklist and, if so, identify the types of checklists that would most benefit from training.

1.3 Objectives

The specific objectives of this project were as follows:

- Undertake a literature review to establish the current state of knowledge
- Use a questionnaire survey of representative companies within the UK manufacturing base to establish current practices and attitudes to checklist based risk assessment and the application of interventions
- Collect a range of checklist based risk assessments and undertake an expert review to:

a. Determine consistency of the identification of risk between participants and experts.
b. Assess the selection of effective intervention strategies to eliminate or reduce the risks.
c. Assess the implementation of risk reduction interventions.

- To undertake walk though audits of volunteer companies to establish the working practices and their effectiveness in risk management and control.
- Undertake a series of trials using volunteer companies to evaluate design criteria for checklists and the impact of training on the use and implementation of those checklists.
- Undertake extended trials over a suitable time period in order to evaluate the longer term effectiveness of the checklists and accompanying training.

1.4 Project structure

This report presents all the work of this research programme and reports on the following 5 phases.

Phase1. Literature review

In Phase 1 of the project a review of the literature has been conducted and is presented in section 2 of this report. Phase 1 reviews previous research that has been conducted in;

- risk assessment
- checklist design
- the implementation of risk reduction/controls
- the current state of knowledge in the area of checklist-based risk assessment and training.

Phase 2. Survey of current musculoskeletal risk assessment practice

In Phase 2 of the project a survey of 300 manufacturing companies was conducted. The survey probed issues relating to:

- current risk assessment processes
- type of risk assessment employed,
- levels of risk and subsequent interventions
- obstacles to conducting risk assessments
- implementation of interventions.

Companies were also asked to send in copies of their current risk assessment checklists for review. The results from the survey and a summary of key characteristics of the reviewed checklists are presented in Section 4 of this report.

Phase 3. Walk Through audits

Walk through audits were conducted at 15 companies to provide further insight into current working practices in relation to risk assessment of musculoskeletal risks. In addition measures of ‘stage of change’, and knowledge, experience and training in ergonomics and risk assessment were gathered to enable companies to be selected and matched for participation in the further phases of the project. The audits also provided baseline data on the number of high, medium, low risk jobs/tasks, attitudes towards health and safety etc. for ‘before and after’ comparisons to be made in phase 5 of the project. The results from this phase of the project are presented in Section 5 of this report.

Phase 4. Risk assessment trials

In this phase of the project the effectiveness of different checklist design characteristics and accompanying training were explored. Two checklists were developed incorporating the same underlying assessment criteria but with different design elements (ascertained from phases 1 and 2).

The consistency within and between different checklist-based risk assessments with and without training were evaluated in terms of identification of risk and selection of appropriate interventions. Focus groups were also conducted to discuss the perceived positive and negative design aspects of each checklist. The results of the risk assessment trials are presented in Section 9 of this report.

Phase 5. Longitudinal study- Implementation of risk reduction measures

Phase 5 of the project investigates the longer term effectiveness of the two checklist designs and level of training on the identification, implementation and acceptance of interventions to control/reduce risks. This phase also investigates whether training resulted in increased confidence, changes in attitudes to Health and Safety, appropriate interventions or if similar or different obstacles in the implementation of interventions were encountered compared to those reported in phase 3.

This report presents the findings of final two phases (phases 4 and 5) of a five phase research project funded by the Institution of Occupational Safety and Health (IOSH). The project investigates the effect of training on the application and effectiveness of checklist-based risk assessments focusing on checklists designed to assess musculoskeletal risk factors in the workplace. The research is driven by the need to understand the link between risk identification and risk control. It is hypothesised that this link is forged by the quality of the design of checklists and the correct identification, and implementation of appropriate training in their use.

The project investigates the effectiveness of two different designs of risk assessment checklists for assessing musculoskeletal risks (MSDs), and measures their performance with, and without, training for a range of users from within the workplace. The project also investigates the effect of checklist design and training on the longer term outcomes of the identification, implementation and acceptance of interventions to eliminate or reduce the risks of musculoskeletal disorders. The overall structure of the project is outlined in the flow diagram overleaf.

Flow chart illustrating the overall structure of the project.

1.5 Aims

The aims of the five phases of the project were as follows.

Phases 1, 2 and 3

- Establish the state of current knowledge and practice.
- Evaluate a representative sample of checklist based risk assessments of varying designs.
- Review current working practices in industry regarding risk assessment and implementation of interventions.

Phases 4 and 5

- Identify design characteristics of risk assessment checklists which are most effective.
- Evaluate whether the provision of accompanying training in the use of the selected checklists is beneficial.
- Assess whether benefits from training varies for the different designs of checklist and identify the types of checklists that would most benefit from training.

This report presents all phases of the research project. Phases 1, 2 and 3 address the first three aims of the project through a review of current knowledge and an examination of current industry practice. Phase 4 of the project (Risk Assessment Trials) addresses the last three of the aforementioned aims. These phases evaluate, using industry partners, the consistency within and between different checklist-based risk assessments both with, and without, training in terms of identification of risk and selection of appropriate interventions. A series of trials in four different companies were conducted and data collected on the ease of use of the checklists and inter-rater reliability with, and without, training. Phase 5 (The Longitudinal Study) investigates the effect of checklist design and training on the longer term outcomes of the identification, implementation and acceptance of interventions to eliminate or reduce the risks of musculoskeletal disorders in the workplace.

2 Phase 1 - Literature review

A comprehensive literature review was undertaken and covered the following topic areas;

- the risk management process - risk identification to risk reduction
- advantages and disadvantages of checklists
- reliability and validity of checklists
- recommended best practice in checklist design
- generic design characteristics of checklists
- current state of knowledge in the areas of checklist-based risk assessment and training
- evaluation methodologies and effectiveness.

A literature search of the extensive in–house ergonomics databases using Loughborough University's online search facilities was conducted. This included searching the following databases:

- Ergonomics Abstracts
- Compendum
- ArticleFirst (OCLC) Database
- Health and Safety Science Abstracts (CSA Illumina)
- Web of Science
- OHSIS : Occupational Health and Safety Information Service

In all, 90 papers were reviewed. Findings and extracts from the relevant literature are discussed and presented in the following sections.

2.1 Musculoskeletal disorders

Musculoskeletal disorders are disorders which result from repeated exposure to musculoskeletal micro trauma. Repeat trauma results in the gradual wear and tear of the muscles, tendons and ligaments etc., causing degeneration of these structures and often resulting in impaired function.

Repeated episodes of trauma can lead to chronic injury resulting in incapacity and invalidity in individuals.

Work related musculoskeletal disorders occur when there is a mismatch between the physical requirements of the job and the physical capacities of the human body. The main risk factors are force, repetition, duration and awkward posture. In the literature many acronyms are used to describe disorders of the limbs e.g. RSI (Repetitive Strain Injury,), WRULD (Work Related Upper Limb Disorders), WMSD (Work Musculoskeletal Disorders). For the rest of this report work related musculoskeletal disorders will be referred to as MSDs.

Although not uniquely caused by work, MSDs constitute a major proportion of all registered and/or compensated work related diseases. In 2005/6 an estimated 2 million people in the UK suffered from ill health which they thought was work related. Of those it is estimated that 1,020,000 were musculoskeletal disorders and, of those cases, 437,000 mainly affected the back, 374,000 mainly affected the upper limbs or neck and 209,000 the lower limbs. In 2005/6 this resulted in 9,450,000 working days being lost due to musculoskeletal disorders (HSC National Statistics, 2006). Musculoskeletal disorders incur substantial costs to the economy and also to the individual, as not only do they act to injure the workforce, they can also be the precursor to secondary surrogate symptoms such as:

- absenteeism
- work accidents
- compensation costs
- high turnover of staff
- poor working climate
- poor quality of work.

Costs to UK employers in 2005/6 were estimated to be in excess of £200 million.

Given the extent of the problem the Health and Safety Commission has instigated a priority programme for musculoskeletal disorders and has set the following targets to be achieved by 2010: 20% reduction in incidence of work related ill health caused by musculoskeletal disorders, 30% reduction in the number of working days lost due to musculoskeletal disorders. However, although the causes of MSDs are now well understood and recognised, their incidence is still not decreasing; rather injury rates have reached a plateau. Whysall *et al.* (2005) suggests that this indicates that health and safety interventions are failing. Research has been conducted to investigate reasons for the lack of decrease in rates and several studies have identified specific obstacles to addressing MSD risks in the workplace. These obstacles relate to problems in risk assessment and the implementation of appropriate controls. These are discussed in more detail in the next section of this review.

2.2 Risk assessment process

2.2.1 Five steps to risk management

The aim of carrying out a risk assessment is to gain an understanding of the level and significance of workplace risks. The risk assessment should then form the basis for making informed decisions relating to the implementation of appropriate risk control and reduction measures (Gadd *et al.* 2003). To assist employers in conducting risk assessment and risk management in the workplace, the Health and Safety Executive (HSE) produced a guidance leaflet on risk assessment. This was first published in 1994. The purpose of the document was twofold:

1. To encourage businesses in general and in particular small and medium sized enterprises (SMEs) to conduct risk assessments.
2. To demonstrate that risk assessment was a straight forward process that employers could undertake themselves without needing to purchase outside assistance.

HSEs leaflet prescribes five simple steps to risk assessment (Table). It takes the reader through the stages of risk identification to risk control, monitoring and review. The five steps clearly states that one should prioritise and tackle the most important things (high risk) tasks first.

HSE also provides more prescriptive guidance and risk assessment forms for specific work tasks, workplaces and/or specific risks i.e. manual handling, repetitive work, dealing with hazardous chemicals etc. However in all these case the ‘five steps’ to risk assessment is still applicable and forms the basis of any risk assessment process conducted in any workplace for any task.

Table 2.1. HSE’s five steps to risk assessment.

STEP 1: Identify hazards
STEP 2: Decide who might be harmed and how
STEP 3: Evaluate the risks and decide on precautions
STEP 4: Record your findings and implement them
STEP 5: Review your assessment and implement

2.2.2 Risk management of musculoskeletal disorders

There are general duties on employers under the Health and Safety at Work act 1974 and the Management of Health and Safety at Work Regulations 1999 which require the risk of MSDs to be addressed. However, other than the draft standard prEN1005 on the biomechanics of manual handling, there is no European standard which primarily covers assessing or preventing musculoskeletal disorders. Over the past 10 years agencies in the USA have been trying to establish a standard for ergonomics (Draft Ergonomic Standard Z365) to tackle musculoskeletal disorders, however this is still in draft form and is still undergoing public debate. To fill this gap the HSE in the UK has produced extensive guidance on the management of musculoskeletal disorders in the form of HSG60 Upper Limb Disorders (ULDs) in The Workplace. HSG60 puts forward a 7 stage approach to management of MSD risks which incorporates the five steps to risk assessment but is more prescriptive for tackling MSDs specifically (Table).

Table 2.2. HSG60 Seven stages to risk management of upper limb disorders.

Stage 1: Understand the issues and commit to action
Stage 2: Create the right organisational environment
Stage 3: Assess the risk of ULDs in your workplace
Stage 4: Reduce the risks of ULDs
Stage 5: Educate and inform your workforce
Stage 6: Manage any episodes of ULDs
Stage 7: Carry out regular checks on programme effectiveness

Similar guidance on the management of musculoskeletal disorders has been produced in other countries (for example, America (OHSA, WAC, NIOSH), Australia (NOHSC:2013(1994))). All of these publications incorporate an over-arching management approach based on a participatory model and incorporate the five steps to risk assessment. To assist in steps 1, 3 and 4 of the five steps, all of these guidance documents contain a checklist for assessing the risks of MSDs.

2.2.3 Obstacles to risk management

Neathey et al (2006) conducted a study to evaluate the effectiveness of the five steps to risk assessment leaflet and the risk assessment process in general. A total of 1002 companies were surveyed and 30, more detailed, case studies were conducted. The report highlights areas where the approach failed. These were mainly: Step 1 (Identify hazards), Step 3 (Evaluate the risks and decide on precautions) and Step 4 (Record your findings and implement them). Failures in these steps to risk management related to resources, support from management and workers, training and problems in linking between risk identification and implementing controls.

A growing body of research also demonstrates that risk management of musculoskeletal disorders also encounters similar obstacles.

Research shows that despite the recognition and identification of the risks present and the potential utility of ergonomics for companies and employees, guidance and recommendations are rarely implemented to reduce the risks (Liker et al. 1984, Urlings et al. 1990, Hendrick 1991, Alexanders and Orr 1999, Lawton and Haslam 2000, Whysall et al. 2005). Obstacles reported in the literature centre round the following themes; training, communication, worker participation, support from management and workers, and problems in linking risk identification to implementing controls. Table 2.3 presents a summary of the failings of general risk management and risk management of MSDs reported in the literature. The identified failings are grouped under the following themes; resources, support, training, communication in the workplace, worker participation, problems progressing through all five stages.

Table 2.3. Obstacles to general risk management and risk management of MSDs.

Obstacles to general risk management	Obstacles to risk management of MSDs
Resources	
• Large and medium sized establishments were more likely than smaller establishments to have a thorough risk assessment strategy (Neathey *et al.* 2006). • Time needed (Neathey *et al.* 2006 and McNally 2006).	• Perceived cost benefit: successfully reducing or eliminating MSD risk creates ‘non events’ that make it difficult to calculate and present cost benefits. (Liker *et al.* 1984 and Imada 1990) • Small/medium sized companies are less likely to perceive interventions as providing benefits than large organisations (Whysall *et al.* 2005) • Insufficient resources (i.e. money and time) available to conduct MSD risk assessment and any required changes (Neathey *et al.* 2006)
Support	
• Gaining senior management and staff support for the approach was often difficult (Neathey *et al.* 2006).	• Gaining senior management and staff support for the approach was often difficult (Neathey *et al.* 2006).
Communication in their workplace	
	• Management and staff having different perceptions of the risks and safe working behaviour (Prussia 2003). • Poor interdepartmental communication i.e. health and safety staff and engineers/managers (Liker *et al.* 1984 and Imada 1990).

Table 2.3. Obstacles to general risk management and risk management of MSDs (continued).

Obstacles to general risk management	Obstacles to risk management of MSDs
Training	
• Getting staff to understand the risk assessment process, and its importance, was seen as a particular challenge (Neathey *et al.* 2006). • Staff confidence in conducting risk assessment was recognised as a particular concern (Neathey *et al.* 2006). • Ensuring consistency across different sites (Neathey *et al.* 2006).	• Management and staff having different perceptions of the risks and safe working behaviour (Prussia 2003) • Insufficient training/education of the workforce in risk identification of MSDs (Hignett 2005, Catherine 1998) • Insufficient training/education of the workforce in MSD issues (Symptoms, severity, costs, effect of production, workstation design, working practices) across the workforce (Hignett 2005, Catherine 1998). • A survey of 609 safety representative in 2006 found that 75% felt that they could usefully contribute to a general health and safety risk assessment where as only 40% felt that they could usefully contribute to an MSD risk assessment (McNally 2006). • Safety representatives in companies with more than 1000 employees were better trained in assessing MSD risks than Safety representatives that worked in companies with less 1000 employees (McNally 2006).

Table 2.3. Obstacles to general risk management and risk management of MSDs (continued).

Obstacles to general risk management	Obstacles to risk management of MSDs
Worker participation	
	• Not involving the workforce in the risk assessment and risk control process (Hignett 2005). • Workforce reluctance to accept change in working practices (Liker *et al.* 1984 and Imada 1990). • Large organisations experience more resistance to change from the workforce than medium or small companies (Whysall *et al*. 2005) • In cases where workers are involved and participate in risk identification and solutions they may not have enough knowledge or employees do not have enough influence to change their work situation (Vink *et al.* 2006)
Problems progressing through all five stages	
• Some companies saw risk assessment as only identifying risks (Gadd *et al.* 2003). • Lack of linkage between hazard identification and risk control (Gadd *et al.* 2003). • Tendency to conduct risk assessments as an occasional or one off rather than an ongoing activity (Neathey *et al.* 2006). • Making appropriate adjustments (Neathey *et al.* 2006). • Maintaining compliance (Neathey *et al*. 2006).	• Problems linking risk identification to risk controls (Lawton and Haslam 2000, McNally 2006). • Workforce reluctance to accept change in working practices (Liker *et al.* 1984 and Imada 1990). • Workers may not understand why the improvement is preferable (Vink *et al.* 2006).

2.3 Checklist based risk assessments for assessing MSD risks

There are many methods available to assess risk of MSDs grouped into direct methods and indirect methods. Direct methods of analysis can be gained through the use of biomechanical or mathematical models, video analysis, electromyography, or devices such as lumbar motion monitors or goniometers. Indirect methods focus on the collection of task variables which may give rise to mechanical exposure within the body. Simple analysis using indirect methods are fast and easy to conduct and are used by a large number of people/companies for assessing MSD risks. They do not provide the same level of information as direct methods, however they do provide a sufficient level of information for most companies to identify risks (Brodie and Wells 1997). Malchaire and Cock (1999) (Cited in Graves *et al.* 2002) highlight the differences in user needs of the experts verses the practitioner (or health and safety representative). They state that “for those at company level the priority is to collect information in order to improve working conditions rather than scientifically quantify risks.” Consequently, many observational and indirect tools have been developed to assist in the identification of MSD risk factors in the workplace, the most proliferate form being the checklist (Brodie and Wells 1997, Graves *et al.* 2002, Li and Buckle 1999).

Typically checklists are used as a screening tool to identify tasks where risks are present though they may also assist in identifying control interventions to reduce the risks. Checklists can also be used to identify when a more detailed assessment is required i.e. when control interventions cannot be readily identified from the initial screening (Z365, HSG60, WAC). Checklists are quick to complete, provide a systematic means of recording risk information, assist in formalising a plan of action and they can help guide companies to comply with health and safety legislation. Neathey et al (2006) states that in an attempt to overcome some of the obstacles to risk management such as linking risk identification to risk control and confidence in conducting risk assessment (discussed earlier in section 2.2.3) a checklist approach should be encouraged.

Neathey states that “HSE has developed an interaction tool designed to take managers through the process of conducting risk assessment in an office environment via a checklist”. Neathey suggests that “similar guidance on other work environments, made available online and in simple hard copy (e.g. in the form of checklists that could cover the majority of common risks in any specific working environment) would seem likely to meet the needs of many employers wanting additional support.”

The Occupational Safety and Health Administration (OSHA) also recognise the benefits of encouraging the use of checklists in risk assessment. OSHA states that “well designed checklists when used in the context for which they are intended, do provided a range of employers , especially small businesses, with an effective alternative to hiring a consultant.” The Occupational Safety and Health Administration (OSHA 2000) are currently proposing an ergonomics program standard to address the significant risks of MSDs. As part of this process OSHA has requested information on the usefulness of checklists to help small businesses conduct job hazard analyses. Specifically, asking whether OSHA should require that employers, or small employers, use checklists and whether OSHA should provide checklists as compliance materials at the time of the final rule of the OHSA ergonomics standard. In the U.K the Health and Safety Executive (HSE) already provides a checklist to assist employers in assessing MSD risks. This is provided in the appendix to HSG 60 guidance on managing upper limb disorders. NIOSH and Washington State Ergonomics Rule (WAC) also provide a checklist to assist in the risk management of MSDs.

2.3.1 Advantages and disadvantages of checklists

Advantages and disadvantages of observational techniques that apply to checklists (in general - not specifically to MSDs) are presented in Table 2. and Table 2.5. The main advantages reported in the literature are;

- efficiency
- ease of use
- form a framework to ensure risk assessments are systematic

- low resources required in their use
- provide a means of maintaining consistency in risk assessment
- may increase confidence of the user in conducting a risk assessment thoroughly through the use of prompts to ensure that all risk factors are accounted for.

A summary of the advantages reported in the literature are presented in Table 2..

Table 2.4. Advantages of checklists

ADVANTAGES
Efficient and unobtrusive
• They are simple to undertake and provide a quick answer (Li and Buckle 1999). • Postural assessments can be made in a confined workplace without disruption to the workforce (Li and Buckle 1999). • A simple checklist is easy and fast to administer (OSHA 2000).
Good at classifying particular postures / motions
• They are most useful for jobs where body postures are held for longer periods of time, or the body movement follows a simple pattern that is repeated during work (Li and Buckle 1999). • Effective in analysing larger joints (shoulder and back) and variables that have quantitative measures i.e. mass, force (Brodie and Wells 1997).
Reliability / consistency
• They provide prompts for both expert and non expert on which factors to observe (Quirk *et al.* 2004).
Provide a written record
• If employers have more than 5 employees the results of a risk assessment must be written down. Checklists help employers know that they did a proper check. Checklist offer an efficient way to achieve this, completing the checklist generates a written record (Neathey *et al*. 2006).
Requires little resources
• They are relatively inexpensive to carry out (Li and Buckle 1999). • A simple checklist has advantages: it can be administered by a person with limited training and provide an effective alternative to hiring a consultant (OSHA 2000).

The disadvantages of checklists reported in the literature include; difficulties in classifying small and fast motions and angles of the smaller joints (such as the wrists) and intra-observer and inter-observer variability of results generated by checklists. However, studies have indicated that inter-observer variability can be reduced by training and by improvements in checklist design (Li and Buckle 1999, Lee and Ferriera 2003). These aspects are discussed in more detail in section 2.4.1 and are also investigated in Phases 4 and 5 of this study.

Although on a scientific level checklists appear to have limitations in quantifying the risks, this has not inhibited their development and use because users want to have tools that are quick, clear and user friendly (Graves *et al.* 2002).

Table 2.5. Disadvantages of checklists

DISADVANTAGES
Difficulties in classifying particular motions
• The observation methods lack precision, are less reproducible in dynamic work situations (Burdoff *et al.* 1992). • Can be poor in analysing movements that are hard to define i.e. twisting, rapid rotation, posture of smaller joints (wrist and elbows) were poorly analysed (Brodie and Wells 1997). • Postures quantified in degrees are difficult to measure (Li and Buckle, 1999). • Problems in classifying (due to inability to measure joint angles) and in estimating the duration of non-neutral postures (Keyserling *et al.* 1992). • People have difficulties assessing small movements of small joints (Quirk *et al.* 2004). • Difficulties in assessment of fast moving small body parts such as the wrist (Neumann *et al.* 1998).

Table 2.5. Disadvantages of checklists (continued)

Intra-observer and inter-observer variability
• Subject to intra and inter observer variability (Burdoff *et al.* 1992). • Open to subjective judgement (Chen *et al*. 1989). • Users often do not have adequate scientific knowledge to carry out detailed task analysis nor do they have the facilities or time to carry out the analysis (Li and Buckle 1999).
Training
• Training is often needed for using an assessment method – but as quality of training may vary then so does the assessment result (Li and Buckle 1999). • Users often do not have adequate scientific knowledge to carry out detailed task analysis (Li and Buckle 1999).
Resources
• Time issues (Li and Buckle 1999). • Too much detailed paper work (Li and Buckle 1999). • Users often do not have adequate facilities or time to carry out the analysis (Li and Buckle 1999).
Observation techniques
• The optimum number of observations for low and high repetitive tasks is still unclear (Genaidy *et al.* 1993).
Simplicity
• A simple checklist might omit questions that are important for a particular job. Some checklists are not designed to capture complex situations. Might be under inclusive, might erroneously exclude a hazardous job or may treat it as no more hazardous than another job. However making a checklist more thorough and accurate would make it harder to use and more costly and complex (OSHA 2000). • Overly simplistic checklists can be open to interpretation by users and may limit the scope of the assessment (Kenningham 1998).

2.3.2 Reliability and validity of checklist based risk assessments

The reliability of a checklist concerns the degree to which the checklist can be repeated and gain the same result.

There are two sorts of reliability; inter-observer reliability which concerns whether a similar result can be obtained by different observers when assessing the same event and intra-observer reliability which concerns the reliability of gaining a similar result when an assessment is made by the same observer but on repeated observations with a time interval. To ascertain inter-observer and intra-observer reliability the results from pairs of assessments are compared, typically through using the kappa statistic or correlations and analysis of variance (ANOVAs).

The validity of a checklist is defined as the extent to which a measuring instrument measures what it is intended to measure. In the case of validating checklists for musculoskeletal risks, previous studies have ascertained their validity by comparing checklist results to results gained from an existing and previously validated assessment method, actual reports of discomfort, MSD cases or direct measures such as detailed postural analysis using video, electromyography, goniometry, etc.

Ten studies of relevance were found that investigated the reliability and validity of different checklist. The reviewed studies date from 1992 to 2005. Eight of those studies included an investigation of the inter-observer reliability (comparing results from different observers assessing the same event) and of those, one looked at the effect of training (Lee and Ferriera 2003) and five studies looked at the effect of experience (expert verse non experts) (Winnemuller *et al.* 2004, Li and Buckle 1999, Lee and Ferriera 2003, Quirk *et al.* 2004, Keyserling 1992). Three studies included an investigation of the intra-observer reliability (comparing results from the same observer but on repeated observations) (Winnemuller *et al.* 2004, Li and Buckle 1999, Neumann *et al.* 1998). Three studies investigated the validity of particular checklists (Li and Buckle 1999, Brodie and Wells 1997, Kemmlert 1995). The methods and conclusions from each of the reviewed studies are briefly summarised in Table.

Overall findings from the studies suggest that, of the checklists investigated;

- Checklists were poor in analysing movements that were hard to define i.e. twisting, rapid rotation, posture of smaller joints (wrist and elbows).

  Checklists investigated: RULA, OSHA draft checklist and Keyserling checklist, MORF.

- There were difficulties in using the tool in some situations i.e. dynamic tasks, rapid but non repetitive actions.

  Checklists investigated: Quick Exposure Check (QEC).

- When expert and non-experts were provided with the same accompanying training / briefing session in the use of the checklist, results gained from expert and non expert did not differ significantly.

  Checklists investigated: Quick Exposure Check (QEC), Manual handling Assessment Charts (MAC), Keyserling checklist, Manual handling code developed in 2000 contains a risk assessment worksheet called RAW.

- Training had a significant effect and improved inter-observer reliability.

  Checklists investigated: Manual handling Assessment Charts (MAC).

The last finding is supported by Kemmlert (1997) (Cited in Li and Buckle 1999) who states “To be honest, reliability and validity tests (of an exposure tool) are actually testing the educational level of the observers”. Li and Buckle further expand on this and state that the format of the tool itself as well as the training materials that come with the tool will affect the quality of the assessment.

Table 2.6. Summary of the methods and conclusions from each of the reviewed studies

Studies	Statistical analysis	Key findings
Keyserling (1992) Developed a checklist and compared the results gained from shop floor workers (with one week's training in the use of the checklist and general ergonomics principles) to 'expert' results. Subjects assessed tasks in the workplace. Expert results were generated from computer aided video postural analysis.	Correlation	Keyserling points out a flaw in the study - The direct comparisons were prone to measurement error as the task analysed by shop floor workers and the experts differed in the operators observed conducting the tasks. Therefore the results from the assessments by experts and shop floor workers may have varied due to differences in the anthropometry and individual work methods of the operator observed. Keyserling states that this may have contributed to poor correlation between expert and shop floor workers results. However results from the checklist were generally in agreement with the expert's results. Keyserling concludes that the checklist was found to be an effective rapid screening tool. The study illustrate the potential of checklists to provide useful output if reliability is improved.
Kemmlert (1995) assessed the validity of PLIBEL checklist by comparing its results to results gained from the German ergonomics job analysis procedure (AET). 24 subjects with "considerable" ergonomics knowledge performed the PLIBEL on four videoed tasks.	Percentage agreement. Kappa.	When comparing the result of PLIBEL and AET the agreement between matching items was considerable. However the modifications of AET scores for a dichotomous coding (yes/no) could not completely eliminate the differences between the methods. PLIBEL was more sensitive to ergonomic hazards. The inter-observer reliability yielded kappa values expressing fair to moderate agreement.
Brodie and Wells (1997) conducted a study testing the validity of 3 previously developed checklists: RULA, OSHA draft risk factor checklist and The posture and upper extremity checklist developed by Keyserling *at al.* (1992 and 1993). Checklist outputs were compared to MSD injury data, self reported pain discomfort, ranking by supervisors regarding job turnover and detailed video postural analysis. To allow comparison of the different checklists, results were converted using a 3 point scale to represent risk of each task. Subjects were trained for 20 minutes in the use of checklist and analysed the same tasks via video.	ANOVA Correlation	They found that the checklists were reliably valid in analysing larger joints (shoulder and back) and for variables that have quantitative measures i.e. mass, force. But reliability was poor in analysing movements that were hard to define i.e. twisting, rapid rotation, posture of smaller joints (wrist and elbows) were poorly analysed. They conclude that caution should be used before checklists are adopted as a component of an ergonomics program.
Neumann *et al.* (1998) The study investigated the inter-reliability of a checklist modified from the one proposed by OSHA called MORF (Manufacturing Operations Risk Factor). Seven workers from a foam manufacturing plant were trained for 7-10 hours in the use of the checklist and then each observed 8 jobs in the workplace.	ANOVA Intra-class Correlation coefficient	ICC intra-class correlation provides an index similar to the kappa statistic. It was found to be poor for the upper limb, moderate for the torso and lower limb and good for the assessment of manual material handling. Observations of the smaller fast moving body segments such arm and wrists were particularly unreliable.

Table 2.6. Summary of the methods and conclusions from each of the reviewed studies (continued)

Studies	Statistical analysis	Key findings
Li and Buckle (1999) conducted inter-observer reliability, sensitivity, and measurement validity of the Quick Exposure Check (QEC) by comparing results between different users and within users to results gained from simulated 3D analysis system. Assessments were made of videoed tasks and also of tasks observed in the field (workplace).	Kappa Percentage agreement	In the laboratory trials intra-observer gained kappa values indicating 'fair agreement' for most of the checklist items. For the shoulder/arm posture this increased to 'moderate agreement'. Percentage agreements supported the kappa results. The inter-observer reliability in laboratory trials resulted in 'moderate agreement'. When the QEC exposure tool was applied to tasks conducted in the field, agreement between practitioners (inter-observer reliability) was between 76% and 91% for most of the items, an acceptable level of accuracy. The assessment tool was relatively low for some items particularly back posture (54.2%), shoulder/arm movement (76.5%) and neck posture (76.3%). Suggesting that there were difficulties in using the tool in some situations i.e. dynamic tasks or rapid but non repetitive actions. Li and Buckle conclude that the study suggests that the intra-observer reliability of the exposure tool is high. It also suggests that people with or without previous experience in making exposure assessment are able to reach an assessment agreement at more or less similar level. Also stated that training could improve reliability and validity of the tool.
Burt and Punnett 1999 The study investigated the inter-observer reliability of a quantitative observational method of assessing non-neutral postures. Two observers independently evaluated 70 jobs using a procedure that included observations of 18 postures of the upper extremities and back. Data recording sheets recorded 18 different posture involving the hands, arms, shoulders and back.	Percent agreement, kappa, intra class correlation coefficients and generalised linear mixed modelling.	Findings from this study suggest that inter-observer reliability of postural observations can be optimised when: operational definitions are simple and unambiguous, longer and multiple training sessions precede data collection, level of detail is limited, real time observations are limited to jobs that do not involve rapid dynamic movements. The study also concludes that percentage agreement is an inadequate measure, because it does not account for chance and can lead to inflated measures of reliability. The study stated that assessing real jobs in real time may have reduced inter-observer reliability, as variation in the assessment may have resulted from the assessor observing workers at different times of the day and/or different workers.

Table 2.6. Summary of the methods and conclusions from each of the reviewed studies (continued)

Studies	Statistical analysis	Key findings
Lee and Ferriera (2003) conducted a study to evaluate the usability and reliability of the Manual handling Assessment Charts (MAC) when used by non-regulatory professional with and without a training briefing. Non-regulatory Persons were subjects who had some level of responsibility for assessing manual handling tasks. The study also compared subject's results to expert results. Subjects assessed a range of tasks from video recordings.	Kendalls Coefficent of concordance. Mann-Whitney U test.	The study found that the non-briefed subjects had significantly lower scores than briefed and expert groups. Briefed and expert groups gained similar results (no significant difference).
Quirk *et al*. 2004 A manual handling code developed in 2000 contains a risk assessment worksheet called RAW. The study investigated its use by expert and non expert when assessing a range of tasks from video recordings.	T-test of means of correct answers.	The study found a high overall usability of the RAW and found no significant difference between experts and non-experts.
Winnemuller *et al.* (**2004) i**nvestigated the ability of supervisors and workers to accurately assess MSD risk factors using a 14 item checklist. Inter-observer reliability was investigated between the experts (n=2), supervisors (n=37) and workers (n=55). Intra-observer reliability was also investigated with an interval of several weeks between repeated assessments.	Kappa Percentage agreement	Inter-observer reliability was calculated using percentage agreements. Agreement of worker to experts was 71% of the time and agreement of supervisor to experts was 81%. Overall, supervisors and workers over estimated presence of risk factors. Intra-observer reliability was assessed using the kappa statistic and found that items were good to excellent reproducibility. The study concludes that supervisors and workers to assess MSD risk in initial ergonomics assessment appear promising.
Park *et al.* (2005) investigated inter-observer reliability of four experts using same checklist (PATH method).	Kappa Percentage agreement	Agreement among observers was higher for jobs with less rapid hand activity and for the analysts with more ergonomics and job analysis experience.

2.3.3 Recommended best practice in checklist design

There are no standards specific to the design of checklists used for conducting risk assessment. However there have been a number of studies conducted investigating different designs of checklists used for assessing MSD risks. These studies have produced qualitative data on the effectiveness and usefulness of different design features of checklists. These findings are presented in Table which groups the study findings under the design characteristics of format, wording, link to interventions, rating system, illustrations and unobtrusiveness.

Table 2.7. Recommended best practice in checklist design.

Design characteristics
Format
Readily coded for computer storage and analysis (Colombini *et al.* 1985 (Cited in Li and Buckle 1999)).
Cheap and easy to use (Corlett 1990 (Cited in Li and Buckle 1999)).
Wording
Improve wording of questions (Brodie and Wells 1997)
The use of descriptive terms rather than angles should be used. I.e. almost neutral, moderately flexed or twisted, excessively flexed or twisted. However these terms need to defined somewhere as regions i.e. 0-20 degrees etc…and frequency definitions (Li and Buckle 1999).
Utilise site specific example (Brodie and wells 1997)
Use landmark descriptions - Estimating degrees of deviations from neutral is more difficult than using landmarks, such as hands are below the hips or hands are above the shoulders (Burt and Punnett 1999)
Link to Interventions
A checklist should also provide suggestions for redesign (Gude *et al.* 1998).
Subjects preferred the placement of guidelines immediately adjacent to the checklist (Kenningham 1998).
Subjects preferred the use of a ‘hints for risk control’ section on each page of the guidelines throughout the OLGAs checklist (Kenningham 1998).
Subjects preferred to progressively record risk control ideas as they came to mind during the RA process, therefore notes space should be provided next to each item (Kenningham 1998).

Table 2.7. Recommended best practice in checklist design (continued).

Rating system
Ranking system using intuitive system should be sued. Such as green, yellow, and red or 1, 2 and 3 (Keyserling *et al.* 1992).
Colour coding is effective in demonstrating the risk to the proprietor (Care *et al.* 2002).
Develop decision criteria (Brodie and wells 1997).
It is advantageous to provide some numerical guidance values for users. Firstly they provide an indication to employers about aspects of tasks that potentially pose a higher risk and secondly assist in prioritising actions to control the risks identified. (Graves *et al.* 2004).
Scoring systems should be developed to help establish priorities for the workplace interventions (David 2005).
Traffic light system should be used for rating (Kenningham 1998).
Although exposure-response relationships are difficult to ascertain, the current knowledge base does allow us to identify workers at high risk of MSDs, therefore rating systems can be adopted (Li and Buckle 1999).
Scoring systems help establish priorities for the workplace interventions – the current scoring systems are popular with practitioners and managers as they assist communication and decision making (David 2005).
Illustration/diagrams
Items in a checklist should be illustrated especially by pictures (Gude *et al.* 1998).
Pictures should be included as they can enable an assessor to show an operative a range of postures and ask them to pick out the particular lifting technique that they use (Care *et al.* 2002).
Addition of graphic representations to the questions or demonstration of motions and postures could improve design (Spielholz *et al*. 1999).
Unobtrusive
The recording equipment should not interfere with the movements being recorded (Wilson 1990).

2.3.4 Common checklist design features

A search of the web was conducted using the word ‘checklist’. Results were selected at random to produce a sample of different checklists from all fields (i.e. not restricted to MSDs). These checklists were then reviewed and a list of checklist design features constructed. These elements have been used to construct checklists for use in Phase 4 of the study (risk assessment trials). Table 2.8 presents a list of features. A tick is placed against characteristics that previous studies have demonstrated to be effective (cross referenced to section 2.3.3).

Table 2.8. Design features of checklists.

Design feature / characteristic	Previous studies indicate effective
Who conducts the assessment	
Background information	
Asks whether injuries or problems reported	
Records if a body part discomfort questionnaire has been completed and the results.	
Number of tasks observed in making the assessment	
Number of employees conducting this type of task	
Records other task employees are likely to perform in addition to this task	
Records total duration conducting task (without break)	
Records length of breaks	
Comes with additional information or guidance pages/ booklet	
Provides definition of terms in additional booklet/pages	

Table 2.8. Design features of checklists (continued).

Format	
Flow diagram format	
List format	
Multiple choice responses	
Dichotomous	
Phrasing / presentation of check items	
Uses numerical figures to describe joint angles	
Uses words to describe joint angles	☑
Uses numerical figures to describe repetition and/or frequency rates	
Uses words to describe repetition and/or frequency rates	☑
Uses numerical figures to describe weights/force	☑
Uses words to describe weight/force	☑
Uses numerical figures to describe duration	
Uses words to describe duration	
Provides definitions of terms on the checklist	
Visual aids	
Illustrations of angles	☑
Illustrations of postures	☑
Illustrations of motions	☑
Provides space or requests for photo of risk action/tools/workstation	
Recording risk details	
Space for notes of reported problems	
Space for notes on risks/probable cause	☑

Table 2.8. Design features of checklists (continued).

Ratings	
Means of rating risk of individual items	☑
Colour coding	
Symbol coding	
Numerical	
Words : i.e. Low, Medium, High Good, Satisfactory, Poor, Unacceptable	
Gives an overall score	☑
Means of prioritising tasks for action	☑
Yes	
Yes but requires reference to other materials	
Controls/interventions per check item	
Asks whether action is required	
Space for notes on potential actions	☑
Provides hints/suggestions for redesign/ control interventions to reduce the risks	
Controls/interventions for the task (as a whole)	
Asks whether action is required	
Space for notes on potential actions	
Provides hints/suggestions for redesign/control interventions to reduce the risks	
Action plan	
Space for notes on action to be implemented	
Provides space or table to plan actions i.e. what required, by whom and date	
Enables recording of whether action implemented	
Date for next assessment	

2.3.5 Paper based MSD checklists

There are hundreds of checklists. This section presents only a small selection of checklists and is limited to those developed to assess MSDs. The selected checklists demonstrate the variations in design and approaches and processes encompassed. This section gives a brief description of the tools, their design characteristics, whom they are aimed at, and what level of experience or training is required. At the end of the section, Table shows the design characteristics used in a range of checklists and enables a quick comparison to be made of the different checklists and their features.

HSG60 Upper limb disorders (ULDs) in the workplace checklist

Description: HSG60 provides a method for identifying and assessing risk in the form of two checklists. One is a filter for conducting an initial screening of work tasks. If the initial screening tool has identified potential risk tasks the guidance states that a more detailed risk assessment should be conducted. The guidance provides a series of checklist worksheets to conduct this more detailed assessment. It is this checklist which we discuss here.

The checklist is presented in landscape over seven pages of A3 paper. The first page asks for preliminary information about the task which includes: frequency, other tasks undertaken by workers that may pose risk of MSDs, how long the task is typically performed without breaks etc.

The checklists is split into six columns, the check item (with or without definition/illustration), response column (to be completed by the assessor), description of the problem or probable cause (to be completed by the assessor), column for noting control options (to be completed by the assessor), a column titled ‘Control options’ (the column presents a list of hints of possible controls and provides reference to specific sections in the accompanying guidance).

The checklist consists of 50 items, which are grouped in terms of risk factors i.e. repetition, posture, force, etc., Response to each item is dichotomous (i.e. yes, no). The assessor progresses through all the check items and makes notes in corresponding columns.

At the end of the checklist there is a table outlining the construction of an action plan to aid in implementing the control interventions identified through conducting the checklist. The action plan has columns to be completed by the assessor. The heading for these columns are; ‘Controls to be implemented’, ‘Priority’, ‘Who is responsible for implementing controls’, ‘Target implementation date’ and ‘Date of re-evaluation’.

To calculate priority for action the checklist instructions state that assessors should add up the number of yes ticks, tasks with a higher number of ticks indicating a higher priority for control interventions.

Who should complete it? It does not say specifically. However in a paper explaining the development of the tool (Graves et al 2002) it is stated that HSG60 checklist is targeted at non-specialists who are unlikely to have expert or trained help (Graves et al 2002).

What level of training/experience does it specify: The risk filter and risk assessment checklist do not require specific training. The guidance states that before undertaking the assessment the assessor should read the chapter entitled 'Assess the risk of ULDs in your workplace'. This is an 11 page document.

PLIBEL

Description: PLIBEL is a method for the identification of musculoskeletal stress factors which may have injurious effects. It is designed to be used as a screening tool. It is conducted when an injury has been reported and is aimed at ascertaining the cause in terms of the physical work actions. It is presented in landscape format on an A4 page and consists of 17 questions which are asked for various parts of the body depending on which area has been injured. It is a self-explanatory subjective assessment method, registering only on a dichotomous level. It does specify, however, that a solid ergonomics understanding is required.

Who should complete it? Knowledgeable and experienced observers.

What level of training/experience does it specify: A handbook is provided which presents the scientific background for each item and also provides information to help the assessor identify the cut off points for 'yes' and 'no' answers. However in a study investigating the reliability of the checklist (Kemmlert 1995) one week of training was provided which included training in the use of the checklist and general ergonomics principles.

Washington State Ergonomics Rule (WAC)

Description: The checklist is used to assess jobs that have already been identified as a ‘caution zone job’ from applying the screening criteria provided in WAC documentation (page 3 of the WAC document). When a job has been identified as a ‘caution zone job’ the employer must analyse the jobs to identify MSD hazards. A MSD hazard is classed as a physical risk factor when it exceeds the criteria provided in the WAC checklist. The main checklist comprises four sub-checklists presented in portrait layout on A4 paper. The four checklist components refer to:

1. awkward posture (7 check items)
2. high hand force (6 check items)
3. highly repetitive motion (4 check items)
4. repeated impact (2 check items).

All the checklists are identical in format. Each checklist is the form of a table with 4 columns entitled ‘Body part’, ‘Physical risk factor’, ‘Combined with’, and ‘Duration’. Some items are illustrated. Illustrations show different postures with angles of motion to help define the check item.

What level of training/experience does it specify: The WAC document only states the level of training required for those workers supervising or working in a caution zone job. It does not state outright the training requirements for conducting the checklist assessment.

However, training of individuals supervising or working in caution zone jobs includes: providing information on MSDs and all the risk factors include in WAC, the types and symptoms, information on identifying MSD hazards and common measures to reduce them.

NIOSH

Description: Comprises two checklists, in portrait format on A4 paper. The first checklist 'General ergonomics risk analysis checklist' consists of 56 items which are grouped under headings; 'Manual handling', 'Computer', 'Physical demands', 'Other musculoskeletal demands', 'Environment', 'General workplace', 'Tools', 'Gloves' and 'Administration'. This first checklist acts as a filter and directs the assessor to one or more of five other more in-depth and task specific checklists. These are:

- Workstations layout.
- Task analysis.
- Hand tool analysis.
- Material handling.
- Computer workstation.

The accompanying guidance states that one or more checklists or items within several checklists can be used or combined to compose a form that is most appropriate for the particular work situation.

Each of the five checklists consists of dichotomous response (yes/no), where 'no' indicates a potential problem area deserving more investigation. In another section in the accompanying guidance 'Evaluating job risk factors' each risk factor is explained and provides references to relevant standards and information to help the assessor identify potential controls to reduce the risk. There is no direct link between the checklists and the section 'Evaluating job risk factors'. Prioritising tasks is calculated using a table that is provided in the guidance documentation

Who should complete it? NIOSH does not specifically state who should conduct the checklist but is does say " When checklist data are gathered by persons familiar with the job, task, or process involved, the quality of the data is generally better".

What level of training/experience does it specify: NIOSH document does not specifically say what level of training is required to complete the checklist, although it does state that employee training compliments efforts to address workplace safety and health problems, including those focusing on ergonomics hazards and related concerns. Ergonomics training may take different forms for various categories of employee. It can range from awareness training for all employees, especially those in a suspected problem job to more intensive training for those expected to undertake job analyses and problem solving.

Quick Exposure Check (QEC)

Description: The Quick Exposure Check comprises two check sheets; one that is to be completed by the assessor, the other is completed by the operator/worker. The checklist, completed by the assessor, consists of eight check items which are grouped by body part; Back, Shoulder/arm, Wrist/hand, and Neck. Definitions for some items are provided and responses are multiple choice. The check sheet completed by the operator/worker is a multiple choice questionnaire that consists of seven questions. Results from both check sheets are transposed onto a third sheet -'the scoring sheet'. The scoring sheet comprises matrices for each check item. The matrices enable the assessor to cross reference the assessor's results with the worker's to gain a single score. The scores from all the matrices for a particular body region are then summed, to give a total indicative risk score for that body region.

The QEC is designed to be used to assess the effects before and after an intervention has been implemented, to monitor and ensure that a reduction in risk has been achieved.

Accompanying the checklists is a three page A4 guidance sheet which provides more detail of each check item, giving clear definitions of each check item and, where appropriate, diagrams i.e. it provides specific angles and diagrams illustrating the postures and range of motion and also explanations of particular terms such as deviated, neutral etc.

Who should complete it? The tool was developed so that it could be used by ‘naïve’ or ‘inexperienced’ users (i.e. users who have little or no knowledge in ergonomics and who are inexperienced in making exposure assessment in the workplace).

What level of training/experience does it specify: A short (three pages) and simple training package is attached to the tool which explains the meaning of terms and assessment items.

Posture checklist - Ergonomic risk factor checklist for awkward posture of the legs, trunk and neck.

Description: This is a one, A4 page, checklist used for evaluating ergonomics risk factors associated with awkward postures. It is a screening tool to identify jobs with potentially harmful exposures to ergonomic stress. It was designed to be biased, more likely to classify an ‘acceptable’ job as a problem job (a false positive). It is not designed to be a diagnostic tool. The checklist consists of 15 items designed to evaluate the presence and duration of exposure to awkward postures. For each item there are a multiple choice of responses consisting of never, sometimes or 1/3 cycle. Definitions of these terms are presented in the ‘supplemental note page’ accompanying the checklist. Responses to each question results in a stress rating from a three level qualitative scale (Table 2.9). Once the checklist is completed the number of checks (✓) and stars (*) are summed to produce an overall score of postural stress. Any job receiving one or more stars is a high priority for additional investigation. The accompanying one page guidance provides further definition for some of the terms used in the checklist items and also presents some diagrams to illustrate specific postures and angles of motion.

Table 2.9. Stress rating system

0	Insignificant risk of injury.
✓	Moderate exposure to postural stress was present indicating a potential risk of injury to some workers.
*	Substantial exposure to postural stress was present, indicating significant risk of injury.

Who should complete it? The checklist was designed to be used by people with limited ergonomics training.

What level of training/experience does it specify: It does not specifically states the training that is required however it does state that the checklist was designed to be used by people with limited ergonomics training.

Summary

From the aforementioned checklists it can be seen that there are distinct differences in not only the design features but also the extent of the risk management process each checklist encompasses. For example, HSG 60 encompasses risk identification through to risk control and identifying solutions (control interventions) whereas PLIBEL and NIOSH checklist just identify risk actions.

Table presents eight checklists for assessing MSD risks against the design features identified in Section 2.3.4. It enables quick comparisons of the features of each of the checklists to be made. Features shaded are those that literature indicates are effective as describe in section 2.3.3.

Table 2.10. Different checklists and their design features.

Checklists	**Design feature / characteristic**	Who conducts the assessment	Background information	Asks whether injuries or problems reported	Records if a body part discomfort questionnaire completed and the results	Number of tasks observed in making the assessment	Number of employees conducting this type of task	Records other task employees worker are likely to perform in addition to this task	Records total duration conducting task (without break)	Records presence of or length of breaks	Comes with additional information or guidance pages/ booklet	Provides definition of terms in additional booklet/pages	**Format**	Flow diagram format or similar	List format	Multiple choice responses	Dichotomous	**Phrasing/presentation of check items**	Uses numerical figures to describe joint angles	Uses words to describe joint angles	Uses numerical figures to describe repetition and/or frequency rates	Uses words to describe repetition and /or frequency rates	Uses numerical figures to describe weights/force	Uses words to describe weight/force	Uses numerical figures to describe duration	Uses words to describe duration	Provides definitions of terms on the checklist	**Visual aids**	Illustration of angles	Illustrations of postures	Illustrations of motions	Provides space to describe task or requests for photo of risk action/tools/workstation
HSg 60		✓					✓	✓	✓	✓	✓	✓			✓		✓			✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓
NIOSH											✓	✓			✓		✓			✓		✓		✓		✓						
WAC												✓			✓		✓		✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	
VDU		✓		✓						✓	✓	✓			✓		✓			✓										✓	✓	
QEC		✓									✓	✓			✓	✓				✓	✓	✓	✓	✓	✓	✓	✓					
Keryserling											✓	✓			✓	✓				N/A	N/A	N/A	N/A	N/A		✓						
PLIBEL				✓						✓		✓		✓			✓			✓												

Table 2.10. Different checklists and their design features (continued).

Checklists	**Recording risk details**	Space for notes of reported problems	Space for notes on risks/probable cause	**Ratings**	Means of rating risk of individual items	Colour coding	Symbol coding	Numerical	Words : i.e. Low, Medium, High	Good, Satisfactory, Poor, Unacceptable	Gives an overall score	Means of prioritising tasks for action	Yes	Yes but requires reference to other materials	**Controls / interventions per check item**	Asks whether action is required	Space for notes on potential actions	Provides hints/suggestions for redesign/control interventions to reduce the risks	In checklist	In accompanying guidance document	Provides references for guidance/information	**Action plan**	Space for notes on actual action to be implemented	Provides space or table to plan actions i.e. what required, by whom and date	Enables recording of whether action implemented	Date for next assessment
HSG 60		✓	✓								✓		✓			✓	✓		✓	✓			✓	✓	✓	✓
NIOSH																				✓	✓					
WAC														✓												
VDU		✓	✓													✓	✓	✓					✓		✓	
QEC								✓			✓		✓													
Keryserling		✓				✓							✓										✓			
PLIBEL																										

2.3.6 New developments

ART

The Health and Safety Executive are currently developing a new risk assessment tool called ‘Assessment of Repetitive Tasks of the upper limbs’ (ART). It is in a similar style as the HSE risk assessment tool for assessing manual handling tasks (the MAC tool) comprising of a set of check items which are colour coded relating to level of risk (Green for low level risk, Amber for medium level risk and Red for high level risk). Numerical scores are also attributed to each item. At the end of the assessment all scores are collated and an overall level of risk is calculated. ART is currently in draft form and trials will be run later in the year. The tool has been developed to be used by HSE inspectors; however it is envisage that the tool will later be released for general use within companies by persons responsible for health and safety.

Technological developments

There are several computerised assessment programmes which can be used to evaluate the risks of musculoskeletal disorders such as Ovako Working position Analysing System (OWAS), MORF, Rapid Upper Limb Assessment (RULA). These programmes are designed to be used by experts. Although these programmes include a series of check items they are typically much more complicated and cannot be compared to the checklists under consideration in this study. They do, however, illustrate a development in the use of technology in the assessment of MSD risks.

No research was found to have been conducted in the development of computerised assessment techniques for non-experts use to asses MSDs. However, a review of the literature did find that new developments are being made in the construction industry with the use of mobile technologies to assist in conducting health and safety work site assessments.

These studies provide an insight to the potential benefits of using mobile technologies for conducting checklist assessments.

It is easy to see how some of the findings from these studies could be transferred to the development of similar systems for the assessment and management of musculoskeletal disorders. May 2006, Kimoto *et al.* 2005, and Abdullah and Thai 2006 investigated the user requirements of conducting assessments on construction sites through the use of mobile IT devices.

Table provides a list the potentials benefits of using mobile technology to conduct assessments on construction sites based on findings from the literature.

Table 2.11. Potential benefits of using mobile technology to conduct assessments on construction sites.

Potential benefits
• Can provide structured checklists to support novice or less experienced inspectors (May *et al.* 2006) • Enable easy addition of voice, text or graphic annotations at the time of data capture to add richness and context to the data (May 2006 and Abdullah and Thai 2006). • The device can incorporate a camera (Kimoto *et al.* 2005. • Enable real time data exchange (Kimoto *et al.*2006) • Can use location-based service to ensure that information is relevant to the current location (May *et al.* 2006). • Provide ways of tagging and coding images at the point of capture to maximise the use of photos. Particularly useful in monitoring changes (May *et al.* 2006). • Can be programmed to calculate priority for action (May *et al.* 2006). • Easy to compare results over time and across different worksites, work areas, task etc (May 2006, Kimoto *et al*. 2005). • Increased productivity of inspectors enables assessments to be centralised and standardised (Abdullah and Thai 2006, Kimoto et al 2005). • Aids in the communication of problems to relevant people/departments (Abdullah and Thai 2006) • Can be linked to other software packages for analysis and presentation. i.e. scheduling software, redesign (Kimoto *et al*. 2005).

In a conference entitled ‘Assessing musculoskeletal disorders at work: which tools to use when’ (2003) it was reported that one of the potential negative aspects of using computerised assessment techniques is that scoring via a laptop/handheld computer may obscure the process so that the assessor has no understanding of the various contributory factors of the score and how the combined effects may be reduced.

It was argued that this is needed to inform making effective interventions. Other issues about the use of mobile technologies concern the size of screen, the ease of inputting dating using a stylus as opposed to mouse, visibility issues and speed of connections.

2.4 Checklist-based risk assessment and training

2.4.1 Training in the use of checklists for assessing MSD risk

The Management of Health and Safety at Work Regulations 1992 (amended in 1994 and 1997) states that “Employers are solely responsible for ensuring that Health and Safety people are competent”. Competent means that people have an understanding of relevant current best practice, are aware of the limitations of their own experience and knowledge and have the willingness and ability to supplement existing experience and knowledge where necessary by obtaining external help and advice. Therefore people that conduct risk assessments must have this basic competence in addition to any specific training required in the use of the checklists.

The level of training required to conduct risk assessments using checklists varies. For example, HSG 60 and QEC only require the reading of the accompanying guidance booklets/pages where as for other checklists more in-depth training is suggested i.e. Keyserling checklist intended to be used by plant personnel requires one week of training.

It is argued that checklists should be designed as standalone tools that require limited training (Li and Buckle 1999, HSG60, OSHA 2000). The reasons for this are to encourage their use by keeping the resources required to a minimum and not relying on one specific individual to conduct the risk assessments (i.e. assessments can be conducted by a range of workers). Studies comparing checklist results gained by experts and non-experts support this. Several studies show that checklists designed as standalone tools can be used effectively and reliably by non-experts (Li and Buckle 1999, Quirk *et al.* 2004, Winnemuller *et al.* 2004, Keyserling *et al.* 1992).

Although Li and Buckle acknowledge that in the case of the QEC further research into the level of training required is needed, reporting that “It is anticipated that experience and training can improve the assessment reliability, but questions remain as to how much training is needed and what type of training should be given, for practical use of the exposure tool.”

One of the important aspects of conducting risk assessment is to identify risk and then to identify potential control interventions. This is often not achieved. Research has shown that, typically, risk assessments are completed but often remain as a paper-based exercise resulting in little effective action (Gadd *et al.* 2004). Studies by Care *et al* (2002) and Jones *et al.* (1999) which looked at the effects of providing training in addition to the written guidance provided with standalone checklists showed that training can improve inter-observer reliability and validity of their results of checklists. Furthermore, research shows that in addition to providing training in completing a particular checklist, training in ‘general ergonomics’ can also further enhance the reliability and, importantly, the identification of control interventions.

Jones *et al.* (1999) investigated the ability of non-ergonomists to make manual handling risk assessments with, and without, additional training and to implement changes to the work environment. The study reported that training was needed. Jones states that “It was felt that use of checklists in isolation was insufficient and that a focus for discussion was required – which was provided by the training.”

In a study by Ketola *et al.* (2002) (Cited in Greene *et al.* 2005) it was found that risk exposure was reduced in a group that received an intensive ergonomics training program compared to a group who only received training to use a workstation checklist. There was no improvement in risk exposure in the group that received only training in the use of the checklist.

Devereux et al (1998), cited in Saleem *et al.* (2003), documented a case study in which ergonomics training was not provided to workers. Control subjects redesigned the job with relatively fewer benefits than subjects who received a fundamental level of ergonomics training.

Saleem *et al.* (2003) conducted a study of 48 novice subjects. In total 16 subjects were given ergonomics training , 16 subjects were given instruction in how to use the tool (the NIOSH lifting equation) and 16 subjects acted as the control group receiving no training. Subjects had to analyse a job for potential risk factors and then redesign the job to eliminate or reduce the risks they had identified. More risks were eliminated by the group that had received ergonomics training than those that had received training on the use of the checklist alone. This study showed that training in ergonomics was more effective in eliminating risks than just providing training in the use of the tool.

In studies by Tauok (2001) and Hal (2002) a risk assessment process was introduced as a package in which training in the use of a risk assessment checklist was also provided. Tauok and Hal recognised the importance of training. However in each of these studies no comparison was made to assess how effective the training had been compared to when no training was given.

2.4.2 Who should receive training and/or assess the risks - workforce participation

HSG60, NIOSH, OSHA, and Z365 all emphasise and encourage worker/employee involvement in the management of MSDs, recommending that employers provide employees with knowledge and understanding of MSDs and their associated risks. Involving the workforce in the management of MSDs is a participatory-based approach. The basic concept of participative ergonomics is to involve workers in improving their workplaces to reduce injury and increase productivity. In this way the expert knowledge workers have of their own tasks is utilised to assist in risk assessments and controls.

Potential benefits of the participative approach include; improved flow of useful information within an organisation, an improvement in the meaningfulness of work, more rapid technological and organisational change, improved acceptance to change, enhanced performance and reductions in work related health problems (Brown 1993, Haims and Carayon 1998, HSG 60, Saleem *et al.* 2003, Vink *et al.* 2006).

From the reviewed literature it appears that there is evidence for involving the workers in the assessment of risks. For example, studies investigating the effect of manual handling training on reducing risk and injury indicate that training workers in correct working methods was ineffective (Hignett 2003, Stubbs 1983, Catherine et al 1998). Hignett (2005) states to effectively reduce risks and injury from manual handling, workers need to be trained in recognising and assessing risk. Furthermore, Hignett (1994) recommends restricting the involvement of 'experts', suggesting instead that their input is limited to auditing large departmental checklist assessments and give help where necessary. This gives basis to the argument that workers should be actively involved and potentially conduct risk assessments.

Zalk (2001) reports that "Checklists have frequently been the ergonomics tool of choice within participatory ergonomics interventions. Regardless of the intricacy of the tool (checklist) workers should fully assist in gathering and analysing data then in identifying and implementing solutions. This argument is supported by both NIOSH and the HSE. NIOSH states "When checklist data are gathered by persons familiar with the job, task or processes involved, the quality of the data is generally better". Similarly HSG60 reports that risk assessment requires input from people who conduct the task. Carrivick *et al.* (2005) conducted a study that indicated that an interactive participatory process does not have to be complex and that a small group of unskilled personnel with training and guidance can effectively assess risk and address risks of manual handling.

Similarly, in a study by Winnemuller *et al* (2004*)*, it was concluded that the ability of supervisors and workers to assess MSD risk in initial ergonomics assessment using checklists appeared promising, results showing that supervisors and worker's results did not differ significantly from those of experts. In a report by Cameron (2006), it is reported that trained workers were found to be better equipped for identifying hazards.

Research suggests that there are significant benefits in getting workers from the shop floor trained to conduct the risk assessment and that checklists appear to provide the ideal tool to enable this. Studies have shown that by educating workers in the MSD risk and getting workers to conduct MSD risk assessments the following benefits can be gained:

- workers co-operatively identify and report safety and health problems to management/supervisors (Morken *et al.* 2002, Straker *et al.* 2004)
- workers employ better working techniques (change of behaviour) (Morken *et al.* 2002)
- improves compliance with health and safety procedures (Straker *et al.* 2004, Arezes *et al.* 2006)
- improved Worker acceptance to intervention and changes in work practices (Haims and Carayon 1998, Imada 1990)
- encouraged shared mental models between management and workers leading to improved agreement in actions and the perceived need for action (Prussia *et al.* 2003)
- showing management commitment to workers health, safety and wellbeing (Prussia *et al.* 2003)
- workers are often best placed to recognise problems and solutions; training in risk assessment supports and develops this ability (Saleem *et al.* 2003)

Many of these possible benefits could potentially overcome some of the difficulties in the management of MSDs previously outlined in Section 2.2.3.

In particular, the aforementioned benefits could offset the obstacles relating to training, worker participation, support from workers and problems linking risk identification to risk controls.

However there are downsides to involving members of the workforce at this level. Neathey (2006) comments on peoples' concerns about being liable. Jones *et al.* (1999) comments that in their study (which investigated the ability of non ergonomists (with training) to make manual handling risk assessments) although they could reliably conduct the risk assessments most of the assessments were felt to be inadequate in terms of setting up long term plans for monitoring etc. Jones reported that this, in part, might have been affected by non-managerial participants being unaware of the need for, or how to deal with, such measures. Jones et al conclude that this points to the need for assessments to be undertaken by subjects with managerial authority.

To summarise, research suggests that training the workforce in risk assessment will be of benefit to supporting the risk management of MSDs, from risk identification through to controls and monitoring. Even if workers themselves do not conduct the risk assessments, training in risk assessment would still appear to be potentially of benefit. Research suggests that training the workforce in risk assessment would encourage and actively involve the workforce, making them more aware of the risks and encouraging the use of safe work practices.

2.5 Evaluation methodologies and effectiveness

The problems, benefits and limitation of intervention evaluation in an occupational setting and relating to workplace health and safety are well documented by Robson et al (2001). This work identifies common threats to the success of studies which attempt to collect real world data and makes numerous recommendations for ways to design, manage, improve and review strategies, approaches and analysis.

Because of the complex nature of projects attempting to address this area of research, the best practice approaches detailed in this report provide a valuable resource researchers.

2.6 Conclusions of literature review

Numerous checklist assessment tools have been developed to assess the risk of MSDs. Research has been conducted to assess the effectiveness and reliability of these checklists in identifying the risk factors. Previous research has focused on:

- Comparing the validity of different risk assessment tools (Ghafarian et al 2003, O'Keeffe *et al.* 2004, David 2005)
- Comparing inter-observer reliability and intra-observer reliability of risk assessment tools (Chen *et al.* 2002, Tolmie and Potvin 2003)
- Investigating inter-observer between checklist results of non-expert and experts (Winnemuller *et al.* 2004, Li and Buckle 1999, Lee and Ferriera 2003, Quirk *et al.* 2004, Keyserling 1992).

However very little research has been conducted in assessing the effectiveness of the actual design of checklists and the level of accompanying training that is required and/or is sufficient to ensure they are used correctly.

Design features of checklists

This review of the literature shows that although numerous checklists tool exists only a few incorporate some of the good practice design features identified in 2.3.3. Furthermore the recommended design features are only supported by qualitative data typically being identified from focus groups with users or discussion with experts. No research was found which limited itself to only exploring the effects of design characteristics rather than the checklist criteria (items). Therefore there is a need to determine the effectiveness of the design recommendations reported in section 2.3.3.

Furthermore the review has also shown that checklists vary in the extent of the risk assessment process they encompass. For example, some checklists incorporate risk identification with identifying solutions and producing an action plan, where as other stop at just identifying risk. There is also a need therefore, to further investigate the effect of this design feature.

Training in conducting checklist-based risk assessments

Research has shown that standalone tools can be used effectively by non-experts. This is important as there is a move towards a more participative approach to MSD management. A participative approach may result in a greater range of people (other than health and safety practitioners or representatives) conducting risks assessment. Research has demonstrated that there are significant benefits to be gained from involving a broader range of the workforce in the risk assessment of MSDs. Primarily, these are worker acceptance to change, improved support from workers, improved reporting of risk and problems, improved communication and improved solution generation. A study by Care *et al.* (2002) showed that training in conducting checklist risk assessment can significantly improve reliability of the results when checklists are completed by non-experts. The training needs of these individuals require further investigation. Furthermore, studies by Saleem (2003) and Ketola *et al.* (2002) have shown that the reliability of checklist results and the progression from risk identification to identifying and implementing control interventions can be significantly improved when training in more general ergonomics principles is included (in addition to training in conducting checklist based assessments).

Research is needed to evaluate the effectiveness of training a broader range of the work force and whether this would overcome some of the current obstacles that have been identified as preventing the successful management of MSD risks.

In summary, from the literature review the following gaps in research have been identified;

- there is a need to determine the effectiveness of the design recommendations reported in section 2.3.3
- there is a need to identify the training needs to engage a broader range of the workforce in the risk assessment process
- there is a need to evaluate the effectiveness of training a broader range of the work force in risk assessment.

3 Phases 2 and 3 - Methods

A questionnaire was developed and distributed to a range of manufacturing companies. The questionnaire was aimed at staff responsible for health and safety and probed issues relating to current risk assessment processes, the type of risk assessment employed, subsequent interventions identified and obstacles to conducting risk assessment and implementation of interventions. Companies were also asked to send in copies of their current risk assessment checklists for review. Information on who conducts risk assessments and levels of training were also collected.

The questionnaire was developed by the project team and peer reviewed by colleagues within Loughborough University. The structure was conventional and relied on traditional data collection approaches so as to be robust and reliable whilst staying within ethical requirements in terms of data collected and time required for completion. A combination of closed questions, qualitative responses, Likert scales and free text was utilised to extract the most complete data. The questionnaire was piloted on three Health and Safety Personnel within Loughborough University for comprehensions and appropriateness of responses gained. A brief trial analysis of the pilot data was undertaken to ensure that the data collected effectively addressed the research questions for which the questionnaire was being employed. Minor revisions were undertaken to aid the clarity of both the questions and the responses received. A copy of the questionnaire is presented in Appendix A.

Three hundred questionnaires were sent to manufacturing companies in the East and West Midlands. The midlands provided a convenience sample resource. Manufacturing was chosen as the appropriate sector since this reflected the location of highest incidence of the type of MSD injuries which are intended to be addressed by many of the risk assessment checklists. Companies were selected at random from the yellow pages. Companies that did not return a questionnaire within two weeks of receipt were telephoned to encourage the completion and return of the questionnaires.

However response rate from this initial distribution was very poor (27 returned questionnaires, 9%). To increase response rate a second set of manufacturing companies were selected at random from the yellow pages but this time each company was contacted prior to sending a questionnaire. Telephone contact was first established with the person responsible for health and safety and it was ascertained from that individual whether they would be willing to complete the questionnaire for the research project. All those that said they would like to complete a questionnaire were then sent a questionnaire in the post. From this a further 81 questionnaires were distributed but again response rate was very low (7 returned questionnaires, 9%).

To further increase response the questionnaire was developed into an online version which was placed on the ESRI and IOSH website. A number of conferences within different sectors of manufacturing were visited to gain email addresses of attendees to send out links to the questionnaire. Furthermore, advertisements with links to the questionnaire were placed on the IOSH and ESRI websites and a hundred questionnaires were distributed at a training course held by the Trades Union Congress (TUC) where persons responsible for health and safety were attending. These efforts significantly improved the number of responses (Table). In total 88 completed questionnaires were received from companies with more than 5 employees. Section 4 of this report presents the results of the survey.

Table 3.1. Distribution of the questionnaire

Source of Distribution	Number of questionnaires distributed	Number of completed questionnaires returned
Yellow pages –Manufacturing section	381	34
Health and safety at work magazine advertisement		3
IOSH website and ESRI online questionnaire (Email links sent direct to members of: • IOSH Food and Drink Production • The Health and Safety Confederation of British Wool Textiles • The British Tyre Manufacturing Association		IOSH web - 3 Online questionnaire - 30
Conference stand -Occupational Health & Safety in the Food Industry 2007	20	5
Conference stand- PLEDGE Ceramics Industry Health and Safety 2007.	35	6
Training courses - Regional Education Midlands TUC.	100	7
	TOTAL	**88**

3.1 Phase 3 - Walk through audits

Fifteen companies were randomly selected from those of the 88 that had stated an interest in participating further in the questionnaire. These companies were contacted with and asked to provide copies of their risk assessment procedures and their risk assessment checklists used for assessing MSDs. Each company was then visited by two ESRI researchers. During each site visit information concerning the following was collated;

- type of work tasks conducted
- general risk assessment process
- risk assessment process specific to MSDs (for this, a distinction was made between manual handling risk assessments which were defined as those assessments used to assess tasks which involved lifting, lowering, pushing and pulling of objects and Upper Limbs Disorders (ULDs) risk assessment which assessed tasks that did not necessarily

involve heavy objects but were manually intensive and perhaps repetitive in nature).

- risk assessment outcomes and interventions
- any problems encountered in the risk assessment process
- general comments relating to health and safety and the assessment and control of risk.

The audit took the form of a semi-structured interview with the interviewer providing a skeletal framework of fundamental generic questions, posed in a common format, and enhanced by additional information revealed by the visit. In principle, the core data of the audits would be comparable since the information would be gained by structured questions. In practice, the variability of the environments, activities and approaches meant that the main content was addressed but significant additional information was acquired. This information was either further detail on the prompted issues or spontaneously volunteered by the interviewee in the course of the audit.

In some cases considerable discussion revolved around the specific processes being observed and the data collected could therefore extend significantly beyond the specific structured questions. An example would be where the industry had two components which serviced the artisan and the mass produced sectors. The approaches and interventions required for the company in this case were much more diverse than for those involving a single production process. It was also the case that preconceptions regarding the nature of the manufacturing processes were often dispelled by the site visit and consequently the discussions regarding Health and Safety practices were, by necessity, less structured. However, the key issues were consistently addressed by the main prompts during the audit. The results can be seen in Section 4 of this report.

4 Phase 2 - Survey results

4.1 Respondent companies

In total 88 completed questionnaires were received from companies with more than 5 employees. Companies with less than 5 employees were not included as valid respondents as these companies are not required under the Health and Safety at Work Act 1974 to record risk assessment results and therefore are unlikely to have or use checklists or other written forms of assessing and recording risk.

Of the 88 responding companies, 40 (45%) were large companies (300 or more employees), 24 (27%) Medium (50 to 299 employees) and 24 (27%) were small (5 to 49 employees) (Figure 4.1).

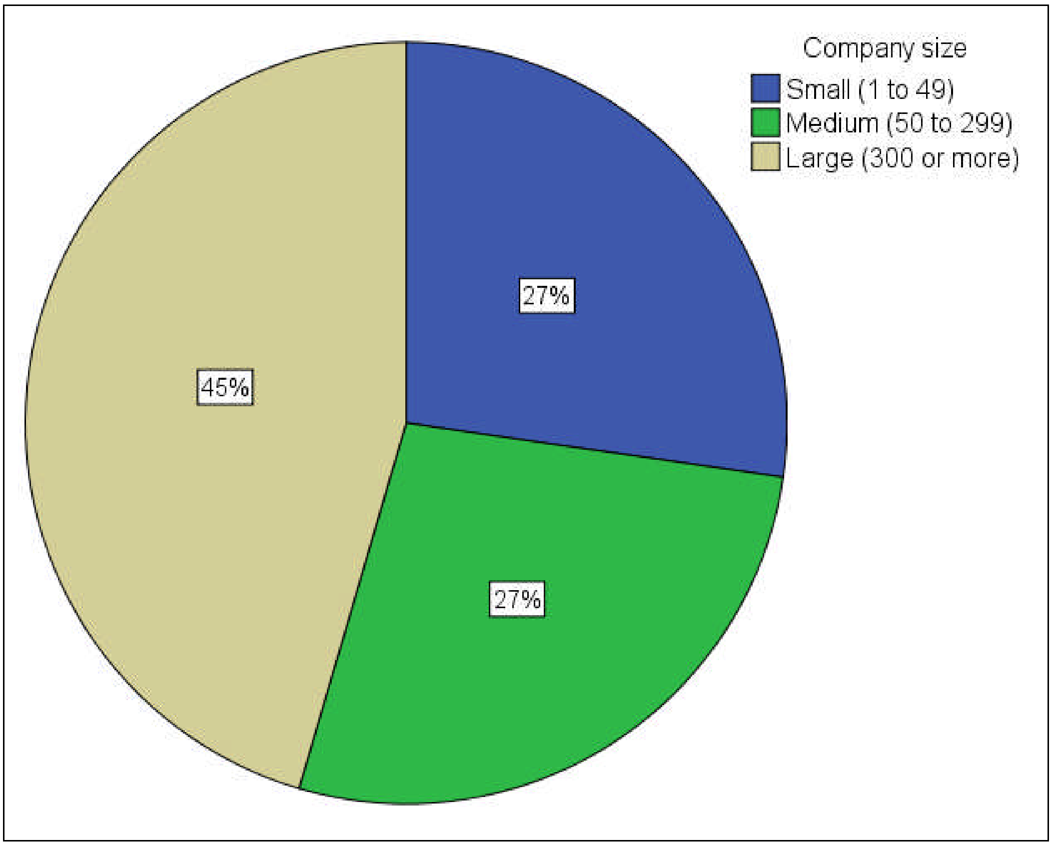


Figure 4.1. Percentage of responding companies and the size of company.

The sectors with the largest number of responding companies were the food and drink sector and the transport manufacturing sector, both with 32% of respondents (Table). Table 4.3 shows the reported mean percentage of employees engaged in particular activities within each sector.

Shaded cells within the table highlight the sectors which had the greatest mean percentage of employees engaged in each activity. ‘Food and drink’ and ‘Metal and metal goods’ had the greatest mean percentage of the workforce engaged in manual handling activities and ‘Glass and ceramic’ and ‘Transport’ had the greatest mean percentage of the workforce engaged in repetitive short cycle work activities.

Table 4.2. Manufacturing sector

Industry sector	Number of companies	Percentage of companies %
Food and Drink Manufacturing	28	31.8
Transport Manufacturing	28	31.8
Refrigeration	10	11.4
Manufacturing Tools	9	10.2
Consumer Goods	6	6.8
Fuel	6	6.8
Paper Manufacturing	6	6.8
Textile Manufacturing	6	6.8
Other	6	6.8
Chemical manufacturing	5	5.7
Rubber and Plastics	5	5.7
Electrical and Electronics	4	4.5
Mining and Quarrying	4	4.5
Timber Manufacturing	4	4.5
Metal and Metal Goods	3	3.4
Packaging	3	3.4
Optical and Precision Instruments	2	2.3
Glass, Ceramic and Brick	1	1.1
Machinery Manufacturing	1	1.1
Total	**88**	**100.0%**

Table 4.3. Percentage for the workforce engaged in particular activities split by manufacturing sector

	Manufacturing sector												
	Chemical	Consumer Goods	Electrical and Electronics	Food and Drink	Glass, Ceramic and Brick	Machinery	Tools	Metal and Metal Goods	Refrigeration	Rubber and Plastics	Textile	Timber	Transport
Type of task activities.	Mean percentage of work force engaged in type of activities (%)												
Manual handling	66	69	30	74	69	10	10	71	57	63	70	50	55
Repetitive short cycle	34	49	10	50	65	10	10	33	33	30	10	27	63
Repetitive long cycle	20	47	33	44	13	10	0	51	20	35	55	33	43
Seated	26	41	60	18	18	80	70	26	27	23	25	30	30
Standing	30	55	13	44	20	.	10	22	27	35	40	17	27
Machine paced	26	22	0	53	53	10	0	36	0	30	55	30	32
Hand held tools	20	17	28	21	10	.	20	24	30	45	5	15	53
Computer	34	52	68	24	15	70	70	29	40	38	25	27	22
Frequent bending, twisting or reaching	50	57	15	55	50	10	30	56	53	53	55	27	72

4.2 Health and safety responsibilities and training

Of the 88 respondents that completed the questionnaire only 58 completed questions regarding their own training and health and safety responsibilities. 53 respondents answered the question asking 'what percentage of their work time is spent conducting health and safety responsibilities?'. The mean percentage of time spent on health and safety responsibilities was 46% of total working time. Figure shows that 13 respondents (25%) reported spending approximately 10 – 20% of their total working time conducting their health and safety responsibilities and 11 out of 53 (21%) reported spending 90-100% of their time conducting their health and safety responsibilities.

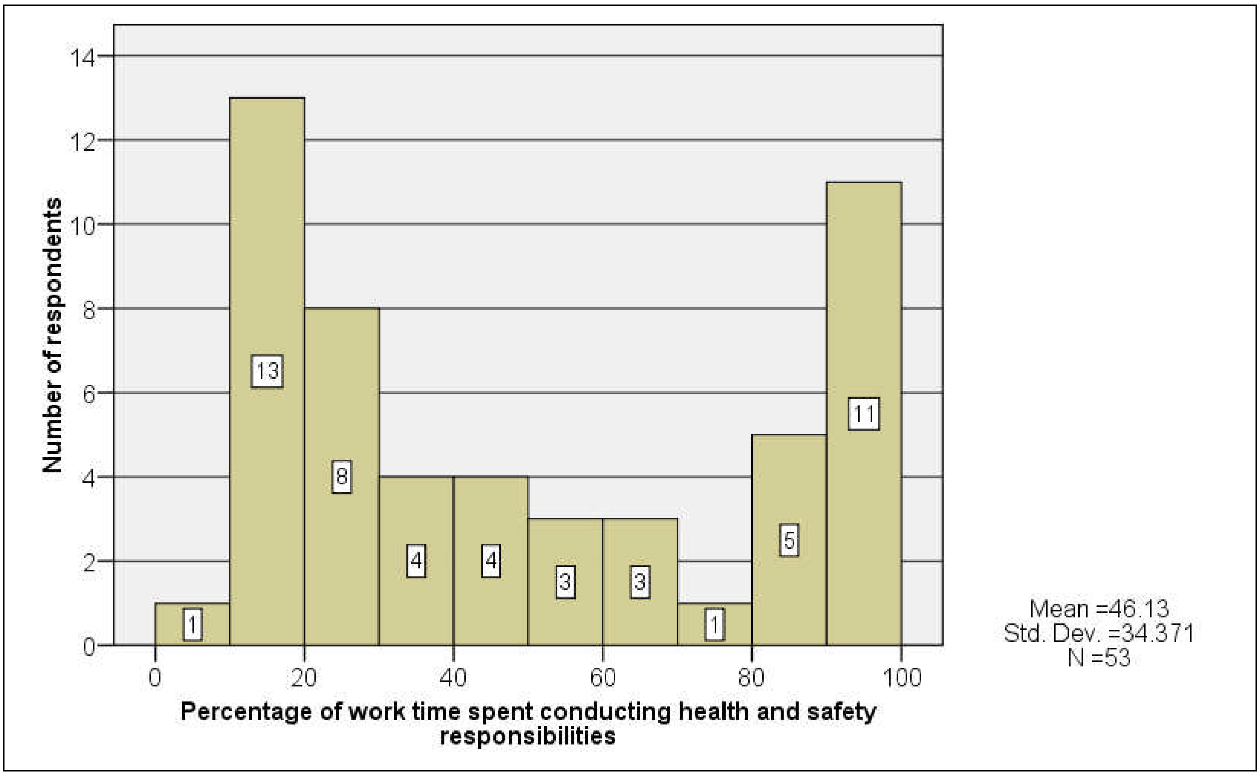


Figure 4.2. Percentage of work time spent by respondents conducting health and safety responsibilities.

The percentage of work time spent conducting health and safety responsibilities may be related to company size. People responsible for health and safety in large companies spent a greater percentage of their work time on health and safety duties than medium and small companies (Figure.3) with larger companies tending to have a dedicated health and safety manager/officer.

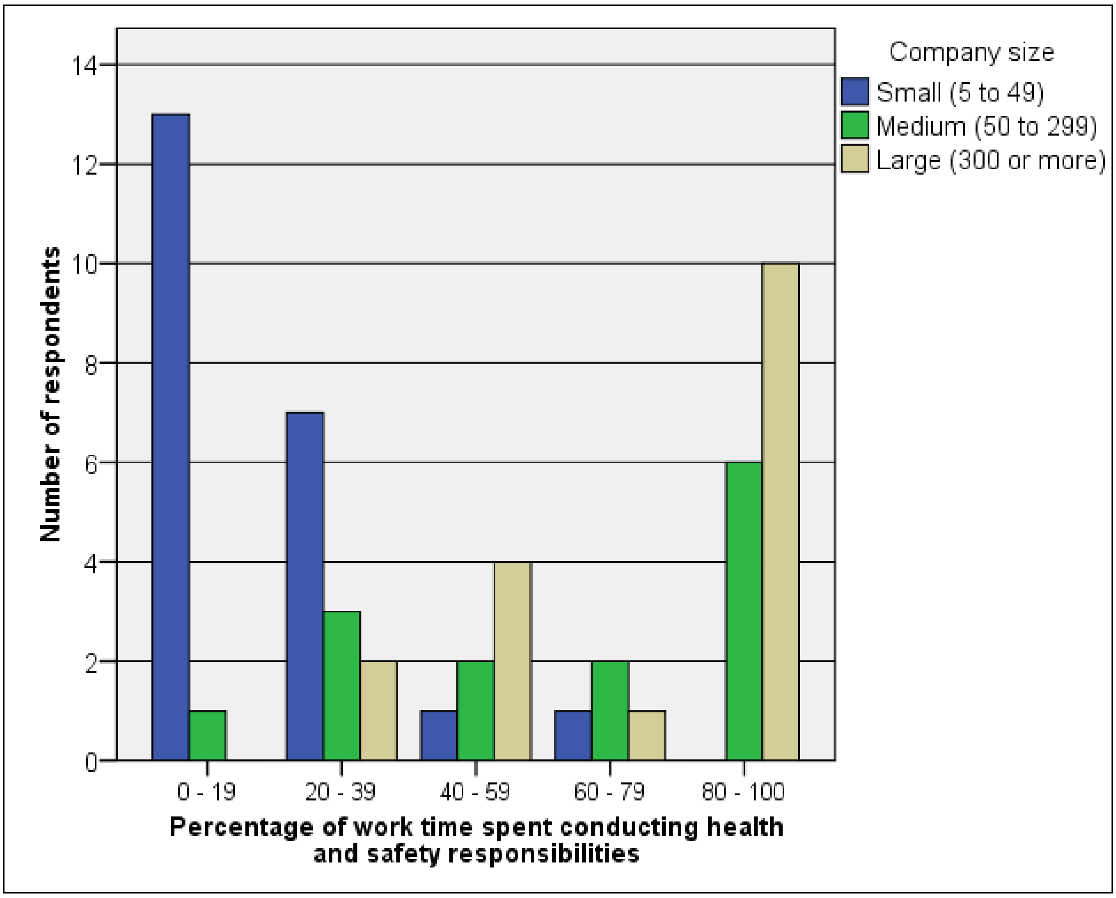


Figure 4.3. Number of respondents from small, medium and large sized companies and the percentage of work time spent conducting health and safety responsibilities.

53 respondents answered the question asking whether they had received specific training in risk assessment, of those 41 (77%) had received specific risk assessment training. Nearly all persons responsible for health and safety in large and medium sized companies had received specific training in risk assessment whereas less than 50% of persons responsible for health and safety in small companies had received specific training in risk assessment (Figure). Of those 41 respondents receiving specific training in risk assessment, 32 (77%) received training while attending face to face training sessions (Figure).

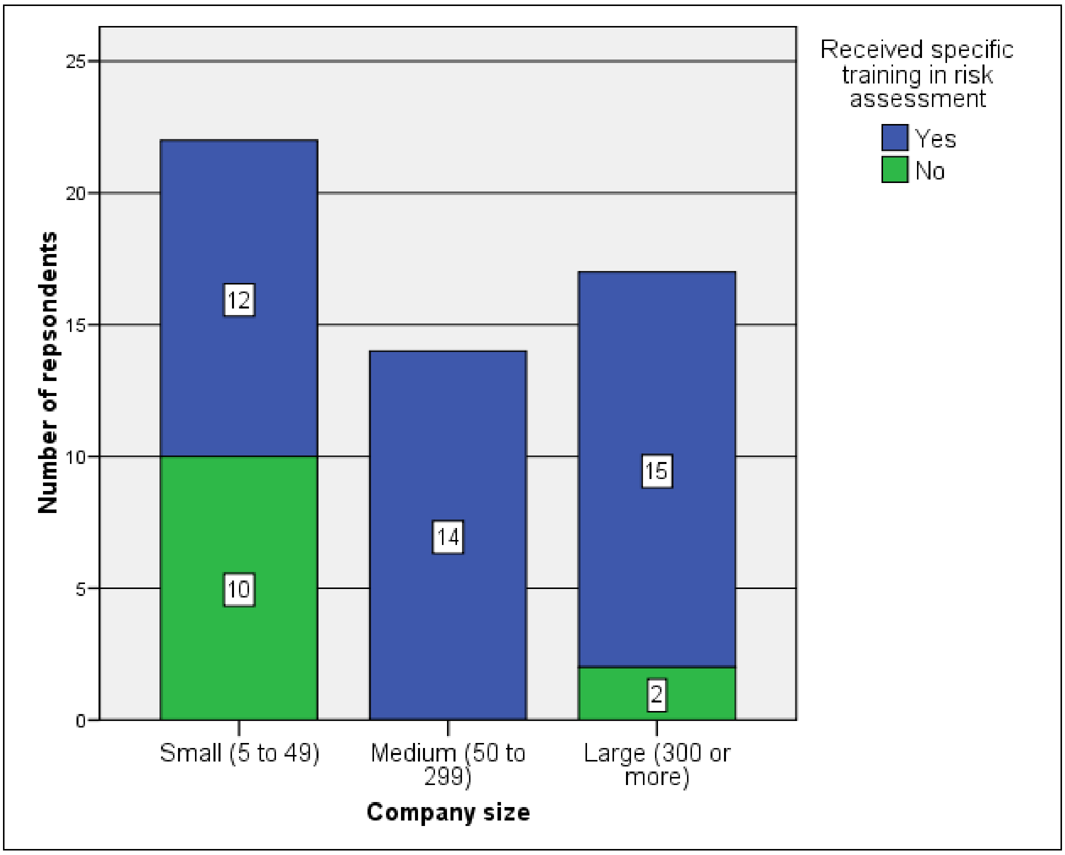


Figure 4.4. Number of respondents from small, medium and large sized companies that had received specific training in risk assessment.

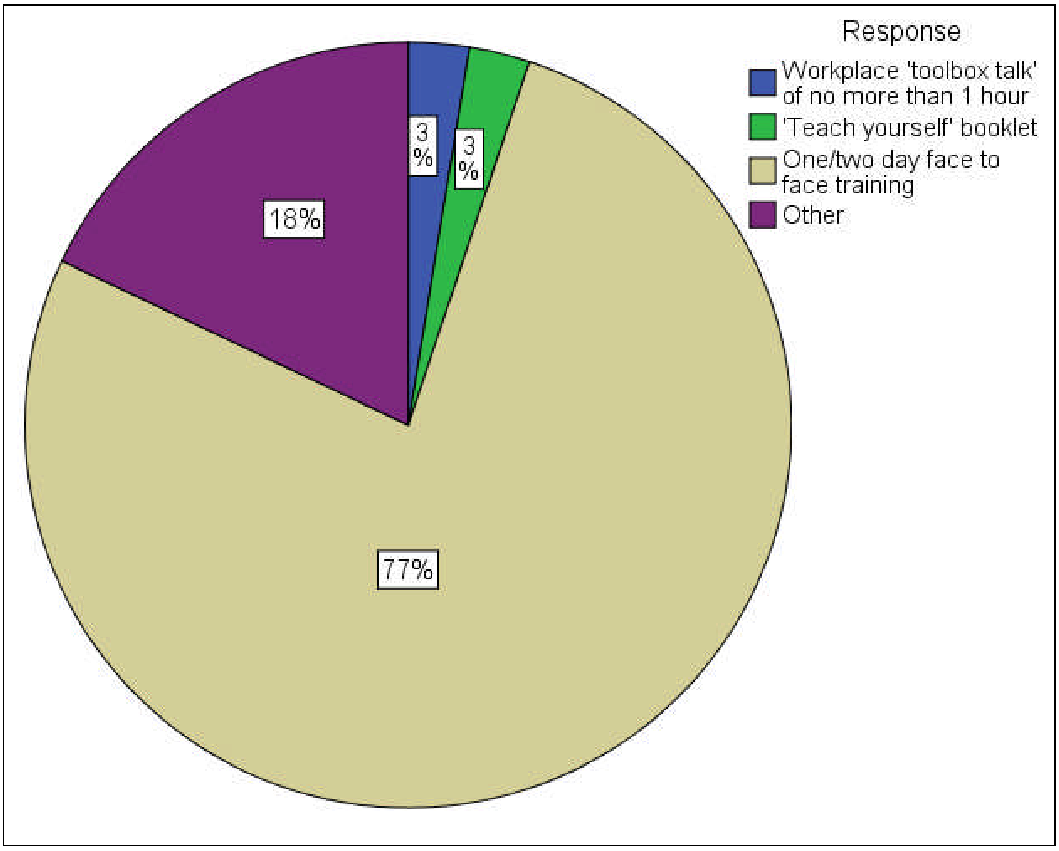


Figure 4.5. Percentage of respondents that had received specific risk assessment training and what format they received that training.

Of the 41 respondents who had received specific training in risk assessment 15 respondents (37%) received training from a training company and 11 respondents (27%) receive training from a consultant held in another location (away from the workplace) (Figure).

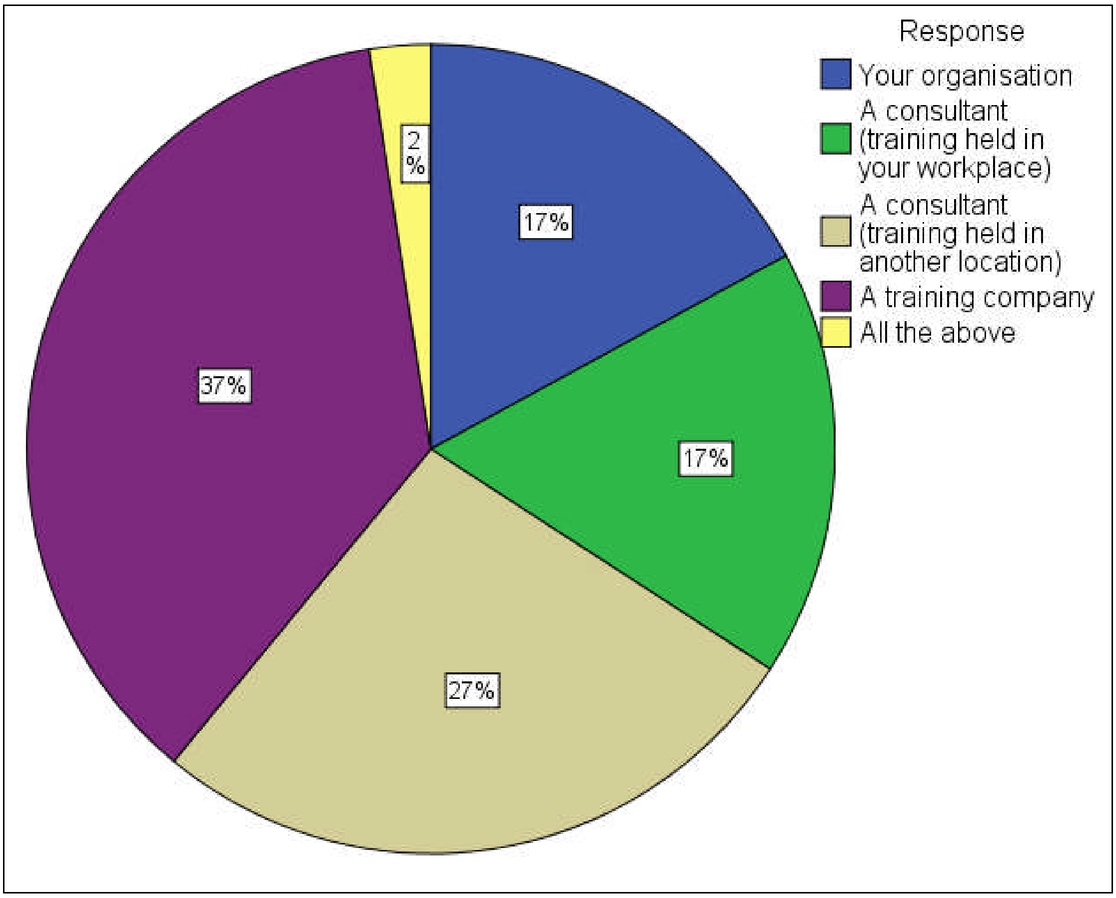


Figure 4.6. Percentage of respondents that had received specific training in risk assessment and where they received that training.

Out of the 41 respondents who had received specific training in risk assessment 29 respondents (71%) reported that this training also included information specifically relating to the assessment of musculoskeletal risks. Figure shows that a greater percentage (93%) of respondents from medium sized companies attended risk assessment training courses that included providing information about assessing MSD risks than small or large companies (67% and 53% respectively).

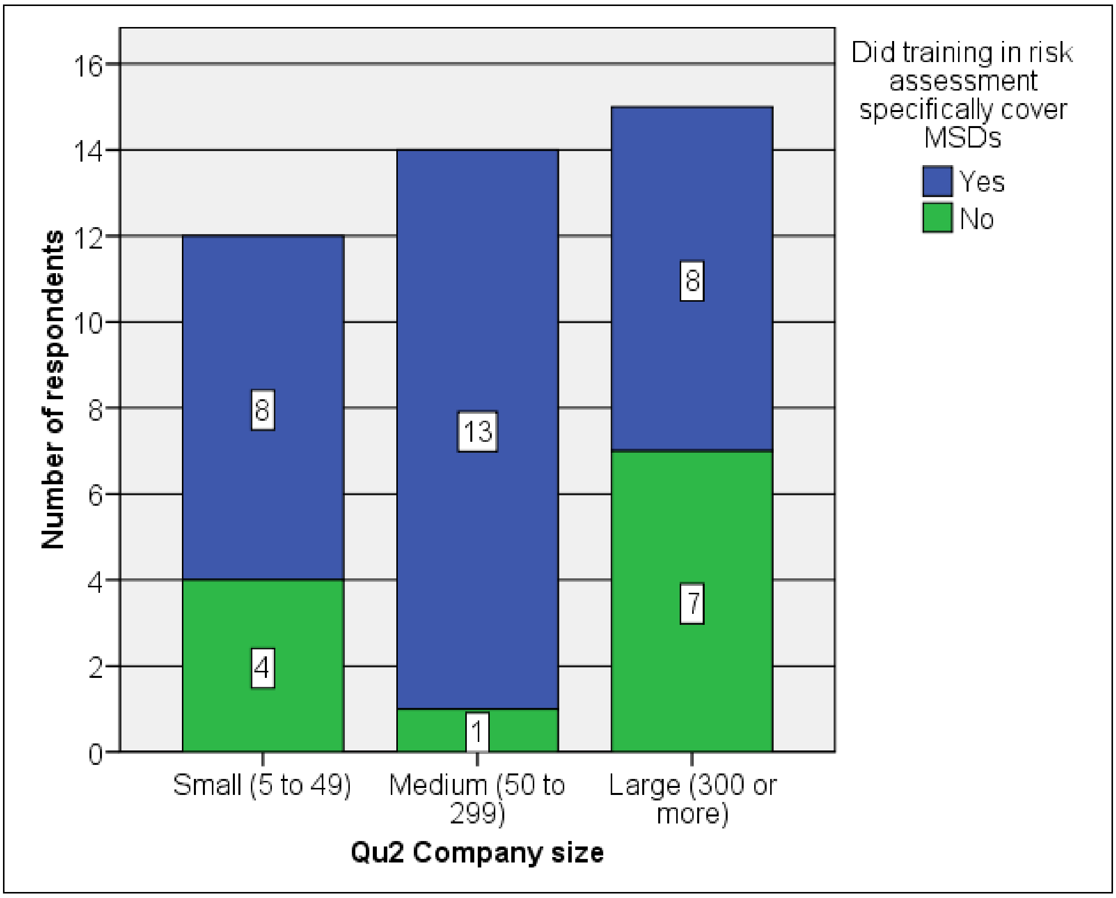


Figure 4.7. Number of respondents from small, medium and large sized companies that attended risk assessment training courses that included providing information about assessing MSD risks.

4.3 Risk assessment of musculoskeletal risks

Of the 82 respondents that answered the question as to whether any risk assessments for musculoskeletal risks had been conducted, 22 respondents (27%) reported that all work tasks had been assessed, 47 respondents (57%) reported that some MSD risk assessment had been conducted and 13 respondents (16%) reported that no risk assessments for MSD risk had been conducted (Figure). A greater percentage of medium and large sized companies reported that they had conducted MSD risk assessments for all tasks than small companies (8 medium companies (38%) and 10 large companies (27%) and 4 small companies (17%)) (Figure).

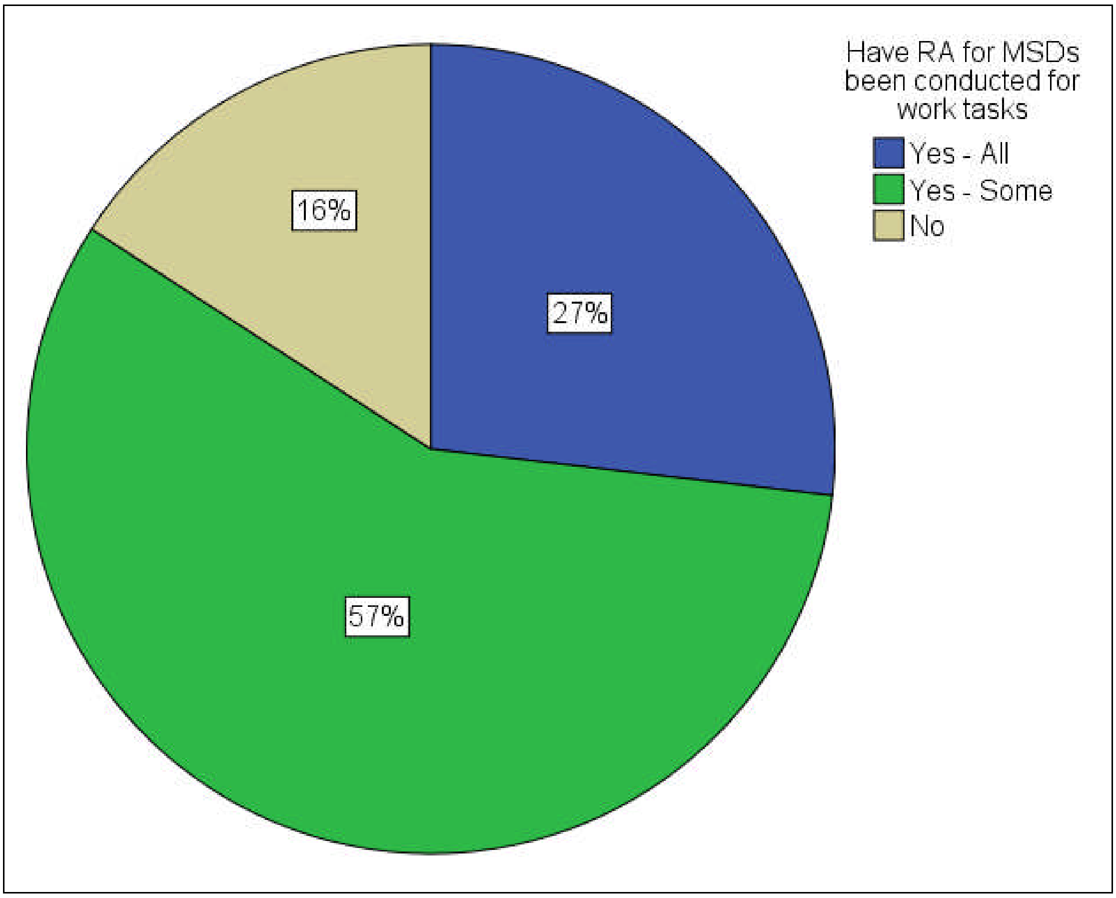


Figure 4.8. Percentage of respondents and their responses to whether any risk assessments for musculoskeletal risks had been conducted.

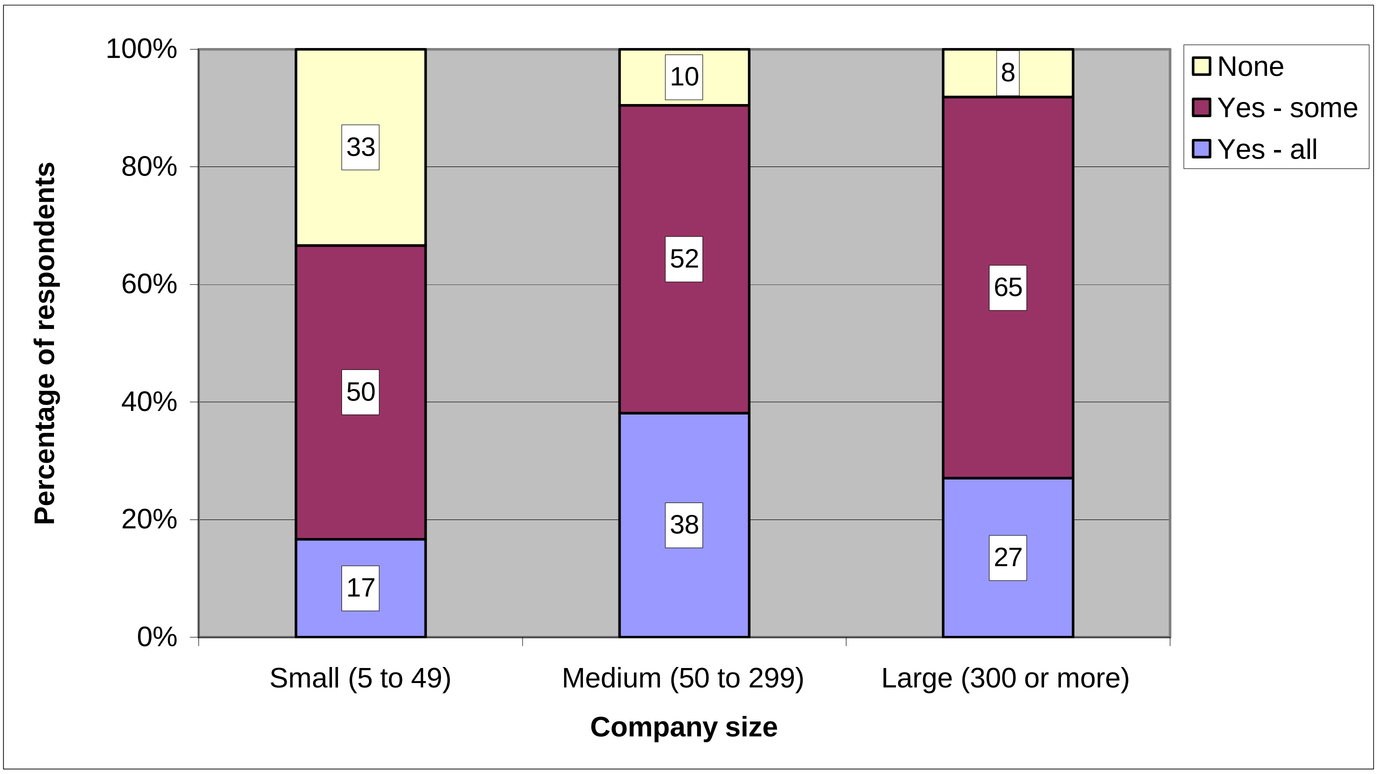


Figure 4.9. Percentage of respondents from small, medium and large sized companies and their responses to whether any risk assessments for musculoskeletal risks had been conducted.

The majority of companies that had conducted risk assessments of MSD risks reported using checklist based risk assessments. Of the 69 respondents that reported that their company had conducted all or some musculoskeletal risk assessments, 30 respondents (43%) reported that all their risk assessment used to assess MSD risks were a checklist based risk assessment, 28 respondents (41%) reported that only some of their MSD risk assessments used a checklist based risk assessment and 16% reported that none of their MSD assessments used a checklist (Figure).

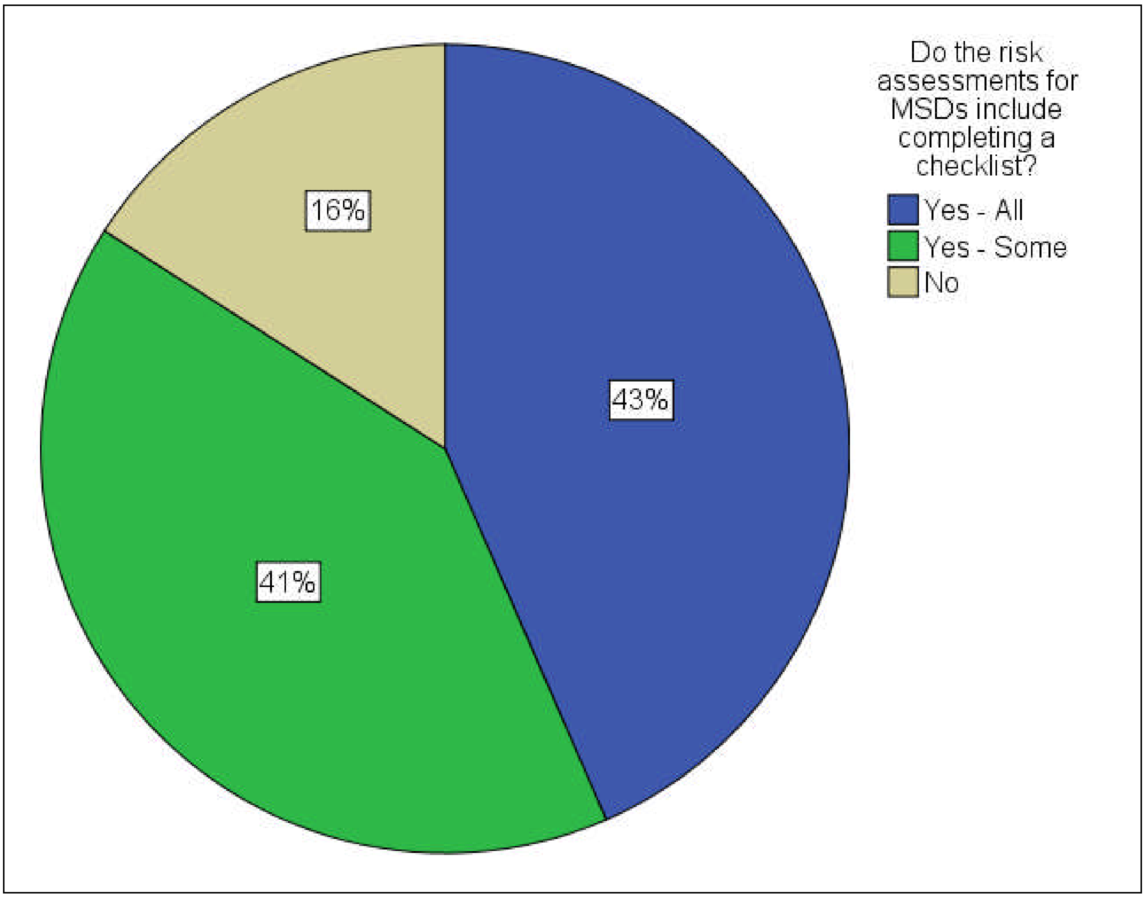


Figure 4.10. Percentage of respondents and their response to whether the risk assessment used to assess MSD risks are checklist based risk assessments.

4.3.1 Resources used

The resource reportedly used by most companies was the HSE Manual Handling Operations Regulations 1992 (53 out of 88 respondents, 60%). The second most reported resources were the Health and Safety (Display Screen Equipment) regulations 1992 and HSE ‘Five Steps to Risk’ assessment leaflet. Additionally, 56% of all companies used a checklist that was developed in house to assess musculoskeletal risks (Table 4.4).

Table 4.4. Resources used to assist in the risk assessment and control of MSD risks.

Resource	Number of respondents	Percentage of respondents
HSE Manual handling operations regulations 1992	53	60%
Checklist developed in house	49	56%
HSE five steps to RA leaflet	48	55%
Health and Safety (Display Screen Equipment) regulations 1992	48	55%
HSE Manual handling assessment charts (MAC)	37	42%
HSE HSG60 Work related upper limb disorders: a guide to prevention	23	26%
Checklist provided by external consultant/advisor	19	22%
Quick Exposure Check (QEC)	6	7%
NIOSH lifting equation	5	6%
Rapid Upper Limb Assessment (RULA)	1	1%
Don't know	2	2%

People responsible for conducting the risk assessments

In response to the question ‘Who conducts the risk assessments for musculoskeletal risks?’ 47 out of 74 respondents (64%) reported that the person responsible for health and safety conducted risk assessments of MSDs, i.e. the Health and Safety Officer or Manager. This was followed by ‘Supervisors’ (43%) and then ‘Health and Safety Representatives’ (42%) and ‘Managers’ (41%).

Table 4.5. Number and percentage of respondents and who they reported who conducts MSD risk assessment in their workplace

	Number of respondents	Percentage of respondents
The health and safety officer/manager (person responsible for health and safety)	47	64
Supervisor	33	43
Health and Safety Representatives	32	42
Manager	31	41
Worker	26	34
External consultant	14	18

27% of respondents reported that none of the assessors of MSD risks had received any training in completing the risk assessment checklist, 45% reported that some of the assessors had received training and 28% reported that all assessors had received training in how to conduct the MSD assessments.

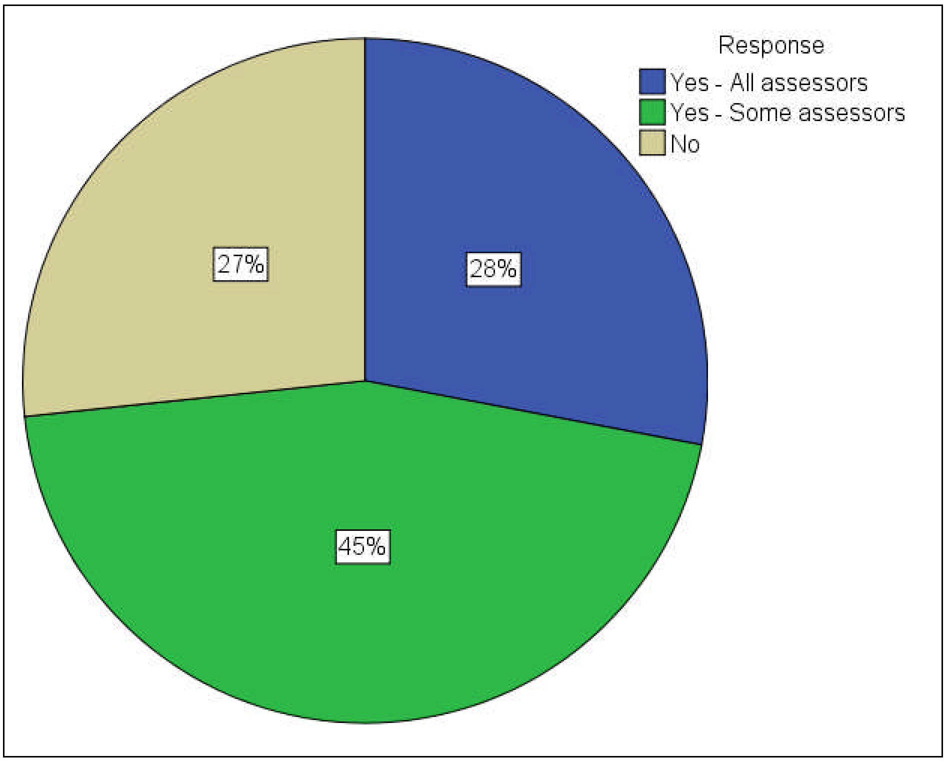


Figure 4.11. Percentage of respondents and their response to whether assessors of MSD risk has received training in how to use the checklist.

4.3.2 Effectiveness of risk assessments for assessing MSD risks

Questions 32 – 37 of the questionnaire required respondents to mark on a scale their level of confidence in the effectiveness of the risk assessment used to assess MSD risk in specific aspects;

- capturing all the risks
- prioritising areas for improvement/action
- differentiating between high, medium and low risk tasks
- correct use
- sufficient time for correct use.

The Likert scale ranged from 0% (not at all confident) to 100% (completely confident) (Figure).

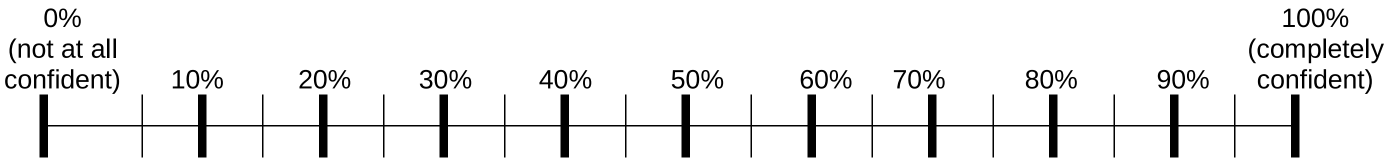


Figure 4.12. Confidence scale

73 respondents completed question 32 - "How confident do you feel that the risk assessment used to assess musculoskeletal risk factors in your company is capturing all the risks?" 23% of respondents were less than 50% confident in the risk assessment used for assessing MSD risks in their workplace. However, 50% of respondents reported 70% or greater confidence in the risk assessments used for assessing MSD risks (Figure).

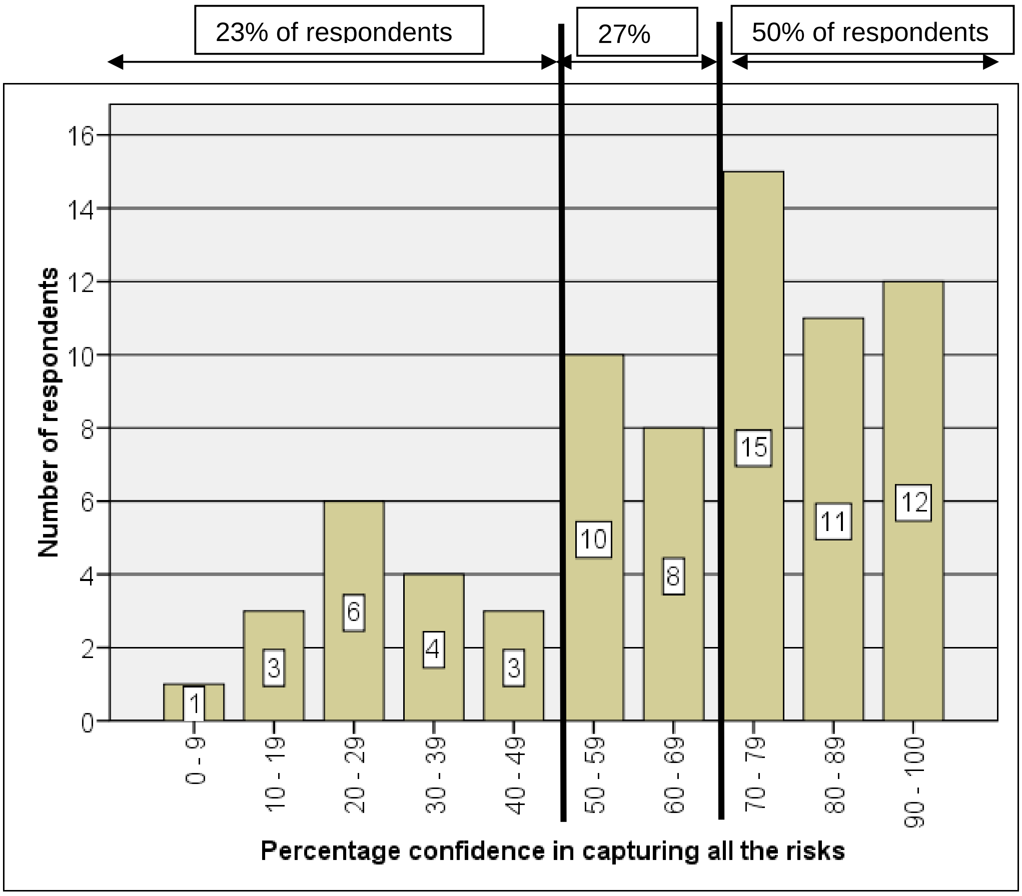


Figure 4.13. Number of respondents and their percentage rating of confidence that the risk assessment is capturing all the risks.

67 respondents completed question 33 - “How confident do you feel that the risk assessment to assess musculoskeletal risk factors in your company is in prioritising areas for improvement/action?” 18 respondents (27%) were less than 50% confident in the risk assessment prioritising areas for improvement/action. 32 respondents (48%) reported having 70% or greater confidence in their risk assessments in providing an output to assist in prioritising action/interventions for improvement (Figure).

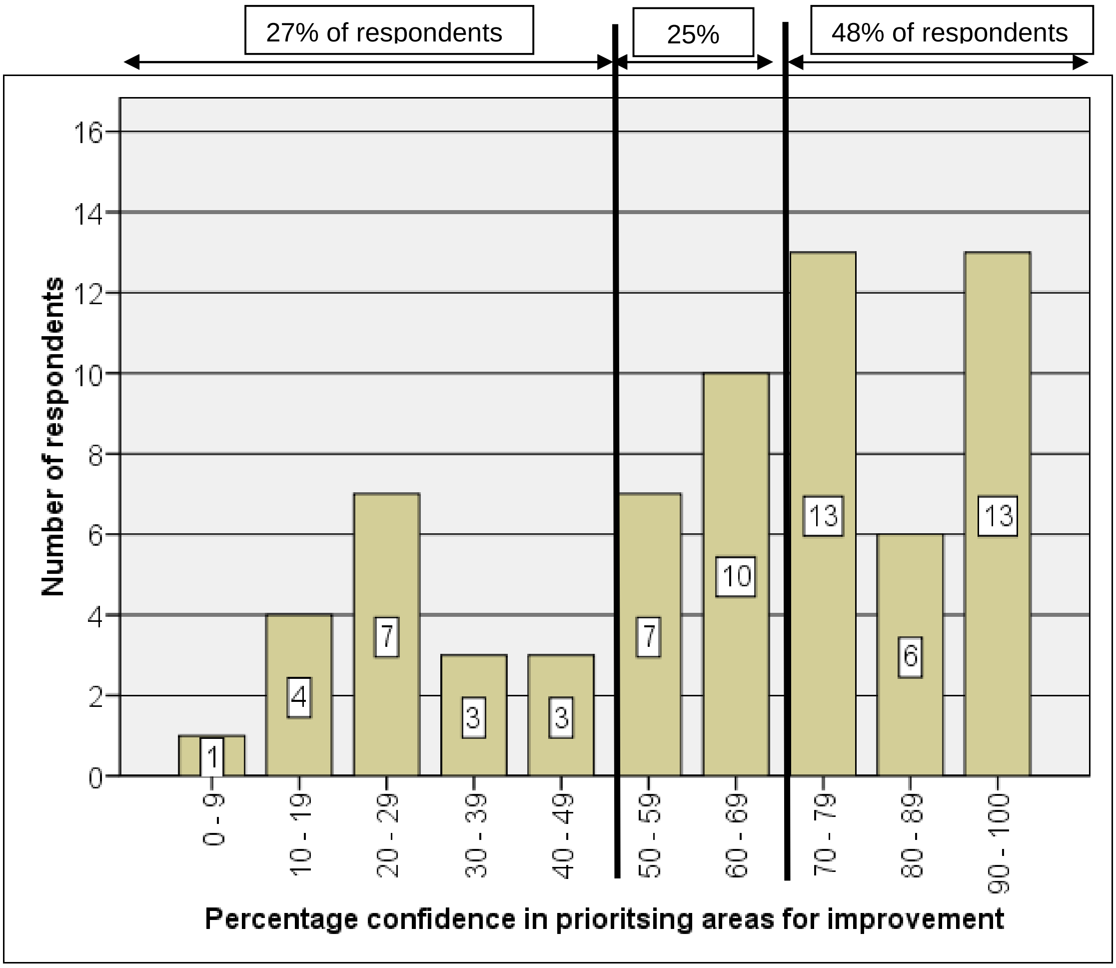


Figure 4.14. Number of respondents and their percentage rating of confidence that the risk assessment prioritises areas for improvement/action.

67 respondents completed question 34 - “How confident do you feel that the risk assessment used to assess musculoskeletal risk factors in your company is accurate in differentiating between high, medium and low risk tasks?” Nine respondents (13%) were less than 50% confident in the risk assessment for differentiating between high / medium and low risk tasks. However, over half of respondents (37 respondents, 55%) reported 70% or greater confidence in the risk assessments for differentiating between high, medium and low risk tasks (Figure 4.15).

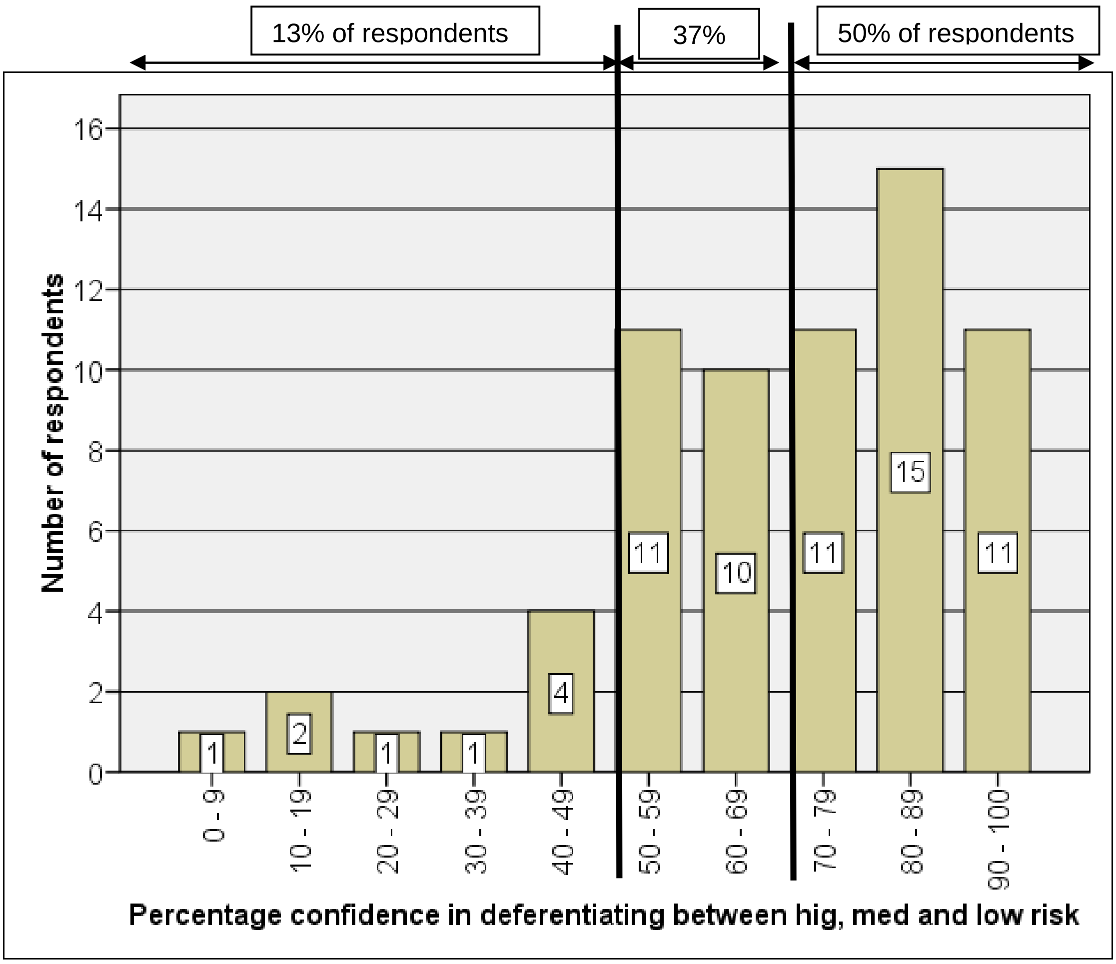


Figure 4.15. Number of respondents and their percentage rating of confidence that the risk assessment is accurate in differentiating between high, medium and low risk tasks.

67 respondents completed question 35 - “How confident do you feel that you (or whoever conducts the risk assessment) are using the musculoskeletal risk assessment correctly?” 13 respondents (19%) were less than 50% confident that whoever conducts the risk assessment is using the musculoskeletal risk assessment correctly. Whereas over half of respondents (36 respondents, 54%) reported 70% or greater confidence that whoever conducts the risk assessment were using the musculoskeletal risk assessment correctly (Figure 4.16).

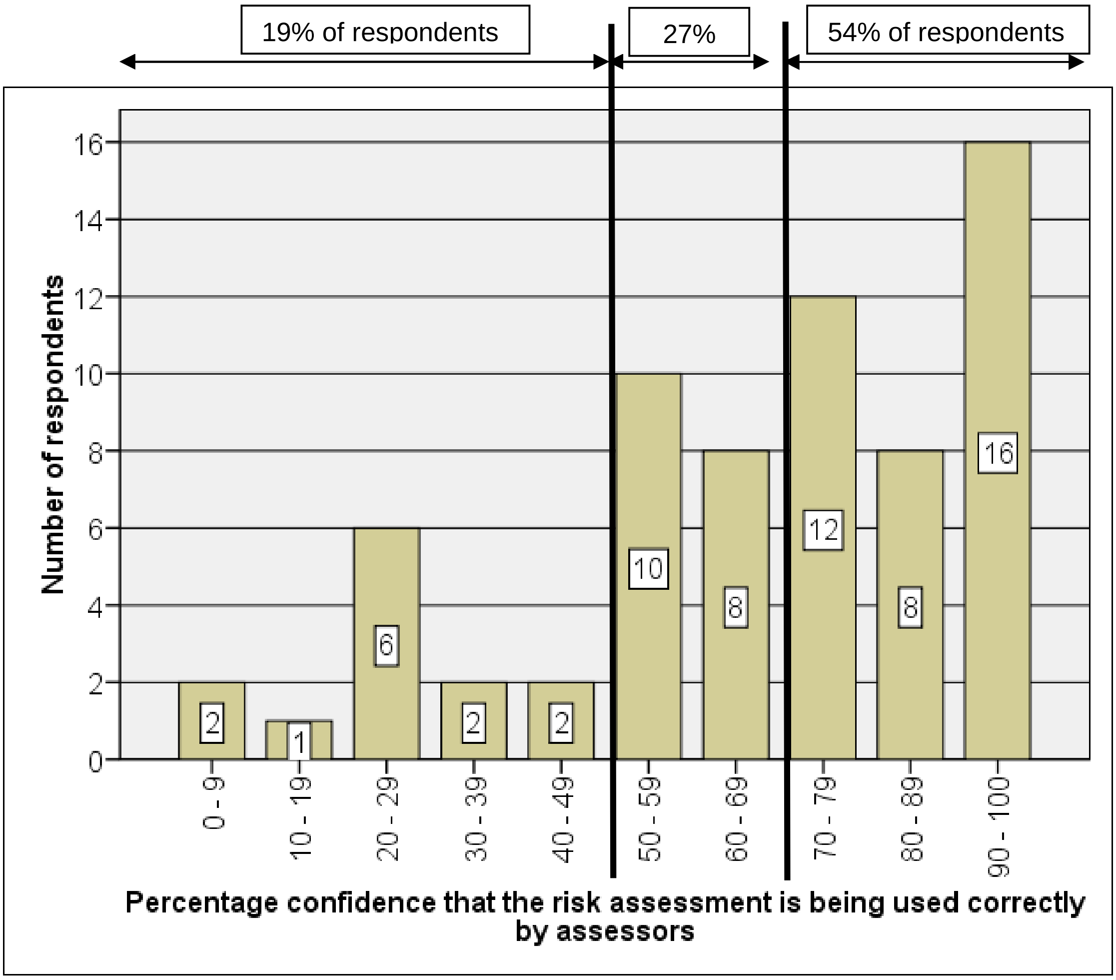


Figure 4.16. Number of respondents and their percentage rating of confidence that the risk assessment is being used correctly.

73 respondents completed question 36 - “How confident do you feel that you (or whoever conducts the risk assessment) have sufficient time to conduct the risk assessment correctly?” 16 respondents (22%) were less than 50% confident that whoever conducts the risk assessment had sufficient time to conduct the risk assessment correctly. Whereas, 36 respondents (49%) reported 70% or greater confidence that whoever conducts the risk assessment had sufficient time to conduct the risk assessment correctly (Figure).

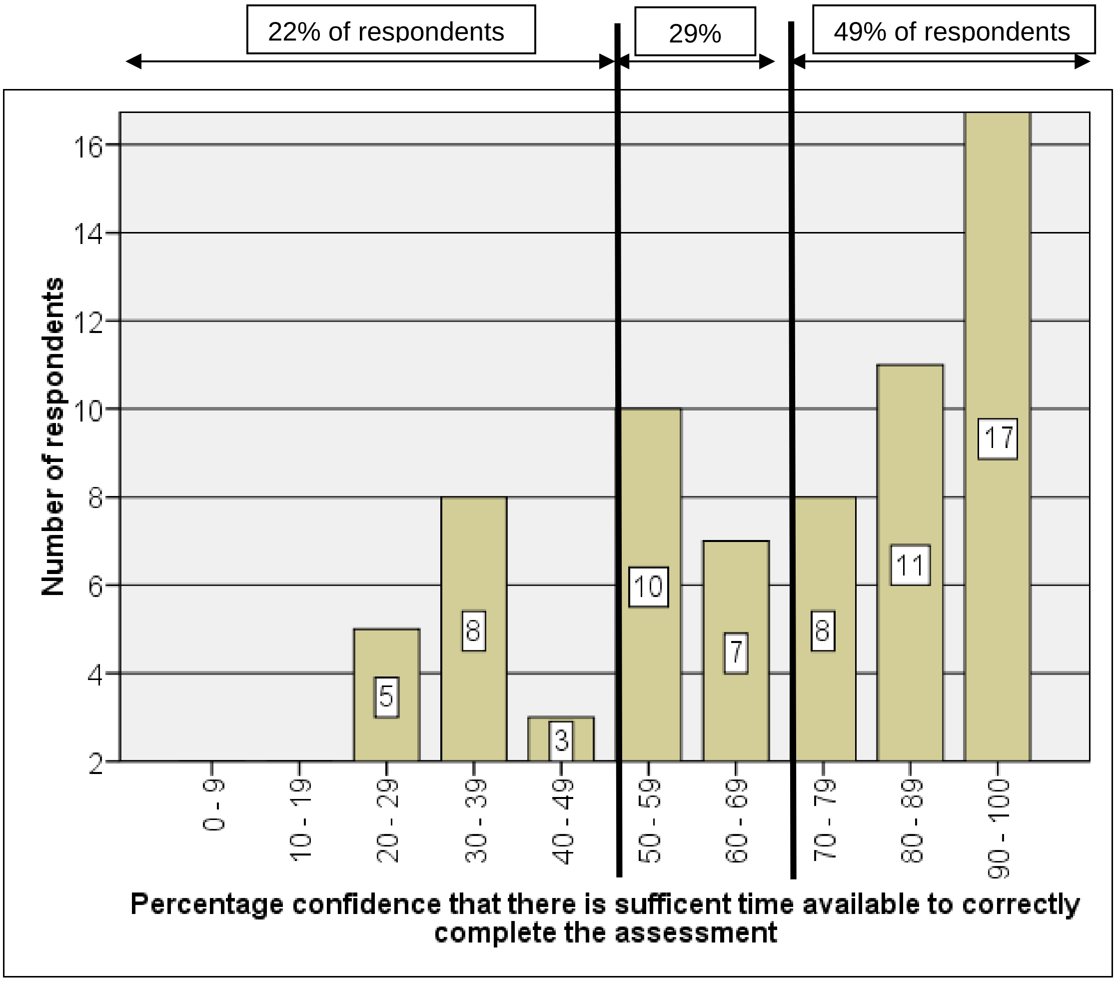


Figure 4.17. Number of respondents and their percentage rating of confidence that whoever conducts the risk assessment) has sufficient time to conduct the risk assessment correctly.

Overall, 7% and 49% of respondents were very satisfied and satisfied (respectively) with the risk assessment that their company used to assess MSD risk. 19% were either dissatisfied or very dissatisfied overall with the risk assessments used by their companies (Figure).

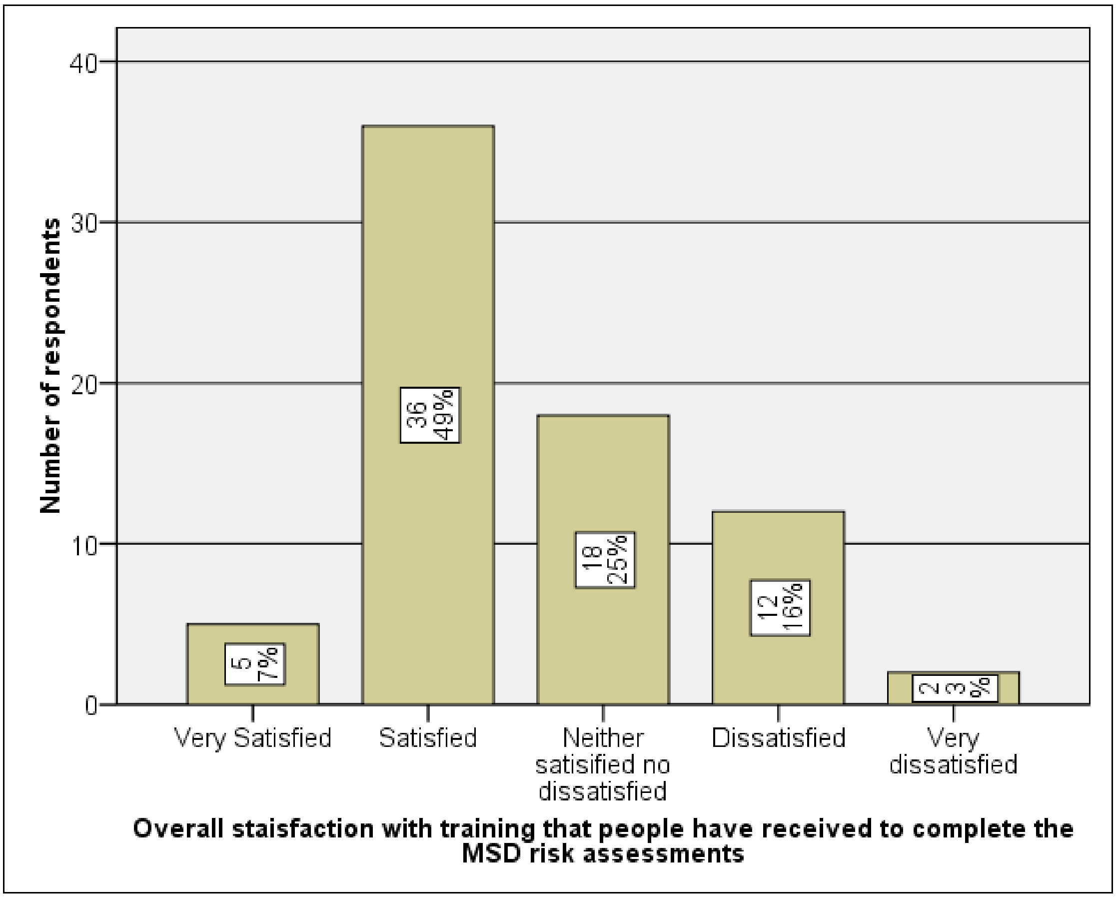


Figure 4.18. Number of respondents and their overall rating of the risk assessment used for assessing MSD risk.

26 respondents reported what they liked most about the risk assessment they currently use to assess MSD risk. A full list of the reported 'most liked' aspects are presented in Appendix B, Question 38. Table6 presents a summary of the aspects respondents liked most. The most liked aspect was that the checklist was straight forward and simple to use. This was followed by improving consistency across assessment and ensuring nothing is missed out and also that best practice/guidance is used to make the assessment.

Table 4.6. Number of respondents and the most liked aspects of their risk assessment used for assessing MSD risks.

Most liked aspects of risk assessments used for assessing MSD risks	Number of respondents
Straight forward and simple to use	8
The checklist ensures that you are following guidance and best practice as it is based on either set of regulations, consultations of best practices and HSE guidance.	3
The checklist makes it difficult to forget to perform any of the required steps and improves consistency across assessments	3
Incorporates a numerical and colour coding score system to highlight high risk manual handling tasks	2
It gets the workers involved	2
It triggers areas to check	1
Easy to demonstrate results	1
Requires little training	1

23 respondents provided dislikes about the risk assessment they use to assess MSD. A full list of the likes and dislikes are presented in Appendix B, Question 39. Table presents a summary of the aspects respondents disliked. The most commonly reported dislike was the time taken to conduct the assessments. This was followed by difference in ratings between assessors due to differences in level of understanding.

Table 4.7. Number of respondents and the most disliked aspects of their risk assessment used for assessing MSD risks.

Most disliked aspects of risk assessments used for assessing MSD risks	Number of respondents
Time	6
There are difference between assessors and their level of understanding. Very subjective.	2
Often not completed correctly or	1
Problems accessing the results from the assessments	1
Could be more comprehensive	1
It is a very involved document and could be trimmed down	1
It’s too simple	1
There is no-where on the form to document how you come to the numerical score. The form doesn’t allow a description on how you come to the score.	1
There are no separate columns for the target dates and responsibilities for each individual action,	1

4.4 Identifying and implementing interventions and actions

Respondents were asked to rate the level of likelihood that once musculoskeletal risks have been identified, then changes to reduce the risk will be also identified. 49 respondents answered this question. 25 of the respondents (51%) reported that it was 80-100% likely that changes to reduce the risk would be identified, whereas 11 respondents (22%) reported that the likelihood was between 30% and 59%.

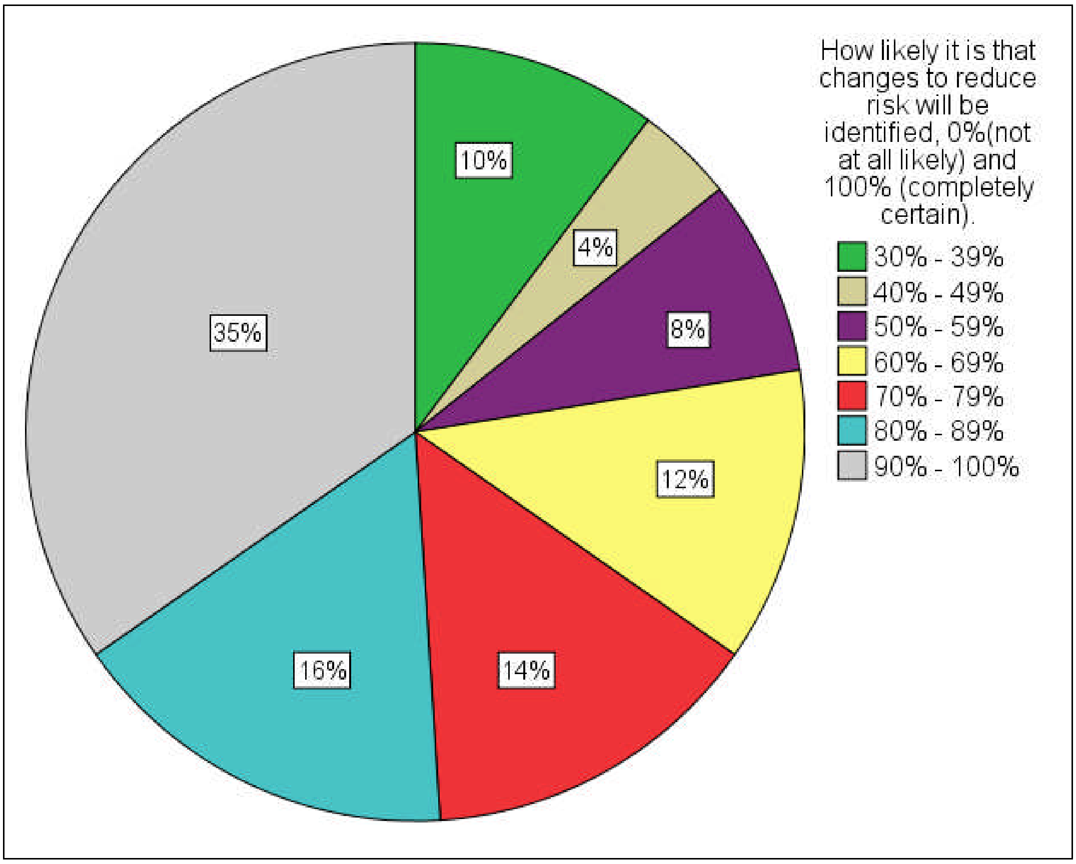


Figure 4.19. Percentage of respondents and their percentage rating of how likely it is that changes to reduce the risk will be identified.

Respondents were asked to rate the level of likelihood that ‘once musculoskeletal risks have been identified, how likely is it that changes to reduce the risk will be Implemented?’ 83 respondents answered this question. Just under half of respondents (37 respondents (45%)) reported that it was 80-100% likely that changes to reduce the risk would be implemented. 17 respondents (20%) reported that the likelihood was be between 0% and 59%.

Of those 83 respondents who answered question 34, 74 respondents provided additional information regarding the types of obstacles encountered. Table presents a summary of the main reported obstacles to implementing action/controls. Full comments are presented in the table in Appendix B, Question 43. The most reported obstacle was cost (34 respondents) followed by employees attitudes and resistance to change (19 respondents) and then time (11 respondents) (Table).

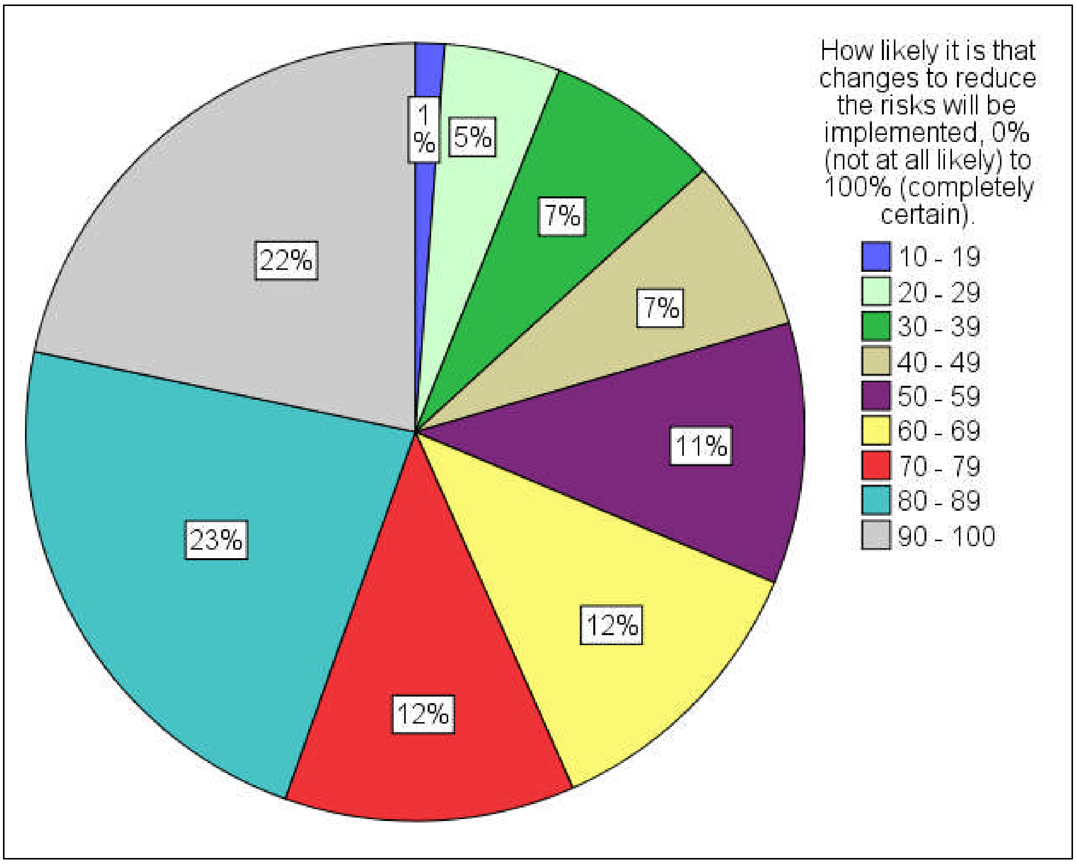


Figure 4.20. Percentage of respondents and their percentage rating of how likely it is that changes to reduce the risk will be implemented.

Table 4.8. Number of respondents reporting the following main obstacles to implementing change/intervention to reduce the risk of MSDs.

Main obstacles	Number of respondents	Percentage %
Cost	34	41
Employee attitudes and resistance to change	19	23
Time	11	13
Enforcing changes	4	5
Communication with employees and management	4	5
Training	4	5
Finding / identifying solutions	3	4
Awareness	2	2
Changes to production	2	2
Space	2	2
Customer requirements	2	2
Language (foreign workforce)	1	1
Flexible labour force with frequent changes in staff	1	1

4.5 Involvement of the workforce

Supervisors

Over half of all respondents (49 out of 74, 66%) reported that supervisors were involved in the risk assessment of musculoskeletal disorders. 23 respondents (31%) reported that supervisors were not involved in the assessment process (Figure 4.1).

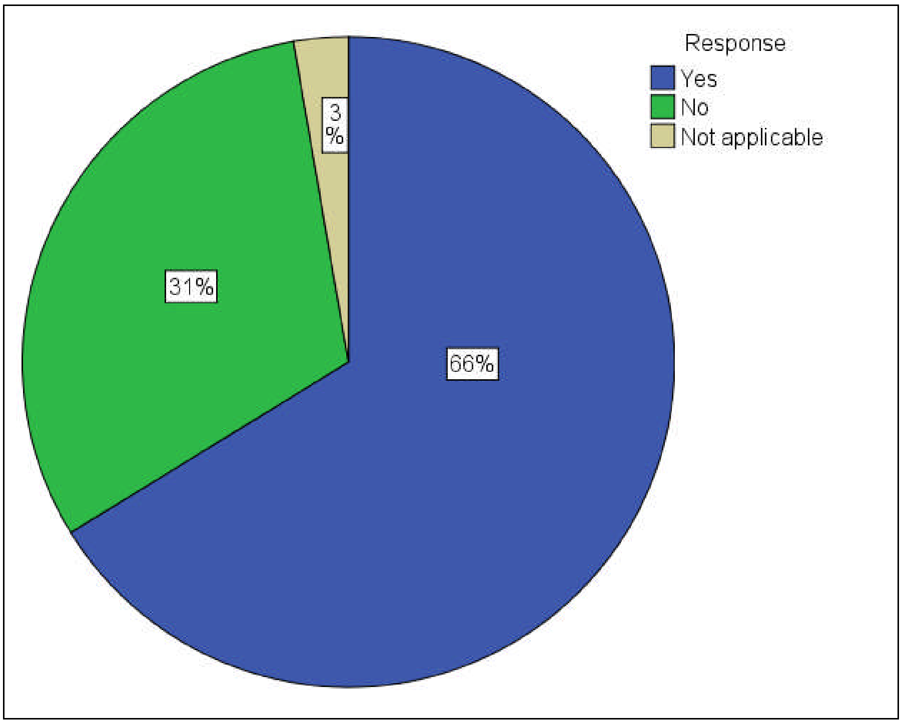


Figure 4.1. Percentage of respondents and their responses to whether supervisors were involved in the risk assessment of musculoskeletal disorders.

Of those 49 respondents that reported that supervisors were involved in the risk assessment of musculoskeletal disorders 46 respondents provided more information on how the supervisors were involved. Table 4.9 presents a summary of the main ways in which supervisors were reported to be involved in the assessment of MSD risks. Appendix E, Question 27 presents the full comments. The most commonly reported way in which supervisors are involved was “Supervisors advise and provide information on the type of tasks conducted”. This was reported by 11 respondents.

Table 4.9. Summary of main ways in which supervisors are involved in the risk assessment of MSDs.

Responses	Number of respondents
Supervisors advise and provide information on the type of tasks conducted	11
Supervisors conduct the risk assessments	8
Supervisors assist with and/or are consulted during the assessment	8
Supervisors are part of the risk assessment team	6
Supervisors are trained and conduct the risk assessments	5
Supervisors are given the results and the recommendation for improvement actions.	4
Supervisors expected to ensure recommendation / action are implemented and followed.	4
Supervisors report any problems	3
Supervisors are made aware of the results from the risk assessments	3
Supervisors are consulted regarding control measures/changes	2
Supervisors review any control that are implemented following an assessment	2

Workers (Operatives/shop floor workers)

Over half of all respondents (50 out of 75, 67%) reported that workers were involved in the risk assessment of musculoskeletal disorders. The remaining 25 respondents (33%) reported that workers were not involved in the assessment process (Figure).

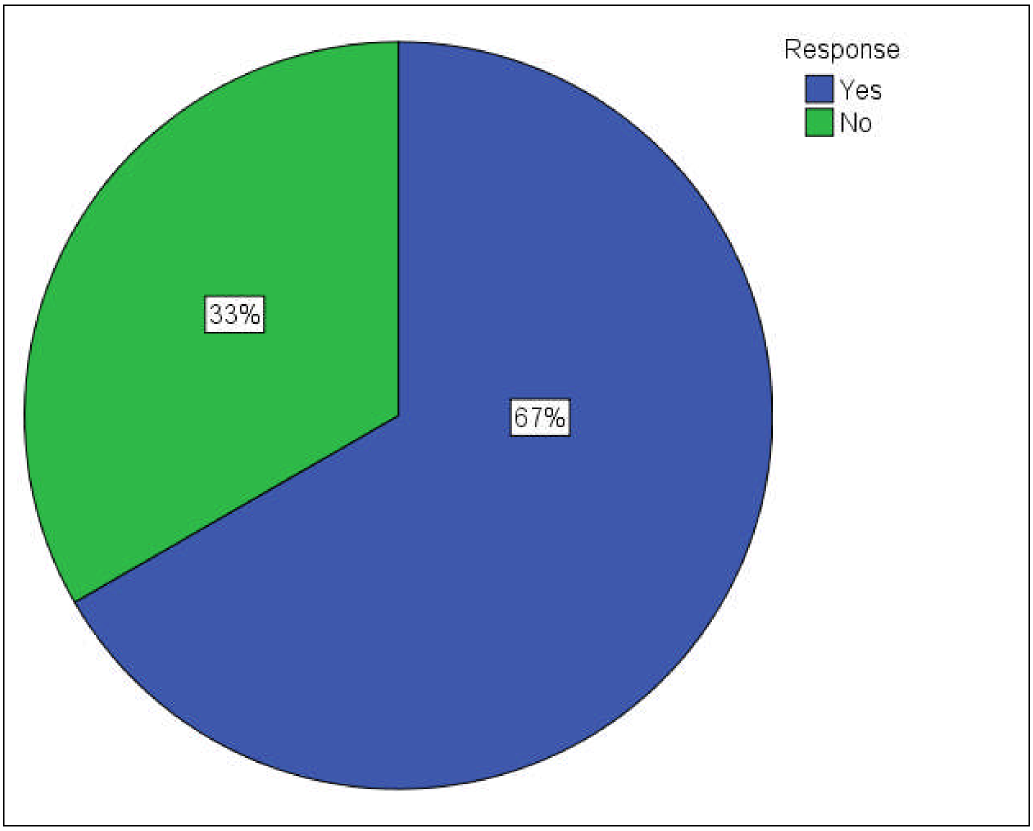


Figure 4.22. Percentage of respondents and their responses to whether workers were involved in the risk assessment of musculoskeletal disorders.

Of those 50 respondents that reported that workers are involved 42 provided more information on how the workers are involved. A summary of the main ways in which workers are involved in the assessment of MSD risks is presented in Table 4.10. Full comments are presented in Appendix B, Question 28. The most commonly reported way in which workers are involved was “Workers are consulted and provide information on the type of tasks/postures conducted”. This was reported by 17 respondents.

Table 4.10. Summary of main ways in which workers are involved in the risk assessment of MSDs.

Responses	Number of respondents
Workers are consulted and provide information on the type of tasks/postures conducted	17
Some workers are part of the risk assessment team	7
Workers are invited to assist the assessment	6
Workers are consulted and asked to report any problems	3
Some workers conduct the risk assessments	3
Workers are trained to identify/understand the risks	2
Workers can put forward suggestions for improvement	2
Workers are made aware of the results from the risk assessments	2
Workers are trained and conduct the risk assessments	1
Workers are consulted regarding control measures/changes	1

4.6 Support towards health and safety activities

Questions 21a to 21d asked respondents to mark on a percentage scale the level of perceived support they gained from different members of staff for health and safety initiatives and activities to address MSDs. The scale ranged from 0% (no support) to 100% (complete support), see Figure. The following section presents the results for perceived support received from;

- workers
- supervisors
- managers
- engineers/equipment designers.

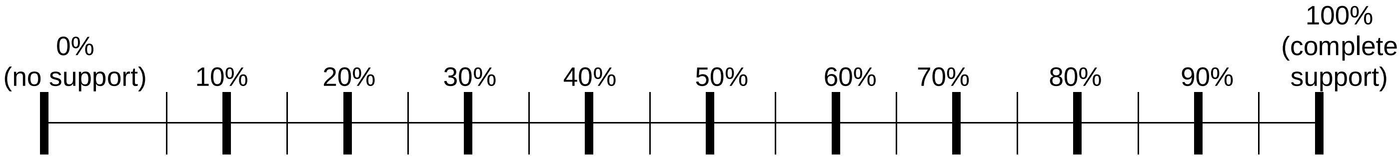


Figure 4.23. Support scale

Respondents from small companies reported a higher mean percentage value of support was gained from manager and supervisors than medium and large companies (Table 4.11). Small, medium and large companies all reported similar mean levels of support from workers and engineers, ranging from mean values of 42% to 65% level of support (Table 4.11).

Table 4.11. Mean, minimum and maximum percentages of support reported to be gained from worker groups in small, medium and large companies

		Supported by			
Company size		**Workers**	**Supervisors**	**Management**	**Engineers & equipment designers**
Small (1 to 49)	Number of respondents	21	18	20	17
	Mean %	54	71	70	57
	Minimum %	10	20	0	0
	Maximum %	100	100	100	100
Medium (50 to 299)	Number of respondents	23	23	22	21
	Mean %	54	58	60	65
	Minimum %	10	20	10	10
	Maximum %	95	90	100	90
Large (300 or more)	Number of respondents	39	39	40	38
	Mean %	56	44	53	42
	Minimum %	2	10	10	0
	Maximum %	100	90	90	80

Support from workers

31 out of 83 respondents (37%) reported that they felt more than 70% supported by the workers in health and safety maters, whereas 29% felt less than 50% supported. The remaining 34% felt between 50% and 69% supported (Figure 4.24).

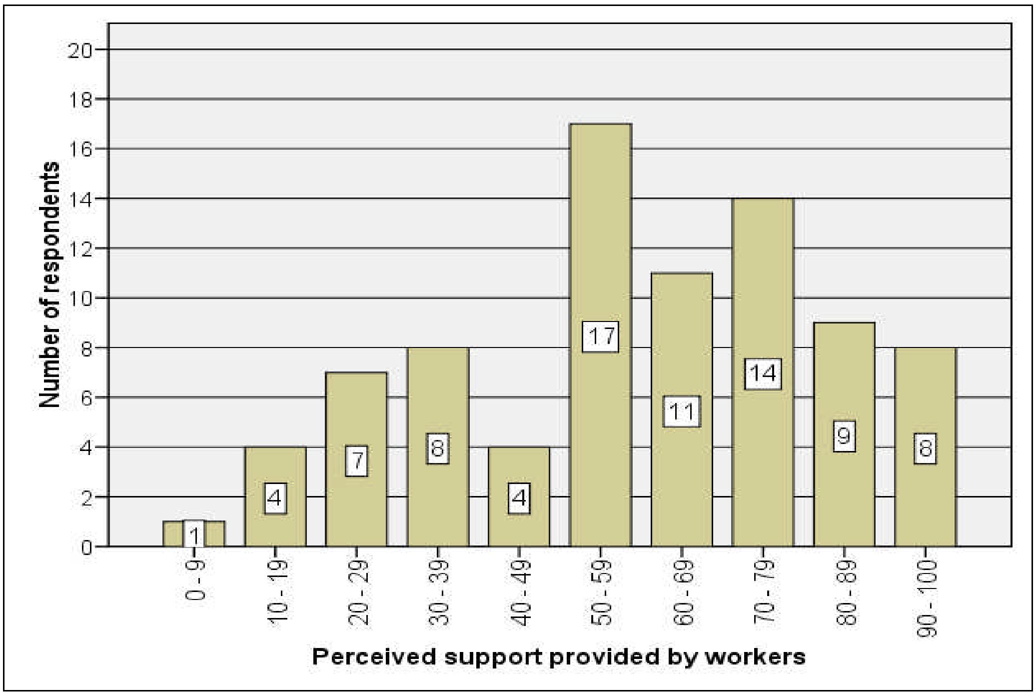


Figure 4.24. Percentage of respondents and the percentage of perceived supported received from workers.

Support from supervisors

27 out of 80 respondents (34%) reported that they felt more than 70% supported by supervisors in health and safety matters, whereas 39% felt less than 50% supported. The remaining 27% felt between 50% and 69% supported (Figure).

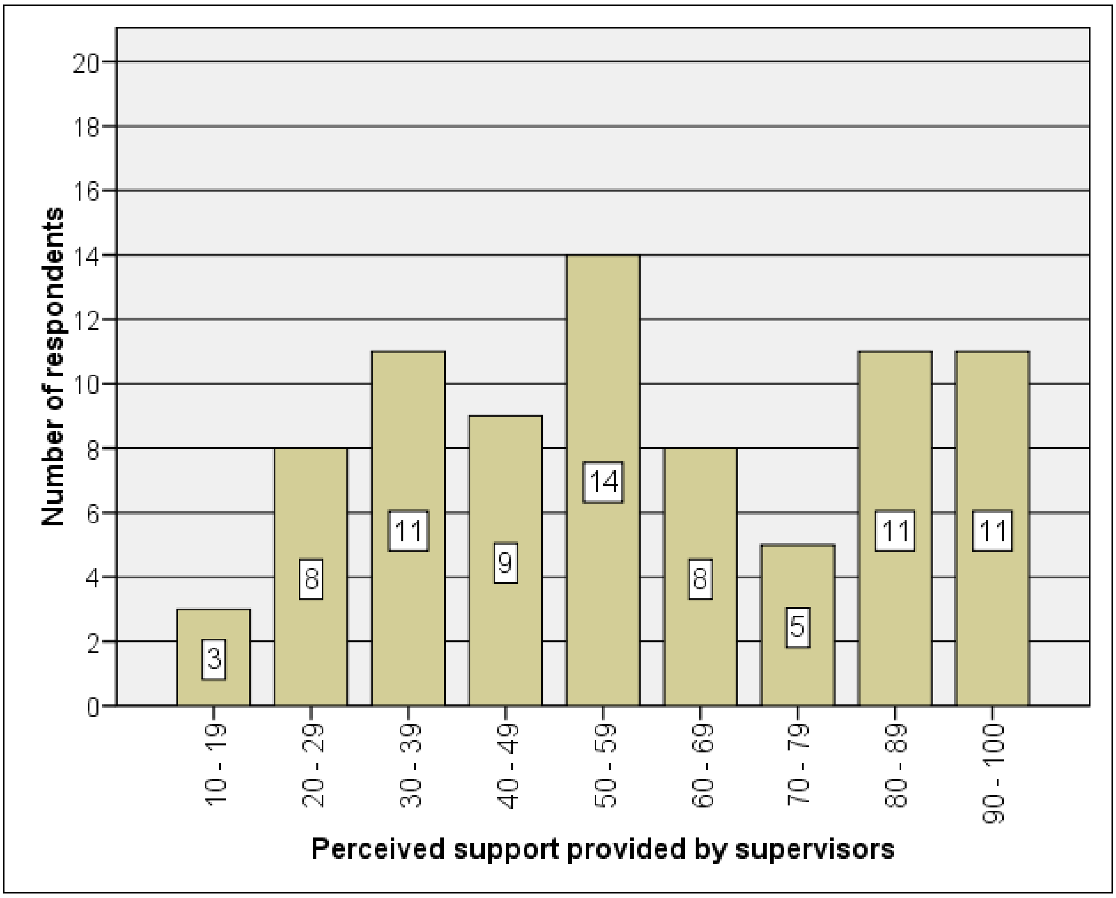


Figure 4.25. Percentage of respondents and the percentage of perceived supported received from supervisors.

Support from managers

37 out of 82 respondents (45%) reported that they felt more than 70% supported by managers in health and safety matters, whereas 32% felt less than 50% supported. The remaining 23% felt between 50% and 69% supported (Figure 4.26). It should be noted that analysis based on company size shows that small companies reported the greatest number of respondents reporting high percentage of support. This may be due to the respondents from small companies tending to be the managers and therefore this result may be skewed slightly in a positive direction. Table 4.12 shows the level of reported support split by company size.

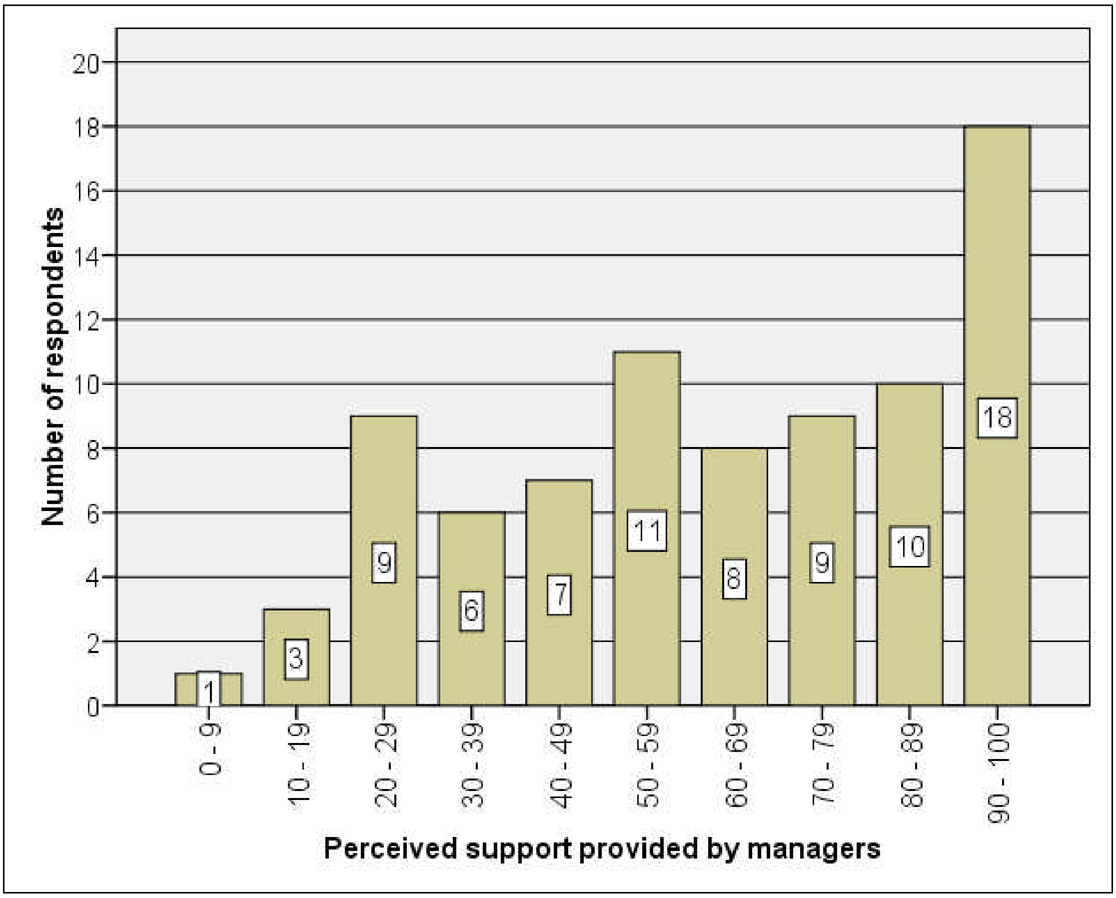


Figure 4.26. Percentage of respondents and the percentage of perceived supported received from managers.

Table 4.12. Percentage of respondents from different sized companies and the percentage of perceived supported received from managers.

	Company size					
	Small (1 to 49)		**Medium (50 to 299)**		**Large (300 or more)**	
	Count	**Percent**	**Count**	**Percent**	**Count**	**Percent**
0 – 9%	1	5	0	0	0	0
10 – 19%	0	0	2	9	1	3
20 – 29%	2	10	2	9	5	13
30 – 39%	1	5	1	5	4	10
40 – 49%	2	10	2	9	3	8
50 – 59%	0	0	2	9	9	23
60 – 69%	1	5	2	9	5	13
70 – 79%	0	0	2	9	7	18
80 – 89%	3	15	4	18	3	8
90 – 100%	10	50	5	23	3	8
TOTAL	**20**	**100**	**22**	**100**	**40**	**100**

Support from engineers/equipment designers

32 out of 76 respondents (42%) reported that they felt more than 70% supported by engineers/equipment designers in health and safety matters, whereas 37% felt less than 50% supported. The remaining 21% felt between 50% and 69% supported (Figure 4.27).

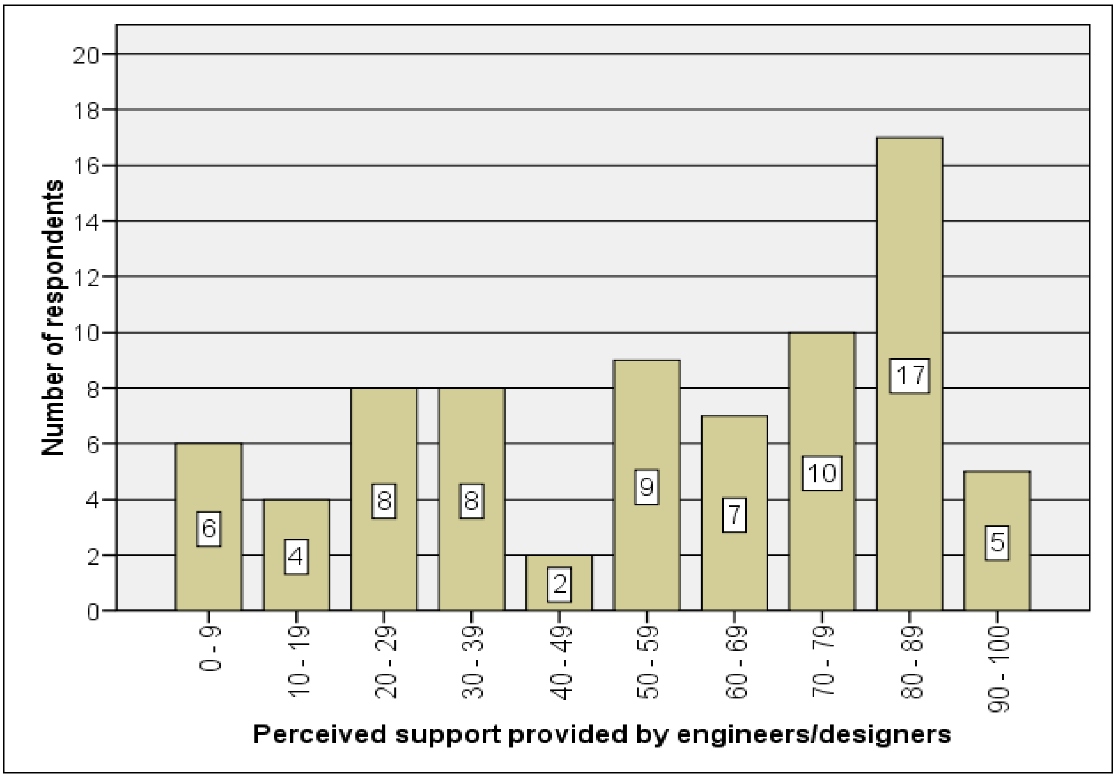


Figure 4.27. Percentage of respondents and the percentage of perceived supported received from engineers/equipment designers.

4.7 Summary of survey results

Training

- 77% of respondents (41/53) had received specific risk assessment training. Nearly all persons responsible for health and safety in large and medium sized companies had received specific training in risk assessment whereas less than 50% of persons responsible for health and safety in small companies had received specific training in risk assessment.
- A significantly greater percentage (93%, 13/14) of respondents from medium sized companies attended risk assessment training courses that included assessing MSD risks than small or large companies (67% and 53% respectively).

- 27% of respondents (20/74) reported that none of the assessors of MSD risks had received any training in completing the risk assessment checklist, 45% (33/74) reported that some of the assessors had received training and 28% (21/74) reported that all assessors had received training in how to conduct the assessments.

Assessing tasks for MSD risks

- 64% of respondents (47/74) reported that the person responsible for health and safety who conducted risk assessments of MSDs was the Health and Safety Officer or Manager. This was followed by 'Supervisors' (43%, 32) and then 'Health and Safety Representatives' (42%, 31) and 'Managers' (41%, 30).
- 27% (22/82) reported that **all** work tasks had been assessed for MSD risks. A greater percentage of medium and large sized companies reported that they had conducted MSD risk assessments for all tasks than small companies (8 medium companies (38%), 10 large companies (27%) and 4 small companies (17%) respectively). 57% (47/82) reported that only **some** tasks had been assessed for MSD risks and 16% (13/82) reported that **no** risk assessments for MSD risks had been conducted.

Type of risk assessment used

- 43% (30/69) reported that all their risk assessments used to assess MSD risks were a checklist based risk assessment. 41% (28/69) reported that only some of their MSD risk assessments used a checklist based risk assessment and 16% (11/69) reported that none of their MSD assessments used a checklist.
- 56% (49/88) of all companies used a checklist that was developed in house to assess musculoskeletal risks.
- The most liked aspect was that the checklist was straight forward and simple to use. This was followed by improving consistency across assessment, ensuring nothing is missed out and also that best practice/guidance is applied to make the assessment.

- The most commonly reported dislike was the time taken to conduct the assessments. This was followed by difference in ratings between assessors due to differences in level of understanding.

Acting on the risk assessment findings - Reducing the risks

- 51% of respondents (25/49) reported that it was 80-100% likely that changes to reduce the risk would be identified, whereas 11 respondents (22%) reported that the likelihood was between 30% and 59%.
- Just under half of respondents (45%, 37/83) reported that it was 80-100% likely that changes to reduce the risk would be implemented. 20% of respondents (17/83) reported that the likelihood was between 0% and 59%. The most reported obstacle was cost (34 respondents) followed by employees' attitudes and resistance to change (19 respondents) and then lack of time (11 respondents).

Involvement of staff in MSD risk assessment

- Over half of all respondents (66%, 49/74) reported that supervisors were involved in the risk assessment of musculoskeletal disorders. The most commonly reported way in which supervisors are involved was "Supervisors advise and provide information on the type of tasks conducted". This was reported by 11 respondents.
- Over half of all respondents (67%, 50/75,) reported that workers were involved in the risk assessment of musculoskeletal disorders. The most commonly reported way in which workers are involved was "Workers are consulted and provide information on the type of tasks/postures conducted". This was reported by 17 respondents.

5 Phase 3 - Findings from the walk through audit

This section presents a summary of the common themes and findings recorded from 15 site visits made to a range of manufacturing companies. The summary highlights comments made by particular companies regarding general risk assessment and MSD risk assessments. Appendix C presents the full results for each company.

Companies are referred to as cases 1 – 15.

5.1 General risk assessment

General risk assessments were conducted at all sites and all demonstrated similar processes. These general risk assessments were typically conducted using a checklist comprising items of general top level risks e.g. handling of chemicals, manual handling, PPE. For every ticked item a reference is provided to a more detailed and specific risk assessment that covers that topic and which needs to be completed- i.e. Manual Handling, Control Of Substances Hazardous to Health (COSHH).

Case studies 6 and 7 commented that the risk assessment process was often seen as just a form filling exercise. Case 12 reported that "People get hung up on completing the checklists correctly rather than implementing the solutions. Sometimes the actual completion of a checklist acts as a deterrent in doing anything to reduce the risks. People tend to think that completing a checklist is the end of the process".

Cases 1 and 3 commented that the benefit of using a checklist based general risk assessment ensured consistency across assessors and different departments. The prompts and checklist items also provided a good 'aid memoir' for assessors to consider all the risks.

Cases 1, 2, 11 and 12, reported that support from upper management on implementing and enforcing action based on risk assessment results was often poor due to lack of understanding and awareness.

Informing staff of the results of risk assessments was reported as problematic in companies that employed a high percentage of migrant workers due to language difficulties. A number of the companies visited are currently investing in getting documentation and training translated and some companies are investigating the increased use of pictorials to present important health and safety information (Cases 3, 7, 8 and 11).

5.2 Musculoskeletal disorder risk assessment

This section focuses on issues raised in relation to risk assessment processes specific to musculoskeletal disorders. During discussions with persons responsible for health and safety a distinction was made between manual handling risk assessments (which were defined as those assessments used to assess tasks which involved lifting, lowering, pushing and pulling of objects) and Upper Limbs Disorders (ULDs) risk assessment which assessed tasks that did not necessarily involve heavy objects but were manually intensive and perhaps repetitive in nature.

5.2.1 Training

Training supervisors

A maximum of 6 companies out of the 15 provided training to supervisors in general, manual handling and ULD basics and risks/hazards (Table 5.1). In Case 9 it was explained that Line Leaders are trained in the hazards and what to look for regarding MSD risk e.g. poor postures. It was stated that this training is undocumented. When the line leaders observe someone adopting a poor working posture or adopting an inappropriate or poor work technique, the line leader will point out their concern to the worker and discuss how to improve their working technique. If it continues they will inform the Health and Safety Manager who will come and observe the tasks and assess the likely cause.

Training the broader workforce (shop floor workers)

Nine out of 15 companies provided manual handling information to workers. Fewer companies (6 out of 15) provided information about ULDs to workers.

The majority of the training given to workers for general health and safety, manual handling and ULDs was provided as part of the induction process (Table 5.1).

Cases 1,2,8,5 and 12 all stated that they would like to have all members of staff at all levels trained to conduct risk assessment for musculoskeletal disorders. Case 2 commented that this would assist in the acceptance of change by the workforce.

Case 12, in particular, had an interesting health and safety training package which forms part of all new workers induction. The training includes basic health and safety information and behavioural health and safety. It is a package that was developed in house but which is delivered at Grimsby College. It is a two hour session and the main part is a board game called 'Risky'. The game presents a series of home and work based scenarios with different risks and outcomes. It is designed to get people thinking about the broader implications of taking risks i.e. effect on them personally and on time etc.

Case 15 has just introduced a new training program in which external trainers come in and train a range of shop floor workers to be trainers in manual handling and ULDs. The contractors will train a small number of shop floor workers in the 'best' working practices (i.e. training the trainers). These shop floor workers will then train the remaining workforce. It is hoped that these individuals will also conduct the assessments in the future. By training workers to be the trainers rather than just giving this role to the supervisors it is hope that this will improve:

- esteem of the workers
- recognition
- assist in combating peer pressure causing the adoption of bad practice by installing peer pressure to conduct good practice
- policing
- empowering the workforce.

Table 5.1 .The number of visited companies and the level of training provided to supervisors and shop floor workers.

	Training received	General health and safety	Manual Handling	ULDs
Supervisors	Basic introduction	2	2	2
	Specific training in identifying hazards/risk factors	1	4	3
	Specific training in conducting risk assessments	2	0	0
	None	4	4	5
	Not provided		4	
Workers	As part of inductions	3	6	5
	Specific training in identifying hazards/risk factors	1	3	1
	Specific training in conducting risk assessments	0	0	0
	None	1	2	5
	Not provided		3	

5.2.2 Types of risk assessment used

All sites visited had a high percentage of repetitive tasks and manual handling tasks that would require some form of ULD or manual handling risk assessment. However, several of the sites visited reported low percentage of tasks as repetitive and tended to report them as manual handling tasks. From observations it became apparent that in most companies the health and safety officer or managers referred to the majority of tasks as manual handling and used manual handling assessment to assess them. There appeared to be a lack of understanding of the difference between manual handling and ULD risk tasks. It was often not recognised that a different assessment for the different types of tasks was required (cases 1, 3, 9, 10, 11).

It was found that a number of companies assessed repetitive tasks (low loads) using the MAC tool or other manual handling lifting assessment tools.

These were inappropriate tools for these types of tasks and therefore a lot of the hazards presented by highly repetitive task were being missed (Cases 8, 2, 1).

ULD assessments

Table 5.2 shows the type of checklists used for risk assessment for ULDs and manual handling. Eight out of the 15 companies do not conduct risk assessment for ULDs (Cases 3, 7, 8, 9, 11, 12, 13, and 14). One company (case 9) reported that assessments of ULDs were currently not being conducted because they were confident that risks would be identified but they were concerned that once identified and recorded they would not know what to do or how to address the risks. They feared they would be ‘opening a can of worms’. Two out of the 15 companies used HSG 60 to assess ULD risks (cases 5 and 6). Four out of 15 companies used checklists that were developed in house to assess ULD risk (Cases 1, 2, 10, 15). Case 10 used assessments that were made four years ago by a consultant to predict the risks presented by new equipment. They did not complete new and specific assessments but looked for similarities to existing equipment and applied their risk assessments.

Manual handling assessments

Table 5.2 shows the type of checklists used for risk assessment for manual handling and ULDs. Seven out of the 15 companies used the MAC tool to conduct manual handling assessments (2, 5, 7, 8, 9, 10, and 12). Case 8 commented that they liked the MAC tool because it was consistent and not subjective. Case 12 reported problems with this tool regarding the number of assessments required. The health safety manager pointed out that the MAC tool is seen as specific to the individual rather than the task and because there are a large number of staff it is unpractical to complete an assessment for every individual. Case 6 commented that the MAC tool is poor for assessing tasks which involve pushing and pulling.

Table 5.2. Type of checklists used for risk assessment for Manual handling and ULDs.

		Manual Handling	ULDs
Yes - all	**In-house developed checklist**	2	0
	Standard checklist	1 (MAC)	2
Yes - some	**In-house developed checklist**	4	4
	Standard checklist	6 (MAC)	0
None		0	8
Information not provided		2	1

5.2.3 Involvement of staff in MSD risk assessment

Cases 4 and 5 commented that staff are involved, and encouraged to get involved in all risk assessments. Case 8 stated that recently the company has provided funding to train up a greater number of staff in risk assessment and the health and safety officer wanted to use the funding to focus on MSDs.

Cases 1 and 12 reported that they would ideally like a greater number of the workforce involved in the assessment process. Case12 stated that "The Company has a new Operation Director who is very keen on health and safety and they are acting as main driving force for new developments in health and safety. The Operations Director wants people on the shop floor to get more involved in the risk assessment process and would like the responsibility to shift to the supervisors, production managers and to the workers themselves. The Health and Safety Manager supports this and commented involving and training workers in more specific risk assessments such ULDs would improve worker understanding of the risks".

Case 4 commented on their concerns regarding older staff and tackling ingrained bad habits. It was reported that company incidents involving older staff were particularly high. The Health and Safety Manager reported that the older staff find it difficult to switch to new and safer work routines.

This company has initiated a training programme to address these issues which is targeted at this group of staff.

Case 8 highlighted a negative aspect and concern for involving non health and safety trained staff in assessing risk. They provided an example where in the past a supervisor conducted risk assessment for manual handling. However it was found that the supervisors tended to under estimate the risks and the method of risk assessment used was very subjective. Now only Health and Safety Officer and Manager conduct assessment and that they now use the MAC tool which is less subjective.

5.2.4 Acting on the risk assessment findings – reducing the risks

Difficulties in identifying solution/controls

Cases 5 and 9 reported that they were able to identify risks but they found it difficult to identify solutions or controls. Because of this case 9 stated that they had not carried out any formal assessment of ULD problems fearing that they would be ‘opening a can of worms’.

Perception of MSDs as a low priority problem

Case 6 explained that the outcomes of MSD injuries are not fatal so there is a tendency for staff and managers to give them a low priority in terms of addressing the risks. Previous risk assessment and prioritising action has tended to focus on prioritising high risk hazards such as COSHH and chemical burns. This prioritising action is based on perception rather than probability and actual frequency rates. The Health and Safety Manager is currently addressing this by showing that manual handling and MSDs need high priority as although they have a relative low severity the frequency rate is high.

Cases 7 and 8 raised their concern that migrant and agency staff could be covering up problems as injury or health problems may be going unreported. Short term staff may leave due to problems but this is data is currently not collected.

Worker resistance to change

Several companies (Cases 2, 8, and 15) commented that worker's resistance to change was the main obstacle to successfully implementing changes to reduce risks. Furthermore, Cases 2 and 8 commented that workers are currently aware of the risks posed by current working practices but they are happy to accept them. Case 12 reported that one of the obstacles to implementing changes or new initiatives was convincing staff that the changes were for their benefit and not the company's.

A few companies had taken different approaches in an attempt to reduce workers resistance to change. Case 11 reported that they now always involve staff (the end users) in equipment selection and where ever possible ask for a trial period before making a purchase. However of several occasion this had resulted in equipment being selected by workers and approved by workers (after a trial period) but as soon as the equipment was purchased workers refused to use it. The Health and Safety Officer was unclear why this was and was now looking at methods of enforcement. Case 15 reported on a new scheme to train up shop floor workers (long established staff) to become trainers in musculoskeletal issues and correct working practices. This was attempting to give ownership to the new working methods and also to combat peer pressure and macho cultures which sought to retain old working practices.

Culture (macho and performance pride)

Case 6 reported that it was the 'macho culture' regarding manual handling that makes the adoption of new practices very difficult and often unsuccessful. Macho culture was reported as resulting in staff ignoring recommended lifting practices to outdo, or outperform, colleagues. Similarly, Case 15 reported that work pride was an issue, with staff being determined to meet deadlines even though management accepted that certain deadlines could not always be met due to outside problems i.e. traffic and delivery problems. However, in an effort to make up time to still meet deadlines staff pressurise themselves to work at faster rates, which is often at expense of safety.

Enforcement of correct or good working practices

Case 12 reported that they use enforcement to ensure safe working practices are adopted. Case 12 stated that there are disciplinary procedures that team leaders can follow to ensure that workers engage in safe working practices and also where required that workers perform set exercises and take rest breaks. However supervisors often fail to implement disciplinary actions to ensure safe working practices. This is primarily due to team leaders not wanting to damage relationships within teams. Team leaders are often members of staff that have been promoted internally and therefore tend to have strong friendships within their teams and are unlikely to conduct disciplinary actions.

Communication

Informing staff of the results from risk assessment was reported as problematic in companies that employed a high percentage of migrant workers due to language difficulties. A number of the companies visited are currently investing in getting documentation and training translated and some companies are investigating the increased use of pictorials to present important health and safety information (Cases 7, 8, and 11).

Contract demands from clients

Several companies commented on the impact from clients demands. In order to win contracts large clients specify a range of criteria to which the companies must perform. They are also very specific as to how the process should be run and how the output should be presented or packaged. Several companies reported that this places constraints on health and safety interventions which can be implemented. It was stated that it is often difficult to design work to the benefit of the workers as this is normally at the expense of losing a client. The criteria set by the client are of highest importance. The criteria very rarely include health and safety.

Case 15 provided an example where the client's specification for how the product must be delivered dictated the processes the company could use.

Previously the company lines had been automated to remove a high percentage of the repetitive and manually intensive work conducted by staff. This resulted in automated packing of products into large shelving containers. However due to the clients demands for delivery of the same number of products but in smaller units workers were required to repack off the automated process thereby turning it from an automated process back again into a heavily manually intensive task.

Case 12 reported that the industry is very strongly driven by the main clients such as Tesco's, ASDA etc who conduct audits of all their suppliers to ensure suppliers are using good practice. This has significantly increased the budget given for food safety. There are 25 food safety technical staff to ensure good practice and standards compared to only one health and safety member of staff. The Health and Safety Manager stated that if clients included health and safety work practice in their audit funding then resources for health and safety would significantly increase.

Similarly suppliers also have an impact on health and safety by dictating how work has to be performed. Cases 7 and 11 provided examples regarding deliveries. Case 7 and 11 receive deliveries of fresh produce which comes on trolleys where the products are stacked often above shoulder and head height. This is to maximise the use of space in transport lorries at the expense of greater manual handling difficulties at the receiving company.

Requirements from clients may change the situation. It was reported that customers such as Tesco use 'environment' as a criteria for filtering who gets a contract. It was commented that if they placed empathise on health and safety as a criteria, funding would soon become available to resource new initiatives and equipment. Case 15 is currently trying to get funding by placing an environmental twist to the reason for change and return back to using their fully automated system. Case 4 stated that this already happens in their industry and that to gain contracts from particular clients they have to demonstrate good health safety policies and practices.

Cost

Case 2, 11 and 12 reported that cost was an issue for installing solutions to reduce risks and that often management commitment to making changes was poor. Case 2 stated that the cost of solutions was often too great when they are already working to tight margins. Cases 11 and 12 reported that the cost of purchasing new equipment or training courses to solely improve health and safety was difficult to justify to senior management or company directors as there is nothing to illustrate the reduction in cost unless an accident has already occurred.

Paper based exercise

Often risks are identified but no changes are made. Case 12 commented that people get hung up on completing the checklists correctly rather than implementing the solutions. It was stated that sometimes the actual completion of a checklist acts as a deterrent in doing anything to reduce the risks. People tend to think that completing a checklist is the end of the process.

6 Phase 2 and 3 - Summary and discussion

The results from Phases 2 and 3 provide a snapshot of current risk assessment processes used in the manufacturing industry. The results show that for those responding companies, checklists are the predominant format of, and method for, assessing risks at a general level and for conducting more specific risk assessment such as MSDs. The most reported positive aspects for using checklists were that they were straight forward and simple to use, that they provided a consistent means of assessing tasks and that they employed best practice or guidance. The most commonly reported dislike was the time taken to conduct the assessments, followed by difference in ratings between assessors due to differences in level of understanding.

Findings from the audit walk through showed that all companies used a similar format of checklist for conducting general risk assessment.
Typically comprising items of general top level risks i.e. handling of chemicals, manual handling, PPE which then provided a reference to a more detailed and specific risk assessment which needed to be completed- i.e. Manual handling, Control Of Substances Hazardous to Health (COSHH).

Results from the questionnaire revealed that just over half of all responding companies (56%) used checklists that had been developed in house to assess MSD risks, 42% reported using the MAC tool for specifically assessing manual handling tasks and 60% reported using HSE manual handling operations regulations as a resource to assist in making assessments. In comparison only 26% of companies reported using HSE the publication ‘HSG60 Work related upper limb disorders: a guide to prevention’ as guidance to preventing upper limb problems.

This difference in figures regarding the use of manual handling and ULD assessment resources is reflected in findings from the walk through audit which suggests that there are issues relating to understanding and distinguishing between manual handling tasks and manually intensive tasks.

All sites visited during the walk through audits (Phase 3) had a high percentage of repetitive tasks and manual handling task that would require some form of ULD or manual handling risk assessment. However, several of the sites visited reported a low percentage of tasks as repetitive and tended to report them as manual handling tasks and consequently used manual handling assessment to assess them. It was found that a number of companies assessed low load repetitive tasks using the MAC tool or other manual handling lifting assessment tools. This was found to be inappropriate for the type of tasks to which they had been applied and may therefore have resulted in the hazards of highly repetitive tasks being missed.

Although a high percentage of respondents reported using checklist based risk assessments to assess MSDs only a few had conducted some form of assessment of **all** work tasks (27%).

In comparison, 57% reported that only **some** tasks had been assessed for MSD risks and 16% reported that **no** risk assessments for MSD risks had been conducted. Results from the walk through audit provided an insight into one of the reasons this might be, with several companies commenting that they had not conducted assessments as they were confident that they would identify risks but that they had no idea how to address those risks once they had been formally identified.

A large proportion of the participating companies (64%) reported that the person responsible for health safety conducted risk assessments of MSDs, i.e. the Health and Safety Officer or Manager. This was followed by ‘Supervisors’ (43%) and then ‘Health and Safety Representatives’ (42%) and ‘Managers’ (41%) and workers (34%). Only some of these individuals conducting the assessment had received specific training in their use. Of the companies that reported that risk assessment of MSDs had been conducted, 27% used the checklist as a standalone tool in which no training in their use had been provided to assessors. Additionally, 27% had provided training to the assessors in how to conduct the assessments using the supplied checklist and 45% reported that only some of the assessors had received training.

The walk through audit showed that up to 6 companies out of the 15 provided training to supervisors in general health and safety, manual handling and ULDs but this did not include conducting risk assessments. Nine out of 15 companies provided information on manual handling to workers and fewer companies (6 out of 15) provided information about ULDs to workers. The majority of the training given to workers for general health and safety, manual handling and ULDs was provided as part of the induction process and just provided a brief overview. Discussion with companies during the walk through audit showed that several companies wanted to have all members of staff at all levels trained to conduct risk assessment for musculoskeletal disorders. Case 2 in particular commented that this would assist in the acceptance of change by the workforce.

From the questionnaires it was found that the most reported obstacles to implementing interventions to reduce the risk were cost (41%) followed by employees attitudes and resistance to change (23%) and then lack of time (13%). These results were supported and probed further in the walk through audit which found that the following all acted as obstacles to implementing improvements to reduce risk:

- worker resistance to change
- enforcement of correct/good working practices
- communication
- contract demands from clients
- cost.

It is interesting to note that underlining nearly all of these aspects is the workforce and their awareness and understanding of the problems and risks. One way in which this may be addressed, and which is recognised by most of the participating companies of the walk through audit, is through improving the training and awareness of the workers on the shop floor regarding the risks and to get them actively involved in assessing these risks.

7 Phase 4 and 5 - Methods

This section details the methods employed to achieve the following.

1. Identify design characteristics of risk assessment checklists which are most effective. This was achieved by comparing the ease of completion, subjective opinions and the effectiveness of two different designs of checklist based risk assessments.
2. Evaluate whether accompanying training in the use of the selected checklists is beneficial and whether benefits from training vary for the different designs of checklist. This was achieved by comparing the effectiveness of untrained and trained use of two different designs of checklist based risk assessment.

The first method section (Section 7.1) presents the method employed to select companies and employees to participate in the project. Section 7.2 outlines the development of the two test checklists to be used in the project. Section 7.3 presents the method for the risk assessment trials and section 7.4 outlines the method for the longitudinal study.

7.1 Selection of participating companies

Information collected from 15 companies during the Audit walk through (Phase 2 of the project) was used to select four companies for participation in the trials. All selected companies for inclusion in the trials needed to be similarly matched in terms of level of training, structure, work tasks and size. The following selection criteria were used to select four similar companies.

1. **Level of training**

   Selected companies needed to provide a similar level of training in relation to awareness and risk assessment of MSDs to all potential participants (Line managers, Line leaders and Line workers). This was ascertained from Phase 2 (walk through audit) and results from the workplace questionnaire (Section 4.1.2).

2. **Structure**

   Companies needed to comprise at least two separate sections from which two distinct groups of participants could be gathered to provide a control group (untrained in using checklist A or B) and a test group (to be provided with training in using checklist A or B). The study design uses two discrete areas within a single company to enable better control for external factors such as company budgets and attitudes towards health and safety which may have an effect on the longitudinal part of the study in which comparisons are made between trained and untrained groups and the identification and implementation of solutions over a 6 month period.

3. **Work tasks**

   Companies needed to conduct work tasks that were similar in terms of physical and time demands. Tasks needed to be manually intensive, primarily involving the upper limbs and repetitive in nature (not manual handling), and conducted in a production line setup.

4. **Size**

   Selected companies needed to be similar in size in terms of company and number of employees working in each of the selected separate work areas.

7.2 Selection of participating employees

Each company was asked to provide eight to ten people from each of the two distinct work areas within the company to participate in the study. It was requested that individuals should be selected who had either professionally or personally shown/reported an interest in developing their risk assessment skills in relation to musculoskeletal problems. In addition, it was requested that all participants were able to understand, read and write English to a reasonable standard.

It was requested that each group should comprise of one to two Line Managers, one to three Supervisors (line leaders or team leaders) and six to eight Production line workers (line operative/line workers) from each area. The aim was to gain at least 16 participants from each company providing a study cohort of approximately 64 participants. To ensure that each group from each company had similar training and understanding of musculoskeletal disorders (MSDs) each participant was asked to complete a workplace questionnaire prior to the trials.

Workplace questionnaire

A workplace questionnaire was designed to probe participants understanding of MSDs and their attitudes towards health and safety prior to completing the trials. The data was used to ensure that each group of participants comprised people with similar levels of understanding and training in MSDs in relation to their job position (i.e. Supervisor, Line leader, Line worker). In addition the questionnaire provided the ‘before’ data for the longitudinal study. The workplace questionnaire was redistributed after a period of up to six months to ascertain if, following the training, there had been any significant long term uptake of knowledge and/or changes in attitudes towards health and safety. A copy of the questionnaire is presented in Appendix D.

Questionnaires were completed a month before attending the assessment trials. Due to the nature of some of the questions (e.g. regarding personal attitudes towards health and safety and feelings regarding the management of health and safety) the questionnaire was made anonymous to encourage true responses. In total 70 questionnaires were distributed.

7.3 Development of risk assessment checklists

Based on findings from the literature review conducted during Phase 1 of this study a standard risk assessment checklist for assessing Upper Limb Disorder (ULD) risk factors was selected.

The criteria from this checklist were then repackaged into two different formats to create two different test checklists (Checklists A and B) which differed in design features only, rather than assessment criteria. Checklists A and B incorporated a range of design features previously identified and discussed in the literature review. Table 7.1 presents a summary of the design features included in each of the checklists and highlights the features where the two checklists differ. A detailed review and comparison of the two checklists for language, layout etc is presented in Appendix J.

The format used in Checklist A was based on a newly developed checklist by HSE entitled ‘Assessment of Repetitive Tasks of the upper limb’ (ART). This is similar in design format to the now widely used MAC tool used for assessing manual handling tasks. The format incorporates a ‘traffic light’ rating scheme and provides numerical scores for each check item and a total overall risk score. The check items are presented in a tabular form with three or more response categories. A copy of Checklist A is presented in Appendix E.

Checklist B is based on a more traditional list type design in which each check item is presented in a list format with a ‘yes/no’ risk present response. Checklist B includes reference to a list of potential solution ideas and provides areas for the assessor to write more information about the probable cause and proposed solutions worthy of further investigation. A copy of Checklist B is presented in Appendix F.

Table 7.1. The different design characteristics of Checklist A and B (characteristics where they differ are highlighted in yellow).

		Checklist A	Checklist B
Format			
Flow chart		☒	☒
List format		☑	☑
Multiple choice		☑	☒
Dichotomous		☒	☑
Phrasing definitions			
Uses numerical figures to define joint angles		☑	☒
Uses only words to describe joint angles		☒	☑
Uses numerical figures to define frequency rates		☑	☒
Uses only words to describe frequency rates		☒	☑
Uses numerical figures to define duration		☒	☑
Uses only words to describe duration		☑	☒
Uses numerical figures to describe weight/force		☑	☒
Uses words to describe weights/force		☒	☑
Visual aids			
Illustrations of postures		☒	☑
Recording risk details			
Space for notes on reported problems		☒	☑
Space and notes on risk /probable cause		☒	☑
Ratings			
Means of rating individual items	Colour coding	☑	☒
	Symbol coding	☒	☒
	Numerical	☑	☒
	Words i.e. high, medium and low, good, satisfactory	☑	☒
Means of prioritising specific aspects of concern within a single task		☑	☒
Means of calculating an overall scores		☑	☑
Means of prioritising tasks for action		☑	☑
Controls / interventions			
Asks whether action is required		☒	☑
Space for notes on potential actions		☒	☑
Provides hints/suggestions for control actions	In checklist	☒	☑
	In accompanying guidance	☒	☒
	Provides reference to other sources of information.	☑	☑

7.4 Risk assessment trials

7.4.1 Overview

The risk assessment trials were split into two sets of trials, referred to as Trial 1 and Trial 2. Trial 1 collected data on the use of checklists when used as a standalone tool (i.e. only using the accompanying written instructions in how to use and complete the checklists). Trial 1 was designed to collect data to;

- Compare the effectiveness and ease of completing Checklist A with Checklist B.
- Provide comparative qualitative data on participant's opinions and views of Checklist A and Checklist B.
- Provide 'before' training data (completion of the checklists by untrained participants) to be compared to results gained from Trial 2 (completion of the checklists by participants after receiving training).

Trial 2 collected data on the use of the checklists following a two hour training session in their completion and use developed by an IOSH accredited trainer. Two of the companies were trained in the use of Checklist A and the remaining two companies were provided training in Checklist B. Data from Trial 2 was compared to data gained in Trial 1.

Two groups from distinct areas within the same company participated in the trials (Group 1 and Group 2). All groups attended Trial 1 and only groups 1 from each company attended Trial 2 (where training in the use of either checklist A or B was given). Both groups from each company were encouraged to use only one of the checklists following the trials. Companies 1 and 2 were encouraged to use Checklist A and companies 3 and 4 were encouraged to use Checklist B. This was primarily for the purpose of the longitudinal study to enable data to be collected that would allow comparison of the effects of completion of assessments and the generation of solutions within companies before training (Group 2) and after training (Group 1) after a period of up to six months (Phase 5 - Longitudinal study, Section 7.5).

7.4.2 Trial 1 - Untrained in the use of the checklists

Trial 1 consisted of two parts; the task assessments and a comparison questionnaire.

Task assessment

Four tasks were assessed by each company using either checklist A or B. Data was collected to investigate comparative ease of completion and effectiveness in terms of agreement with assessments completed by experts which are referred to as the 'Model' responses.

Selection of tasks for assessment

Between four and six tasks from each participating company were initially recorded on video. One videoed task from each company was then selected for inclusion in the task assessment trials. The tasks were selected to present a range of different risk factors for assessment in the trials.

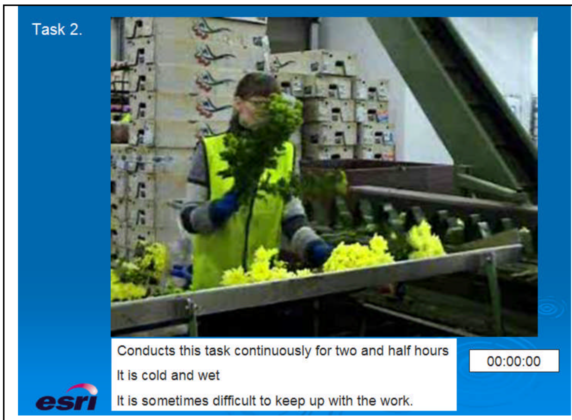
'Model' response

Prior to the trials each of the tasks were assessed independently by three experts from ESRI using the checklists. These results provided the 'model' response for comparative measures to be made between participant assessments and the 'model' correct responses. To ensure that the experts assessments provided the correct risk assessment result for each of the check items for assessment A and B; the experts were allowed to slow down and pause video footage. This allowed them to make detailed observations and measures of the types and degrees of postures adopted whilst the task was being performed, and also to calculate repetition rates. Where the three expert results differed the experts met and jointly viewed the video footage and discussed each point of view regarding that particular check item. Where necessary freeze frames were taken and images enlarged to ascertain the correct assessment result. This process was conducted until an agreement on the correct response for that particular check item was achieved.

Trial procedure

The researcher gave a brief introduction of themselves, the university and the project. The slides and verbal protocol used are presented in Appendix G.

Prior to completing the assessments participants were provided with the appropriate assessment checklist and a two-sided A4 instruction sheet on how to complete the checklist (Appendices H and I). Participants were given ten minutes to read the instructions and familiarise themselves with the assessment checklist. Each participant was then given up to 20 minutes to assess each task. A video of the task being assessed was played throughout the time given to complete the checklist. Each video also displayed a stopwatch to show the passing of time to assist in the calculation of task durations and cycle times (Figure 7.1).



Video slide presentation

Participant group

Figure 7.1. Example slide of a task to be assessed and participants making an assessment.

All participants assessed three out of the four possible videoed tasks. Participants assessed two of the tasks using checklist A and one of the tasks using checklist B (or vice versa). The tasks presented to each participant for assessment were assigned such that each company overall completed assessments for all four tasks (Table) and that all participants gained experience in using both of the checklists. This enabled them to make comparisons on the performance and ease of use of the two different checklists at the end of trial in the comparison questionnaire.

Table 7.2. Type of Checklist used to assess each task (1-4) used by each company

	Company 1	Company 2	Company 3	Company 4
Task 1	A	A	B	B
Task 2	A	A	B	B
Task 3	B	B	A	A
Task 4	B	B	A	A

At the end of the trial participants from companies 1 and 2 were encouraged to consider using checklist A for the duration of the study, whereas companies 3 and 4 were encouraged to use checklist B.

Data collected

For each task assessed the following data was collected.

- For each check item - presence of risk factor (present/not present).
- For each risk factor - level of risk (Red, Amber, Green) – Only for Checklist A.
- Ease of completing each check item on a five point scale, where 1 = Very difficult and 5 = Very easy.
- Total number of risk factors present.
- Overall risk rating of the whole task (Low, Medium or High).
- Number of suggested improvements/changes provided to reduce the risks.
- Types of suggested improvements/changes made to reduce the risks.

Checklist A and B comparison questionnaire

Following the task assessments of Trial 1 a questionnaire probing issues relating to the design and effectiveness of the two checklists was completed by all participants. The aim of the questionnaire was to provide quantitative and qualitative data on the ease of completing each checklist and to identify positive and negative design aspects of each checklist design used in the risk assessment trials. A copy of the questionnaire in presented in Appendix J.

Figure presents a flow diagram of Trial 1 to give an overview of the procedure. The trial took approximately one and half hours to complete. A copy of the full trial schedule and presentation is presented in Appendix G.

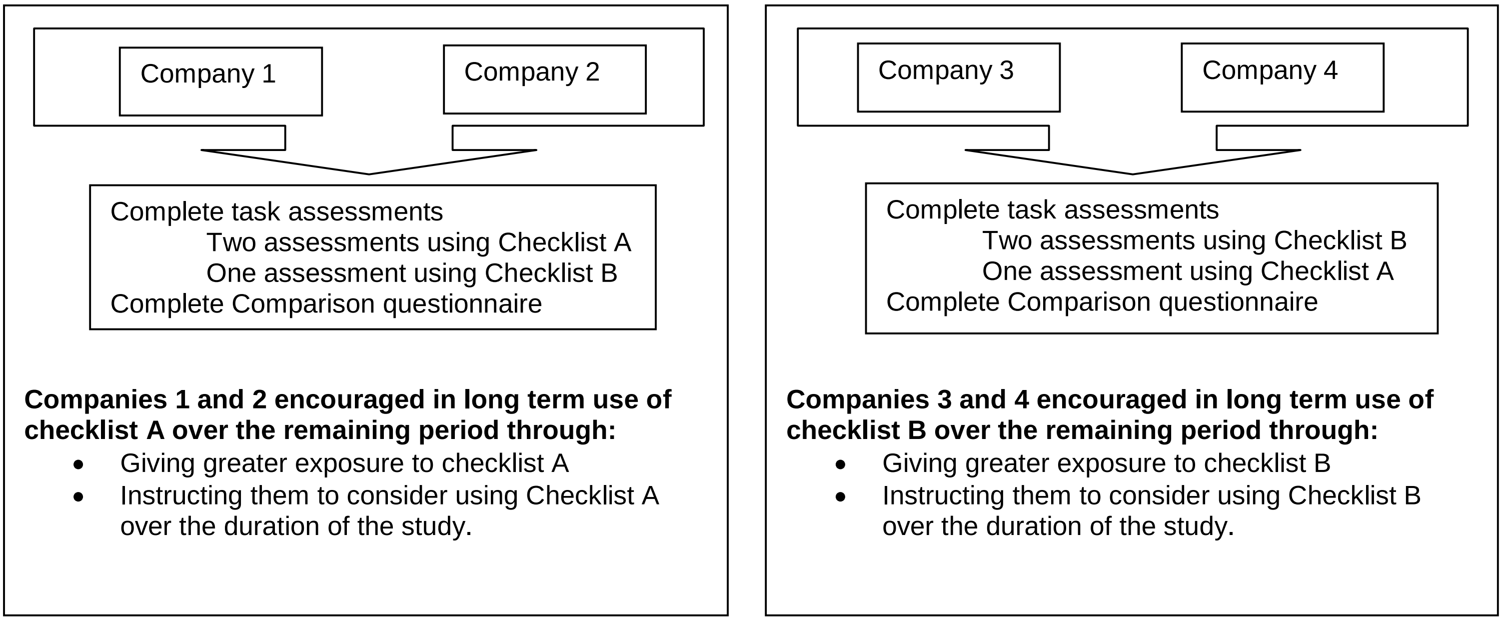


Figure 7.2. Trial 1 schematic

7.4.3 Trial 2 – Training in the use of the checklists

This section outlines the method for Trial 2. Trial 2 consists of three parts; a training session, task assessments and a training evaluation questionnaire.

Training session

One of the selection criteria for participating companies was that each company should comprise at least two separate sections from which two distinct groups of participants could be gathered. This was to enable comparisons to be made for Trial 2 and for the Longitudinal study (phase 5 of the project) to investigate the difference between the groups that had received training and those that had not received training. Group 1 of each company provided the test group (participants that would be given training in the use of checklist A or B) and Group 2, the control group (participants untrained in using checklist A or B) (Figure).

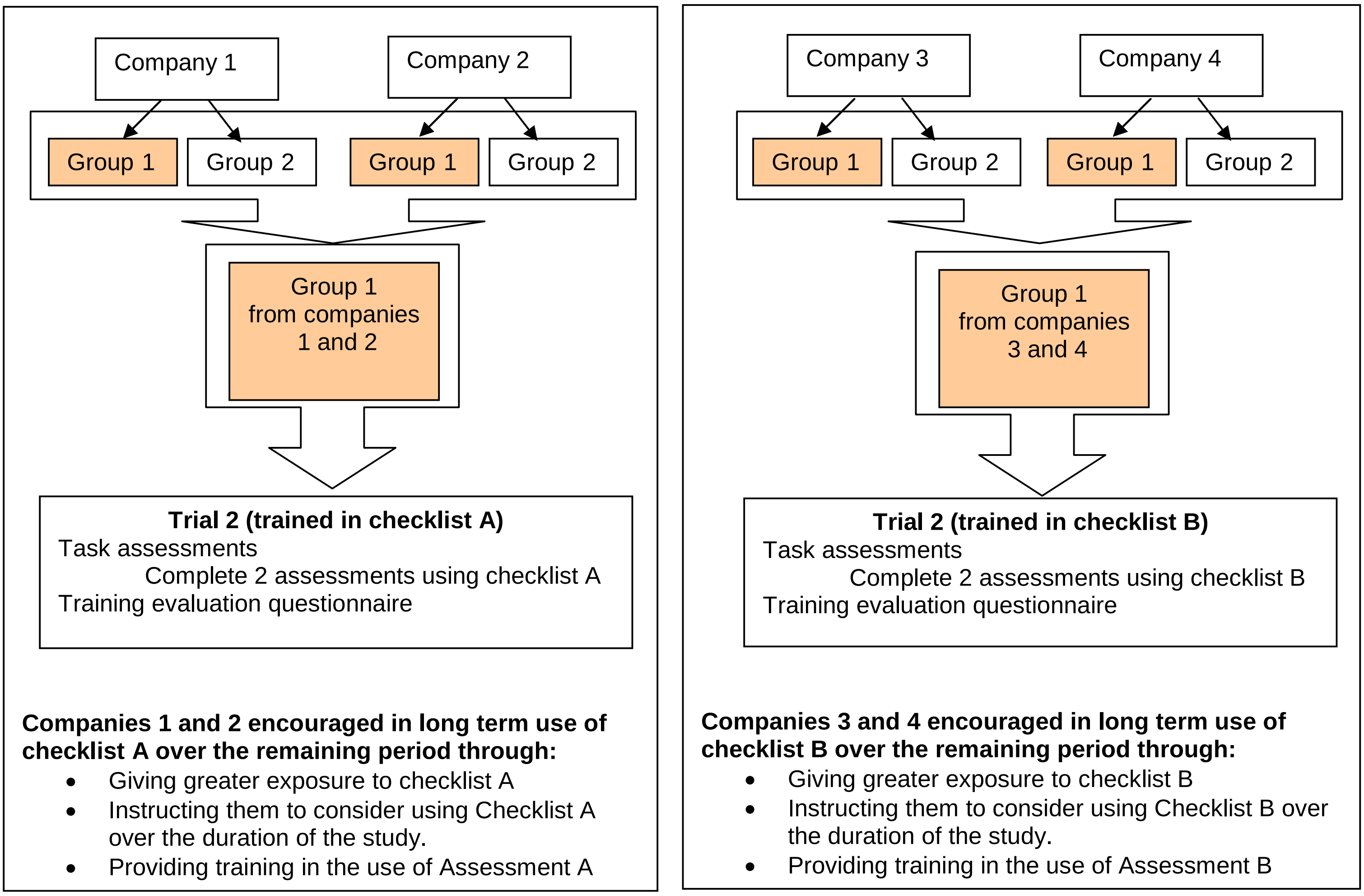


Figure 7.3. Trial 2 schematic

Between five and six weeks after Trial 1, Group 1 from each company attended a two hour training session in how to use assessment A or B by an IOSH accredited trainer and an ESRI lecturer. The training session was first developed by the IOSH accredited trainer. The initial version of the training package and lesson plans are presented in Appendix K. This training session was piloted with a group of eight employees from a company that was not participating in the study. Feedback from this session lead to ESRI researchers further developing the course to;

- simplify the language used in the slides,
- include more interactive segments,
- expand the content regarding education of musculoskeletal disorders – what are they and what are the risks,

- expand the content of how to complete an assessment using either checklist A or B,
- include an example task where the group complete an assessment together with the trainer step by step.

A copy of the final course slides are presented in Appendix L.

Task assessments

Following the training session participants were asked to assess two tasks using the assessment checklist that they had just received training in. Companies 1 and 2 assessed the tasks using Checklist A and companies 3 and 4 assessed the tasks using Checklist B. Data was collected to investigate the ease of completion and effectiveness (in terms of agreement with the 'Model' response) of each checklist comparing their use before and after receiving training. This was achieved by comparing results for Tasks 1 and 2 from Trial 1 to the results gained from Trial 2.

Selection of tasks for assessment

All groups had assessed Task one previously (without training) enabling a within-subject design for comparing the data. For Task 2 the majority of participants had not previously assessed the task hence this was a between-subjects design in which Group 1 (after training) results were compared to Group 2 (without training) results. A more detailed explanation of the analysis of the data of Trial 2 is presented in Section 8.3.

Model response

Each of the tasks had been assessed by three experts from ESRI using the checklists. This provided the 'model' correct risk assessment results for assessment A and B to ascertain level of agreement between untrained and trained responses to the correct 'model' response (as described previously in Section 7.4.2).

Procedure

Each participant assessed two tasks (Tasks 1 and 2). Participants were given up to 20 minutes to assess each task. A video of the task being assessed was played throughout the time given to complete the checklist. Each video also displayed a stopwatch to show the passing of time to assist in the calculation of task durations and cycle times.

Data collected

For each assessment the following data was collected:

- For each check item - presence of risk factor (present/not present).
- For each risk factor - level of risk (Red, Amber, Green) – Only for Checklist A.
- Ease of completing each check item on a five point scale where 1 = Very difficult and 5 = Very easy.
- Total number of risk factors present.
- Overall risk rating of the whole task (Low, Medium or High).
- Number of suggested improvements/changes provided to reduce the risks.
- Types of suggested improvements/changes made to reduce the risks.

Training evaluation questionnaire

A training evaluation questionnaire was developed to assess participants understanding of Upper Limb Disorders (ULDs) and risk assessment after completing the training. The questionnaire was based on the IOSH trainer's standard feedback questionnaire with the addition of some of the questions from the workplace questionnaire to enable comparison with the data collected prior to the trials. All participants of Trial 2 completed the questionnaire. A copy of the training evaluation questionnaire is presented in Appendix M.

7.5 Longitudinal study

For the longitudinal part of the project participating companies were revisited up to six months after Trial 2 by an ESRI researcher to review progress.

The longitudinal study aimed to compare trained and untrained groups within each company and their identification and implementation of solutions following their exposure to the checklist tools.

The longitudinal study comprised two parts: completion of the workplace questionnaire (to compare against the initial results from the workplace questionnaire completed prior to Trial 1) and an interview and walk through with the health and safety officer of each group area of the site (Group 1 and Group 2 work areas).

Table presents the activities that were conducted as part of the longitudinal study and Sections 7.5.1 and 7.5.2 outline the methods for recompletion of the workplace questionnaire and site visits.

Table 7.2. Time schedule for activities for Longitudinal part of the study (phase 5)

Time	Activity
Prior to trials 1 and 2 (phase 2)	Interview and walk thorough with Health and Safety Officer.
Prior to trials 1 and 2	Trial participants complete workplace questionnaire
End of longitudinal period (up to six months after Trial 2)	Trial participants re-complete the workplace questionnaire. Interview and walk thorough with Health and Safety Officer.

7.5.1 Re-completion of workplace questionnaire

Each participant from Trial 1 re-completed the workplace questionnaire. Questionnaire results before and after training for Groups 1 and 2 were compared to identify whether training had resulted in increased confidence, what changes, if any, had occurred in attitudes towards Health and Safety and whether the involvement of staff in identifying and reporting problems and proposing solutions had altered.

7.5.2 Interview and walk through with Health and Safety Manager

Interviews with Health and Safety Officers were also conducted and a walk through of the Group 1 and Group 2 work areas conducted.

During the walk through the Health Safety Officer was asked to point out any changes to tasks that were being planned or had been made during the study period and to discuss;

- **where the request for change had originated from**
  e.g. in response to reports made by workers, engineers, production staff, client demands,
- **why they had been made**
  e.g. to improve health and safety, to improve productions rates, in response to product changes, demands from external clients,
- **what the changes were,**
- **whether the changes had been effective in achieving the aforementioned goal(s),**
- **whether health and safety in relation to MSDs had been improved or worsened by the changes (**Expert appraisals were made of changed tasks in which expert ergonomists from ESRI gave a rating score for the practicalities and potential reduction in risks for each implemented intervention).

8 Phase 4 and 5 - Data analysis

8.1 Workplace questionnaire

Quantitative and qualitative analyses of the data gained from the workplace questionnaire were conducted. Results relevant to the selection of participants are presented in Section 9.1.2. However, the majority of the results from the questionnaire are presented in Section 9.4.1 as part of the longitudinal phase of the project. In the longitudinal phase of the project the data collected from the questionnaire is compared to data collected from the re-completion of the same workplace questionnaire after the longitudinal period. Changes in results gained from the groups that received training (Group 1) and those that did not receive training (Group 2) within each company over that period were compared.

8.2 Comparing Checklist A and B (without training)

This section details the analysis conducted on six sets of data gathered from Trial 1 of the risk assessment trials (Table 8.2). The sets of analyses were conducted to investigate the comparative effectiveness of checklist A verses Checklist B. The results from the data analyses are presented in Section 9.2. In some instances (marked in Table 8.2) two levels of analysis have been conducted;

- Level 1- provides an overview where data from all the assessed tasks have been combined
- Level 2 - data gained from assessing each task is analysed separately.

The main body of this report presents the results and findings gained from Level 1 analysis which combines the data gathered from the assessments of all four tasks. Table 8.1 shows that across all four companies both checklists (A and B) were used to assess each of the four tasks. Combining all task data for each checklist reduces the effects which might be attributable to the type of task being assessed and/or differences which might arise from checklists being used by different participants.

Combining the result from all four tasks means that the pooled data for Checklist A will be directly comparably to data gathered using Checklist B, as the data for both checklists would then have been generated by the same participants from all four companies and across all four tasks.

Table 8.1. Type of Checklist each company used to assess each task (1-4)

	Checklist A		**Checklist B**	
Task 1	Company 1	Company 2	Company 3	Company 4
Task 2	Company 1	Company 2	Company 3	Company 4
Task 3	Company 3	Company 4	Company 1	Company 2
Task 4	Company 3	Company 4	Company 1	Company 2

The second level of analysis looks at each task separately. All the results from this level of analysis are presented in the Appendix R and only discussed in the main body of the report if the results are of particular interest or differ significantly from those gained by looking at the pooled task data (Level 1 analysis).

Table 8.2. Type of analyses conducted on six sets of data

Data set	Level of analysis conducted	Type of analysis conducted
Comparison questionnaire	Not applicable	Quantitative and qualitative
Ease of completing Checklist A and B	1 (data from all task combined) 2 (data from each task separately)	Descriptive Statistics. Between-subjects design using Mann Whitney statistical test to compare companies 1 and 2 data with companies 3 and 4 for each checklist.
Level of agreement between participants and model response	1 (data from all task combined) 2 (data from each task separately)	Percentage of participants that agreed with the Model response for each check item of each checklist.
Overall risk score (Total number of risk factors present)	1 (data from all task combined) 2 (data from each task separately)	A within-subjects statistical analysis test using Friedman. A within-subjects statistical analysis test using Kruskal-Wallis. A between-subject analysis using Mann Whitney.
Overall risk rating	1 (data from all task combined) 2 (data from each task separately)	Descriptive Statistics. Percentage of participants that agreed with the Model response rating.
Suggestions for improvement	1 (data from all task combined)	Descriptive Statistics.

8.2.1 Comparison questionnaire – participants opinions

A quantitative and qualitative analysis of the data gained from the comparison questionnaire was conducted. The quantitative data was appraised using largely descriptive statistics. Qualitative data was filtered and collated by hand with common themes recorded, grouped and counted. The outcome of this process is then collated and presented in comparative form. The prevalence of specific issues are therefore recognised and prioritised, whilst still retaining recognition of low incidence, high importance, responses. The results are presented in Section 9.2.1.

8.2.2 Ease of completion of each check item

Level 1 – Analysis of all task data combined (Tasks 1 to 4)

Descriptive statistics of mean, mode and standard deviation of ratings for 'ease of completion' for each check item were calculated, enabling differences between Checklist A and B to be investigated.

Furthermore, a between-subjects statistical analysis test was conducted on the pooled data (from all tasks) to compare the 'ease of completion' ratings for Checklist A to Checklist B. The Mann-Whitney statistical test was applied to investigate whether any differences were statistically significant (results are presented in Section 9.2.2). This was conducted first for all participants and then the analysis was repeated for participants split by job position.

Level 2 – Analysis of data for each task separately

A between-subjects statistical analysis test using Mann-Whitney was conducted to investigate whether differences in ease of completing each check item between checklist A and B were statistically significant for each separate task. These results are presented in the Appendix R and only discussed in the main body of the report if the results are of particular interest or differ significantly from those gained by looking at the pooled task data.

8.2.3 Percentage agreement for each check item

Level 1 – Analysis of all data combined (Tasks 1 to 4)

The percentage of participants that agreed with the 'Model' response for each check item were calculated for each checklist (A and B) for each check item (1 to 13) for each task. The results of all four tasks were then combined to provide a single percentage value for each check item to enable a direct comparison between overall performance of Checklist A and Checklist B. The data was split and analysed in two different ways to investigate the level of agreement and the effect of:

1. The type of checklist (A and B).
2. The job position (Team leaders, Line leaders, Line managers, and Line workers).

Level 2 - Analysis of data for each task separately

Comparison between each of the four different tasks was investigated by looking at percentage agreement data gained for each task separately. These results are presented in the Appendix R and only discussed in the main body of the report if the results are of particular interest or differ significantly from those gained by looking at the pooled task data.

8.2.4 Total number of risk factors

The total number of risk factors reported as present for each completed checklist was calculated for each participant, for each task. The dependant variable was then calculated by subtracting the Model response value (for the total number of risk factors present) from participant values (of the total number of risk factors present). This was conducted for each task. All negative values were then changed to positive values to give a pure measure of the degree of discrepancy between participant's value and the Model value for each task. These positive values provided the dependant variable. In the remainder of this report this measure is referred to as the Absolute Discrepancy Value.

Level 1 – Analysis of all task data combined (Tasks 1 to 4)

All Discrepancy Values from every participant for every task was first put onto a single database to investigate whether the type of task assessed had a significant effect on the Absolute Discrepancy Values. This was determined by applying a Kruskal Wallis Statistical test. Findings showed that the type of task had no significant effect on the Absolute Discrepancy Values ($p=0.153$) and therefore justified using the mean values from all tasks per participant to enable a within subjects comparison of the data in the following set of analyses.

Within-Subjects Analysis

For each participant the Discrepancy Value for each task using checklist A were added and the mean value taken to give the Absolute Mean Discrepancy Value for Checklist A. This was repeated for Checklist B scores to the give Absolute Mean Discrepancy Value for Checklist B.

A within subjects statistical analysis test using Friedman was conducted to investigate whether differences between Absolute Mean Discrepancy Values for Checklist A and Checklist B were statistically significantly different. To investigate the interactions of company, job position and checklist the differences between Mean Discrepancy Value A and Mean Discrepancy Value B were calculated (Referred to as Checklist Difference). Table and 8.4 summarise the effects and interactions that were investigated and the statistical tests applied.

Table 8.3. The effects that were investigated and the statistical tests applied

Effect investigated	**Questions aimed at answering**	**Statistical test employed**
Main effect of company on participant – expert scores before training.	On average, before training, in what way do the participant-expert score differences change with company, regardless of the effect (if any) of other variables?	Kruskal-Wallis using Company as Independent Variable and Mean Discrepancy Value as Dependant Variable.
Main effect of job position on participant – expert scores before training	On average, before training, in what way do the participant-expert score differences change with job position, regardless of the effect (if any) of other variables?	Kruskal-Wallis using Job position as independent variable and Mean Discrepancy Value as Dependant variable
Main effect of checklist on participant – expert scores before training.	On average, before training, in what way do the participant-expert score differences change with checklist, regardless of the effect (if any) of other variables?	Friedman using Mean Discrepancy Value Checklist A and Mean Discrepancy Value Checklist B.

Table 8.4. The interactions that were investigated and the statistical tests applied.

Interaction investigated	**Questions aimed at answering**	**Statistical test employed**
Interaction of company and job position on participant – expert scores before training.	On average, before training, to what extent is the effect of company on the participant – expert score differences modified by the effect of job position, regardless of the effect of other variables?	Kruskal-Wallis using Company and Job position as Independent variable, Mean Discrepancy Value as Dependant variable
Interaction of job position and checklist on participant –expert scores before training.	On average, before training, to what extent is the effect of job position on the participant – expert score differences modified by the effect of checklist, regardless of the effect of other variables?	Kruskal-Wallis using Job position and Checklist as independent variable, Mean Discrepancy Value as Dependant variable

Level 2 – Analysis of data for each task separately

For each separate task a between-subjects statistical analysis test using Mann-Whitney was conducted to investigate and confirm whether differences in Discrepancy Values for checklist A and B were statistically significant. The results are presented in the Appendix R and only discussed in the main body of the report if the results are of particular interest or differ significantly from those gained by looking at the pooled task data.

8.2.5 Overall risk rating

Level 1 – Analysis of all task data combined (Tasks 1 to 4)

The percentage of participants that agreed with the 'Model' response for overall risk rating was calculated for Checklist A and B separately. The data was split and analysed in two different ways to investigate the level of agreement and the effect of the following.

1. Type of checklist (A and B).
2. Job position (line leader, line worker).

Level 2 –Analysis of data for each task separately

The percentage of participants that agreed with the 'Model' response for overall risk rating was calculated for (Checklist A and B separately) for each task (Tasks 1, 2, 3 and 4). These results are presented in the Appendix R and only discussed in the main body of the report if the results are of particular interest or differ significantly from those gained by looking at the pooled task data.

8.2.6 Suggested improvements

Level 1 – Analysis of all task data combined (Task 1 to 4)

Descriptive statistics of mean, mode and standard deviation of the number of suggestions were calculated, enabling differences between Checklist A and B to be investigated.

8.3 Comparing trained and untrained users

This section outlines the analyses conducted on data gathered from Trial 2 of the risk assessment trials (Table). The trial was a within-subjects design for Task 1, comparing results provided by Group 1 before training to those results gained after training. Task 2 was a between-subjects design comparing data from Group 2 (untrained participants) to Group 1 results (after receiving training). The results from the analyses are presented in Section 9.3. In this section data is analysed for each task separately. The following sets of analyses aim to investigate the comparative effectiveness of checklist A before and after training and Checklist B before and after training.

Table 8.5. Analyses conducted on data gathered from Trial 2

Data set	Data analysed	Type of analysis conducted
Ease of completing Checklist A and B	Task 1 Group 1 data	Descriptive Statistics. Within-subjects design comparing Group 1 before training with Group 1 after training.
	Task 2 Group 1 and Group 2 data	Descriptive Statistics. Between-subjects design comparing Group 2 before training with Group 1 after training.
Level of agreement between participants and model response	Task 1 Group 1 data	Percentage of participants from Group 1 that agreed with the Model response for each check item comparing before and after training results.
	Task 2 Group 1 and 2 data	Percentage of participants from Group 1 that agreed with the Model response for each check item comparing before (Group 2) and after training (Group 1) results.
Overall risk	Task 1 Group 1 data	Descriptive Statistics. Within-subjects design comparing Group 1 before training with Group 1 after training.
	Task 2 Group 1 and 2 data	Between-subjects design comparing Group 2 before training with Group 1 after training.
Overall risk rating	Task 1 Group 1 data (All companies).	Descriptive Statistics. Percentage of participants that agreed with the Model, comparing Group 1 before and after training results.
	Task 2 Group 1 and 2 data	Descriptive Statistics. Percentage of participants that agreed with the Model, comparing before (Group 2) and after training (Group 1) results.
Suggestions for improvement	Data from each task separately	Descriptive Statistics.

8.3.1 Ease of completion of each check item

Descriptive statistics of mean, mode and standard deviation for ratings of ease of completion for each check item were calculated, enabling differences between the completion of each checklist before and after training to be investigated. Furthermore, a within-subjects statistical analysis test was conducted. The Willcoxon (for within-subjects) and the Mann-Whitney (for between-subjects) statistical tests were applied to investigate whether any differences in ease of completing each check item for checklists before and after training were statistically significant for Tasks 1 and 2 (results are presented in Section 9.3.1).

8.3.2 Percentage agreement for each check item

Each checklist comprised 13 check items. The percentage of participants that agreed with the ‘Model’ response for each check item were calculated to enable a direct comparison of the performance of each checklist when completed by trained and untrained participants. The data from Trial 2 for Tasks 1 and 2 (trained) were compared to data gained from Trial 1 for Tasks 1 and 2 (untrained).

8.3.3 Total number of risk factors

The total number of risk factors reported by each participant was calculated for each task and Discrepancy Value calculated. A within-subjects analysis was conducted on data gained for Task 1 (Table) and a between-subjects analysis was conducted on data gathered for Task 2 (Table). These statistical analyses compared the Absolute Discrepancy Values from Trial 1 (no training) to Trial 2 (with training) for each type of Checklist for each of the two tasks. Table presents a summary of the type of statistical tests employed.

Table 8.6. Trial 2 – Type of checklist used by participant groups for assessing Task 1 and type of analysis conducted

Company	**1**		**2**		**3**		**4**	
Checklist	**A**		**A**		**B**		**B**	
Trial	**1. Before training**	**2. After training**	**1. Before training**	**2. After training**	**1. Before training**	**2. After training**	**1. Before training**	**2. After training**
Participant group	Group 1	Group 1	Group 1	Group 1	Group 1	Group 1	Group 1	Group 1
Task 1	Compare data (Within-subjects Wilcoxon) ↔		Compare data (Within-subjects Wilcoxon) ↔		Compare data (Within-subjects Wilcoxon) ↔		Compare data (Within-subjects Wilcoxon) ↔	

Table 8.7 . Trial 2 – Type of checklist used by participant groups for assessing Task 2 and type of analysis conducted

Company	**1**		**2**		**3**		**4**	
Checklist	**A**		**A**		**B**		**B**	
Trial	**1. Before training**	**2. After training**	**1. Before training**	**2. After training**	**1. Before training**	**2. After training**	**1. Before training**	**2. After training**
Participant group	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1
Task 2	Compare data (Between-subjects Mann Whitney)		Compare data (Between-subjects Mann Whitney) ↔		Compare data (Between-subjects Mann Whitney) ↔		Compare data (Between-subjects Mann Whitney) ↔	

Table 8.8. Within-subjects data analysis of Task 1 (all companies data) and Between-subjects data analysis of Task 2 (companies 1 and 4 data))

Effect or interaction investigated	**Questions aimed at answering**	**Statistical test employed**
1. Main effect of company on participant – expert scores for group1 after training	On average, for Group1, after training, in what way do the participant-expert score differences change with Company, regardless of the effect (if any) of other variables?	Kruskal-Wallis using Co as IV and AT as DV
2. Main effect of checklist on participant – expert scores for group1 after training	On average, for Group1, after training, in what way do the participant-expert score differences change with Checklist, regardless of the effect (if any) of other variables?	Kruskal-Wallis using CL as IV and AT as DV
3. Interaction of company and checklist on participant – expert scores for group1 after training	On average, for Group1, after training, to what extent is the effect of Company on the participant – expert score differences modified by the effect of Checklist difference, regardless of the effect of other variables?	Kruskal-Wallis using Co_CL as IV and AT as DV
4. Main effect of training on participant – expert scores	On average, after training, in what way do the participant-expert score differences change with Training, regardless of the effect (if any) of other variables?	Freidman's analysis of variance or Wilcoxon signed ranks test ? For Task 1 Checklist A
4. Main effect of training on participant – expert scores	On average, after training, in what way do the participant-expert score differences change with Training, regardless of the effect (if any) of other variables?	Freidman's analysis of variance or Wilcoxon signed ranks test ? For Task 1 Checklist B

Effect or interaction investigated	**Questions aimed at answering**	**Statistical test employed**
5. Main effect of training on participant – expert scores	On average, after training, in what way do the participant-expert score differences change with Training, regardless of the effect (if any) of other variables?	Mann whitney (Between subjects) for Task 2 Checklist A
5. Main effect of training on participant – expert scores	On average, after training, in what way do the participant-expert score differences change with Training, regardless of the effect (if any) of other variables?	Mann whitney (Between subjects) for Task 2 Checklist B

8.3.4 Overall risk rating

The percentage of participants that agreed with the 'Model' response for overall risk rating was calculated for Checklist A and B before and after training. The data was split and analysed in two different ways to investigate the level of agreement and the effect of the following.

1. Type of checklist (A and B).
2. Job position (line leader, line worker).

8.3.5 Suggested improvements

Descriptive statistics of mean, mode and standard deviation for the number of suggestions were calculated for before and after training, enabling differences between each checklist before and after training to be compared. Respondents descriptions of the type of changes suggested are also reported for Task 1 and 2 split by respondents job position and type of checklist used.

8.3.6 Training evaluation questionnaire

A simple analysis was undertaken of the training questionnaire in order to establish the participant's views on the effectiveness of the training that they had received. This was not intended to be a comprehensive evaluation due to the varying experiential backgrounds of the participants, which would significantly colour their stated preferences. Additionally, whilst qualitative feedback was welcomed, the expertise of the individuals would not necessarily qualify them to recommend good or bad elements.

Accordingly, whilst it was felt that there was value in assessing the training experience, this aspect of the work was of a lower priority. Its main aim was to inform further studies on the content and style of presentations so that they may appeal to participants rather than necessarily increase their effectiveness.

9 Phase 4 and 5 - Results

This section presents the results under the following headings.

- Participants – companies and employees
- Trial 1
- Trial 2
- Longitudinal Study.

9.1 Participants

9.1.1 Companies

Four companies previously visited in Phase 2 of the study were selected to participate in the trials. All four companies were selected because they were similar in terms of:

- Level of training in MSDs.
- Comprising two distinct sections/areas.
- Type of work tasks undertaken.
- Size – number of employees working in each participating work area.

Table 9.1 and Table 9.2 present a summary description of each of the selected participating companies.

Table 9.1. Summary descriptions of each of the selected participating companies.

	Company 1	**Company 2**	**Company 3**	**Company 4**
	The company imports flowers from around the world and makes them into bouquets and packs them into boxes to distribute across the U.K. The site employs 255 workers. The site comprises 3 separate areas/factories. Employees are paid by salary (not piece rate).	The company is a laboratory that tests soil, water and asbestos samples. The company employs approximately 110 people. Employees are paid by salary (not piece rate). There are five areas of work, Cold store, Sample preparation, Samples reception/logging in, Fume cabinets, and Analysis.	The company prepares and packages salad. The company is part of a larger group but each company within this group acts independently. Therefore there are no common health and safety procedures prescribed for all the member sites/companies. The company employs 180 workers. Employees are paid by salary (not piece rate).	The company manufacturers a range of desserts although the predominant product is cake. The company is part of a large group, which has a further 15 food production sites across the U.K. The health and safety manager for this site is only responsible for this site. The site employs 800 staff across three shifts (266 per shift).
Groups	1 (Factory 1) approx 30-40 workers	1 (Site 1) approx 30 workers	1 (Low risk) 25 – 30 workers	1 (Zone 1, line 3) approx 20 workers
	2 (Factory 2) approx 30-40 workers	2 (Site 2) approx 30 workers	2 (Packing) approx 20 workers	2 (Zone 2, line 1) approx 20 workers
Description of distinct groups	• Physically separate buildings but on the same site. • Workers from the two factories have separate rest areas. • Workers do not swop between different factories. Both factories complete very similar work activities but are split based on the different companies that they supply to.	• Physically separate buildings at different locations in the UK. • Workers do not swop between different sites. • Both laboratories complete identical work activities. Both laboratories are under the supervision of the same Health and Safety Officer and have the same health and safety policies and training programmes.	• Physically separate areas within the same large building. • Can not walk from one area to the next without pass/clearance and going through appropriate clothing and cleaning regimes. • Workers from the two areas have separate rest areas. • Workers very rarely swop to work within the different work areas. Both areas complete different work activities but they are similar in nature, physical demands, postures and cycle times.	• Physically separate areas within the same large building. • Cannot walk from one area to the next without pass/clearance and going through appropriate clothing and cleaning regimes. • Workers very rarely swop to work within the different work areas. Both areas complete different work activities but they are similar in nature, physical demands, postures and cycle times.

Table 9.2. Summary descriptions of the work tasks conducted by each of the selected participating companies.

	Company 1	Company 2	Company 3	Company 4
Type of tasks conducted	Both groups conduct similar tasks in similar setups. Production line setup. Line feeders feed flower stems to line workers. Line workers conduct one of the following tasks along the line; • Bunch formers • Hand tying • Sleeving the bunches • Labeling • Bottom and length check, trim stems • Packing - Make box All tasks are highly repetitive and of short cycle time. Machine paced.	Both groups conduct similar tasks in similar setups. Employees work at shared sit stand workstations (i.e. each day they could be working at a different work stations conducting input tasks or preparation tasks). Inputting tasks include: Lifting and carrying sample trays to workstations, lifting out individual sample containers from the trays, inputting data into a computer, returning samples into trays, and lifting trays back to reception to be placed into storage. Preparation tasks include: lifting out individual sample containers from the trays, unscrewing sample containers, sifting samples, weighing samples, inputting data into a computer, and returning samples into the trays. All tasks are highly repetitive and of short cycle time.	Both groups conduct similar tasks in similar setups. **Low risk** There are three lines in preparation. The preparation tasks conducted on all the lines are similar and include: • Picking up individual produce from the conveyor, • Taking out the core of lettuces using a hand held knife, • Removing dead leaves. Each item is also visually inspected for foreign bodies. The produce in then placed back onto a different conveyor. Repetition rate are high and machine paced. **Packing** There are three lines in packing. The packing tasks conducted on all the lines are similar and include: • Picking up individual packaged produce from the rotating conveyor • Inspecting labels are correct • Placing packaged produce into boxes.	Both groups conduct similar tasks in similar setups. **Zone 1** Each line produces a different type of cake. For each line the production process is very similar and includes the following tasks; • Greasing cake tins • Lifting filled cakes tins and feeding into the oven • Applying filling to one side of the sponge (palette knife or hand) • Placing top sponge onto bottom sponge • Coating cake (icing etc.) • Applying sprinkles/decoration • Piping • Inspection • Removing from conveyor **Zone 2** Each line produces a type of prepackaged dessert. This includes \Placing product components into plastic trays/packages. Different workers along the line each have a different task- adding a different product component. Repetition rate are high and machine paced.

9.1.2 Employees

Between 9 and 20 employees from each company participated in the project, providing a study cohort of 63 participants (Table 9.3).

Table 9.3. Number of employees from each company that participated in the trials.

	Company				Total number of participants
	Company 1	Company 2	Company 3	Company 4	
Number of participants	20	19	15	9	63

All participants from each company had received similar company training and education and had similar awareness of MSDs. This was ascertained from the results from the workplace questionnaire (discussed below) and interviews with health and safety officer/managers (Summary presented in Table8).

Workplace questionnaire

In total 48 participants completed the workplace questionnaire (Table).

Table 9.4. Number of completed workplace questionnaires.

	Number of respondents				
	Company 1	Company 2	Company 3	Company 4	Total
Number of respondents to the workplace questionnaire.	15	18	6	9	48

Results from the questionnaire showed that over 85% of respondents from companies 1, 2 and 4 had heard of RSI or Musculoskeletal disorders (TableTable 9.5). Company 3 had a significantly lower percentage of respondents reporting that they had heard of either Repetitive Strain Injury (RSI) or Musculoskeletal Disorders (MSDs). However it should be noted that only 6 of the 15 participants from this company completed the workplace questionnaire and so results are not reflective of the entire participant group.

Table 9.5. Summary of training levels and awareness of MSDs amongst all participants split by company.

	Percentage of respondents			
	Company 1	**Company 2**	**Company 3**	**Company 4**
Yes, I have heard of Musculoskeletal disorders / problems.	7%	22%	33%	0%
Yes, I have heard of RSI.	73%	22%	33%	44%
Yes, I have heard of both Musculoskeletal disorders / problems and RSI.	20%	44%	0%	56%
No, I have not heard of either.	0%	11%	33%	0%

Of the participants that reported that they had heard of MSDs or RSI, between 44% to 60% of these stated that they had heard of MSDs through work, however only between 0 to 25% of participants from each company that had heard of MSD or RSI reported that this was from attending a work training course (Table). This is in contrast to reports made by the health and safety officer/manager of each company regarding training and education given to staff on MSDs or RSI. Health and safety officers and managers from all companies reported that training was provided to staff either during risk assessment training sessions or general work task training (provided to Line supervisors, leaders, managers) and through induction courses (provided to line workers) (Table).The largest percentage of participants from all companies reported that they had heard about MSDs or RSI from television and magazines (Table).

Table 9.6. Percentage of respondents and how they had heard of MSDs or RSI.

	Percentage of respondents from each company			
	Company			
	1	2	3	4
Television	60%	63%	7%	33%
Radio	7%	31%	25%	11%
Books	7%	44%	0%	0%
Magazines	53%	56%	25%	33%
Websites	0%	25%	0%	0%
Work	60%	50%	50%	44%
Training course	20%	25%	0%	11%
Doctor	27%	19%	25%	44%
Physiotherapist	13%	19%	0%	22%
Other	7%	19%	0%	22%

Question 11 of the workplace questionnaire investigated peoples understanding and knowledge of MSDs, and asked respondents to list up to six risk factors which may lead to musculoskeletal problems or RSI. Table 9.7 shows that similar numbers of reported risk factors were reported from respondents from all companies, except Company 3 in which a higher percentage (50%) reported not knowing any risks/causes (Table and Figure).

Table 9.7. Descriptive statistics for the number of risks/causes out of potential 6 risks/causes provided from each company.

	Company			
	1	**2**	**3**	**4**
Mean	3.5	3.3	1.8	3.2
Std. Deviation	1.9	1.9	2.6	2.4
Minimum	0	0	0	0
Maximum	6	6	6	6

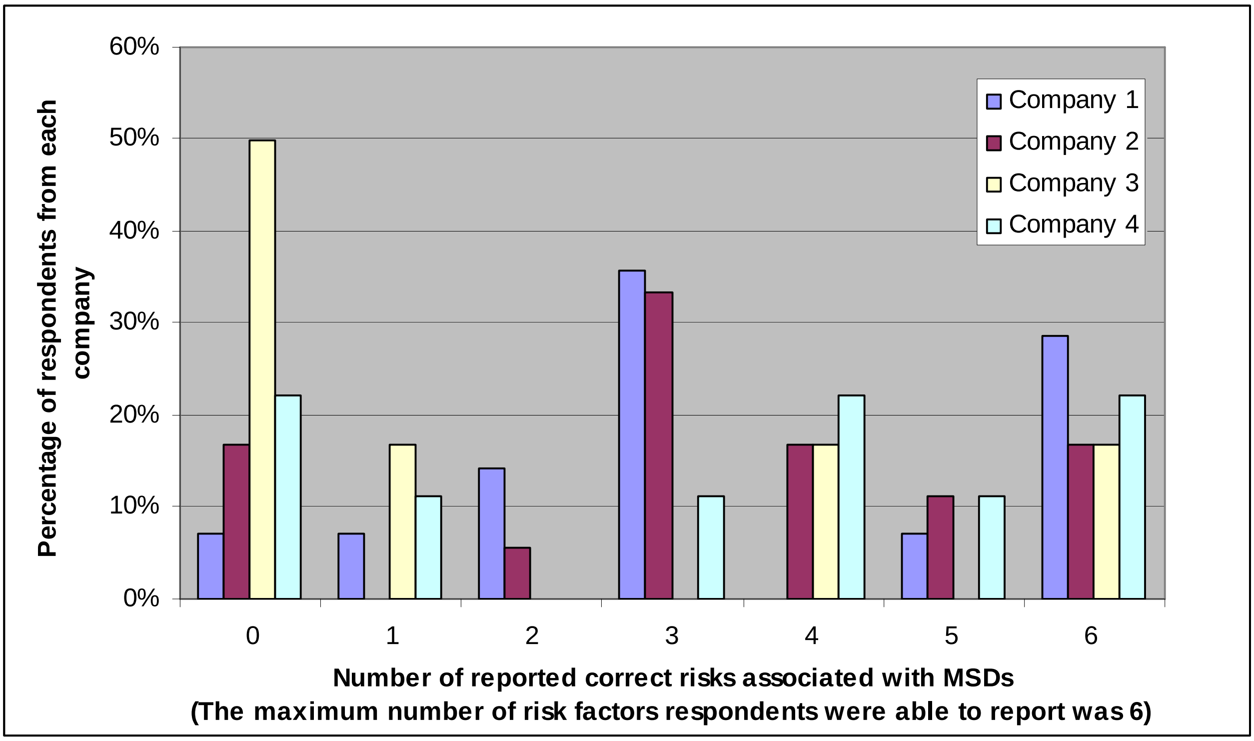


Figure 9.1. The percentage of respondents from each company and the number of correct risks/causes of MSDs and RSI reported.

Table9.8. Result from audit walk through - Training provided by each company as reported by Health and Safety Managers.

	Company 1	Company 2	Company 3	Company 4
Potential participants				
	• Team leader/Supervisor • Line leader • Operative / line worker	• Laboratory Manager • Team leader • Laboratory operative	• Line Supervisor • Cell leader • Line worker	• Line leader • Team leader • Bakery operative/line worker
Level of training previously provided in MSDs				
	Team leader Receive training in conducting general risk assessment. This is a package designed by the Health and Safety Manager. Undocumented training in the hazards and what to look for regarding MSDs and manual handling, e.g. poor postures.	**Laboratory manager** Receive training from the Health and Safety Manager about musculoskeletal disorders symptoms, risk factors and general good practice.	**Line supervisor** Attend an induction in which specific risks associated with their work tasks are discussed and explained including MSDs.	**Line supervisor** Receive training from the Health and Safety Manager about MSD symptoms, risk factors and general good practice.
	Line leader Receive a 2.5 hour induction training covering all aspects of the job. This includes a manual handling video. They also receive a handout about ULDs to inform them of the symptoms and increase awareness of the issues. This forms part of the induction package.	**Team leader** Receive training from the Health and Safety Manager about musculoskeletal disorders symptoms, risk factors and general good practice.	**Cell leader** Attend an induction in which specific risks associated with their work tasks are discussed and explained.	**Team leader** Receive training from the Health and Safety Manager about MSD symptoms, risk factors and general good practice.
	Line worker Receive a handout about ULDs to inform them of the symptoms and increase awareness of the issues. This forms part of the induction package.	**Laboratory operative** Attend an induction in which specific risks associated with their work tasks (including ULDs) are discussed and explained.	**Line worker** Attend an induction in which specific risks associated with their work tasks are discussed and explained.	**Line worker** Attend an induction in which specific risks associated with their work tasks (including ULDs) are discussed and explained. Training on the importance of micro pauses and hand exercises given to all line staff.

9.2 Trial 1 - Comparing Checklist A and B (without training)

This section presents the results for investigating the comparative effectiveness of Checklist A and Checklist B. The results are presented under six headings:

- Comparison questionnaire – participant opinions.
- Ease of completion of each check item.
- Percentage agreement of each check item between participants and model response.
- Total number of risk factors.
- Overall risk rating.
- Suggestions for improvement.

9.2.1 Comparison questionnaire – participants opinions

Respondents

In total 57 participants completed the comparison questionnaire. 16 were Team Leaders, Line Leaders, or Line Managers and 41 were Line Workers or Line Operatives. Table 9.9 presents the number of respondents from each company.

Table 9.9. Number of respondents that completed the comparison questionnaire.

	Work position		
Company	Team Leader/ Line Leader/ Line Manager	Line Worker/ Operative	**Number of respondents**
1	6	10	16
2	4	14	18
3	3	12	15
4	3	5	8
Total	**16**	**41**	**57**

Preferred checklist

The majority of all respondents reported that they would prefer to use Checklist A (72%) to assess their workplace rather than Checklist B (28%). However when split by job position a significant difference in preferences emerged, with 63% of Team leaders, Line leaders and Line Managers preferring Checklist B compared to 15% of all Line workers. Whereas the majority of Line workers (85%) stated that they would prefer to use Checklist A compared to only 38% of all Team Leaders, Line Leaders and Line Managers (Figure).

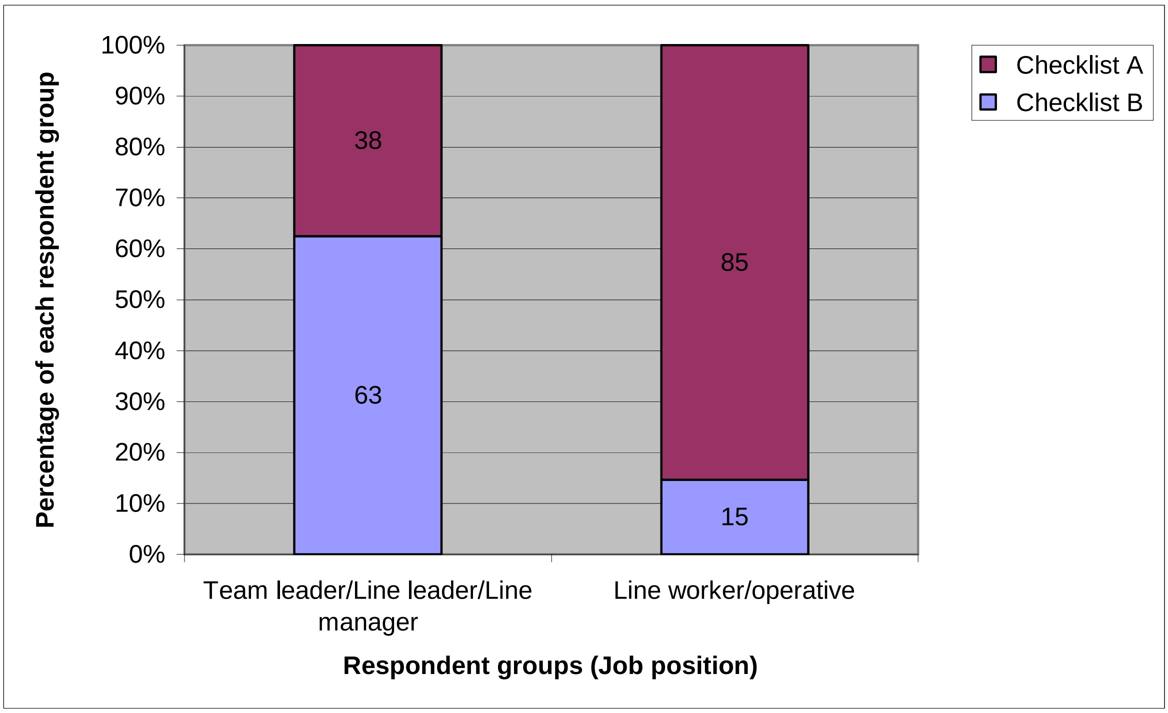


Figure 9.2. Percentage respondent preference for use of Checklist A or B in assessing their workplace, by job position.

Similar results were found regarding responses to which of the two checklists respondents thought would be the best to help their company reduce the risks of musculoskeletal problems in their workplace. 61% of all respondents reported Checklist A and 39% reported that Checklist B would be the most helpful in reducing risks. However when split by job position it was found that the majority of the Team Leaders, Line Leaders and Line Mangers reported that Checklist B would be the most helpful (69%) whereas Line workers reported that Checklist A would be the most helpful (73%) (Figure 9.3).

Reasons for the differences in preferences were explored further in questions 12 and 13 of the questionnaire which asked respondents to list two things they liked and two things they disliked most about each of the two checklists. Table 9.10 to Table 9.13 present summaries of the responses made split by respondent's job position.

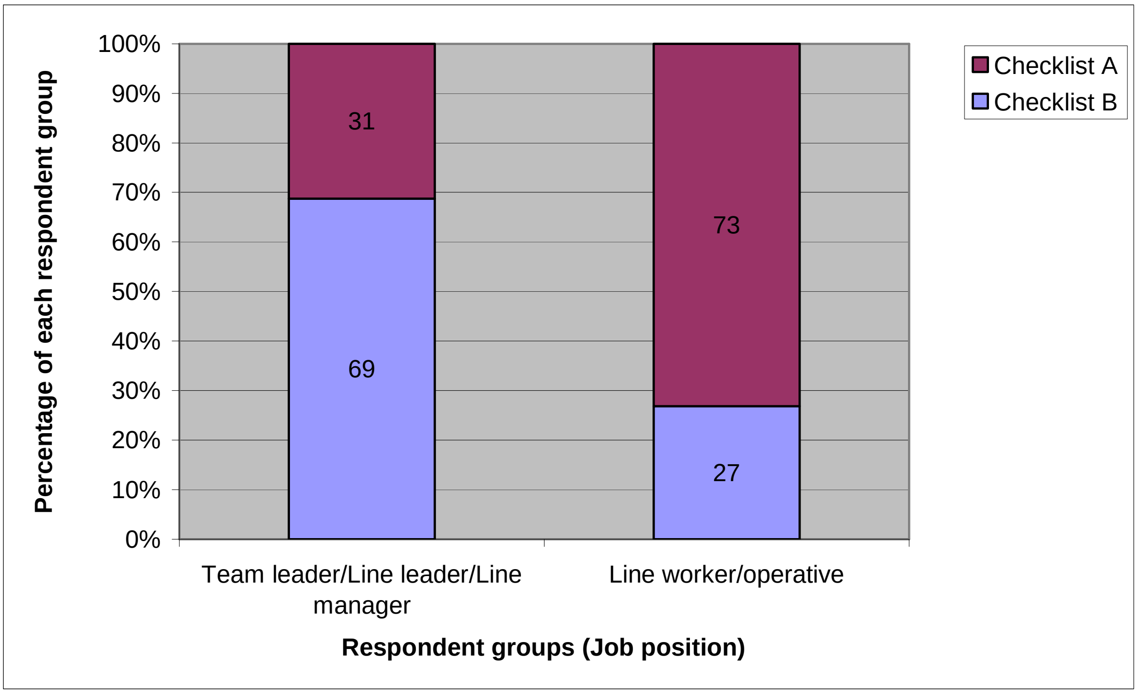


Figure 9.3. Percentage preference of respondents for Checklist A or B in helping to reduce the risks of MSDs in their workplace, by job position.

Positive comments – Checklist A

In total 51 positive comments out of a potential 114 comments (45%) were received regarding Checklist A. When split by job position it was found that from a potential total of 32 comments regarding positive aspects of Checklist A from Team Leaders, Line leaders and Line Managers 13 positive responses were received (41%) and from a potential total of 82 positive comments from Line workers, 38 positive comments were received (46%). Table 9.10 shows all the comments received. However, the following positive aspects were reported by the greatest number of respondents from each job position group.

- Clear definitions/easy to understand or explained things better than B
- Use of colour coding
- Easy/simple to follow or use
- Number/Scoring

Table 9.10. Positive comments made regarding Checklist A

Checklist A			
	Team Leaders, Line Leaders, Line Managers	Line workers	Total number of respondents
Clear definitions or Easy to understand or Explained things better than B	2	13	15
Use of colour coding	2	9	11
Easy/simple to follow or use	4	7	11
Number / Scoring	3	5	8
Format seemed logical	1	1	2
More option to choose from making it easier to complete	1	2	3
Automatically assigned a level of risk High, Medium, Low.	0	1	1
Total number of positive comments	**13**	**38**	**51**

Positive comments – Checklist B

In total 41 positive comments out of a potential 114 comments (36%) were received regarding Checklist B. When split by job position it was found that from a potential total of 32 comments regarding positive aspects of Checklist B from Team Leaders, Line leaders and Line Managers, 12 positive responses were received (38%) and from a potential total of 82 positive comments from Line workers, 29 positive comments were received (35%). Table 9.11 shows all the responses received. However, the following positive aspects were reported by the greatest number of respondents from each job position group:

- Illustrations.
- Presentation of possible solutions that you could tick if appropriate.
- Space to write and describe tasks in detail and any particular problems.
- Number of choices (yes/no) easy to decide between just the two choices.
- Easy/simple to follow and/or use.

Table 9.11. Positive comments made regarding Checklist B

Checklist B			
	Team Leaders, Line Leaders, Line Managers	Line workers	Total number of respondents
Illustrations	3	7	10
Presentation of possible solutions that you could tick if appropriate. Made identify solutions easier.	4	4	8
Space to write and describe tasks in detail and any particular problems	2	4	6
Number of choices (yes/no) easy to decide between just the two choices.	0	6	6
Easy/simple to follow or use	1	3	6
More in-depth explanations than A	0	4	1
Number / Scoring – easy to score	1	0	1
Clear and concise	1	0	1
Layout of questions	0	1	1
Total number of positive comments	**12**	**29**	**41**

Negative comments – Checklist A

In total 24 negative comments out of a potential 114 comments (21%) were received regarding Checklist A. When split by job position it was found that from a potential total of 32 comments regarding negative aspects of Checklist A from Team Leaders, Line leaders and Line Managers 10 negative responses were received (31%) and from a potential total of 82 positive comments from Line workers, 14 negative comments were received (17%). Table 9.12 shows all the responses received. However, the following negative aspects were reported by the greatest number of respondents from each job position group:

- No space to describe problem or make comments. Another person would not be able to tell much about the task just from reading a completed assessment.
- Too many options.
- No illustrations.

Table 9.12. Negative comments made regarding Checklist A

Checklist A			
	Team Leaders, Line Leaders, Line Managers	Line workers	Total number of respondents
No space to describe problem or make comments. Another person would not be able to tell much about the task just from reading a completed assessment.	3	2	5
Too many options	2	1	3
No illustrations	1	2	3
Too much reading for each level of risk i.e. too wordy.	1	1	2
No list of improvements	0	2	2
The colour coding meant nothing in the final scheme of things	0	2	2
Sometimes no middle ground option	1	0	1
Use of percentage measurements for time/duration	1	0	1
Different grades are not detailed enough for example, most of the time, part of the time, more than half of the time.	0	1	1
Each point had different numbers/scores for Green, Amber and Red.	0	1	1
People with colour vision problems may find it difficult to read/follow.	0	1	1
Time consuming	1	0	1
No space next to each factor to describe possible solutions- only one space at end	0	1	1
Total number of negative comments	**10**	**14**	**24**

Negative comments – Checklist B

In total 37 negative comments out of a potential 114 comments (32%) were received regarding Checklist B. When split by job position it was found that from a potential total of 32 comments regarding negative aspects of Checklist A from Team Leaders, Line leaders and Line Managers 7 negative responses were received (22%) and from a potential total of 82 positive comments from Line workers, 30 negative comments were received (37%). Table 9.13 shows all of the responses received. However, the following negative aspects were reported by the greatest number of respondents from each job position group:

- The overall risk level is not calculated rather just left to be rated by the individual assessor. Open to interpretation and self opinion.
- Required more time.
- Not easy to follow.
- Not short or simple to complete/too wordy.
- The yes/no were easy to complete but did not inform much about the task.
- Having to describe causes of problems.
- Did not really understand the questions.

Table 9.13. Negative comments made regarding Checklist B

Checklist B			
	Team Leaders, Line Leaders, Line Managers	Line workers	Total number of respondents
The overall risk level is not calculated rather just left to be rated by the individual assessor. Open to interpretation and self opinion	2	7	9
Required more time	1	4	5
Not easy to follow	0	4	4
Not short or simple to complete. Too wordy	0	4	4
The yes/no were easy to complete but did not inform much about the task.	0	3	3
Having to describe causes of problems	0	3	3
Did not really understand the questions.	0	3	3
Not enough information for each risk factor	1	0	1
Too much writing required	1	0	1
Improvement list not always relevant to the task being assessed.	1	0	1
Unclear exactly what the risk was	1	0	1
Lack of any individual risk level for each risk factor	0	1	1
Not enough background info to make suggestions	0	1	1
Total number of negative comments made	7	30	37

On a 5 point rating scale for **confidence in using each of the checklists** (where 1 = Not at all confident to 5 = Very confident) a greater percentage of all respondents reported confidence ratings of 4 or 5 in using Checklist A (74%) than Checklist B (46%) (Figure 9.44). When split by job position 63% of Team leaders, Line leader and Line managers gave ratings of 4 or 5 for Checklist A and 44% for Checklist B (Figure 9.5). 78% of all Line workers rated Checklist A with rating of 4 or 5 where as only 47% rated Checklist B with 4 or 5 ratings (Figure 9.5).

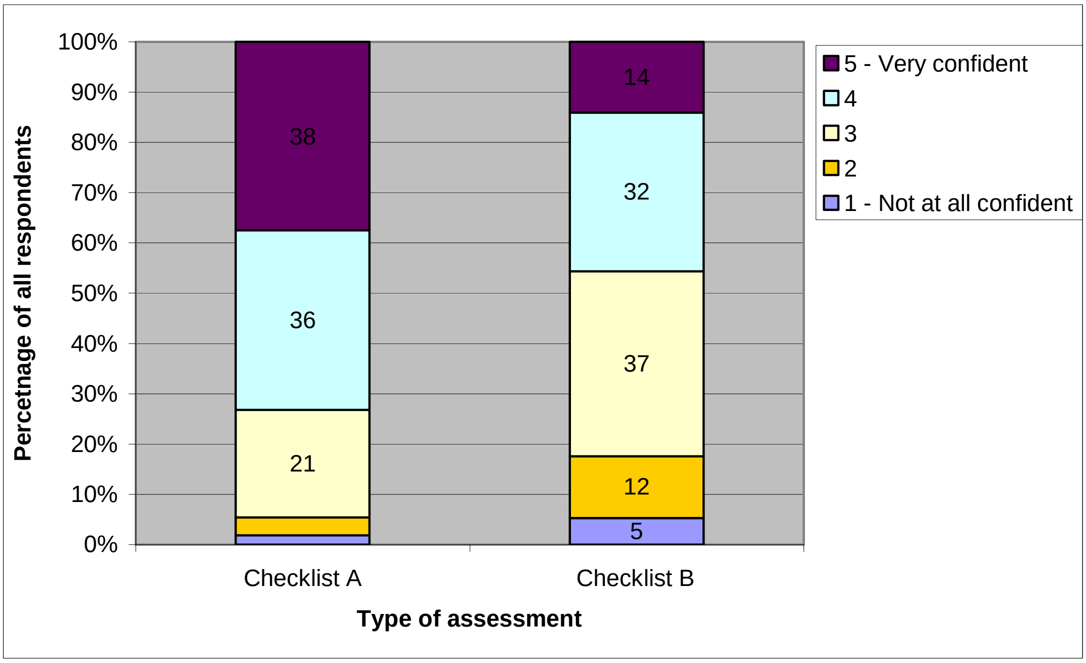


Figure 9.4. Percentage of all respondents and their ratings of confidence in using each of the Checklists.
(Rating on a five point scale, rating 1 = Not at all confident to rating 5 = Very confident.)

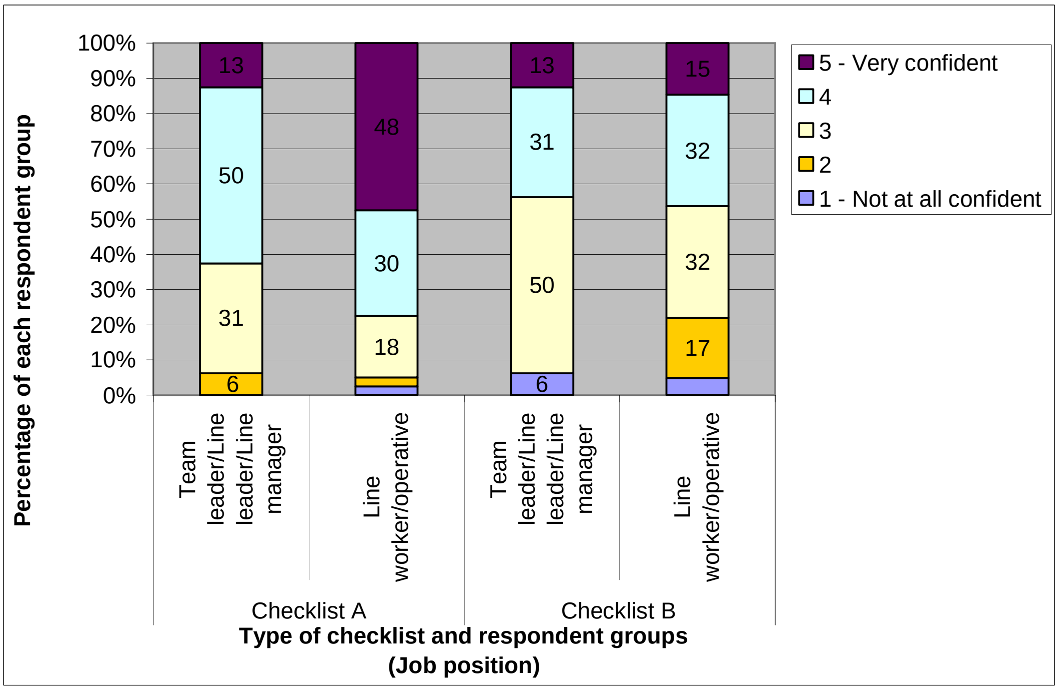


Figure 9.5. Percentage of respondents from each job position group and their ratings of confidence in using each of the Checklists.
(Rating on a five point scale, rating 1 = Not at all confident to rating 5 = Very confident.)

On a 5 point rating scale for **confidence that they had assessed the tasks correctly using each of the checklists** (where 1 = Not at all confident to 5 = Very confident) a greater percentage of all respondents reported confidence rating of 4 or 5 when using Checklist A (49%) over Checklist B (33%) (Figure). When split by job position 50% of Team leaders, Line leader and Line managers gave ratings of 4 or 5 for Checklist A and 63% for checklist B (Figure). Overall confidence in assessing the tasks were lower for Line workers than for the Line leaders group. 48% of all Line workers rated Checklist A with rating of 4 or 5 where as only 22% rated Checklist B with 4 or 5 ratings (Figure).

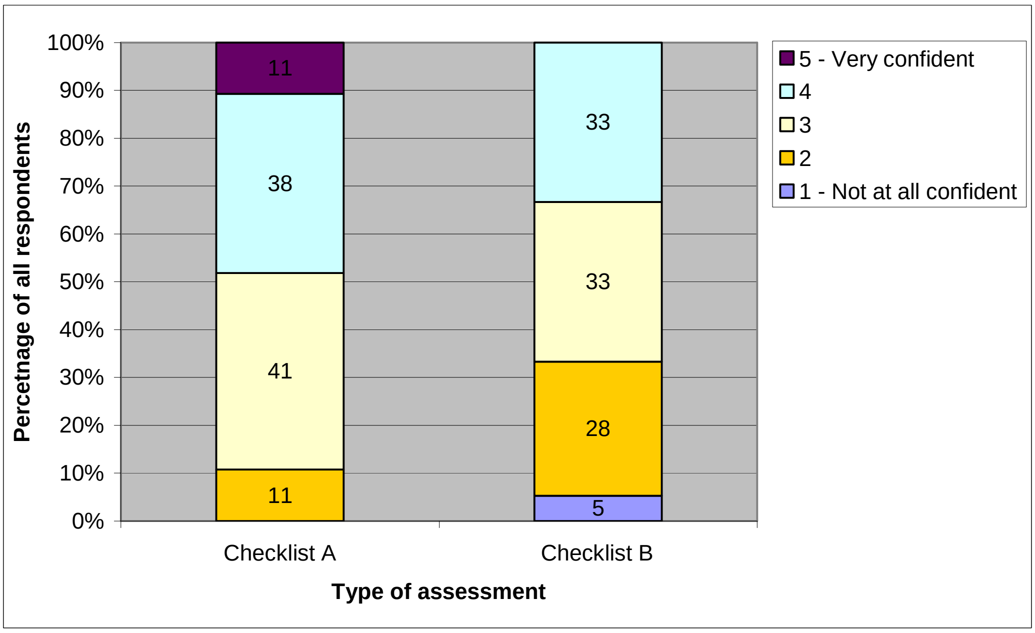


Figure 9.6. Percentage of all respondents and their ratings of confidence in correctly assessing tasks when using each of the Checklists.
(Rating on a five point scale, rating 1 = Not at all confident to rating 5 = Very confident.)

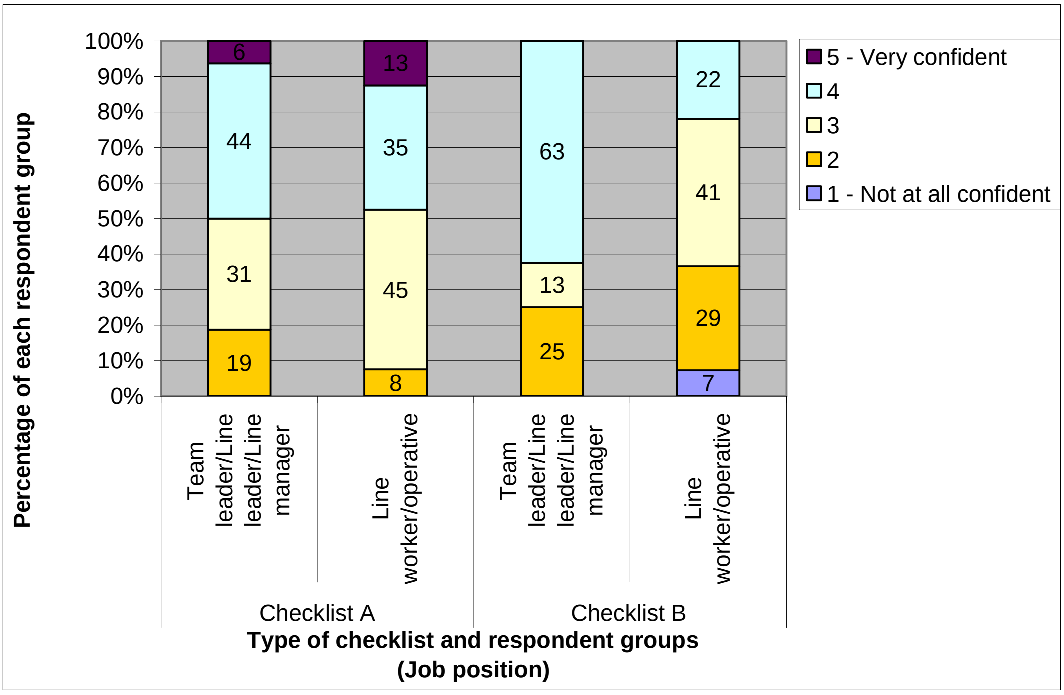


Figure 9.7. Percentage of all respondents from each job position group and their ratings of confidence in correctly assessing tasks when using each of the Checklists.
(Rating on a five point scale, rating 1 = Not at all confident to rating 5 = Very confident.)

Perceived effectiveness

On a 5 point rating scale for **effectiveness in identifying the task as High, Medium or low risk using each of the checklists** (where 1 = Not at all effective to 5 = very effective) a greater percentage of all respondents reported effective rating of 4 or 5 in using Checklist A (69%) than Checklist B (35%) (Figure 9.). When split by job position 50% of Team leaders, Line leader and Line managers gave ratings of 4 or 5 for Checklist A and 62% for Checklist B (Figure). Greater differences between Checklist A and B levels of rated effectiveness were shown by Line workers, with 77% of all Line workers rated Checklist A with ratings of 4 or 5 where as only 25% rated Checklist B with ratings of 4 or 5 (Figure).

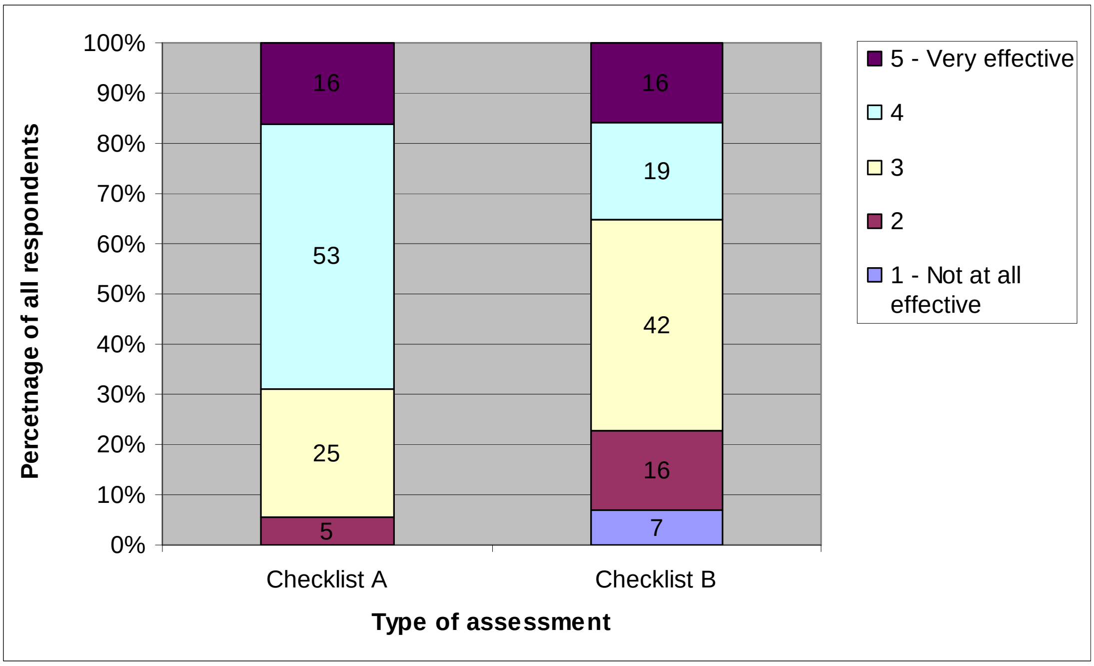


Figure 9.8. Percentage of all respondents and their ratings of effectiveness in identifying task as presenting High, Medium or Low risk when using each of the checklists.
(Rating on a five point scale, rating 1 = Not at all effective to rating 5 = Very effective.)

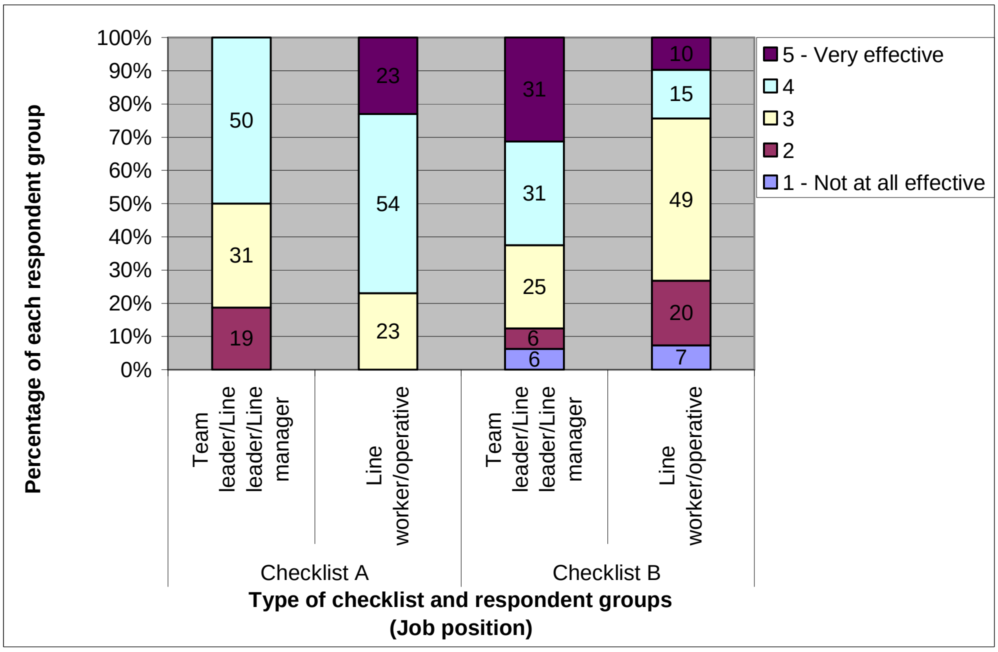


Figure 9.9. Percentage of all respondents from each job position group and their ratings of effectiveness in identifying task as presenting High, Medium or Low risk when using each of the checklists.
(Rating on a five point scale, rating 1 = Not at all effective to rating 5 = Very effective.)

On a 5 point rating scale for **effectiveness in identifying what the causes to the problems were** (where 1 = Not at all effective to 5 = Very effective) a slightly greater percentage of all respondents reported effective rating of 4 or 5 in using Checklist A (60%) than Checklist B (38%) (Figure). When split by job position there was little difference in percentage of Team Leaders, Line Leaders and Line Managers ratings of 4 or 5 for Checklist A and B. 58% of Team leaders, Line leader and Line managers gave ratings of 4 or 5 for checklist A and 50% for checklist B (Figure). Greater differences between Checklist A and B levels of rated effectiveness were shown by Line workers, with 63% of all Line workers rating Checklist A with ratings of 4 or 5 where as only 33% rated Checklist B with 4 or 5 ratings (Figure).

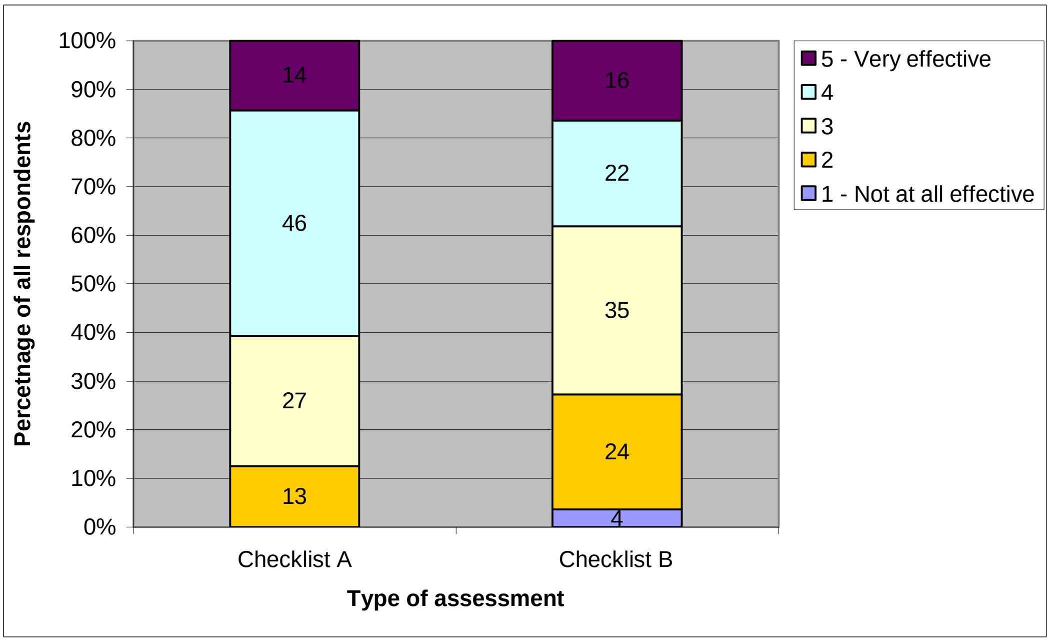


Figure 9.10. Percentage of all respondents and their ratings of effectiveness in identifying the causes to the problems .
(Rating on a five point scale, rating 1 = Not at all effective to rating 5 = Very effective.)

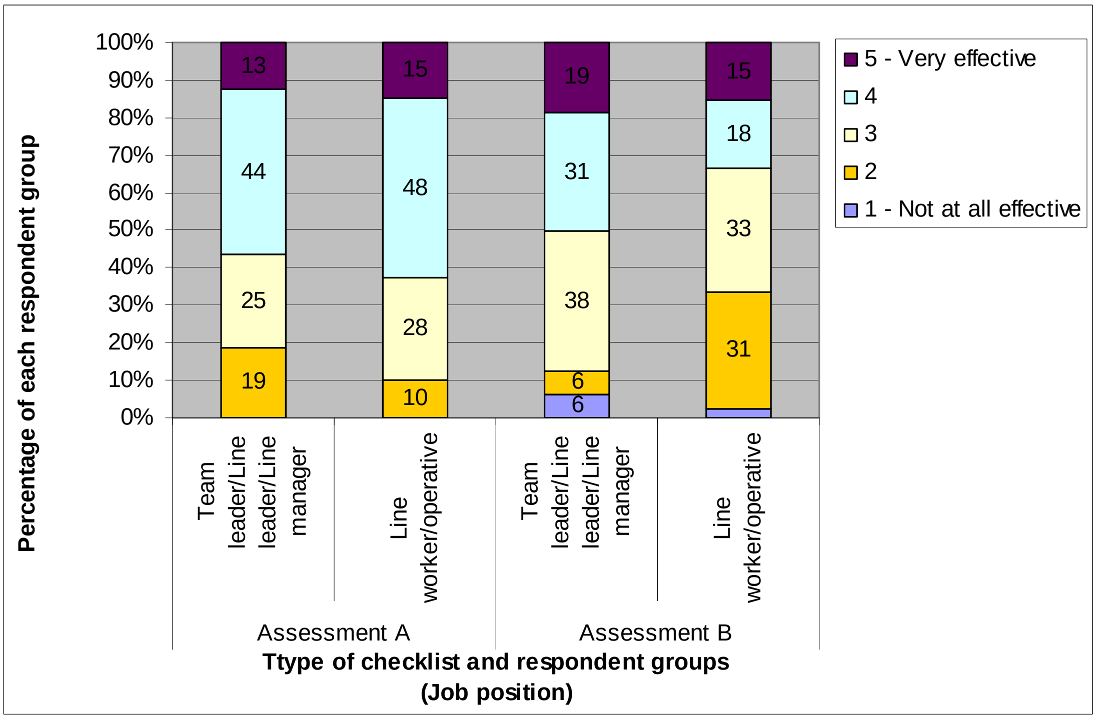


Figure 9.11. Percentage of all respondents from each job position and their ratings of effectiveness in identifying the causes to the problems.
(Rating on a five point scale, rating 1 = Not at all effective to rating 5 = Very effective.)

On a 5 point rating scale for **effectiveness in identifying what changes should/could be made to reduce the risks** (where 1 = Not at all effective to 5 = Very effective) similar percentages of respondents reported effective ratings of 4 or 5 in using Checklist A and B (42% and 49% respectively) (Figure). When split by job position there were significant differences in percentage of Team Leaders, Line Leaders and Line Managers ratings of 4 or 5 for Checklist A and B, with a greater percentage of respondents rating Checklist B with ratings of 4 or 5. 19% of Team leaders, Line leader and Line managers gave ratings of 4 or 5 for Checklist A compared to 57% for Checklist B (Figure). However there were no significant differences between levels of rated effectiveness for Checklist A and B by Line workers, with 51% of all Line workers rating checklist A with ratings of 4 or 5 and 47% rating Checklist B with 4 or 5 ratings (Figure).

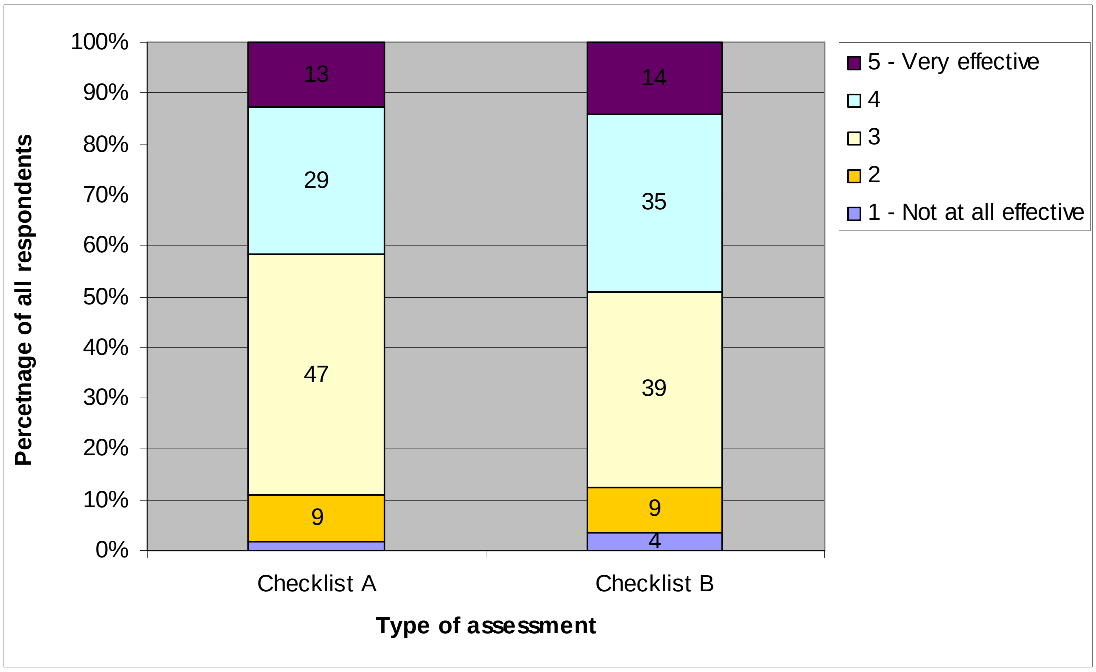


Figure 9.12. Percentage of all respondents and their ratings of effectiveness in identifying changes to reduce the risk.
(Rating on a five point scale, rating 1 = Not at all effective to rating 5 = Very effective.)

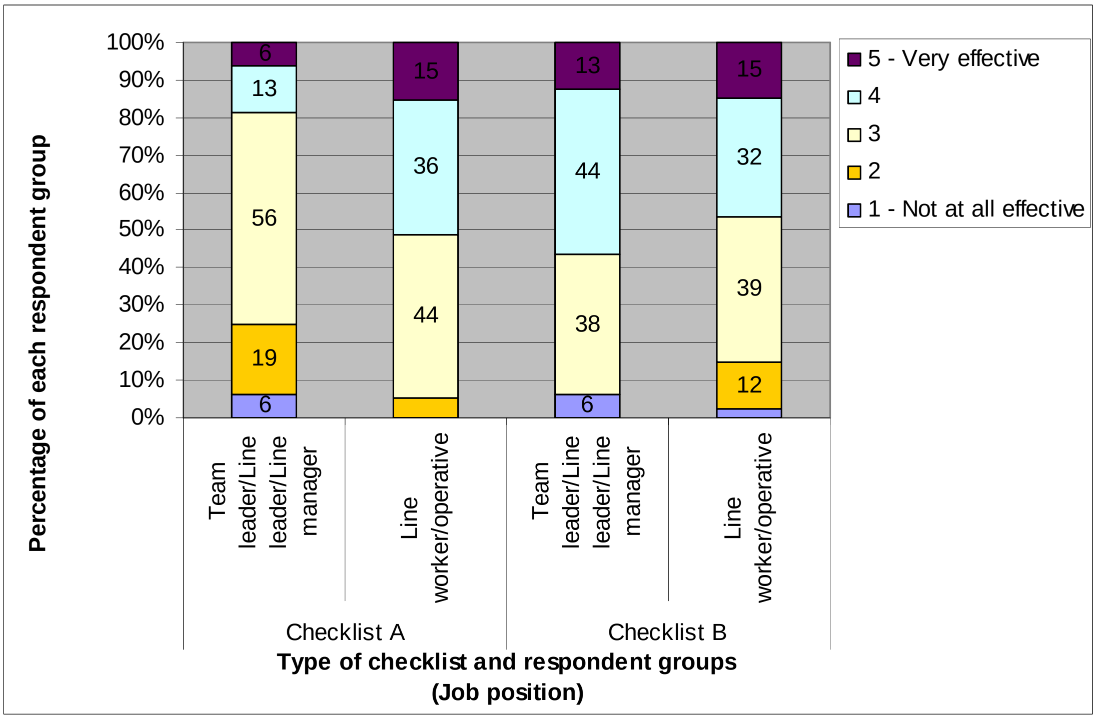


Figure 9.13. Percentage of all respondents from each job position and their ratings of effectiveness in identifying changes to reduce the risk.
(Rating on a five point scale, rating 1 = Not at all effective to rating 5 = Very effective.)

Perceived ease of use

68% of all respondents reported that they found Checklist A the easiest to use. 32% reported that Checklist B was the easiest to use. When analysed in relation to job position, it was found that equal numbers of team leaders / line leaders/Line Managers found Checklist A and Checklist B was the easiest to use (50% for each Checklist). Whereas the majority of Line workers (76%) reported that they found Checklist A the easiest to use (Figure).

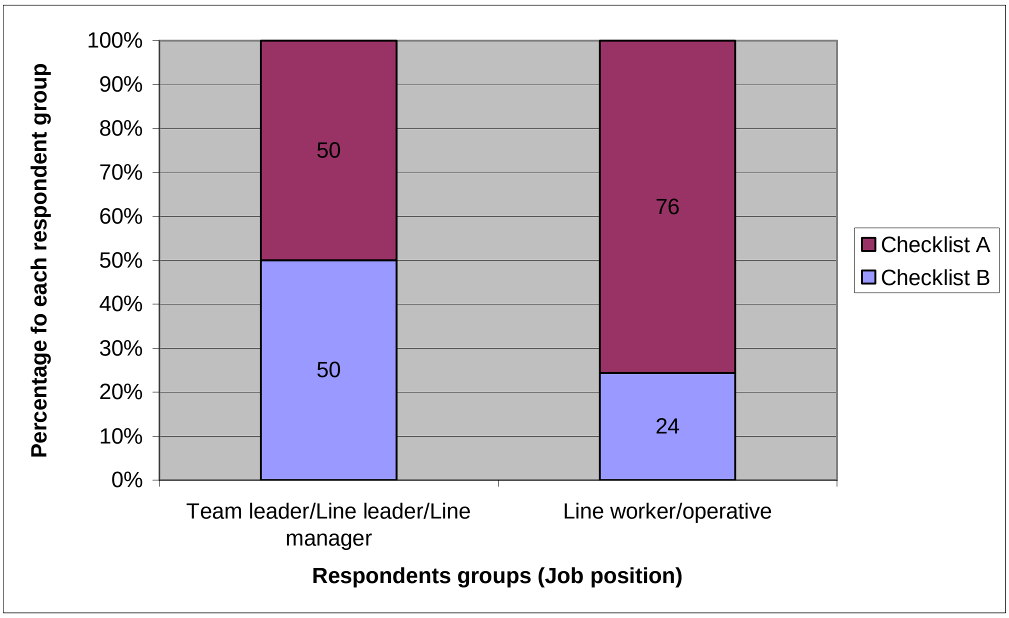


Figure 9.14. Percentage of all respondents from each job position and which Checklist they found easiest to use.

On a 5 point rating scale of **ease of following the instructions on how to use each of the assessment tools** (where 1 = Very difficult to 5 = Very easy) a slightly greater percentage of all respondents rated Checklist A instructions as easier to follow than Checklist B. 63% of all respondents rated Checklist A with ratings of 4 or 5 and 46% rated Checklist B with 4 or 5 ratings (Figure). When analysed in relation to job position, it was found that Line workers reported both checklist instructions as easier to follow than the Team leader, Line leader and Line manager group (Figure).

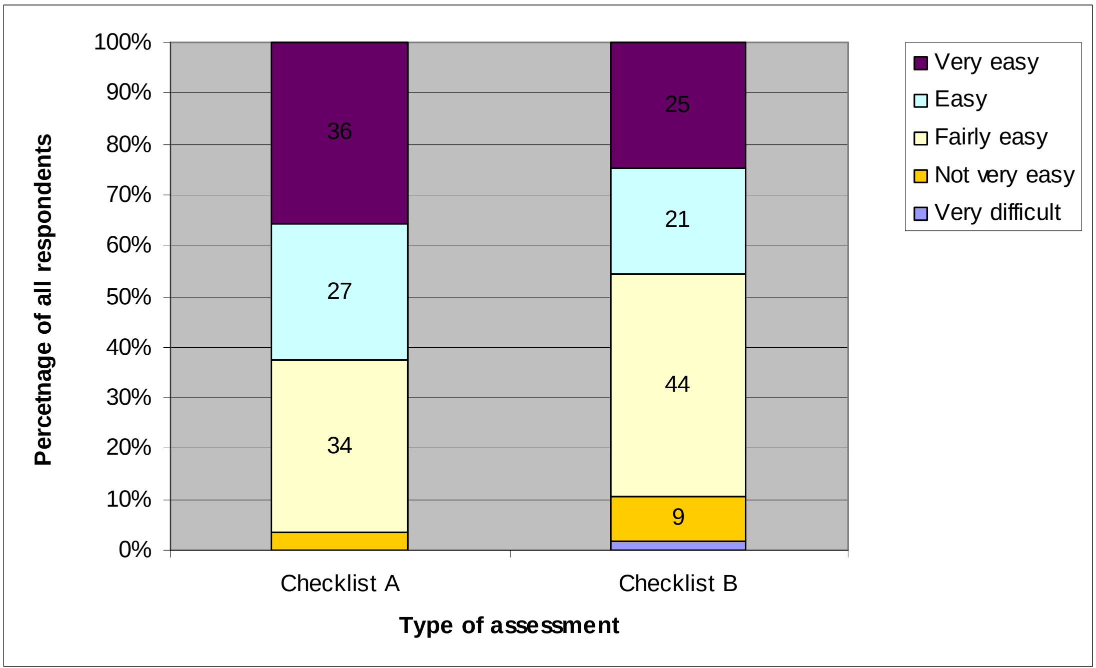


Figure 9.15. Percentage of all respondents and their ratings on ease of following the instructions in how to use each of the Checklists.

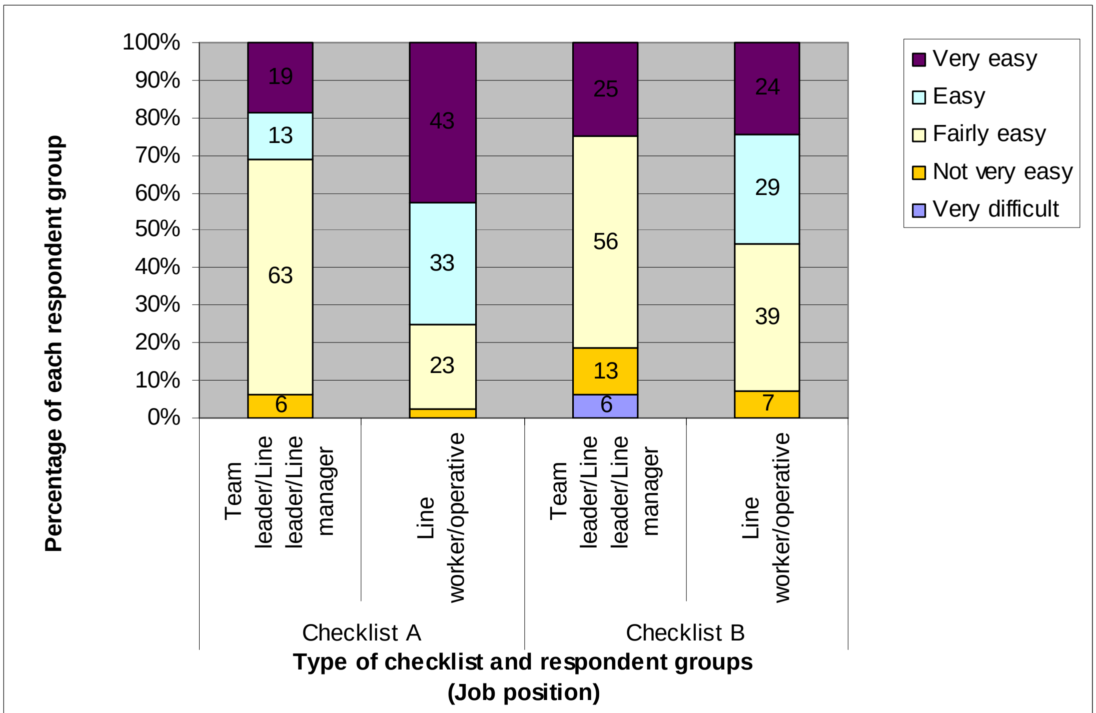


Figure 9.16. Percentage of all respondents from each job position and their ratings on ease of following the instructions in how to use each of the Checklists.

Respondents' views on the need for additional information and means of providing that additional information

Respondents were asked to circle the response that best described their level of agreement with each of the statements 'A' through to 'G' below:

A) I would have liked more background information about the risk factors (please circle)

B) I would have liked more information about how to complete the risk assessments.

C) I would have liked more information about possible control actions/changes to make to reduce the risks.

D) I think face to face training in the use of the assessments would be more useful than following written instructions.

E) I think following written instruction would be more useful than attending a face to face training session.

F) I thought that the written instructions were sufficient to conduct the assessments.

G) I would have liked to have gone through some example assessments with a trainer.

The full results are shown in Table. However, the key points are summarised below.

- 64% of all participants would have liked more background information about the risk factors.
- There were mixed views on whether more information was needed about how to complete the risk assessments with 46% agreeing that they would have liked more information whereas 30% reported that they did not require any more information than that which was provided (A two sided A4 instruction sheet – Included in Appendix H for Checklist A and Appendix I for Checklist B).
- Over half of all respondents (62%) agreed that they would have liked more information about possible control actions/changes to reduce the risks.

- 62% of all respondents agreed that they would have liked face to face training rather than just written instruction and only 11% disagreed with this. Over half of all respondents (57%) agreed that they would have liked to have gone through some example assessment with a trainer.
- However 63% of all respondents did agree that the written instructions that they had received with each checklist was sufficient to conduct the assessments.

Table 9.14. Percentage of all respondents and their level of agreement to each statements 'A' through to 'G'.

Statements	Percentage of respondents				
	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
A) I would have liked more background information about the risk factors	7	57	30	5	0
B) I would have liked more information about how to complete the risk assessments	7	39	25	26	4
C) I would have liked more information about possible control actions/changes to make to reduce the risks	13	49	27	11	0
D) I think face to face training in the use of the assessments would be more useful than following written instructions	18	44	28	11	0
E) I think following written instruction would be more useful than attending a face to face training session	0	18	33	42	7
F) I thought that the written instructions were sufficient to conduct the assessments	2	61	28	7	2
G) I would have liked to have gone through some example assessments with a trainer	7	47	30	16	0

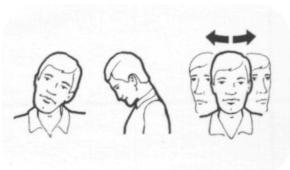
Preference for risk descriptors

Question 12 was designed to investigate respondent's preferences to the use of numerical description verses word description for repetition, force, time and postures, and also the use of illustrations.

Each respondent was asked to pick one of two different descriptions (Term 1 or 2) which described the same risk. Table presents the percentage of respondents and their preference to either term 1 or 2 for descriptions A to E.

In response to which of the terms (for descriptions A through to E) respondents found most helpful in describing a risk, significant differences were only observed in descriptions D and E. Notably these were the descriptors that included an image. In other respects this section did not reveal anything significant regarding preferences of descriptive terms such as comparing word descriptions to numerical terms, or descriptions of time as a percentage compared to a word description.

Table 9.15. Percentage of respondents and their preference for terms 1 or 2 for Descriptions A to E.

Description	Term 1	Term 2
A	Does the task involve similar motion patterns being repeated frequently	Similar motion patterns are repeated more than 11-20 times per minute
Respondents preference (Percentage of respondents)	44%	55.6%
Used in Checklist	B	A
B	Moderate force (1-4kg) or Strong force (More than 4kg) is exerted	Moderate or strong force is exerted
Respondents preference (Percentage of respondents)	54.4%	45.6%
Used in Checklist	A	B
C	Does the task involve holding the neck bent or twisted more than 15% of the time	Does the task involve holding the neck bent or twisted a part of the time
Respondents preference (Percentage of respondents)	49.1%	50.9%
Used in Checklist	B	A
D	Does the task involve holding the neck bent or twisted 	Does the task involve holding the neck bent or twisted (more than 15 degrees relative to the upright and forward facing position)
Respondents preference (Percentage of respondents)	75%	25%
Used in Checklist	B	A
E	The back is bent forward, sideways or twisted (more than 20 degrees from upright forward facing position)	The back is bent forward, sideways or twisted 
Respondents preference (Percentage of respondents)	29.8%	70.2%
Used in Checklist	A	B

9.2.2 Ease of completion of each check item

The results presented in this section investigate whether there was a significant difference in ratings for **ease of completion** for each check item of Checklist A compared to Checklist B. Each checklist comprised 13 check items. The list below presents the topic areas of each of the thirteen check items. The actual descriptors of each check item used in checklist A and B differ in terms of layout and information provided (e.g. numerical or word descriptor and illustration). For full versions of each check item used in checklist A and B refer to Appendix E for Checklist A and Appendix F for Checklist B.

1. Frequency - Shoulder / arm movements
2. Repetition
3. Force
4. Posture **-** Awkward head / neck posture
5. Posture **-** Awkward back posture
6. Posture **-** Awkward shoulders/arm posture
7. Posture - Static shoulder and elbows
8. Posture - Awkward wrist posture
9. posture **-** Awkward hand / finger grip
10. Posture - Static fingers, hand and wrist
11. Breaks
12. Work pace
13. Additional factors

The following results are from data collected from 88 completed assessments using Checklist A and 86 completed assessments using checklist B. A Mann Whitney between-subjects statistical test was applied to the data. Results show that there were no significant differences in ratings for Checklist A and B for all check items except check items 4 and 5. These check items were rated as significantly more easy to complete on Checklist B than Checklist A (Table 1 in Appendix O).

When the data was split in relation to participant job position, it was found that there was no significant difference between the ease of completion ratings for each check item of Checklist A compared to Checklist B when completed by line leaders or line workers.

Looking at just Checklist A there was no significant difference between Line leaders and Line workers ratings of each check item, except for check item 4 and 6 where line workers gave significantly higher ratings (easier ratings) than Line leaders group (Table 2 in Appendix N).

Looking at just Checklist B there was no significant difference between line leaders and line workers ratings of each check item of Checklist B (Table 3 in Appendix N).

Level 2 analysis

Results for ease of each check item for each task separately are presented in Appendix O.

9.2.3 Percentage agreement for each check item

This section investigates the level of agreement of participant responses to the model response as to whether the risk factor was present or not present. This was calculated for each of the 13 check items. In total, data has been collected from 90 completed assessments using Checklist A and 86 completed assessment using checklist B. Because the number of completed assessments using checklist A and B differed for each task (Table) the percentage values were calculated to enable direct comparison of the performance of each checklist for each of the 13 check items. Table 9.17 shows that across all four companies both checklists (A and B) were used to assess each of the four tasks.

Table 9.16. Number of completed assessments

Task	Worker group	Checklist A	Checklist B
Task 1	Team Leaders, Line Leaders and Line Managers	10	8
	Line workers	24	16
	Unknown	1	0
Task 2	Team Leaders, Line Leaders and Line Managers	5	5
	Line workers	13	6
	Unknown	0	0
Task 3	Team Leaders, Line Leaders and Line Managers	7	10
	Line workers	17	24
	Unknown	0	0
Task 4	Team Leaders, Line Leaders and Line Managers	2	5
	Line workers	11	12
	Unknown	0	0
	TOTAL	90	86

Table 9.17. Type of Checklist each company used to assess Tasks 1 - 4

	Company 1	Company 2	Company 3	Company 4
Task 1	A	A	B	B
Task 2	A	A	B	B
Task 3	B	B	A	A
Task 4	B	B	A	A

The results have been presented to enable comparisons of the level of agreement and the effect of the following aspects:

- Comparing Checklist A and B.
- The effect of participant’s job position.

Comparing Checklist A and B - Analysis of all task data combined

This section compares the percentage of agreement between participants and the model response achieved for both Checklist A and Checklist B when the results from all four tasks are combined.

Table 9.18. Percentage agreements of participants and model responses for each check item for checklist A and B (poor performance is highlighted in yellow, major differences highlighted in grey)

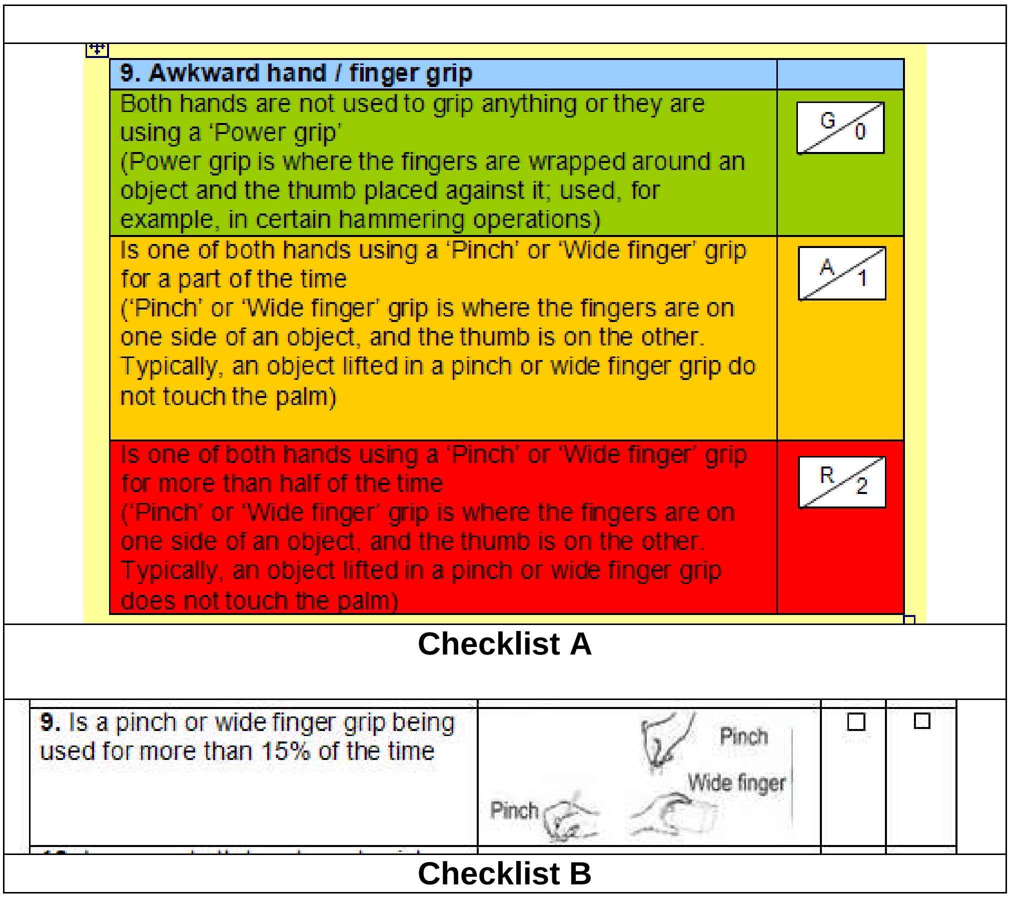
Check item	Percentage agreement of participant responses to model responses (all tasks combined)	
	Checklist A (All companies, n=90)	Checklist B (All companies, n=86)
1	96%	85%
2	62%	49%
3	72%	66%
4	62%	67%
5	50%	38%
6	74%	64%
7	67%	55%
8	47%	50%
9	81%	49%
10	57%	78%
11	86%	84%
12	84%	90%
13	99%	95%

Table 9.18 shows that level of agreement across the check items ranged from 47% to 99% for Checklist A and 38% to 95% for Checklist B. More than 80% of participants provided the same response as the model response for both Checklist A and B for check items 1(Frequency - Shoulder / arm movements), 11 (Breaks), 12 (Work pace), 13 (Additional factors). It is important to note that these check items (1 and 11-13) refer to aspects where there is a definitive answer. The other items gaining significantly less agreement with the model response tend to require a judgement regarding body angles and ranges of motion rather than just time based aspects.

These poorer performing check items included 3 (Force), 4 (Awkward head/neck posture), 6 (Awkward shoulder/arm posture) and 7 (Static shoulders and arms) with 55% to 72% of completed checklists agreeing with the model response. Check items 2 (Repetition), 5 (Posture - Awkward back posture), and 8 (Posture - Awkward wrist posture) which are highlighted in yellow in Table 9.18, were particularly poor with less than 50% of all respondents providing responses that agreed with the model response.

It is interesting to note that for most check items the performance of Checklist A and Checklist B were very similar, except for Check items 9 (Awkward hand/finger) and 10 (Static finger/hand/wrist). Checklist A (81% correct) significantly outperformed Checklist B (49% correct) for check item 9 (Static fingers, hand and wrist) These results are highlighted in grey in Table 9.18. Figure 9.17 shows the check item 9 from Checklist A and B.

In contrast, Checklist B significantly outperformed Checklist A for item 10 with 78% compared to 57% correct. These results are also highlighted in grey in Table 9.18.



9. Awkward hand / finger grip	
Both hands are not used to grip anything or they are using a 'Power grip' (Power grip is where the fingers are wrapped around an object and the thumb placed against it; used, for example, in certain hammering operations)	G 0
Is one of both hands using a 'Pinch' or 'Wide finger' grip for a part of the time ('Pinch' or 'Wide finger' grip is where the fingers are on one side of an object, and the thumb is on the other. Typically, an object lifted in a pinch or wide finger grip do not touch the palm)	A 1
Is one of both hands using a 'Pinch' or 'Wide finger' grip for more than half of the time ('Pinch' or 'Wide finger' grip is where the fingers are on one side of an object, and the thumb is on the other. Typically, an object lifted in a pinch or wide finger grip does not touch the palm)	R 2

Checklist A

9. Is a pinch or wide finger grip being used for more than 15% of the time	Pinch, Wide finger, Pinch	☐	☐

Checklist B

Figure 9.17. Check item 9 from Checklist A and Checklist B.

10. Static fingers, hand and wrist	
Both hands and wrists regularly change position to adopt relaxed/neutral postures during every hour of work	G/0
One or both hands and wrists are in a static position (i.e. infrequently moved) for between 1 and 2 consecutive hours	A/1
One or both hands and wrists are in a static position (i.e. infrequently moved) for more than 2 consecutive hours	R/2

Checklist A

10. Is one or both hands and wrists held in a static position (i.e. infrequently moved) for more than 1 hour		☐	☐

Checklist B

Figure 9.18. Check item 10 from Checklist A and Checklist B.

The effect of participants job position* - *Analysis of all task data combined

This section compares the percentage of agreement between participants and the model response achieved by Checklist A and Checklist B by job position. In particular it looks at the performance when completed by Team Leaders, Line Leaders and Line Managers compared to Line Workers when the results from all four tasks are combined. The results, presented in table 9.19, show that overall Team Leaders, Line Leaders and Line Managers gained slightly higher percentage level of agreement when using checklist B compared to checklist A for all check items. In comparison Line workers gained slightly higher percentage level of agreement when using Checklist A rather than Checklist B.

For each Check item within each Checklist there was only a small difference between level of agreement achieved by Team Leaders, Line Leaders and Line Managers compared to Line Workers, accept for Check items 7 and 9 of Checklist A and Check items 6 and 9 for checklist B. These are highlighted in yellow in Table. A greater percentage of Check item 9 from Checklist A were completed correctly (i.e. matching the model response) by Line workers (77%) compared to Team Leaders, Line Leaders and Line Managers (50%)

For Check item 9 of Checklist B a greater percentage were completed correctly by Team Leaders, Line Leaders and Line Managers (71%) compared to Line workers (45%).

Table 9.19. Percentage agreements of participants and model responses for each check item for checklist A and B split by respondents Job position (key differences highlighted in yellow).

	Percentage agreement of participant responses and model response for tasks 1 to 4			
	Checklist A		Checklist B	
	Team Leader, Line Leader or Line Manager (n=24)	Line Worker or Operative (n=65)	Team Leader, Line Leader or Line Manager (n=28)	Line Worker or Operative (n=58)
1	96%	95%	89%	83%
2	67%	60%	46%	50%
3	75%	77%	82%	59%
4	58%	65%	61%	71%
5	54%	49%	46%	35%
6	75%	74%	82%	55%
7	54%	71%	61%	52%
8	42%	48%	57%	47%
9	50%	77%	71%	45%
10	67%	52%	86%	74%
11	88%	86%	82%	85%
12	75%	89%	86%	91%
13	100%	99%	89%	98%

The effect of type of task assessed - Analysis of separate task data

Table 1 to Table 3 in Appendix P present the percentage of respondents who agreed with the model response for check items 1 to 13 for each task individually. These are split by Checklist Type (Table 1), Job position (table 2) and Task (Table 3). Results show that whilst there are differences in level of agreement across tasks, with some tasks gaining less correct responses for some check items than others, overall similar patterns are seen across both Checklists A and B.

9.2.4 Total number of risk factors

The following results are from data collected from 90 completed assessments using Checklist A and 85 completed assessment using Checklist B. Table 9.20 presents descriptive statistics for the Discrepancy Values (Participant total number of risk factors present minus 'Model' response total number of risk factors present) of Checklist A and B. Figures 9.19 to 9.22 present histograms depicting the percentage of completed checklist and the range of discrepancy values gained from each. Figure 9.19 shows that 23% of all completed Checklist A's agreed with the number of total risk factors present in the model response. The majority (54%) provided a total number of risk factors present that varied by 1 - 2 from the model response. The remaining 22% had discrepancies values between 3 and 8. Similar performance was gained from Checklist B but with slightly less agreeing exactly with the model response (13% of all completed checklist B's with 0 discrepancy) and 58% varying from the Model response by 1 - 2 risk factors.

Table 9.20. Descriptive statistics for the Absolute Discrepancy Values for Checklists A and B.

	Absolute Discrepancy Values	
	Checklist A	**Checklist B**
Number of completed checklists	90	85
Mean	1.7	1.9
Median	1	2
Mode	1	1
Std. Deviation	1.6	1.5
Minimum	0	0
Maximum	7	8

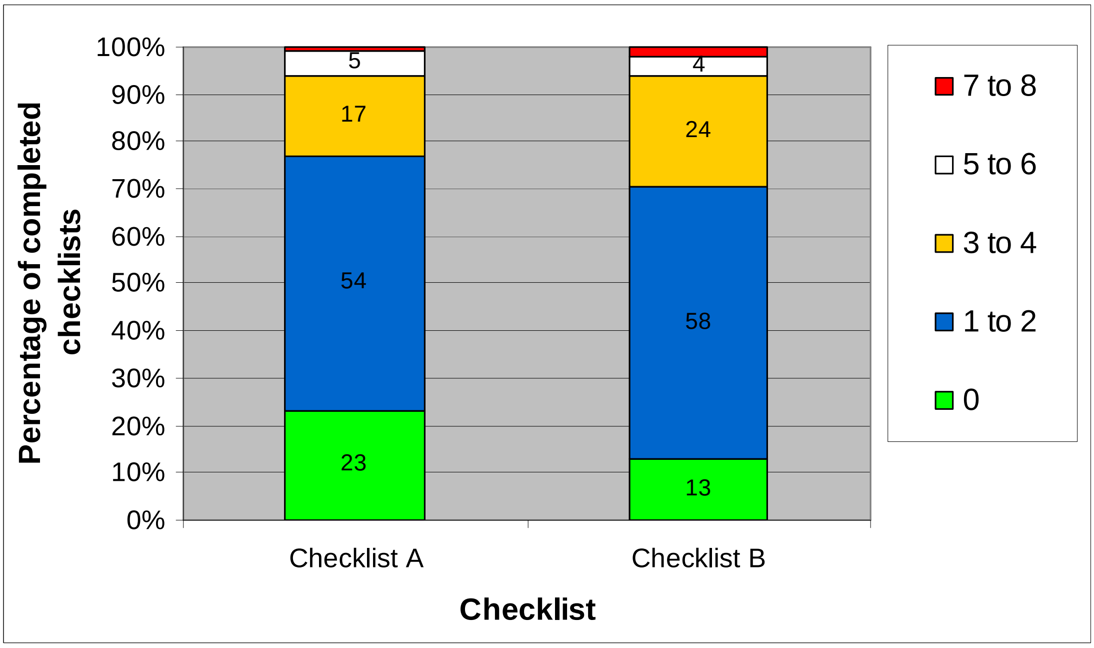


Figure 9.19. Percentage of completed Checklists A and B and the absolute discrepancy values from the Model response.

When split by job position similar ranges of discrepancies values were found for Team leaders, Line and line managers and Line workers (Table 9.21). It can be seen in Figure 9.20 that similar percentages of completed checklists gained the same Discrepancy Values for the Line leaders and the Line workers. For both groups Checklist A gained slightly higher percentage of correct values (i.e. discrepancy value of 0) with 23% for the Line leader group and 24% for the Line workers. Checklist B gained less correct values with 7% for the Line leader group and 16% for Line workers.

Table 9.21. Descriptive statistics for the Absolute Discrepancy Values for Checklists A and B when split by job position.

	Absolute Discrepancy Values			
	Checklist A		Checklist B	
	Team Leader, Line Leader or Line Manager	Line Worker or Operative	Team Leader, Line Leader or Line Manager	Line Worker or Operative
Number of completed checklists	26	57	28	57
Mean	1.8	1.7	2.1	1.8
Median	1	2	2	1
Mode	1	2	2	1
Std. Deviation	1.8	1.5	1.6	1.5
Minimum	0	0	0	0
Maximum	6	7	8	7

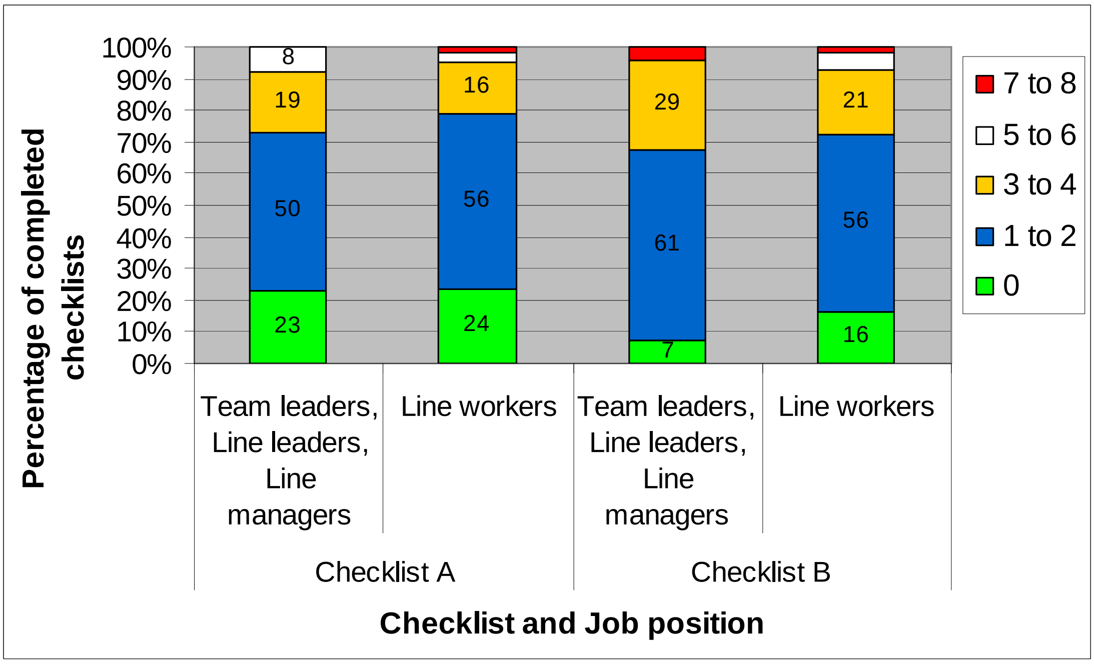


Figure 9.20. Percentage of completed checklist by Team leaders, Line leaders and Line managers and Line workers and the absolute discrepancy values from the Model response.

To investigate if checklists differed in terms of a tendency to either over or under assess the total number of risk factor present, the negative values of the discrepancy values were also considered.

A negative discrepancy value means that the participant under assessed the total number of risk factors present, whereas as a positive value means that the participant over assessed the total number of risk factors present. The results show that 45% of the Checklist B users tended to under assess the total number of risk factors present. In comparison only 23% of Checklist A users under assessed the total number of risk factors (Figure 9.21).

Table 9.22. Descriptive statistics for the Discrepancy Values for Checklists A and B.

	Discrepancy Values	
	Checklist A	**Checklist B**
Number of completed checklists	90	85
Mean	0.9	-.14
Median	1	0
Mode	0	1
Std. Deviation	2.2	2.5
Minimum	-4	-8
Maximum	7	5

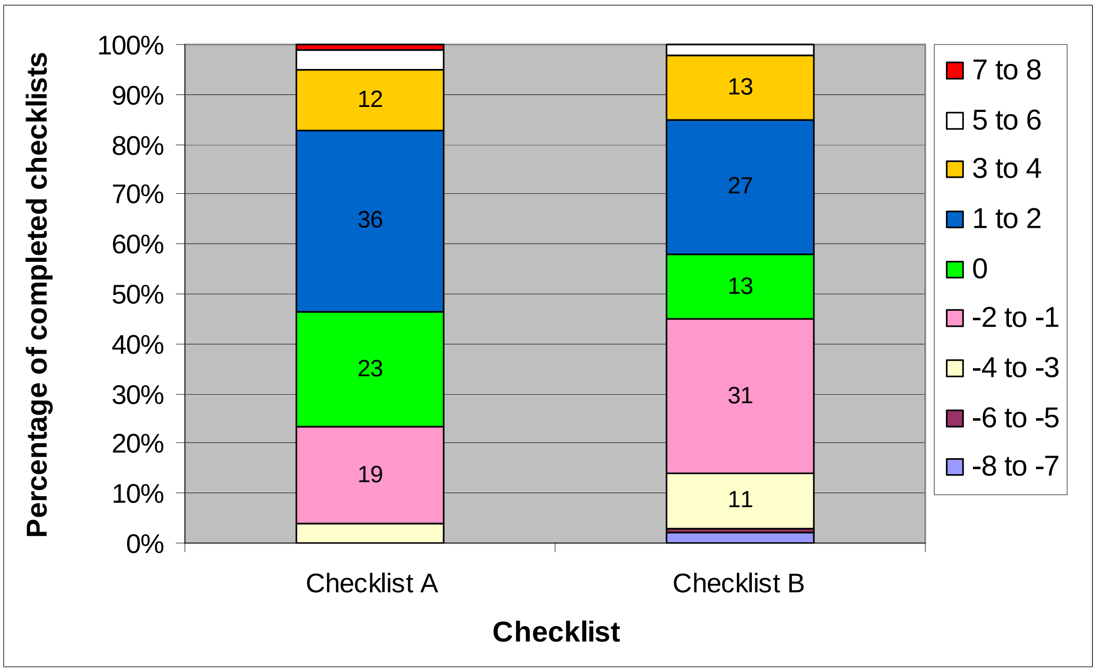


Figure 9.21. Percentage of completed Checklists A and B and the discrepancy values from the Model response.

Table 9.23 shows the Discrepancy Values when split by job position. Here it was found that for Checklist A a slightly higher percentage of the Team leaders, Line Leaders and line managers group tended to under assess the number of risk factors present, with 35% gaining discrepancy values between -1 and -4. Only 19% of Line workers under assessed the number of risk factors present (-1 to -4). Conversely, line workers tended to over assess the number of risk factors present, with 57% Over assessing the number of risk factors present, compared to 42% of team leaders group (Figure 9.22).

The figures for Checklist B show that a similar percentage of both groups under and over assessed the total number of risk factors present, as can be seen in Figure 9.22.

Table 9.23. Descriptive statistics for the Discrepancy Values for Checklists A and B when split by job position.

	Discrepancy Values			
	Checklist A		Checklist B	
	Team Leader, Line Leader or Line Manager	Line Worker or Operative	Team Leader, Line Leader or Line Manager	Line Worker or Operative
Number of completed checklists	26	63	28	57
Mean	.9	.9	-0.3	-.1
Median	0	1	-0.5	
Mode	-1	0	-1(a)	1
Std. Deviation	2.4	2.1	2.7	2.4
Minimum	-3	-4	-8	-7
Maximum	6	7	4	5

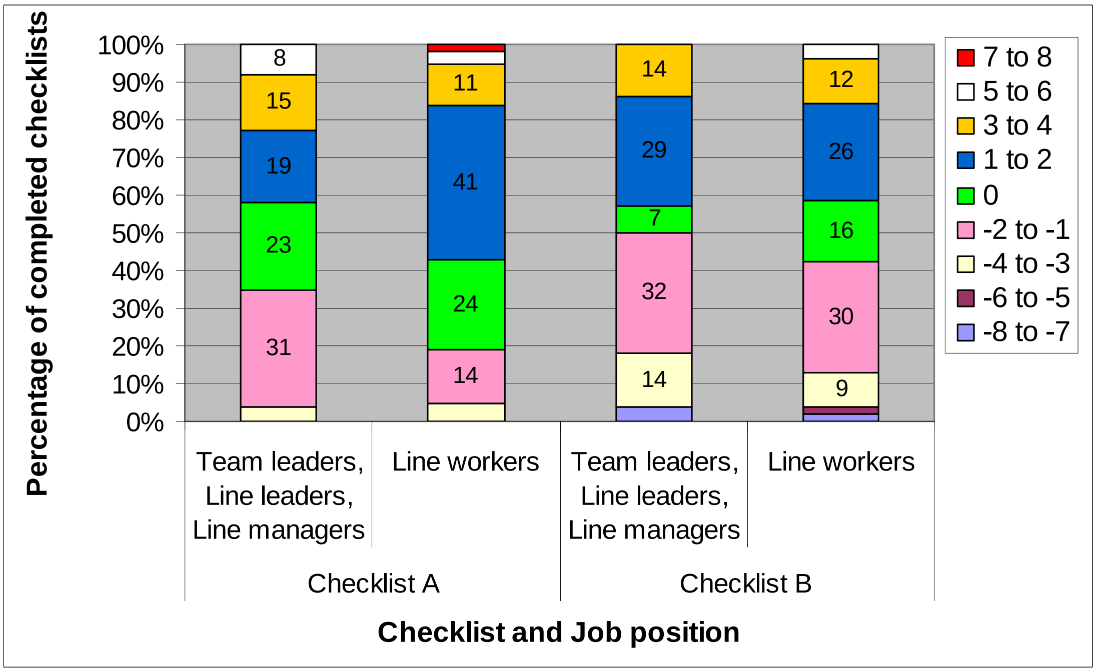


Figure 9.22. Percentage of completed checklist by Team leaders, Line leaders and Line managers and Line workers and the discrepancy values from the Model response when suing Checklist A and B.

Statistical analysis of the Absolute Discrepancy Values

Statistical analysis of the Absolute Discrepancy Values supports the aforementioned percentage results. It was found that there was no statistically significant difference between Checklist A and B in terms of agreement with the model response for the number of total risk factors present. It also confirmed there was no statistically significant differences between the two Job position groups with respect to agreement with the model response for the number of total risk factors present (Table 9.24). Both checklist and Job position groups performed equally well.

Table 9.24. Results from the statistical analysis of the Absolute Discrepancy Values

Effect / interaction investigated	Question aimed at answering	Statistical result
Main effect of checklist on Absolute Discrepancy Values.	On average, before training, in what way do the Absolute Discrepancy Values change with Checklist, regardless of the effect (if any) of other variables?	No significant difference between Checklist A and B, p= 0.166
Main effect of company on Absolute Discrepancy Values.	On average, before training, in what way do the Absolute Discrepancy Values change with Company, regardless of the effect (if any) of other variables?	No significant difference between Companies, p= 0.105
Main effect of Job position on Absolute Discrepancy Values.	On average, before training, in what way do the Absolute Discrepancy Values change with Job position, regardless of the effect (if any) of other variables?	No significant difference between Job position groups (Team leaders, Line leaders, Line managers group and Line workers group), p= 0.698
Estimated interaction of company and job position on Absolute Discrepancy Values.	On average, before training, to what extent is the effect of Company on the Absolute Discrepancy Values modified by the effect of Job position, regardless of the effect of other variables?	No significant effect, p=0.280
Estimated interaction of job position and checklist on Absolute Discrepancy Values.	On average, before training, to what extent is the effect of Job position on the Absolute Discrepancy Values modified by the effect of Checklist, regardless of the effect of other variables?	No significant effect, p=0.136

Level 2 - Analysis of data for each task separately

When comparing the data by job position for each task separately, it was possible to identify a significant difference between Checklist A and Checklist B. It can be seen in Table 9.25 that Checklist B generated significantly less Discrepancy Values when completed by Line Workers compared to Line Leaders. This suggests that Checklist B offers a greater opportunity for Line Workers to obtain scores closer to those identified as correct by the expert assessors.

This was the only statistically significant finding for this section of the Level 2 analysis, although the remaining results are presented in Appendix R

Checklist B had significantly less Discrepancy Values when completed by Line workers compared to Line leaders group for Task 3.

Table 9.25. Statistical results for Task 3 – when comparing individual tasks by job position.

	Team leader, Line leader or Line manager N=8	**Line worker or Operative N=15**
Mean	2.3	1.25
Std. deviation	2.11	1.29
Minimum	1	0
Maximum	8	6
Overall significance in Checklist B results	0.055	

9.2.5 Overall risk ratings

The following results are from data collected from 90 completed assessments using Checklist A and 86 completed assessment using checklist B. Table 9.26 shows that 71% of Checklist A agreed with the model response in terms of overall risk rating, whereas only 38% of completed checklist B's agreed with the model response. The majority of the remaining completed checklists (both A and B) over rated the overall level of risk of the assessed tasks.

Table 9.26. Percentage of completed checklists with risk ratings and how they related to the Model response.

	Percentage of completed assessments	
Percentage of completed assessments that:	**Assessment A n=90**	**Assessment B n=86**
Agreed with ‘Model’ response	71%	38%
Under rated the risk	2%	12%
Over rated the risk	26%	34%
No risk rating given	1%	16%

Comparison of Checklist A and Checklist B assessment results for overall risk rating when split by job position showed that there was little difference between the job position groups, with similar level of percentages of completed assessments by both job groups agreeing with the ‘Model’ response for both checklists. This is shown in Table 9.27.

Table 9.27. Percentage of completed checklists with risk ratings and how they related to the Model response when split by job position.

	Percentage of respondents			
	Assessment A		**Assessment B**	
Percentage of completed assessments that:	**Team Leader, Line Leader or Line Manager n=24**	**Line Worker n=65**	**Team Leader, Line Leader or Line Manager n=28**	**Line Worker n=58**
Agreed with ‘Model’ response	63%	74%	32%	41%
Under rated the risk	4%	2%	3%	16%
Over rated the risk	33%	23%	36%	33%
No risk rating given	0	2%	29%	11%

9.2.6 Suggestions for improvement

Table 9.28 shows that Checklist B produced a greater number of suggestions for improvement than Checklist A. However, in terms of further developing these suggestions by providing more in-depth descriptions of the types of changes to be made both checklists performed equally well (41% of completed Checklist A providing more in-depth suggestions and 42% of Checklist B).

Table 9.28. Descriptive statistics for the number of suggested changes to reduce risks when using Checklist A and Checklist B.

	Number of suggested changes to reduce the risks	
	Checklist A	**Checklist B**
Number of completed checklists	90	86
Mean	.96	9.24
Median	.00	8.00
Mode	0	10
Std. Deviation	1.373	6.608
Minimum	0	0
Maximum	6	25

Table 9.29 presents the descriptive statistics for the number of suggested changes to task activities which are intended to reduce the level of MSD risks. These are split by job position and whether Checklist A or Checklist B. It can be seen that Checklist B encouraged a significantly larger number of suggestions for both worker types. Table 9.30 shows the percentages of respondents who provided additional suggestions from their own initiative or provided more in-depth descriptions of changes. Here there is little difference between the two checklists although it should be noted that the percentage of Line Leaders making such comments was approximately half that of Line Workers.

Table 9.29. Descriptive statistics for the number of suggested changes to reduce risks when using Checklist A and Checklist B split by job position.

	Number of suggested changes to reduce the risks			
	Checklist A		**Checklist B**	
	Team Leader, Line Leader or Line Manager	**Line Worker**	**Team Leader, Line Leader or Line Manager**	**Line Worker**
Number of completed checklists	24	65	28	58
Mean	0.58	1.1	7.11	10.28
Median	0	0	6.50	9.50
Mode	0	0	0	10
Std. Deviation	1.1	1.5	5.315	6.958
Minimum	0	0	0	0
Maximum	3	6	21	25

Table 9.30. Percentage of participants that made their own suggestions/ or wrote more in-depth descriptions of changes that could be made.

	All participants		Team Leader, Line Leader or Line Manager		Line Worker	
	Checklist A	Checklist B	Checklist A	Checklist B	Checklist A	Checklist B
Number of participants	41%	42%	25%	29%	48%	48%

Section 9.2.7 provides a tabulated summary of the main findings of Trial 1.

9.2.7 Summary table of the main results from Trial 1

Data set	Main results
Comparison questionnaire	**Positive/negative comments** • Checklist A gained a greater percentage of positive comments than Checklist B from both job position groups. • The strongest and most noted characteristics of Checklist A by all participants were clear definitions, use of colour coding, easy and simple to follow, and the scoring system for assessing the overall level of risk. • The strongest and most noted characteristics of Checklist B were the use of illustrations, presentation of possible solutions, the provision of space to write and describe tasks and problems in detail and that it was easy and simple to follow. • Checklist A was reported as having clearer definitions and was easier to understand or explained things better than Checklist B. Checklist A used numerical figures to define joint angle and frequency rates, weight and force, whereas Checklist B used words to describe these aspects. However when a direct comparison between these terms was requested in Question 12 of the questionnaire no significant preference was found between the use of numerical verses word descriptive terms. Significant preferences were found when accompanying illustrations were used to help define a check item term compared to the use of word descriptions that did not have an accompanying illustration. **Overall preference** • The majority of Team leaders, Line leaders and Line Managers overall preferred Checklist B. • The majority of Line workers preferred Checklist A. **Confidence in use** • A slightly higher percentage of the Team leaders, Line leaders and Line Managers felt more confident that they had used Checklist B correctly. • Overall, line workers felt less confident than the Line managers that they had used either Checklist correctly, however a greater percentage felt more confident they were using Checklist A (48%) correctly than Checklist B (22%). **Effectiveness in identifying risks** • A high percentage of Line workers (77%) rated checklist A as being very effective compared to only 25% rating Checklist B as very effective.

	Effectiveness in identifying cause • Similar numbers of Line leaders gave high ratings of effectiveness for both checklists, whereas there was a marked difference in perceived effectiveness for the Line workers with a higher percentage reporting Checklist A as the most effective. **Perceived ease of use** • Of the Line leaders group, 50% reported Checklist A was easiest to use and 50% found Checklist B easiest to use. Of the Line workers 76% reported that checklist A was easiest to use.
Ease of completing Checklist A and B	• In contrast to the above results there was no significant difference between the two checklists ratings of ease for completing each check item, except for check items 4 and 5 in which it was found that ease of completion ratings were statistically significantly higher for Checklist B. This means that participants found completing Check items 4 and 5 on Checklist B easier than on Checklist A. Check item 4 and 5 referred to neck and back postures, checklist A used numerical descriptors whereas Checklist B used word descriptors with an accompanying illustration, therefore supporting the findings regarding the effectiveness of Illustrations in depicting posture and ranges of motion. • For Checklist A there was a statistically significant difference in rating of ease of completion between job positions groups, with Line workers rating check items 4 and 6 as easier to complete than Line leaders. Check item 4 and 6 refer to neck and shoulder and arm posture (respectively) – Checklist A uses word descriptors to describe postures and numerical figures to define ranges of motion, in this instance it would indicate that Line workers reported that it was easier for them than the Team leaders, Line managers and Line leaders to equate these descriptors with actual observed motions.
Level of agreement between participants and model response	• Level of agreement across check items ranged from 47% to 99% for Checklist A and 38% to 95% for Checklist B. • Good and poor performing check items were the same across both checklists – indicating that it was the actual criteria used (and the understanding and interpretation of the criteria) rather than design aspects that were having an effect on intra-rater validity. • Check items 1, 11, 12 and 13 of both checklists gained a high percentage of agreement to the model response (more than 80% of completed checklists agreed with the model response). • Poor performing check items were 2, 5, and 8 with more than 50% of completed checklists not matching the model response. • Check item 9 of Checklist A attained significantly greater agreement than Checklist B, even though checklist B provided an illustration depicting the different wrist postures. This shows that for this particular item word descriptors proved more effective than illustrations.

	• Check item 10 of Checklist B attained significantly greater percentage of completed checklists that agreed with the model response than Checklist A. • When split by job position both groups performed similarly, except for Check items 6 and 9 of Checklist B where Team leaders gained significantly greater agreement than Line workers. • Conversely Line workers gained significant greater agreement when using Checklist A for check items 7 and 9.
Overall risk score (Total number of risk factors present)	• 23% of all completed Checklist A responses agreed with the number of total risk factors present in the model response. The majority (54%) provided a total number of risk factors present that varied by 1 - 2 from the model response. The remaining 22% had Discrepancy Values between 3 and 8. Similar performance was gained from Checklist B but with slightly less agreeing exactly with the model response (13% of all completed checklists with no discrepancy) and 58% varying from the Model response by 1 - 2 risk factors. • Similar percentages of completed checklists by the line leader group and the line workers gained the same Discrepancy Values. For both groups Checklist A gained slightly higher percentage of correct values (i.e. discrepancy value of 0) with 23% for Line leader group and 24% for Line workers. Checklist B gained less correct values (i.e. a discrepancy value of 0) with 7% for Line leader group and 16% Line workers. • 23% of completed checklists under assessed the total number of risk factors present when using Checklist A whereas 45% under assessed the total number of risk factors present when using Checklist B. 53% of participants who completed Checklist A over assessed the number of risk factors present compared with 42% for Checklist B. • Statistical analysis of the Absolute Discrepancy Values support the aforementioned percentage results by finding that there was no statistically significant difference between the two checklists in term of agreement with the model response for the number of total risk factors present. • Statistical analysis of the Absolute Discrepancy Values also supported that there was no statistically significant difference between the two job groups in term of agreement with the model response for the number of total risk factors present.
Overall risk rating	• Checklist A gained greater percentage of agreement to model response than Checklist B (71% and 38% respectively). • Where Checklist A disagreed with the model response the majority over estimated the level of risk. • Where Checklist B disagreed with the model response most over estimated the overall level of risk.

	• There was little difference between participants from both job position groups for both checklists. A similar level of percentages of completed assessments by both job groups agreed with the Model response.
Suggestions for improvement	• Checklist B produced a greater number of suggestions for improvement than Checklist A. • In terms of further developing these suggestions by providing more in-depth description of the types of changes to be made both checklists performed equally well (41% Checklist A and 42% Checklist B).

9.3 Trial 2 - Comparing trained and untrained users

The following results are from data collected from a total of 26 participants and 46 completed checklists. Table 9.31 shows the number of completed checklist included in the analysis for Task 1 and Task 2. Still images of Task 1 and Task 2 are shown below.

Figure 9.23 - Task 1 – Laboratory activity

Figure 9.24 - Task 2 – Flower packaging activity

Table 9.31. Ratings for ease of completing each check item of Checklist A when assessing Task 1 before and after training.

Task 1 Number of completed A and B assessments before and after training		
	Before training	**After training**
Checklist A	12	12
Checklist B	10	10
Task 2 Number of completed A and B assessments with and without training		
	Without training	**With training**
Checklist A	12	16
Checklist B	8	10

The discrepancy between the number of participants and the number of checklists is accounted for by staff turnover between evaluations (trained and untrained). Since most of the participating companies employed a large number of temporary workers and are engaged in highly seasonal trades, the changes in staff profile are more significant that in some other market segments.

9.3.1 Ease of completion of each check item

Table 9.32 shows the content of each of the check items for both Checklist A and B

Table 9.32 – Check items by number.

Check items
1. Frequency - Shoulder / arm movements
2. Repetition
3. Force
4. Posture - Awkward head / neck posture
5. Posture - Awkward back posture
6. Posture - Awkward shoulders/arm posture
7. Posture - Static shoulder and elbows
8. Posture - Awkward wrist posture
9. posture - Awkward hand / finger grip
10. Posture - Static fingers, hand and wrist
11. Breaks
12. Work pace
13. Additional factors

The ease of completion of the two checklists was compared for the two chosen activities (Task 1 and Task 2). This was compared between trained and untrained participants to scrutinise for significant differences. Tables 9.33 and 9.35 present the results for Checklist A and Tables 9.34 and 9.36 present those for Checklist B.

Only two areas of significant different were observed between the groups. For Task 1 a difference was noted for check item 3 (Force applied during the task). Here Checklist B revealed an higher typical score with training . For Task 2 a difference was observed between the performances for check item 9 (awkward hand/finger grip). In this instance training resulted in a lower score being recorded for Checklist A.

Task 1 – Checklist A

Table 9.33. Ratings for ease of completing each check item of Checklist A when assessing Task 1 before and after training.

	Task 1 – Checklist A Ratings for ease of completing each check item										
	Before training					After training					Is there a significant difference between before and after training?
	Mean	Mode	Std. dev	Min	Max	Mean	Mode	Std. dev	Min	Max	
1	3.75	3	0.75	3	5	3.67	4	0.89	2	5	No significant difference
2	3.75	3	1.06	2	5	3.67	4	1.37	1	5	No significant difference
3	4.08	4	0.79	3	5	3.91	4	0.94	2	5	No significant difference
4	3.25	3	0.62	2	4	3.17	3	1.03	1	5	No significant difference
5	3.83	4	0.94	2	5	3.83	3	0.83	3	5	No significant difference
6	3.67	5	1.23	2	5	3.67	4	0.89	2	5	No significant difference
7	3.33	3	1.15	2	5	2.83	3	1.19	1	5	No significant difference
8	3.50	3	0.90	2	5	3.27	3	0.90	2	5	No significant difference
9	3.67	4	1.15	2	5	3.50	3	0.90	2	5	No significant difference
10	3.58	5	1.24	2	5	3.17	2	1.19	2	5	No significant difference
11	4.00	5	1.13	2	5	4.42	5	0.67	3	5	No significant difference
12	3.92	5	1.51	1	5	4.25	5	1.22	1	5	No significant difference
13	3.58	5	1.38	2	5	3.58	4	1.00	2	5	No significant difference

Task 1 – Checklist B

Table 9.34. Ratings for ease of completing each check item of Checklist B when assessing Task 1 before and after training.

	Task 1 – Checklist B Ratings for ease of completing each check item										
	Before training					After training					Is there a significant difference between before and after training?
	Mean	Mode	Std. dev	Min	Max	Mean	Mode	Std. dev	Min	Max	
1	3.5	3	1.35	1	5	4.1	4	0.74	3	5	No significant difference
2	3.4	2	1.27	2	5	4.0	4	0.82	3	5	No significant difference
3	3.5	3	0.71	3	5	4.0	4	0.67	3	5	Significant difference (p=0.096)
4	3.6	4	0.52	3	4	3.6	4	0.84	2	5	No significant difference
5	3.67	4	0.87	2	5	3.7	4	1.16	2	5	No significant difference
6	3.0	4	1.12	1	4	3.6	3	0.97	2	5	No significant difference
7	3.25	4	0.89	2	4	3.6	3	0.70	3	5	No significant difference
8	3.0	3	1.0	2	5	3.2	2	1.32	2	5	No significant difference
9	3.22	3	0.83	2	5	3.8	3	1.14	2	5	No significant difference
10	3.5	3	0.53	3	4	3.7	3	0.82	3	5	No significant difference
11	4.4	4	0.52	4	5	3.7	3	0.95	3	5	No significant difference
12	4.11	4	1.27	1	5	4.0	4	0.82	3	5	No significant difference
13	3.3	3	1.16	1	5	3.6	3	0.84	3	5	No significant difference

Task 2 – Checklist A

Table 9.35. Ratings for ease of completing each check item of Checklist A when assessing Task 2 before and after training.

	Task 2-Checklist A Ratings for ease of completing each check item										
	Without training					With training					Is there a significant difference between before and after training?
	Mean	Mode	Std. dev	Min	Max	Mean	Mode	Std. dev	Min	Max	
1	4	4	0.74	3	5	3.67	3	0.82	3	5	No significant difference
2	3.42	4	0.90	2	5	3.57	4	0.53	3	4	No significant difference
3	4	4	0.60	3	5	3.43	4	1.27	1	5	No significant difference
4	3.58	4	1	2	5	4.14	5	0.90	3	5	No significant difference
5	3.33	4	0.78	2	4	4.00	4	0.82	3	5	No significant difference
6	3.58	4	0.79	2	5	4.14	4	0.38	4	5	No significant difference
7	3.42	4	0.79	2	4	3.86	3	0.90	3	5	No significant difference
8	3.58	4	0.51	3	4	3.71	3,4	0.76	3	5	No significant difference
9	3.58	4	0.90	2	5	2.29	1, 2, 3	1.11	1	4	Significant difference (p=0.022)
10	3.55	4	0.82	2	5	3.14	3	1.07	1	4	No significant difference
11	4.25	5	0.97	2	5	4.50	5	0.84	3	5	No significant difference
12	4.25	5	0.97	2	5	4.67	5	0.52	4	5	No significant difference
13	3.67	4	0.89	2	5	4.00	5	0.82	3	5	No significant difference

Task 2 – Checklist B

Table 9.36. Ratings for ease of completing each check item of Checklist B when assessing Task 2 before and after training.

	Task 2-Checklist B Ratings for ease of completing each check item										
	Without training					With training					Is there a significant difference between before and after training?
	Mean	Mode	Std. dev	Min	Max	Mean	Mode	Std. dev	Min	Max	
1	4.25	5	1.17	2	5	4.22	5	.83	3	5	No significant difference
2	4.25	5	1.17	2	5	4.11	5	.93	3	5	No significant difference
3	4.38	5	.92	3	5	4.11	5	.93	3	5	No significant difference
4	4.13	5	.99	3	5	3.56	3	1.01	2	5	No significant difference
5	4.13	5	1.13	2	5	3.89	4	.78	3	5	No significant difference
6	3.88	3	.99	3	5	3.56	3	1.24	2	5	No significant difference
7	4.25	5	.89	3	5	3.67	3	1.12	2	5	No significant difference
8	2.75	1	1.58	1	5	3.22	3	1.48	1	5	No significant difference
9	4	4	1.07	2	5	3.89	4	.78	3	5	No significant difference
10	3.75	4	1.04	2	5	3.22	2	1.39	1	5	No significant difference
11	4.38	5	.74	3	5	4	3	1.0	3	5	No significant difference
12	4.38	5	.74	3	5	3.67	5	1.23	2	5	No significant difference
13	3.5	3	.93	2	5	3.44	3	1.01	2	5	No significant difference

9.3.2 Percentage agreement for each check item

A comparison was undertaken of the participant performance against the model responses recorded by the expert panel.

Task 1

Table 9.37 shows the expert responses for Task 1.

Table 9.37. Model response TASK 1

Question number	Risk status
Q1	Present
Q2	Risk not present
Q3	Risk not present
Q4	Present
Q5	Risk not present
Q6	Present
Q7	Risk not present
Q8	Present
Q9	Present
Q10	Risk not present
Q11	Risk not present
Q12	Risk not present
Q13	Present

Table 9.38 shows that the level of participant agreement with the model responses across check items ranged from 33% to 92% for Checklist A (Before training) and 50% to 100% for Checklist A (After training). There was substantial improvement after training for check items 2, 5 and 11, and substantially worsened performance following training for check items 3 and 8. Training did not appear to have a notable effect for check items which previously gained high performance (i.e. before training attaining 80% + agreement). These include check items 1, 4, 6, 8, and 9. Training also did not appear to have an effect on the poorer performing check items of 7 and 10 (which gained less than 70% before training).

Table 9.38. Percentage agreement of participants to the model response for Task 1 when using Checklist A before and after training by; all participants and then split by job position.

Check item	All participants N=12		Team Leader, Line Leader or Line Manager N=5		Line Worker or Operative N=7	
	Before training	After training	Before training	After training	Before training	After training
1	92%	92%	80%	100%	100%	86%
2	33%	50%	20%	40%	43%	57%
3	83%	58%	80%	40.0%	86%	71%
4	92%	83%	100%	80%	86%	86%
5	33%	67%	40%	60%	29%	71%
6	92%	100%	100%	100%	86%	100%
7	67%	67%	40%	60%	86%	71%
8	83%	75%	60%	80%	100%	71%
9	83%	83%	60%	60%	100%	100%
10	58%	58%	60%	60%	57%	57%
11	67%	92%	40%	80%	86%	100%
12	75%	83%	40%	60%	100%	100%

*Green – significantly improved after training.
*Amber – significantly worse after training.

Table 9.39 extends this comparison for Checklist B. Here, an improvement in performance was demonstrated post training for check item 8 (awkward wrist posture) and 9 (awkward hand posture). However, worse performance was noted post training for check items 5 (awkward back posture), 7 (Static shoulder and elbows) and 10 (static fingers, hand and wrist). These changes were noted within the Line Leader group but not replicated by the Line Workers.

Table 9.39. Percentage agreement of participants to the model response for Task 1 when using Checklist B before and after training by; all participants, then split by job position.

Check item	All participants N=10		Team Leader, Line Leader or Line Manager N=4		Line Worker or Operative N=6	
	Before training	After training	Before training	After training	Before training	After training
1	80	90	100	100	67	83
2	10	0	0	0	17	0
3	50	30	50	25	50	33
4	80	90	75	100	83	83
5	70	30	100	25	50	33
6	80	90	100	100	67	83
7	80	30	100	25	67	33
8	40	70	50	100	33	50
9	70	90	75	100	67	83
10	70	20	100	0	50	33
11	80	100	75	100	83	100
12	90	90	100	100	83	83

*Green – significantly improved after training.
*Amber – significantly worse after training.

Task 2

The exercise was repeated for Task 2. Table 9.40 shows the model response for Task 2 against which participant performance was evaluated.

Table 9.40. Model response TASK 2

Question number	Risk status
Q1	Present
Q2	present
Q3	Risk not present
Q4	Present
Q5	present
Q6	Present
Q7	present
Q8	Risk not present
Q9	Present
Q10	Present
Q11	Present
Q12	Present

For Task 2, a different patter on performance was observed. Table 9.41 shows that, for Checklist A, Line Leaders demonstrated improved performance post training for check item 4 (awkward head/neck posture) and 9 (awkward hand/finger grip). However, decreased post training performance for both Line Leaders and Line Workers was observed for check items 3 (force), 5 (awkward back posture) and 12 (work pace). Line workers additionally recorded worse post training performance for check items 4 (awkward head and neck posture) and 6 (awkward arm/shoulder posture).

Table 9.41. Percentage agreement of participants to the model response for Task 2 when using Checklist A before and after training by; all participants, then split by job position.

Check item	All participants		Team Leader, Line Leader or Line Manager		Line Worker or Operative	
	Without training	With training	Without training	With training	Without training	With training
1	100%	100%	100%	100%	100%	100%
2	100%	94%	100%	80%	100%	100%
3	83%	69%	100%	60%	80%	63%
4	58%	50%	0%	40%	70%	38%
5	75%	56%	100%	60%	70%	38%
6	92%	69%	100%	80%	90%	63%
7	58%	63%	50%	60%	60%	88%
8	42%	38%	50%	40%	40%	50%
9	83%	88%	50%	100%	90%	100%
10	50%	81%	100%	80%	40%	88%
11	92%	100%	100%	100%	90%	100%
12	100%	50%	100%	60%	100%	25%

Table 9.42 goes on to show the results for Checklist B. Here it can be seen that Line Leaders increased performance with training for check items 4 (awkward head/neck posture) and 9 (awkward hand/finger grip). Line Workers saw a fall in performance for check item 4. However, Line Workers saw training improve check item 10 (static fingers/hand/wrist) scores. Line Leaders and Line Workers all showed a decrease in post training performance for check items 5 (awkward back posture) and 12 (work pace).

Table 9.42. Percentage agreement of participants to the model response for Task 2 when using Checklist B before and after training by; all participants, then split by job position.

Check item	All participants N=16		Team Leader, Line Leader or Line Manager N=8		Line Worker or Operative N=8	
	Without training	With training	Without training	With training	Without training	With training
1	100%	89%	100%	100%	100%	100%
2	100%	89%	100%	80%	100%	100%
3	88%	56%	100%	60%	80%	63%
4	75%	89%	0%	40%	70%	38%
5	88%	100%	100%	60%	70%	38%
6	63%	89%	100%	80%	90%	63%
7	38%	44%	50%	60%	60%	88%
8	63%	56%	50%	40%	40%	50%
9	50%	89%	50%	100%	90%	100%
10	38%	78%	100%	80%	40%	88%
11	100%	89%	100%	100%	90%	100%
12	88%	33%	100%	60%	100%	25%

9.3.3 Total number of risk factors

The following results are from data collected from 24 completed assessments using Checklist A and 20 completed assessment using Checklist B. The data are presented in two forms, each looking at the effect of training. Firstly, an evaluation of overall Absolute Discrepancy Values split by Checklist and by job position. Secondly, the Discrepancy Values expressed as positive or negative errors (under or over reporting of apparent hazards) are presented, again by Checklist and job position. The data are presented as both tables and histograms to give a clearer indication of the performance achieved.

Task 1

Checklist A - Absolute Discrepancy Values

Table 9.43 presents descriptive statistics for the Discrepancy Values (Participant total number of risk factors present – model response total number of risk factors present) of Checklist A and B for Task 1. Figure 9.25 presents a histogram depicting the percentage of completed checklist and the range of Discrepancy Values gained from each.

It can be seen that 42% of those completing Checklist A were 3 or more away from the model response before training. After training this improved and was reduced to 25%. 17% of all who completed Checklist A before training agreed with the number of total risk factors present in the model response (i.e. Gained 0 discrepancy value) whereas after training this increased to 33%.

For Checklist B the performance is less positive. Whilst 30% of participants had discrepancy scores of 3 or more before training, this rose to 90% after training. This suggests that reporting error was encouraged by the training – most likely through raising awareness such that false positives are recorded.

Table 9.43. Descriptive statistics for checklist A and B Absolute Discrepancy Values, Task1.

Task 1	Absolute Discrepancy Values			
	Checklist A		Checklist B	
	Before training	After training	Before training	After training
Number of completed checklists	12	12	10	10
Mean	2.5	1.8	2	4.9
Median	2	1	2	4.5
Mode	1	0 and 1	2	4
Std. Deviation	2.1	2.2	1.15	2.69
Minimum	0	0	0	0
Maximum	6	7	4	9

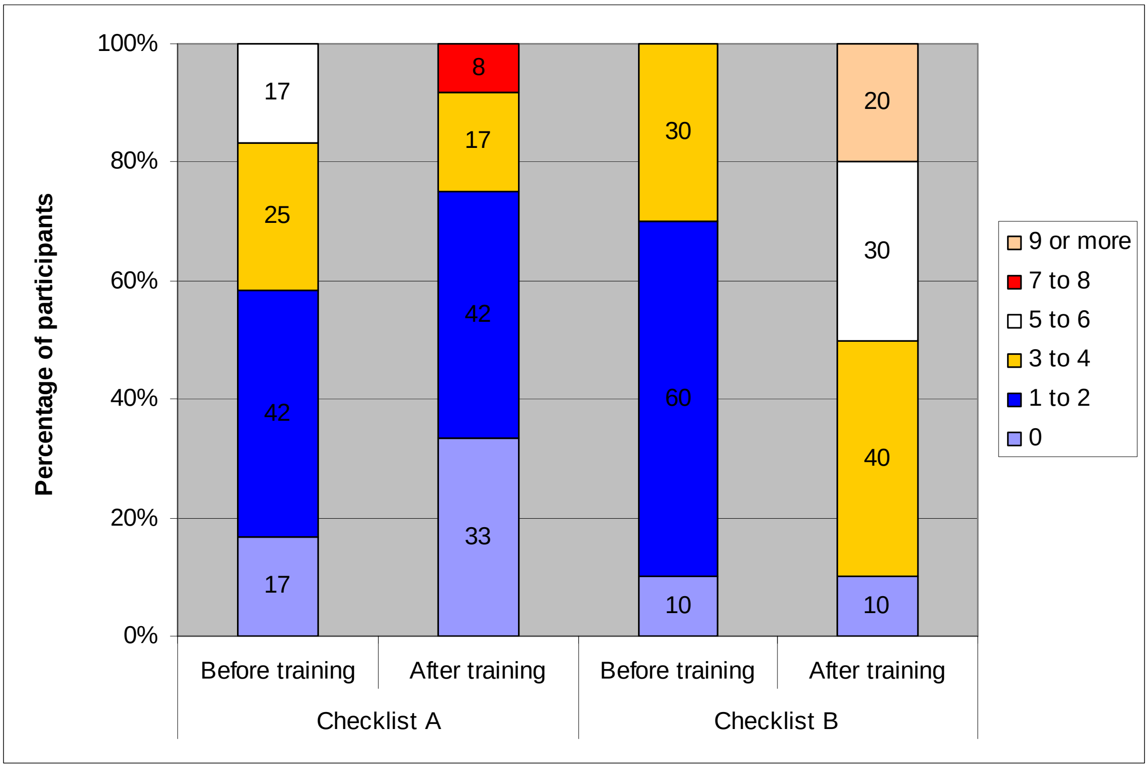


Figure 9.25. Percentage of participants' Absolute Discrepancy values for checklist A and B when used to assess Task 1

Tables 9.44 and 9.45 present the descriptive statistics split by job position for Task 1 when using Checklist A and Checklist B. Figure 9.26 presents the performance as percentages when split by worker type. Here it can be seen that For Checklist A the Line Workers achieved the greatest improvement in accurately identifying the correct number of risk factors.

For Checklist B, Line Leaders showed a large increase in the Discrepancy Values post training, moving from 0% before training to 100% after training recording values of 3 or more. Line Workers were split in their training results, with correct values moving from 0% to 17%, but also values above 3 moving from 50% to 84%.

Table 9.44. Descriptive statistics for Checklist A Absolute Discrepancy Values, Task 1

Checklist A Task 1	**Absolute Discrepancy Values**			
	Team leader/Line leader/Line manager		**Line worker/operative**	
	Before training	**After training**	**Before training**	**After training**
Number of participants	5	5	7	7
Mean	3.4	2.6	1.8	1.1
Median	4	1	2	1
Mode	6	1	1 and 2	0
Std. Deviation	2.8	2.9	1.4	1.5
Minimum	0	0	0	0
Maximum	6	7	4	4

Table 9.45. Descriptive statistics for Checklist B Absolute Discrepancy Values, Task 1

Checklist B Task 1	**Absolute Discrepancy Values**			
	Team leader/Line leader/Line manager		**Line worker/operative**	
	Before training	**After training**	**Before training**	**After training**
Number of participants	4	4	6	6
Mean	1.5	6	2.3	4.2
Median	2	5.5	2.5	4
Mode	2	4	1	4
Std. Deviation	1	2.2	1.21	2.93
Minimum	0	4	1	0
Maximum	2	9	4	9

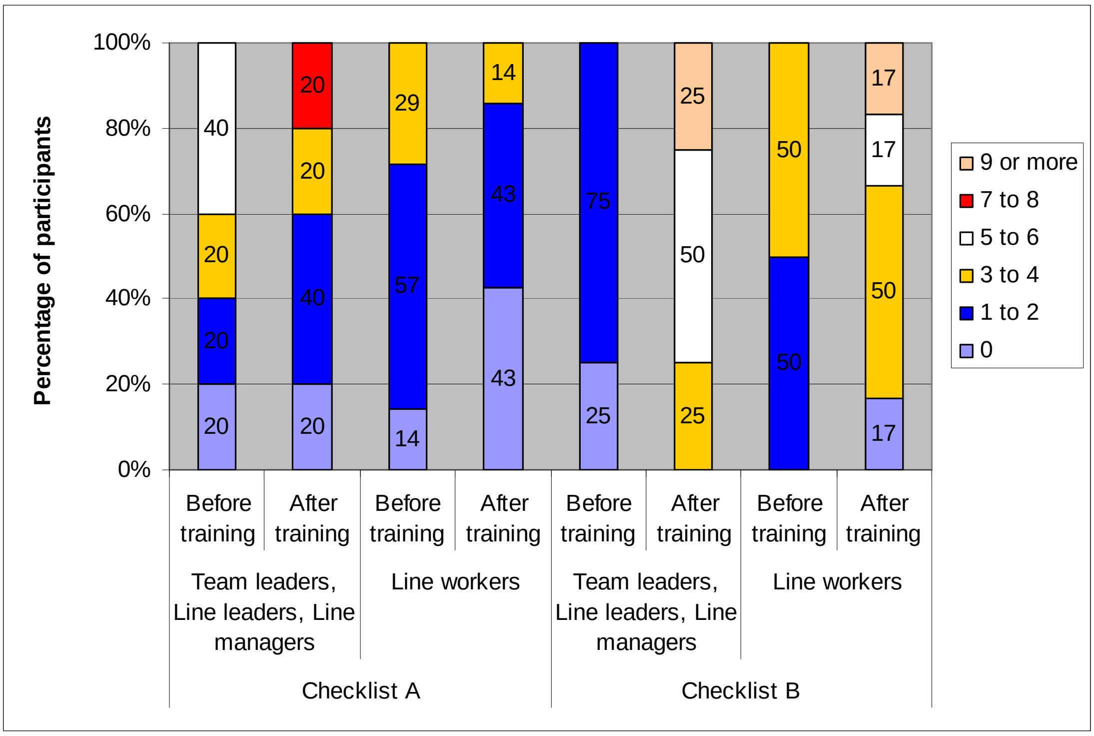


Figure 9.26. Percentage of participants' Absolute Discrepancy values for checklist A and B when used to assess Task 1, split by job position.

The performance was further assessed to identify whether the changes in performance were attributable to over or under reporting of apparent risk factors. This was achieved by breaking the Discrepancy Values into positive and negative bands, representing the drift of participant scores from the expert scores in the model assessment. Table 9.46 gives the descriptive statistics for these revised Discrepancy Values for Checklist A and Checklist B before and after training.

Table 9.46. Positive and negative Discrepancy Values for Checklist A and B, Task 1

	Discrepancy Values (positive and negative values)			
	Checklist A		**Checklist B**	
	Before training	**After training**	**Before training**	**After training**
Number of completed checklists	12	12	10	10
Mean	2.3	1.6	0.8	4.9
Median	2	1	1.5	4.5
Mode	0	0	2	4
Std. Deviation	2.3	2.3	2.25	2.69
Minimum	-1	-1	-3	0
Maximum	6	7	4	9

The positive and negative Discrepancy Values are shown in Figure 9.27. The green band illustrates where the participants agreed with the expert scores. It can be seen that initially, for checklist A, 8% of the responses were due to under reporting and this continued after training. Also after training, whilst there was an increase in the correct score (17% to 33%) there was also an increase in the percentage of respondents over reporting risks by 7 or more. This suggests that some participants were over sensitised to risk factors by the training process.

For Checklist B, underreporting was eliminated by training (30% down to 0%). However, the accurate response rate did not change (10% before and after) with over reporting rising significantly. Again, it appears that training has artificially raised awareness of potential risks.

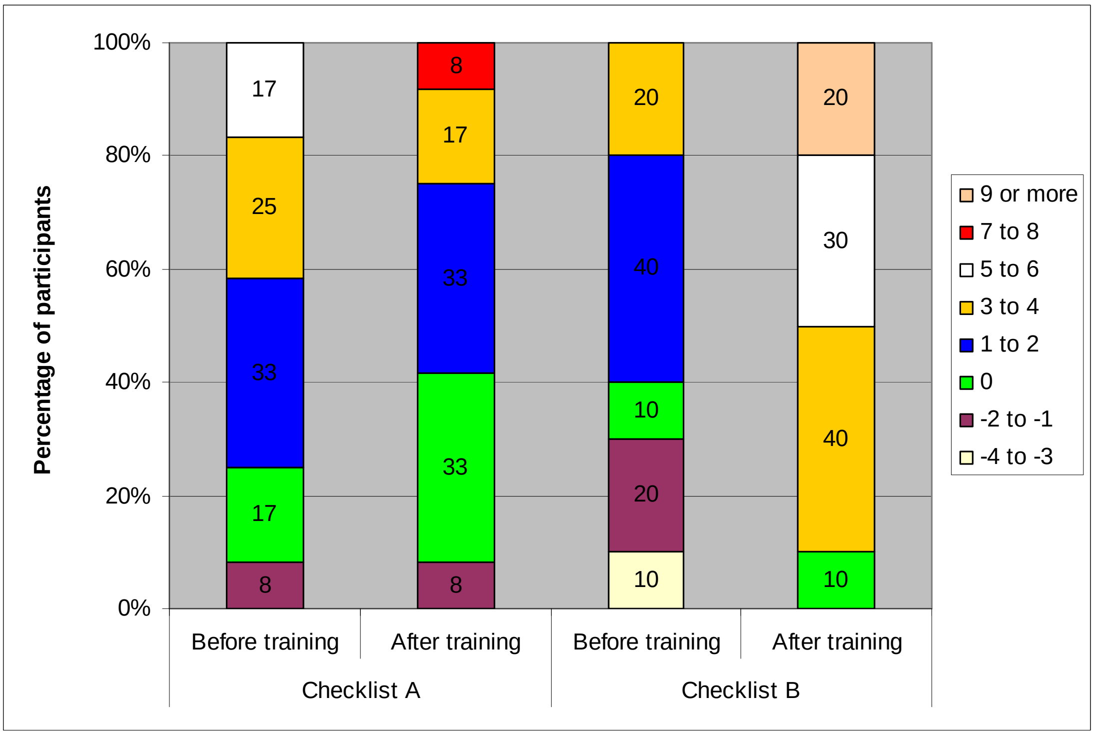


Figure 9.27. Percentage of participants' positive and negative Discrepancy Values for checklist A and B when used to assess Task 1.

Tables 9.47 and 9.48 present the descriptive statistics for Task 1 positive and negative discrepancy values when split by job position.

Figure 9.28 goes onto present the positive and negative Discrepancy Values for both checklists by job position.

Table 9.47. Positive and negative Discrepancy Values for Checklist A Task 1 by job position

Checklist A Task 1	Discrepancy Values (positive and negative values)			
	Team leader/Line leader/Line manager		Line worker/operative	
	Before training	After training	Before training	After training
Number of participants	5	5	7	7
Mean	3	2.2	1.9	1.4
Median	4	1	2	1
Mode	6	-1	1	0
Std. Deviation	3.3	3.3	1.4	1.5
Minimum	-1	-1	0	0
Maximum	6	7	4	4

Table 9.48. Positive and negative Discrepancy Values for Checklist B Task 1 by job position

Checklist B Task 1	Discrepancy Values (positive and negative values)			
	Team leader/Line leader/Line manager		Line worker/operative	
	Before training	After training	Before training	After training
Number of participants	4	4	6	6
Mean	0.5	6	1	4.2
Median	1	5.5	1.5	4
Mode	2	4	-3	4
Std. Deviation	1.91	2.16	2.61	2.93
Minimum	-2	4	-3	0
Maximum	2	9	4	9

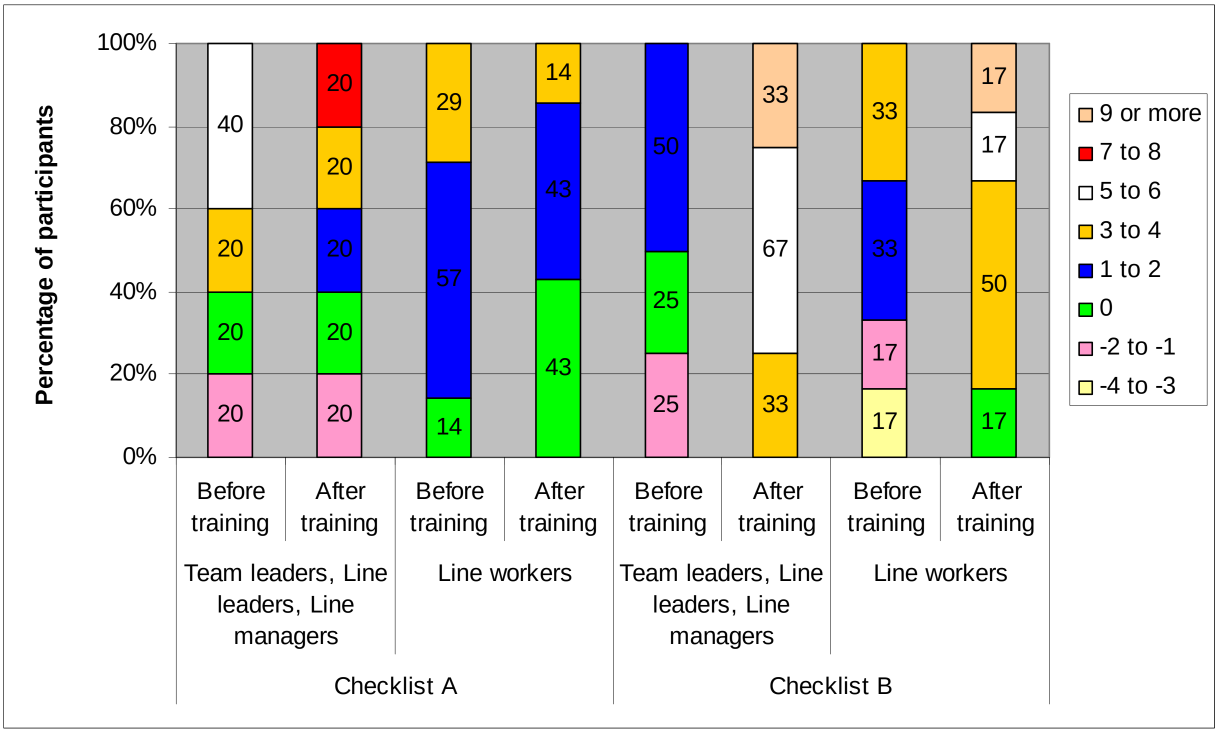


Figure 9.28. Percentage of participants' positive and negative Discrepancy Values for checklist A and B when used to assess Task 1 by job position.

Figure 9.28 shows that for checklist A Line Workers recorded no negative Discrepancy Values, and their increase in accurate responses following training is accounted for in a reduction in both high and moderate over reporting. Line Leaders continued to under report after training (20%), but the over reporting distribution widened. This suggests that training resulted in a wider diversity of positive responses.

For Checklist B, Line Worker's moved from a split between under reporting (34% and over reporting (66%) to a wider spread of responses after training. Once trained, 17% of this group recorded scores that matched the expert score. However, over reported errors moved from 33% recording 3 or more to 84% recording 3 or more. This is strong evidence for over sensitising during training. Line Leaders using Checklist B moved from a 100% spread around the expert score (a Discrepancy Value of plus or minus 2) to 100% recording positive Discrepancy Values of 3 or more. This suggests that Line Leaders were more receptive to over sensitisation by training.

Task 2

A similar analysis was undertaken of the results for Task 2. Again this considered Absolute Discrepancy Values as well as positive and negative Discrepancy Values for Checklist A and B. Each checklist was evaluated by job position both before and after training.

Task 2 (Absolute Discrepancy Values)

Table 9.49 presents the descriptive statistics for the Discrepancy Values for Task 2.

Table 9.49. Descriptive statistics for checklist A and B Absolute Discrepancy Values, Task1.

	Absolute Discrepancy Values			
	Checklist A		Checklist B	
	Before training	After training	Before training	After training
Number of completed checklists	12	16	8	8
Mean	2	2.1	2.25	2.4
Median	2	2	2.5	1
Mode	2	2	1	1
Std. Deviation	1.4	1.2	1.16	3.2
Minimum	0	0	1	0
Maximum	4	5	4	8

The percentile results for Task 2 Absolute Discrepancy Values are shown in Figure 9.29. Here it can be sent that initially, when using Checklist A, participants recorded parity with the experts in 17% of the evaluations. This reduced on training to 6% with a corresponding increase in Absolute Discrepancy Values. It is notable that there is an increase in the spread of Absolute Discrepancy Values moving from 25% for 3 to 4 up to 6% from 5 to 6. There is a corresponding increase in scores of 1 to 2 from 58% to 69%. For Checklist B, there was similar increase in the upward drift of over representation of errors (0% to 25% for values of 7 and more) but this is mitigated by and increase in matches to the expert scores which went from 0% without training to 25% with training.

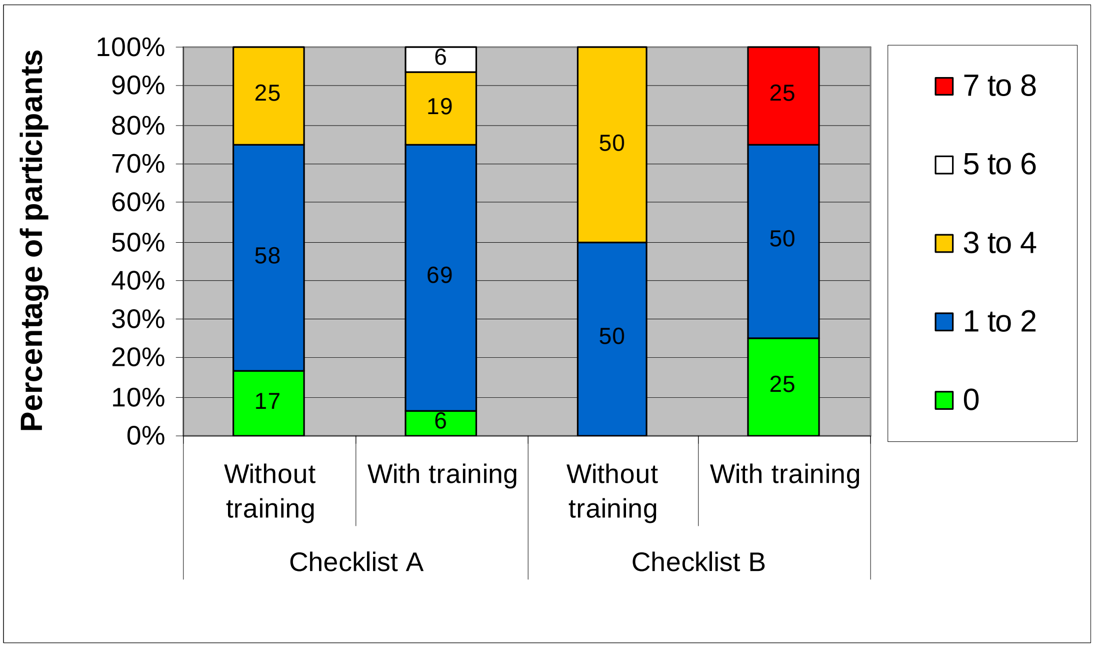


Figure 9.29. Percentage of participants' Absolute Discrepancy values for checklist A and B when used to assess Task 2

Table 9.50 gives the descriptive statistics for Checklist A in the Task 2 evaluation. The results are presented by job position.

Table 9.50. Checklist A statistics for Task 2 by job position

Checklist A Task 2	Absolute Discrepancy Values			
	Team leader/Line leader/Line manager		Line worker/operative	
	Without training	With training	Without training	With training
Number of participants	2	5	10	8
Mean	1.5	2.2	2.1	2.25
Median	1.5	2	2	2
Mode	1	1	2	2
Std. Deviation	0.71	1.64	1.52	0.89
Minimum	1	1	0	1
Maximum	2	5	4	4

Table 9.51 offers the same information for Checklist B

Table 9.51. Checklist B statistics for Task 2 by job position

Checklist B Task 2	Absolute Discrepancy Values			
	Team leader/Line leader/Line manager		Line worker/operative	
	Without training	With training	Without training	With training
Number of participants	3	4	5	4
Mean	-2.67	0.75	-2	0.5
Median	-3	1	-2	0.5
Mode	-4	1	-3	7
Std. Deviation	1.53	0.5	1	6.14
Minimum	-4	0	-3	-7
Maximum	-1	1	-1	8

These data are presented in graphical form in Figure 9.30. Here it can be seen that for Checklist A there is a deleterious effect from training. For Line Leaders the drift was from 100% recording only 1 to 2 errors to 20% recording over 5 errors with the remainder (80%) still recording 1 to 2 errors. This is matched by the Line Workers. Initially, 20% of this group recorded correct scores. However, with training, this dropped to zero, with 75% of all participants scoring 1 or 2 errors and approximately a constant amount (around 25% recording 3 or more errors). This further suggests that training has a negative effect on risk factor identification for this Checklist.

For Checklist B there was a different trend in the number of errors after training. For Line Leaders there was reduction in the error rate, falling from 67% to 0% recording 3 or more errors. It is also worthy of note that 25% of the Line Leader participants were able to generate no errors following training whereas none had before.

Line workers saw a similar generation of correct scores following training (25%) but this was offset by an increase in the number of errors for the remaining participants. 50% of respondents recorded 7 or more errors post training, whereas the highest error rate prior to training had been 4 errors (40%). Training again seems only partially effective here with some users being learning to expert level whilst others become pore error prone.

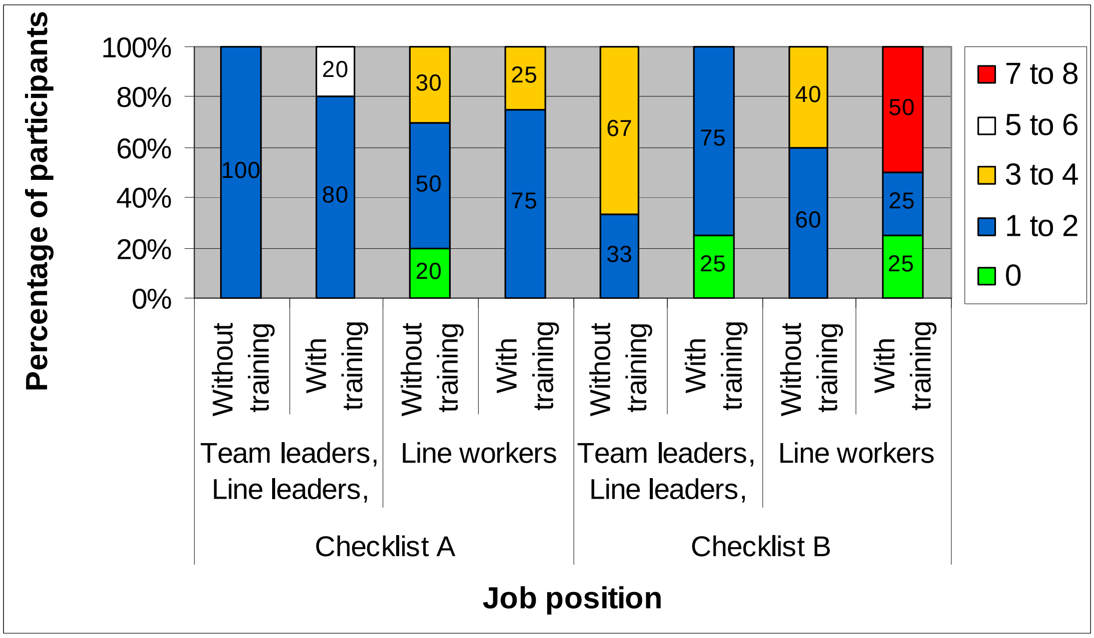


Figure 9.30. Percentage of participants' Absolute Discrepancy values for checklist A and B when used to assess Task 2, split by job position.

The data was then scrutinised to see whether the Discrepancy Values were either positive or negative – indicating whether participants were under detecting risk factors or over identifying these problems. Table 9.52 shows the descriptive statistics for these positive and negative Discrepancy Values.

Table 9.52. Positive and negative Discrepancy Values for Checklist A and B, Task 2

	Discrepancy Values (positive and negative values)			
	Checklist A		Checklist B	
	Without training	With training	Without training	With training
Number of completed checklists	12	16	8	8
Mean	-1.2	-1.3	-2.25	0.63
Median	-1.5	-2	-2.5	1
Mode	-4	-2	-3	1
Std. Deviation	2.2	2.1	1.16	4
Minimum	-4	-5	-4	-7
Maximum	2	2	-1	8

The percentile values are shown in the histogram in Figure 9.31. Here it can be seen that Checklist A generates significant under reporting of risk factors with 58% of respondents without training and 69% of trained respondents identifying less risk factors that the expert score. The amount of over representation remained the same at 25%, suggesting that training caused participants to overlook potential health threats. Checklist B generated a much larger effect with training. Initially 100% of participants recorded fewer risk factors than the expert panel (up to -3). After training this transformed into 25% correct risk identification, but a much wider spread of errors. Under reporting dropped to only 13% but all of these missed 7 or more risk factors. Similarly 13 % over estimated the risks by 7 or more factors. This wide diversity of scores suggests that a degree of confusion is generated by training, leading to a lack of precision.

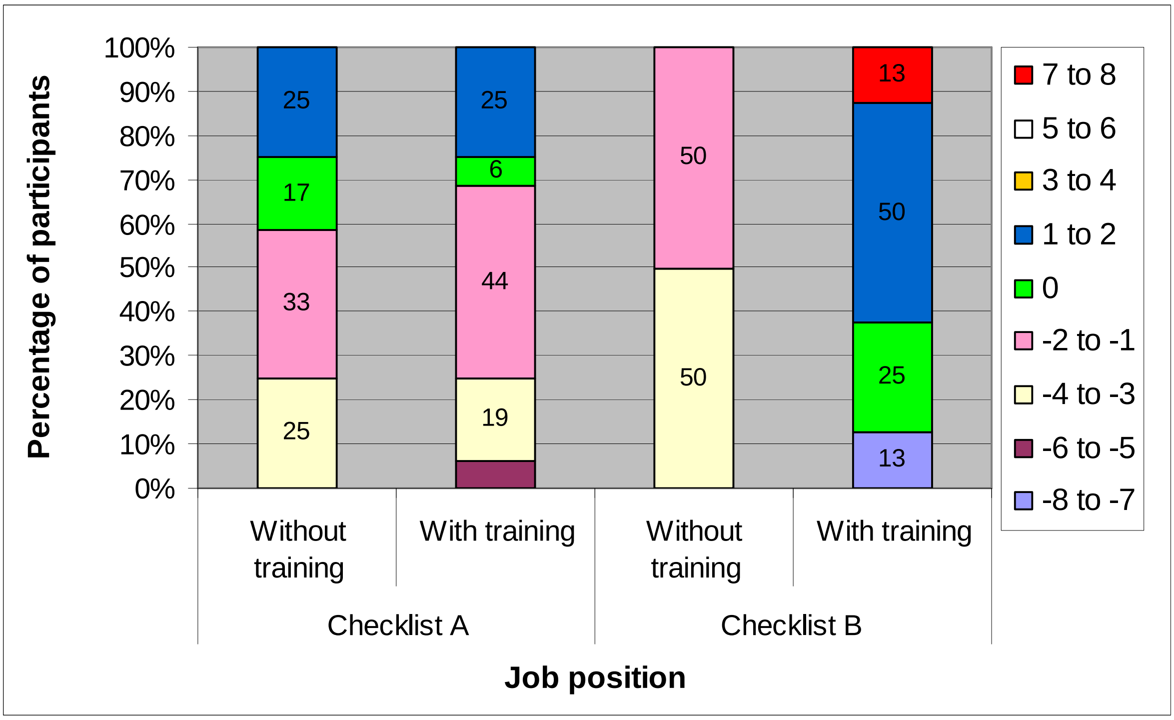


Figure 9.31. Percentage of participants' positive and negative Discrepancy Values for checklist A and B when used to assess Task 2.

The data was then split by checklist and by job position in order to examine the spread of positive and negative Discrepancy Values.

Table 9.53 presents the descriptive statistics for Checklist A by job position and Table 9.54 the corresponding statistics for Checklist B. Each is presented for trained and untrained individuals.

Table 9.53. Positive and negative Discrepancy Values for Checklist A Task 2 by job position

Checklist A Task 2	Discrepancy Values (positive and negative values)			
	Team leader/Line leader/Line manager		Line worker/operative	
	Without training	**With training**	**Without training**	**With training**
Number of participants	2	5	10	8
Mean	-1.5	-1.4	-1.1	-1.3
Median	-1.5	-2	-1	-2
Mode	-2	-2	-4	-2
Std. Deviation	0.7	2.5	2.4	2.2
Minimum	-2	-5	-4	-4
Maximum	-1	1	2	2

Table 9.54. Positive and negative Discrepancy Values for Checklist B Task 2 by job position

Checklist B Task 2	Discrepancy Values (positive and negative values)			
	Team leader/Line leader/Line manager		**Line worker/operative**	
	Without training	**With training**	**Without training**	**With training**
Number of participants	3	4	5	4
Mean	-2.7	0.75	-2	0.5
Median	-3	1	-2	0.5
Mode	-4	1	-3	-7
Std. Deviation	1.53	0.5	1	6.14
Minimum	-4	0	-3	-7
Maximum	-1	1	-1	8

Figure 9.32 shows the percentile breakdown for the positive and negative Discrepancy Values by job position for Checklists A and B. This shows that, for Checklist A, Line Leaders accounted for a significant proportion of before training under representation of risk factors. 100% of these individuals recorded a discrepancy value off between -1 and -2. After training this was reduced to 50% under reporting but 30% were worse with -3 to -4 errors.

The remaining Line Leaders either scored equal to the experts (20%) or slightly over (up to +2 errors).

Line Workers saw a similar amount of over estimation before and after training, but the 20% who matched the expert score prior to training were translated into 75% under reporting risk factors with training. For this checklist there appears to be a negative effect from training such that this group fail to identify health hazards.

For Checklist B, Line Leaders saw a similar trend. Before training all individuals under reported risk factors with Discrepancy Values of more than -1 (33% up to -2, 67% -3 to -4). With training this was converted into a significant over awareness with 75% of respondents identifying 1 or 2 more check items than were present. Line Workers suffered the greatest negative effect from training for Checklist B. Initially all Line Workers under estimated the number of risk items, with 40% scoring l3 or 4 less than the experts. After training this converted into a wide spread of responses clearly split into quartiles from -8 through to plus 8. This indicates that training for Checklist B led to confusion in the Line Workers when appraising Task 2.

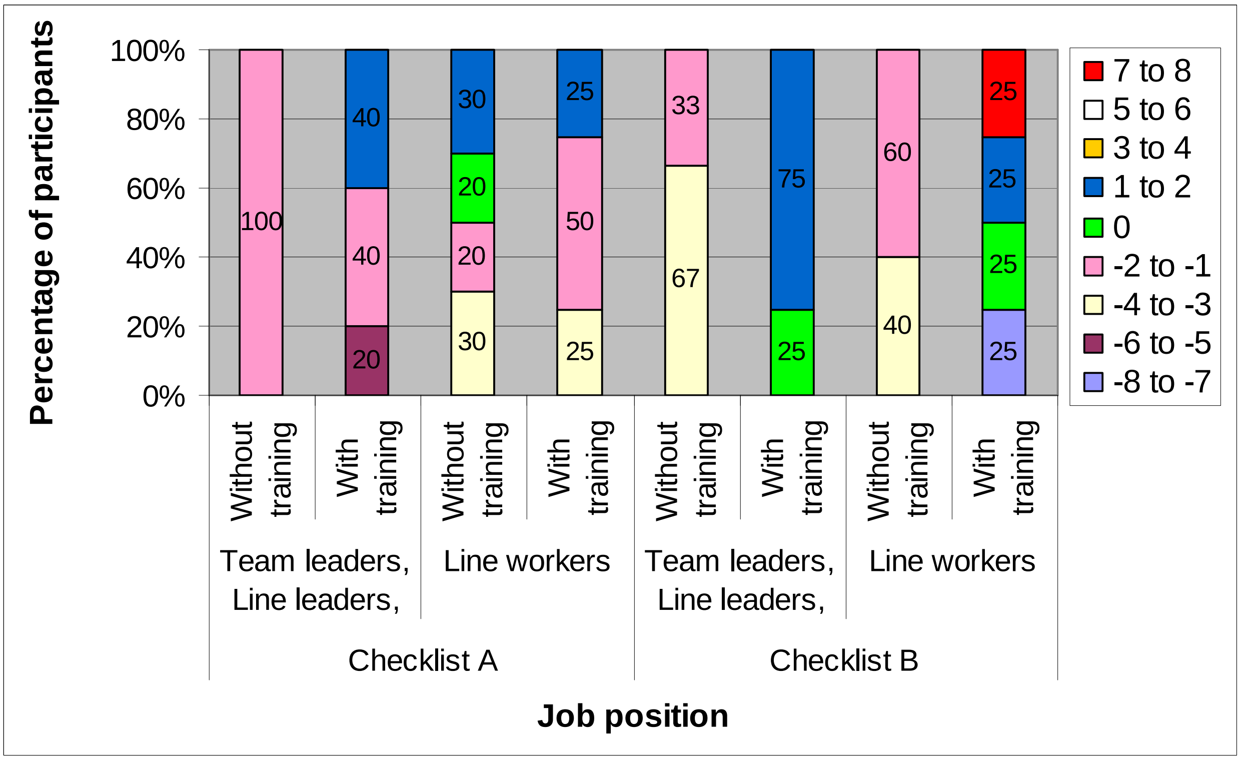


Figure 9.32. Percentage of participants' positive and negative Discrepancy Values for checklist A and B when used to assess Task 2 by job position.

9.3.4 Overall risk level

The respondents' estimation of overall risk level was analysed to compare it with that recorded by the expert group. This is an important variable since the overall risk level category is likely to be the trigger for intervention, or at least to justify prioritisation of action. Accordingly, incorrect estimation of the overall risk could lead to failure to address potentially high risk activities or to waste resources addressing activities that are not particularly hazardous.

Task 1

When considering Task 1, Table 9.55 indicates the percentile agreement between participants and the expert scores for Checklist and Checklist B with and without training.

Table 9.55. Percentile agreement of participants with expert score for overall risk

	Percentage of participants			
	Checklist A		Checklist B	
	Before training	After training	Before training	After training
Percentage of completed assessments that:				
Agreed with 'Model' response	92%	92%	50%	70%
Under rated the risk	0%	8%	20%	10%
Over rated the risk	0%	0%	10%	20%
No risk rating given	8%	0%	20%	0%

It can be sent that Checklist A generates a good correlation between participants and experts with 92% correctly identifying the overall risk. Checklist B does not perform as well with only half of the participants agreeing with the expert score. This increases to 70% with training, which is positive, but still represents a significant error rate.

When comparison is made by job position and Checklist variant the benefits of training for the different worker groups are apparent. Table 9.56 presents the percentile information for Checklist A by job position. Whilst Line Leaders lost some accuracy (20%) after training, Line Workers gained almost as much (14%). These results suggest that Checklist A offers the possibility of achieving a good degree of precision in assessing overall risk , and that training is not necessarily required.

Table 9.56. Percentile agreement of participants with expert score for overall risk using Checklist A for Task 1. Presented by job position.

	Percentage of respondents			
	Team Leader, Line Leader or Line Manager		Line Worker	
Percentage of completed assessments that:	**Before training**	**After training**	**Before training**	**After training**
Agreed with 'Model' response	100%	80%	86%	100%
Under rated the risk	0%	20%	0%	0%
Over rated the risk	0%	0%	0%	0%
No risk rating given	0%	0%	14%	0%

For Checklist B (Table 9.57) the outcome is less clear. Line Leaders maintained a reasonable precision before and after training, with 75% matching the rating of the experts. However, Line Workers saw a significant increase in accuracy after training with 33% rising to 67% agreeing with the expert view. Most of the improvement was gained by elevating the assessment of those who had previously underestimated the overall risk. This would suggest that training with this checklist may have beneficial outcomes in ensuring higher risk activities are correctly identified.

Table 9.57. Percentile agreement of participants with expert score for overall risk using Checklist B for Task 1. Presented by job position

	Percentage of respondents			
	Team Leader, Line Leader or Line Manager		Line Worker	
Percentage of completed assessments that:	**Before training**	**After training**	**Before training**	**After training**
Agreed with 'Model' response	75%	75%	33%	67%
Under rated the risk	0%	0%	33%	17%
Over rated the risk	0%	25%	17%	17%
No risk rating given	25%	0%	17%	0%

Task 2

A similar evaluation was undertaken for Task 2. Table 9.58 shows the overall percentile agreement of the participants with the expert score for Checklist A and Checklist B.

Table 9.58. Percentile agreement of participants with expert score for overall risk

	Percentage of participants			
	Checklist A		Checklist B	
Percentage of completed assessments that:	**Before training**	**After training**	**Before training**	**After training**
Agreed with 'Model' response	50%	69%	38%	50%
Under rated the risk	0%	0%	0%	10%
Over rated the risk	50%	31%	50%	20%
No risk rating given	0%	0%	13%	20%

It can be seen that Task 2 resulted in significantly worse correlation between participants and experts. For Checklist A, only half of the participants correctly matched the overall risk score. This was raised somewhat by training, but only to 69%, meaning that almost a third of participants erroneously assessed the task. Checklist B performed worse, with an initial correlation of only 38%. This was also raised by training, but only to 50%. In both instances the balance of reposes was primarily an overestimation of the score, which could lead to wasted workplace resources.

A further evaluation splits these results by job position and presents them by Checklist. Table 9.59 presents the percentile values for Task 2 when assessed by Checklist A, by job position.

For this checklist, Line Leaders initially completely matched the expert score. However, with training, 20% erroneously underestimated the risk level. Line Workers however remained fairly consistent with about two thirds of participants matching the expert score. Both before and after training the remainder overestimated the risk level.

Table 9.59. Percentile agreement of participants with expert score for overall risk using Checklist A for Task 2. Presented by job position

	Percentage of respondents			
	Team Leader, Line Leader or Line Manager		Line Worker	
Percentage of completed assessments that:	**Before training**	**After training**	**Before training**	**After training**
Agreed with 'Model' response	100%	80%	60%	75%
Under rated the risk	0%	20%	0%	0%
Over rated the risk	0%	0%	40%	25%
No risk rating given	0%	0%	0%	0%

For Task 2 assessed by Checklist B there is again greater diversity, as can be seen in Table 9.60. Line Leaders seemed to respond to training well, raising their correct score from 33% to 80%. Interestingly, the remainder before training overrated the risk level whereas after training the balance underestimated it, suggesting a general downscaling of the risk perception.

Line Workers fared worse with training reducing an already low accuracy of 40% to only 20%. The majority of incorrect scores were overestimations of the risk presented. This suggests that Checklist B may lead to Line Workers identifying a higher level of threat in some tasks, which whilst better than failing to correctly identify high risk activities, may waste safety resources. This situation seems unlikely to be addressed by training for this group.

Table 9.60. Percentile agreement of participants with expert score for overall risk using Checklist B for Task 2. Presented by job position

	Percentage of respondents			
	Team Leader, Line Leader or Line Manager		Line Worker	
Percentage of completed assessments that:	**Without training**	**With training**	**Without training**	**With training**
Agreed with 'Model' response	33%	80%	40%	20%
Under rated the risk	0%	20%	0%	20%
Over rated the risk	33%	0%	60%	40%
No risk rating given	33%	0%	0%	20%

9.3.5 Suggestions for improvement

A further analysis was undertaken of the responses relating to suggestions for improvement. This involved a scrutiny of both the number of participants who made suggestions as well as the number of suggestions they made. This helps to illustrate how effective the checklists may be in prompting the generation of interventions and the diversity of those interventions.

Task 1

Initially the evaluation only looks at Task 1. Table 9.61 examines the number of suggested changes made by participants for the two checklists before and after training and presents the appropriate descriptive statistics. Checklist B generates a significantly larger mean number of suggested changes (9.9/9.1 versus 1.67/1.08), which may be as a result of the prompts within the checklist itself.

Table 9.61. Descriptive statistics of number of suggested changes for Checklist A and B when applied to Task 1

	Number of suggested changes to reduce the risks			
	Checklist A		Checklist B	
	Before training	After training	Before training	After training
Number of completed checklists	12	12	10	10
Mean	1.67	1.08	9.9	9.1
Median	1.50	0	6	3.5
Mode	0	0	0	0
Std. Deviation	1.775	1.505	10.35	10.67
Minimum	0	0	0	0
Maximum	4	4	25	29

This data was further interrogated to establish the performance of the two checklists when compared by job position. Table 9.62 shows the results for Checklist A. It can be seen that this Checklist resulted in a low number of suggested changes for both worker groups both before and after training. However, the Line Workers generated more suggestions than the Line Leaders in both instances.

Table 9.62. Descriptive statistics of number of suggested changes for Checklist A when applied to Task 1 and spilt by job position

	Number of suggested changes to reduce the risks			
	Team Leader, Line Leader or Line Manager		Line Worker	
	Before training	After training	Before training	After training
Number of completed checklists	5	7	5	7
Mean	0.6	0.2	2.4	1.7
Median	0	0	3	2
Mode	0	0	3	0
Std. Deviation	1.3	0.5	1.7	1.7
Minimum	0	0	0	0
Maximum	3	1	4	4

Checklist B results are shown in Table 9.63. It can be seen that there are significantly more suggested changes generated than for Checklist A for both worker groups whether trained or not. It is interesting to note that the Line Leaders nearly doubled the mean number of suggested changes after training, whilst the Line Workers reduced the mean number of suggested changes by approximately 25%. This suggests that training has a meaningful effect with regard to sponsoring intervention ideas for Checklist B.

Table 9.63. Descriptive statistics of number of suggested changes for Checklist B when applied to Task 1 and spilt by job position

	Number of suggested changes to reduce the risks			
	Team Leader, Line Leader or Line Manager		Line Worker	
	Before training	After training	Before training	After training
Number of completed checklists	4	4	6	6
Mean	4.5	8.5	13.5	9.5
Median	4.5	8.5	14.5	3.5
Mode	0	0	25	0
Std. Deviation	3.87	9.26	12.1	12.4
Minimum	0	0	0	0
Maximum	9	17	25	29

Suggestions for changes to activities from Checklist A

The information for Task 1 can be further evaluated by examining the number of participants who made suggestions or wrote more in-depth descriptions of changes. Table 9.64 presents this information for Checklist A. It is clear that the number of participants (of both worker types) contributing in this way remains largely static before and after training. Changes in the number of suggestions post training are likely therefore be attributable to changes within individuals rather than altering the motivation of previously reticent participants.

Table 9.64. Number of participants that made their own suggestions/ or wrote more in-depth descriptions of changes that could be made (Checklist A).

	All participants		Team Leader, Line Leader or Line Manager		Line Worker	
	Before training	After training	Before training	After training	Before training	After training
Number of participants	6	5	1	1	5	4

The suggestions made by the individuals are included for consideration, and these are presented in Table 9.65 for Line Leaders and Table 9.66 for Line Workers.

Table 9.65. Suggestions for changes made by Line Leaders (Task 1, Checklist A)

Team Leader, Line Leader or Line Manager	
Before training	**After training**
A stand for the pot could be used to avoid a wide grip being used to hold it. The bottle could be put into the fume cabinet for filling so as to avoid excessive shoulder arm movement. Arm posture could be improved by moving the fume cabinet up/down for more support.	Some sort of tool to hold the heavy wide grip in place. This would remove factor 13 thus brining score down to 11 (low risk).

Table 9.66. Suggestions for changes made by Line Workers (Task 1, Checklist A)

Line Worker	
Before training	**After training**
Empty contents of bottle which is being gripped into an easy accessible open container, therefore no gripping would be needed. Rather than twisting the body move body and feet to avoid awkward postures/ movement. Place scales on raised platform to prevent neck being bent looking downwards- again avoiding awkward postures	Place contents of bottle into smaller containers i.e. cups which are lighter in weight using less force. Instead of twisting the body move the feet and body encouraging more movement and less static postures. Providing protection for the arms on the dust cabinet as it is uncomfortable. Place the scale higher so that the neck and back aren't bent over.
Lower opening to the cabinet to allow better arm/shoulder posture. Smaller container to allow smaller grip of a holder for the container.	Opening hatch could be lowered. Smaller receptacle for powder in the hand. Raise the work cabinet.
Not to do the task for long. Change position in which you stand. Not to grip object for the whole length of the time performing the task. Put powder in a container that doesn't need to be held.	Change the posture used during the task. Change the bottle in which powder is held so a wide grip is not needed. Have it placed on surface so it doesn't need to be held.
Not to do the task for too long. Have a wider neck on the bottles. Remove the glass that the worker is resting or place some padding on it.	Holder for the powder container. Higher workstation within the fume cabinet to stop leaning on the perfect and neck craning.
Clamp to hold the powder pot. Higher work surface. Smaller pot.	

Whilst these suggestions are not very numerous they are of reasonable quality, identifying meaningful and practical interventions which would address the key check items of most concern. It should be remembered that the activities undertaken in Task 1 are relatively technical compared to purely manual tasks. This would make it more challenging to identify appropriate interventions for participants who had not experienced this type of work activity.

Suggestions for changes to activities from Checklist B

A similar analysis for Checklist B reveals a similar result. A very low number of participants chose to contribute suggestions for changes although the numbers before and after training remain largely constant, as seen in Table 9.67.

Table 9.67. Number of participants that made their own suggestions/ or wrote more in-depth descriptions of changes that could be made (Checklist B).

	All participants		Team Leader, Line Leader or Line Manager		Line Worker	
	Before training	After training	Before training	After training	Before training	After training
Number of participants	3	3	2	1	1	2

The actual suggestions for changes made by participants are shown by job position in Table 9.68 and Table 9.69 below.

Table 9.68. Suggestions for changes made by Line Leaders (Task 1, Checklist B)

Team Leader, Line Leader or Line Manager	
Before training	After training
	Arms resting on edge of fume cupboard liable to cut off circulation

Table 9.69. Suggestions for changes made by Line Workers (Task 1, Checklist B)

Line Worker	
Before training	After training
	Protective glasses. Hair net. Smaller face mask. Better, neater gloves
	Change jobs and tasks every so often. Introduce machines to weigh the powder/put the powder into bottles. Make tables higher

Task 2

Task 2 was a more conventional manual activity involving sorting flower stems and placing them onto a conveyor belt. This offers a range of potential health risks which do not require technical appreciation. Interventions are likely to be more conventional and more universal, transferring more readily from other manual activities. Table 9.70 presents the descriptive statistics for the number of suggested changes made by participants when scrutinising Task 2.

Table 9.70. Descriptive statistics of number of suggested changes for Checklist A and B when applied to Task 2

	Number of suggested changes to reduce the risks			
	Checklist A		Checklist B	
	Without training	With training	Without training	With training
Number of completed checklists	12	16	8	9
Mean	2.1	0.81	10.38	3.56
Median	2.	0	11	0
Mode	1 and 2	0	0	0
Std. Deviation	1.7	1.3	6.82	5.92
Minimum	0	0	0	0
Maximum	6	3	20	15

More detail is revealed when the data is split by job position. Table 9..71 shows the descriptive statistics for Checklist A. Here it can be seen that the Line Workers and Line Leaders generated similar levels of suggestions, suggesting that Checklist A was equally effective at generating intervention ideas with these two groups and that training had little effect.

Table 9.71. Descriptive statistics of number of suggested changes for Checklist A when applied to Task 2 and spilt by job position

	Number of suggested changes to reduce the risks			
	Team Leader, Line Leader or Line Manager		Line Worker	
	Without training	With training	Without training	With training
Number of completed checklists	2	5	10	8
Mean	3	1.2	1.9	0.88
Median	3	0	1.5	0
Mode	3	0	1 and 2	0
Std. Deviation	0	1.6	1.9	1.3
Minimum	3	0	0	0
Maximum	3	3	6	3

A wider range of responses are noted for Checklist B, as shown in Table 9.72. However, as with Task 1, there is a drop in the mean number of suggestions made for both worker groups post training. Line Leaders reduced to approximately half, whilst Line Workers dropped to nearly one tenth of the pre training level. This would suggest that training has a deleterious effect on the generation of suggestions.

However, it is possible that these response changes can be largely accounted for by boredom, fatigue, lack of interest or other variables not directly related to the Checklist structure. This may have real world implications if interest in the assessment process wanes during repeated activities. In this case then exposure to the assessment activity might need to be limited in order to maintain vigilance.

Table 9.72. Descriptive statistics of number of suggested changes for Checklist B when applied to Task 2 and spilt by job position

	Number of suggested changes to reduce the risks			
	Team Leader, Line Leader or Line Manager		Line Worker	
	Without training	With training	Without training	With training
Number of completed checklists	3	5	5	4
Mean	9	5.4	11.2	1.25
Median	10	0	12	0
Mode	3	0	0	0
Std. Deviation	5.57	7.47	7.98	2.5
Minimum	3	0	0	0
Maximum	14	15	20	5

Suggestions for changes to activities from Checklist A

The suggestions made by the participants following use of Checklist A are presented to add depth to the understanding of this participant role. Table 9.73 shows the number of participants who made suggestions. It can be seen that whilst the Line Leader contribution remained constant before and after training, Line Worker involvement decreased by almost two thirds.

Table 9.73. Number of participants that made their own suggestions/ or wrote more in-depth descriptions of changes that could be made (Checklist A).

	All participants		Team Leader, Line Leader or Line Manager		Line Worker	
	Before training	After training	Before training	After training	Before training	After training
Number of participants	10	5	2	2	8	3

The suggestions for change made by the participants are presented in Tables 9.74 and 9.75 below, split by job position.

It can be seen that suggested changes are similar for both worker groups, which implies that the interventions are relatively obvious and more conventional than for Task 1.

Table 9.74. Suggestions for changes made by Line Leaders (Task 2, Checklist B)

Team Leader, Line Leader or Line Manager	
Before training	**After training**
Change to another task more often. Make it easier to keep up. Change the layout of work area to stop the need to twist spine.	Introduce micro breaks. Rearrange work space. Flowers are held in one hand continuously perhaps a mechanical aid to hold flowers would also reduce the risk.
Bring holders and belt closer together. Raise belt and holder higher. More breaks.	Main factor is holding flowers in one hand throughout the process, perhaps shorten the length of time doing the job, and should monitor the situation. Environmental factors such as cold and wet could be improved.

Table 9.75. Suggestions for changes made by Line Workers (Task 2, Checklist B)

Line Worker	
Before training	**After training**
The person working can also work in a high chair with back support. And Reposition themselves tangent to the conveyor as this would prevent twisting the body.	Hold smaller bunches to encourage a power grip. When placing flowers on the belt move the feet and body rather than a twisting motion. Adjustable work stations so they are higher up.
More breaks.	Change posture. Have more breaks.
Split the task and let take 5 minutes rest every half hour. Suggest stretching and relaxing.	Resituate the conveyor so less twisting is required. Have a flower dispenser to eliminate the constant left hand grip.
Slow down the line.	
Less workload. Warmer clothes.	
Reduce cold /draughts, add isolated flooring, better protective clothing. Reduce overall duration of work between breaks. Reduce expected output of work. Work area could be improved in design to make it more ergonomic.	
Reduce amount of time individual’s work at task.	
Slower work rate would reduce neck movement. Better workstation layout would reduce movement. Worker could move right wrist more as it does not need to be static. A quick rest or job swapping could reduce time spent on continuous task. Better PPE could be supplied. Add more workers to reduce work rate.	

Suggestions for changes to activities from Checklist B

Checklist B can be evaluated in the same way. Table 9.76 shows the number of participants who made suggestions, whilst Tables 9.77 and 9.78 give the suggestions made.

Table 9.76. Number of participants that made their own suggestions/ or wrote more in-depth descriptions of changes that could be made (Checklist B).

	All participants		Team Leader, Line Leader or Line Manager		Line Worker	
	Before training	After training	Before training	After training	Before training	After training
Number of participants	4	1	1	0	3	1

Table 9.77. Participants own suggestions for changes made by Line Leaders (Task 2, Checklist B)

Team Leader, Line Leader or Line Manager	
Before training	**After training**
n/a	n/a

Table 9.78. Suggestions for changes made by Line Workers (Task 2, Checklist B)

Line Worker	
Before training	**After training**
n/a	Better fitting gloves. Change area for better position to work in. Warmer clothing. Cold temperature. Draughty area. Head gear.

9.3.6 Training evaluation questionnaire

A questionnaire survey was undertaken on the completion of the training session to establish the attitudes of the participants. A brief summary of their responses are presented below.

Identification of risk factors

Participants from each of the companies were asked to identify up to six risk factors. Figure 9.33 shows the mean value for each company. Whilst the results appear optimistic, many of the risk factors given were not those recognised by conventional guide to MSD prevention.

Accordingly this output should be considered encouraging that risk factors were suggested but cautionary in that the educational process had not been particularly effective in this regard.

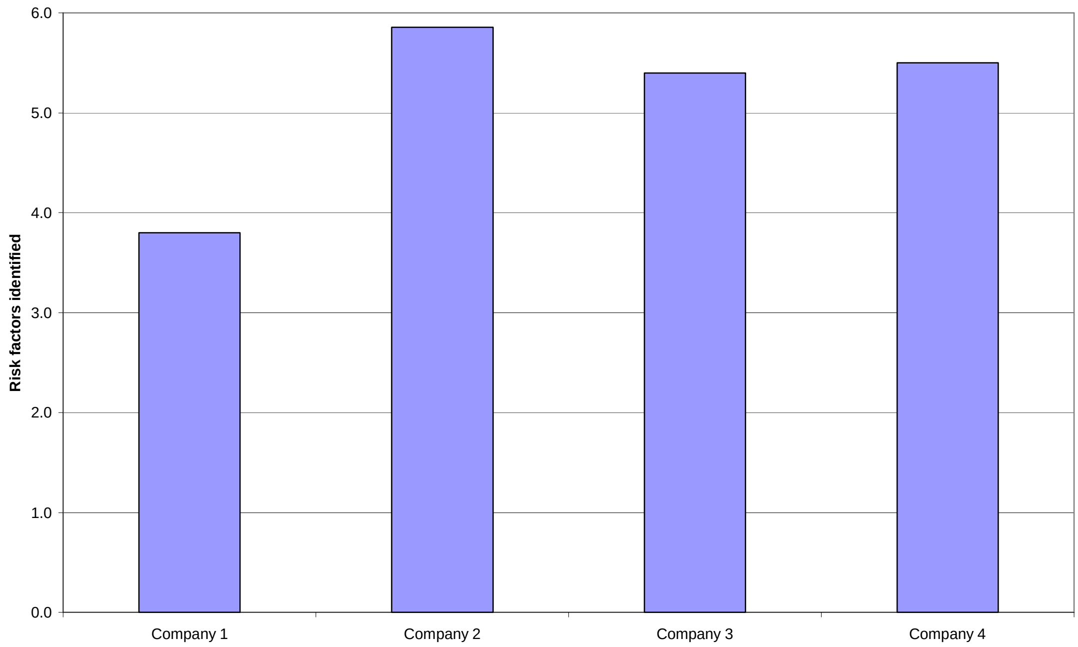


Figure 9.33. Mean number of risk factors identified by participants.

Levels of confidence

Three questions were asked regarding the confidence of the individual. Firstly, the participants were asked how confident they were that had assessed the two tasks correctly (where 1= not at all 5= very). They were then asked how confident they felt using the assessment tool before and after training (where 1= not at all 5= very). The mean results of this survey are shown in Figure 9.34. In this figure it can be sent that general confidence levels are high, with a significant increase of confidence post training for all except one group of company participants.

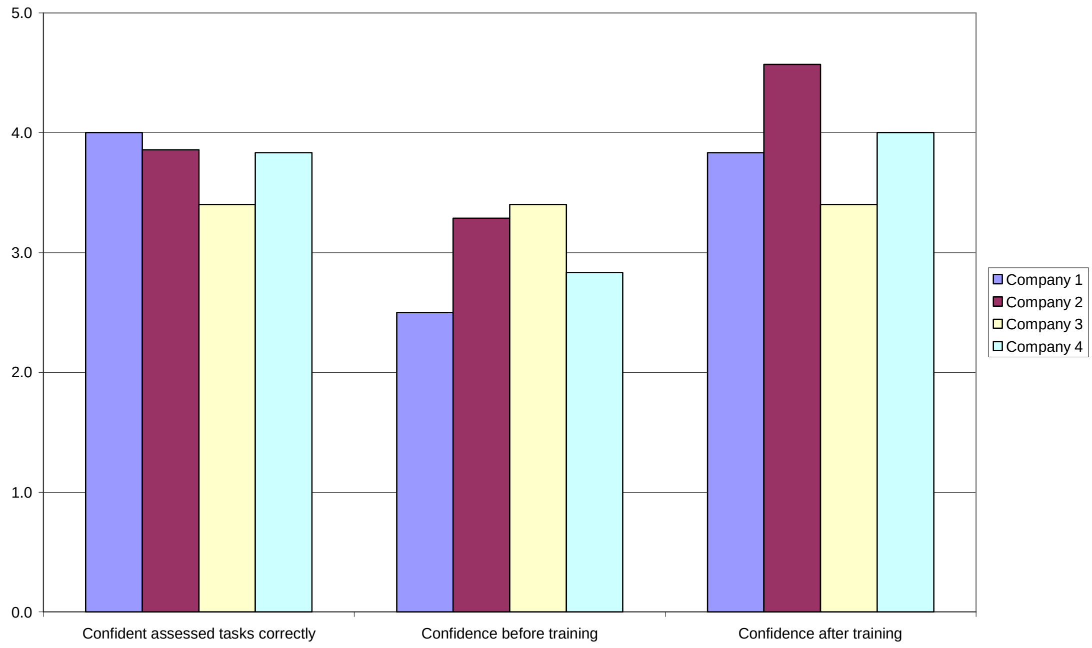


Figure 9.34. Mean confidence levels in assessment and use of tools.

Training preferences

The participants were also asked about their training preferences. In particular they were asked to rate the following on a scale where 1 = strongly agree and 5=strongly disagree:

- I would have liked more background information about the risk factors
- I would have liked more information about how to complete the risk assessments.
- I would have liked more information about possible control actions/changes to make to reduce the risks.
- I think face to face training in the use of the assessments was more useful than following just the written instructions.
- I think following written instruction was more useful than attending a face to face training session.
- It was good to go through an example assessment with the trainer.

The mean results of the preferences are shown in Figure 9.35. It can be seen that the scores were similar across all four companies. Most notable was the preference for face to face training over the provision of written instructions, which indicates that training courses are likely to be well received.

A worked example was also seen as a worthwhile approach. Overall, most participants seemed that they would have preferred more information on the background, the assessment tools and control actions.

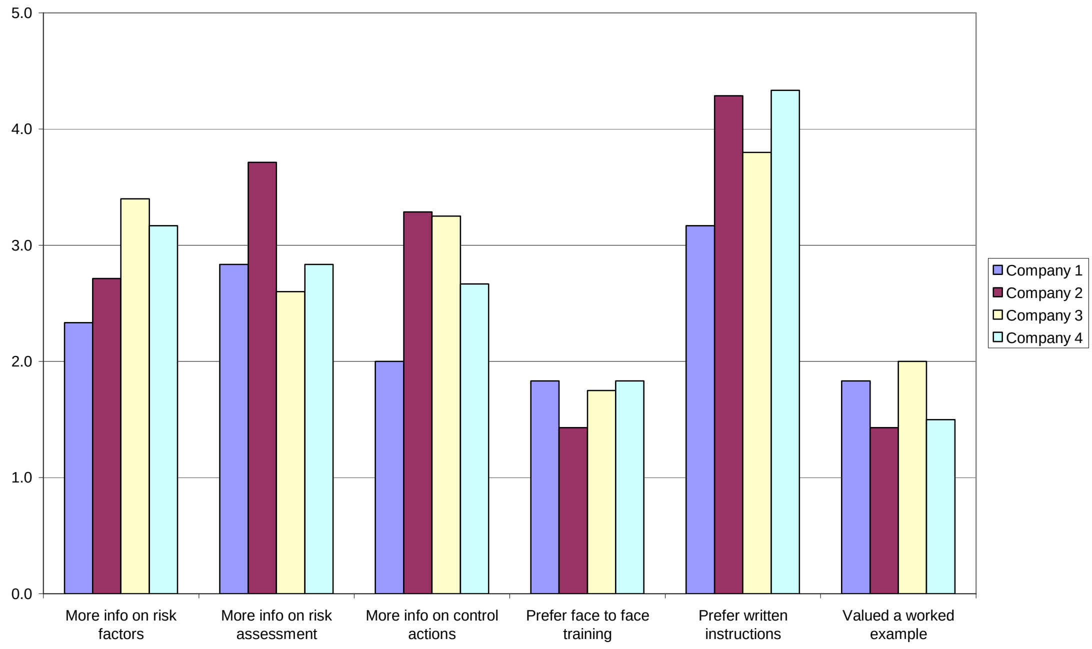


Figure 9.35. Participant preferences following the training course.

Direct benefit

Participants were asked to provide feedback on three questions regarding positive benefit to themselves. These were:

- Have you enjoyed the course?
- Has this course increased your knowledge about the risks for Musculoskeletal problems?
- Has this course been of practical benefit to you? i.e. will you use the knowledge you have gained back in the workplace?

These required simple binary responses (yes/no). The results were unanimous and are shown in Figure 9.36, where 1 = yes.

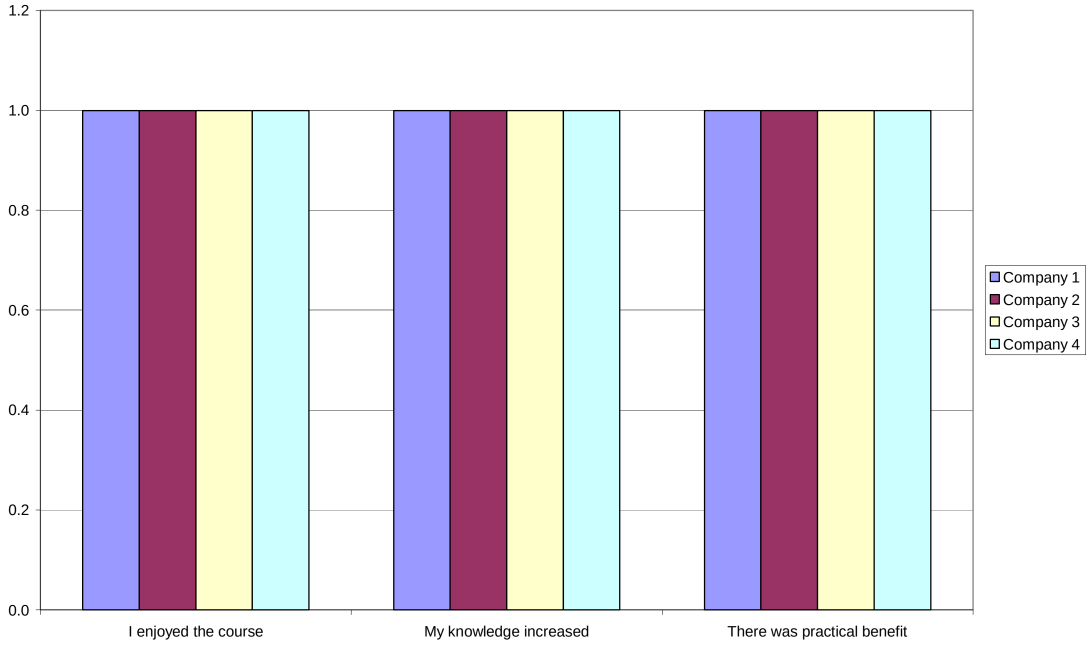


Figure 9.36. Assessed benefits for participants.

Overall opinion

Lastly, participants were asked for their overall opinion of four aspects of the course:

- The content of the course.
- The course material.
- The pace of the course.
- The overall standard of the course.

Responses to these prompts were recorded where 5 = excellent and 1 = poor. The mean responses for each company are shown in Figure 9.37. In each case the mean responses hovered around the values of 3 ("good") and 4 ("very good"). This appears to indicate that the training provided was considered of a reasonably high standard and considered acceptable to all the participants.

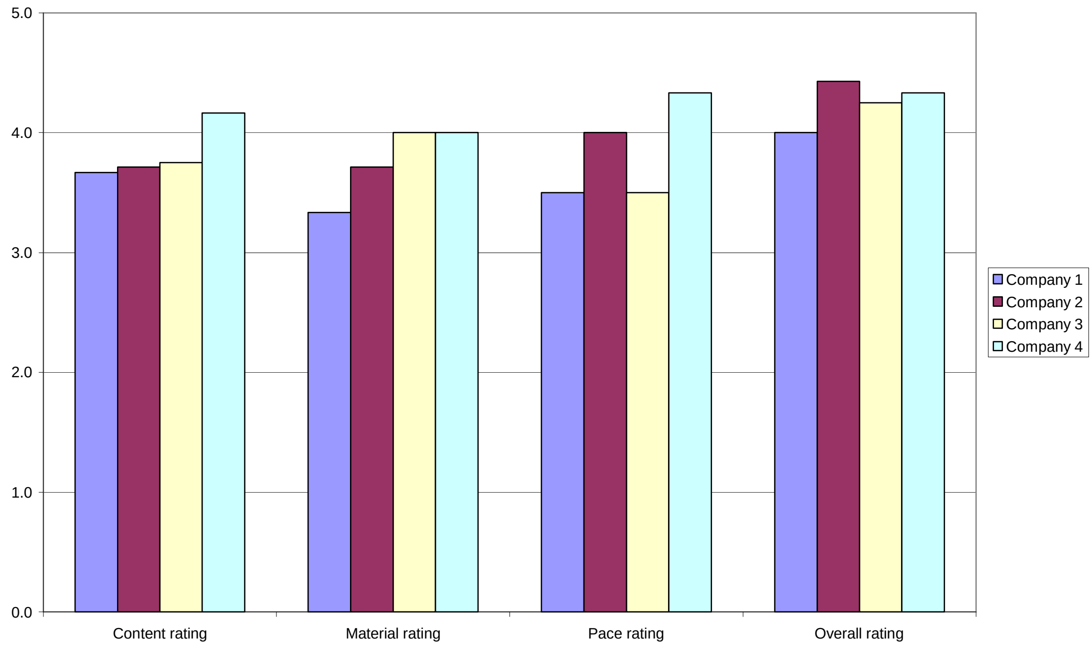


Figure 9.37. Participant overall opinion of the training course.

9.4 Longitudinal study

9.4.1 Workplace questionnaire

At the beginning of the study each participant completed a workplace questionnaire. This was re-completed up to six months after the second set of trials.

Questionnaire results before and after training for groups 1 and 2 were compared to identify whether training had resulted in increased confidence, changes in attitudes towards Health and Safety and the involvement of staff in identifying and reporting problems and proposing solutions.

The results are presented separately for each of the four participating companies. For each company the results are split into uniform categories so that inter-company data can be directly compared.

9.4.2 Company 1 - Flowers

Results

In total 15 participants from Company 1 completed the workplace questionnaire at the start of the study (Before) and 17 at the end of the study (After 6 months) (Table 9.79).

Table 9.79. Percentage of respondents and how they had heard of musculoskeletal problems (MSDs), or repetitive strain injury (RSI).

	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Number of respondents	7	10	8	7

Respondent's awareness and understanding of MSDs

Results from the questionnaire showed that over 75% of respondents from both sites had heard of RSI or Musculoskeletal disorders (Figure 9.38).

Curiously, the participants who had not heard of RSI or MSDs appeared in the post training group, but this is most likely to be accounted for by substitute workers replacing those who had left before the training session.

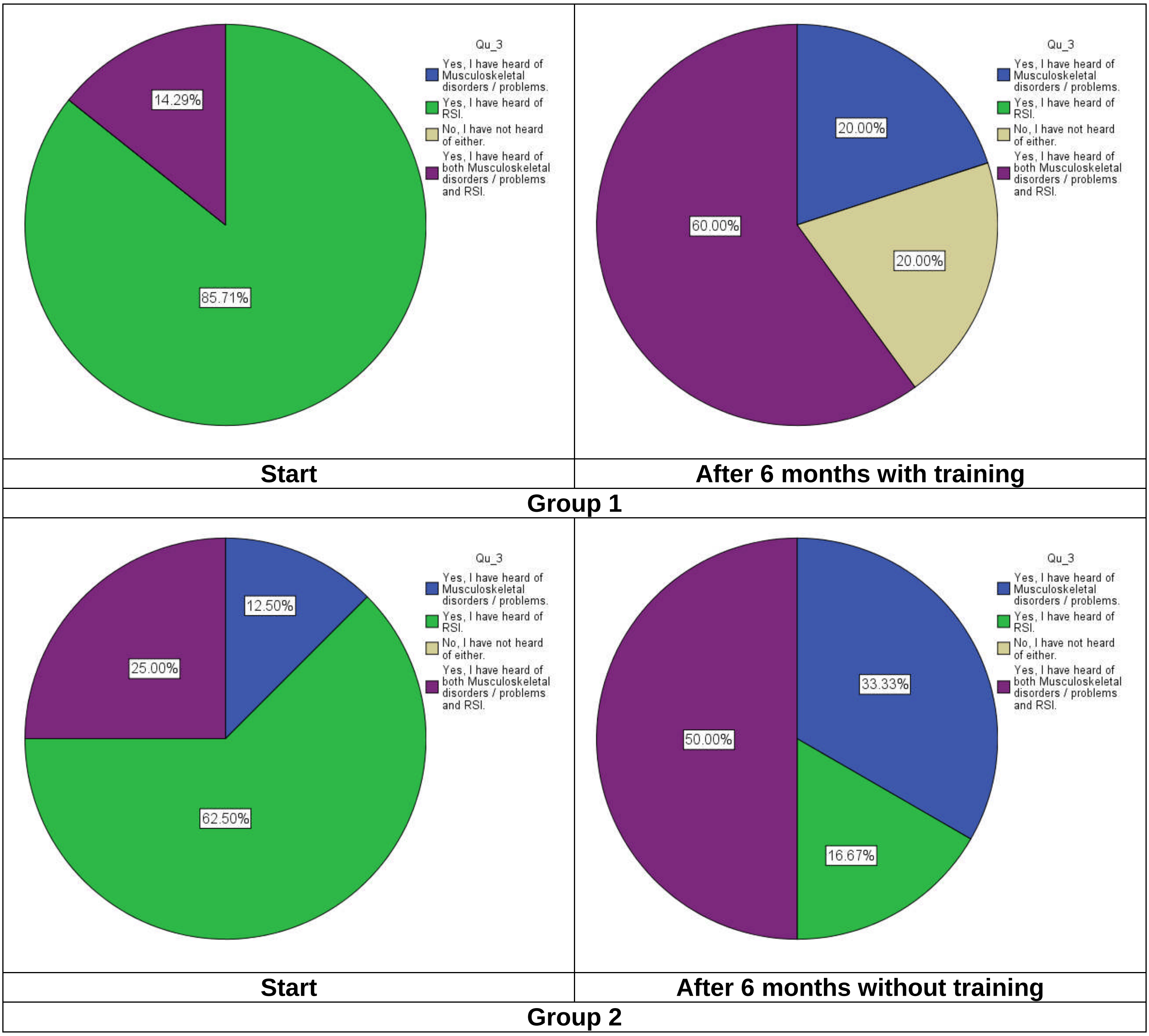


Figure 9.38. Pie charts depicting percentage of respondents from Groups 1 and 2 and their responses to having heard of either MSDs or RSI.

Origin of MSD knowledge

The participants were asked where they had heard of the RSI or MSD terms. Television, magazines and work were the predominant agents for the before training participants from Group 1 and Group 2.

When asked after training the balance shifted such that work accounted for 80% and 71% for the two groups. This may well be explained by the attendance at the training course. The full results are shown in Table 9.80

Table 9.80. Percentage of respondents and how they had heard of musculoskeletal problems (MSDs) or repetitive strain injury (RSI).

	Percentage of respondents from each group			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Television	57%	60%	63%	14%
Radio	0%	0%	13%	0%
Books	0%	0%	13%	0%
Magazines	29%	10%	75%	14%
Websites	0%	0%	0%	14%
Work	43%	80%	75%	71%
Training course	0%	70%	38%	43%
Doctor	0%	20%	50%	0%
Physiotherapist	14%	0%	13%	0%
Other	0%	0%	13%	14%

Knowledge and understanding of MSD risk factors

Question 11 of the workplace questionnaire investigated peoples' understanding and knowledge of musculoskeletal problems, and asked respondents to list up to six risks/causes which may lead to musculoskeletal problems or RSI. Table 9.81 shows the mean number of correct risk factors/ causes reported by respondents. It is notable that this value was not raised by the training process, with the mean dropping for Group 1 and remaining similar for Group 2.

Table 9.81.Descriptive statistics of the number of correct risk factors/causes reported for musculoskeletal problems.

	Percentage of respondents from each group			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Number of respondents	7	10	7	7
Mean	4.4	3	2.6	2.9
Median	6	3	3	2
Mode	6	0	3	0
Std. Deviation	2	2.49	1.6	2.54
Minimum	2	0	0	0
Maximum	6	6	5	6

Figure 9.39 shows the responses as percentiles in graphical form .

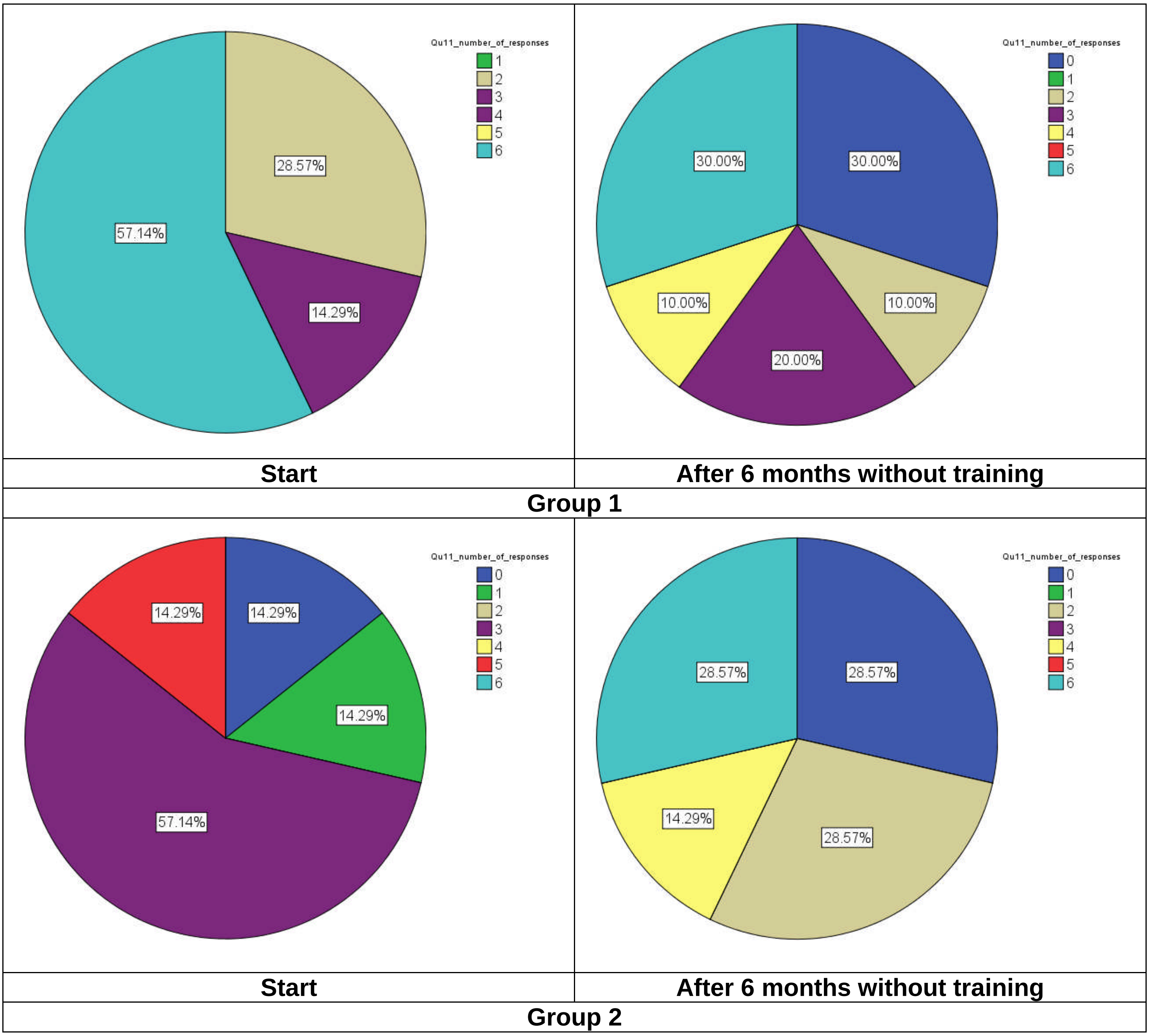


Figure 9.39 Pie charts depicting the percentage of respondents from Groups 1 and 2 and the number of correct risk factors/causes reported for musculoskeletal problems.

Reported pains, aches, discomfort relating to MSDs

Question 5 of the questionnaire described musculoskeletal problems as "affecting the muscles, tendons, ligaments of the neck, shoulders, back, arms, wrist, hands or legs. Symptoms can be feelings of pain, aches, numbness and/or discomfort in any of these body areas".

Respondents were asked if they had experienced any such pain, aches, or discomfort in any body area in the last 6 months or last 7 days. Table 9.82 shows the percentile responses.

Table 9.82. Percentage of respondents that had experienced pain, aches or discomfort.

	Percentage of respondents from each group			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
None	43%	40%	38%	43%
Yes, in the last 6 months	43%	60%	50%	57%
Yes in the last 7 days	29%	20%	13%	14%

This demonstrates that over half of the respondents had experienced pain or discomfort in the last six months, with nearly a fifth experiencing these symptoms in the last seven days. Both groups reported a rise in the percentage of reported pain after training. This might be due to increased awareness, or may be due to more direct work related factors.

For those individuals who reported pain or discomfort, a further question explored the location of the symptoms. This is presented by Group in Tables 9.83 and 9.84.

Group 1

Table 9.83. Percentage of those Group 1 respondents that reported experiencing pain, aches or discomfort and the body part affected and the level of discomfort experienced.

Group 1 (Start), n= 4 Group 1 (After 6 months), n=									
		No problems	Minimal discomfort	2	3	4	5	6	Extreme discomfort
Neck	Start	50%	0%	25%	25%	0%	0%	0%	0%
	After 6 months	67%	0%	0%	17%	0%	0%	17%	0%
Shoulders	Start	25%	0%	25%	25%	0%	0%	0%	0%
	After 6 months	67%	0%	0%	17%	0%	17%	0%	0%
Upper arms	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	50%	0%	17%	17%	0%	0%	0%	17%
Elbows	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	50%	0%	17%	0%	0%	17%	0%	17%
Forearms	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	67%	0%	17%	0%	0%	0%	0%	17%
Wrist	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	33%	17%	0%	17%	17%	17%	0%	0%
Hands	Start	75%	0%	0%	0%	25%	0%	0%	0%
	After 6 months	67%	17%	0%	0%	17%	0%	0%	0%
Upper back	Start	75%	0%	0%	0%	0%	25%	0%	0%
	After 6 months	67%	17%	0%	0%	0%	17%	0%	0%
Lower back	Start	25%	0%	0%	25%	0%	25%	0%	25%
	After 6 months	67%	17%	0%	0%	0%	17%	0%	0%
Legs	Start	50%	0%	0%	0%	0%	25%	0%	25%
	After 6 months	67%	0%	17%	0%	17%	0%	0%	0%

Group 2

Table 9.84. Percentage of those Group 2 respondents that reported experiencing pain, aches or discomfort and the body part affected and the level of discomfort experienced.

Group 2 (Start), n=5 Group 2 (After 6 months), n=									
		No problems	Minimal discomfort	2	3	4	5	6	Extreme discomfort
Neck	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	75%	0%	25%	0%	0%	0%	0%	0%
Shoulders	Start	60%	0%	0%	20%	0%	0%	20%	0%
	After 6 months	75%	0%	0%	25%	0%	0%	0%	0%
Upper arms	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	75%	0%	0%	25%	0%	0%	0%	0%
Elbows	Start	80%	0%	0%	0%	0%	0%	0%	20%
	After 6 months	100%	0%	0%	0%	0%	0%	0%	0%
Forearms	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	100%	0%	0%	0%	0%	0%	0%	0%
Wrist	Start	60%	0%	20%	20%	0%	0%	0%	0%
	After 6 months	0%	25%	0%	50%	0%	25%	0%	0%
Hands	Start	60%	0%	20%	0%	0%	20%	0%	0%
	After 6 months	50%	0%	25%	25%	0%	0%	0%	0%
Upper back	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	75%	0%	0%	0%	0%	25%	0%	0%
Lower back	Start	80%	0%	0%	0%	0%	20%	0%	0%
	After 6 months	50%	0%	0%	0%	0%	25%	25%	0%
Legs	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	75%	0%	0%	25%	0%	0%	0%	0%

These data were further investigated to establish what action, if any, had been taken regarding this discomfort and what the participant considered to be the cause.

Table 9.85 explores whether the participant had seen a doctor ort had time off work because of the discomfort they had experienced..

Table 9.85. The actions of Group 1 and Group 2 respondents that reported experiencing pain, aches or discomfort.

	Group 1		**Group 2**	
	Start	**After 6 months with training**	**Start**	**After 6 months without training**
Percentage who have consulted with a doctor about discomfort	50%	33%	60%	50%
Percentage who have taken time off work because of discomfort	75%	33%	20%	25%

It can be seen that at the start of the study over half of both groups had consulted a doctor about the discomfort experienced. This fell for both groups after training. Absence due to discomfort fell significantly for Group 1 post training but remained roughly constant, albeit at a lower level, for Group 2

Table 9.86 gives the participant's nominated cause of the discomfort, with virtually all respondents identifying work as the origin both before and after training..

Table 9.86. The reported cause pain, aches or discomfort for Group 1 and Group 2 respondents.

	Percentage of respondents that experienced discomfort			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Hobbies	0%	0%	0%	0%
Sport	0%	0%	0%	0%
Work tasks	100%	83%	100%	100%
House work	0%	0%	0%	0%

Future health concerns

A further question in the survey enquired whether the participants were concerned that they may develop MSD problems in the future. The results can be seen in Table 9.87. A greater percentage of Group 1 respondents (57%/40%) reported that they were concerned that they would develop a musculoskeletal problem from their work than Group 2 respondents (13%/14%).

Table 9.87. Percentage of respondents and whether they were concerned about developing musculoskeletal problems at work.

	Percentage of respondents from each group			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Yes	57%	40%	13%	14%
No	43%	60%	87%	86%
No response	0%	0%	0%	0%

Changes to the workplace

Respondents were asked if they would kike the layout of their workplace to be changed so that it was easier or more comfortable to do their job. The results are shown in Table 9.88. Less than a third of respondents from both groups stated that they would like the layout of their workplace changed, despite the apparently high rate of discomfort. This suggests that they may view the activities as more problematic than the immediate location.

Table 9.88. Percentage of respondents and whether they would like the layout of their workplace changed to make it easier or more comfortable to do the work.

	Percentage of respondents from each group			
	Group 1		**Group 2**	
	Start	**After 6 months with training**	**Start**	**After 6 months without training**
Yes	29%	20%	13%	14%
No	71%	70%	87%	86%
No response	0%	10%	0%	0%

For those respondents that said they would like to make changes 100% of Group 1 and Group 2 said they would like the changes to be made in the next 6 months (Table 9.89).

Table 9.89. Percentage of those respondents that said yes they would like to make changes and whether these changes should be made in the next 6 months.

	Percentage of respondents that said yes they would like to make changes			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Yes	100%	100%	100%	100%
No	0%	0%	0%	%0
No response	0%	0%	0%	%0

Table 9.90 goes on to present the type of changes respondents reported they would like to see.

Table 9.90. Description of changes respondents said they would to made to their workplace.

Group 1	Start	• Make tables higher when wrapping. Make wrap boxes lighter. • Reducing packaging in boxes. Higher tables for tall people.
	After 6 months with training	• Move people on line, line speed • Change break times, heating when cold, body warmers for staff
Group 2	Start	• Very cold temperature, change would make the work area more comfortable and happier place to be.
	After 6 months without training	• Times of break (too cold in pack house), body warmers for staff

Employer changes to the workplace

Respondents were asked if they were aware if their employer had made any changes to reduce MSD risks. Less than half of both Groups 1 and 2 responded that this was the case (Table 9.91).

Table 9.91. Percentage of respondents and whether they knew if their employer had made any changes to reduce the risks of musculoskeletal problems.

	Percentage of respondents from each group			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Yes	29%	20%	50%	29%
No	71%	80%	50%	71%
No response	0%	0%	0%	0%

Respondent changes to the workplace.

In comparison, it was noted that a similar percentage of participants had undertaken changes to the workplace themselves, as seen in Table 9.92.

Table 9.92. Percentage of respondents and whether they had done anything to reduce the risks.

	Percentage of respondents from each group			
	Group 1		Group 2	
	Start N=7	After 6 months with training	Start N=8	After 6 months without training
Yes	43%	40%	50%	43%
No	57%	60%	38%	57%
No response	0%	0%	12%	0%

For those respondents who indicated that they had undertaken changes themselves, they were asked to provide further information on the nature of those changes. Details of the responses are given in Table 9.93, below.

Table 9.93 Description of changes respondents have made themselves to reduce the risks.

Group 1	Start	• Get packaging on a trolley and not carrying it. • Change jobs throughout the day. • Thought about how I stand and actually do the job.
	After 6 months with training	• I have changed what I used to do so it is easier on my wrists • Health and safety, cleaning floor, carrying carefully • Make sure I do job in the right way, stand and twist correctly • Moved staff so they aren't doing the same job all the time

Group 2	Start	• Got fingerless gloves and liners to put under working gloves. • Stopped working on the line. • Rotation of staff • Rotating jobs within packhouse
	After 6 months without training	• Health and Safety • Rotating staff • Rotate operatives, don't let them do the same job for more than a certain time.

Communication and attitudes relating to health and safety

The participant survey attempted to explore attitudes to health and safety in the workplace and the manner in which communication took place in the workplace. Table 9.94 shows the participant's responses regarding communication between the operations or production department and company management.

The majority of both groups reported that they felt these communication links were satisfactory. This is encouraging since it suggests that this traditional barrier to improving health and safety is not realised in practice.

Table 9.94. Percentage of respondents and how they felt about communication links between operations/production and management.

	Percentage of respondents from each group			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
No response	0%	0%	0%	0%
Good and efficient	0%	30%	37.5%	14%
Satisfactory	71%	60%	50%	71%
Unsatisfactory	29%	10%	0%	14%
Very poor and inefficient	0%	0%	12.5%	0%

The final section of the questionnaire probed the attitudes of the workers with a series of statements against which the participants could record a level of agreement. The responses ranged from “Strongly Disagree” to “Strongly Agree”.

The probes were:

- "In my workplace management acts quickly to correct health and safety problems"
- "Health and safety information is always brought to my attention by my line manger/supervisor"
- "In my workplace the chances of developing a work related health problem are quite high"
- "There is good communication here about health and safety issues which affect me"
- "Management here considers health and safety to be equally as important as production"
- "I believe health and safety issues are given a high priority"
- "Some health and safety rules and procedures don't need to be followed to get the job done safely"
- "Some health and safety rules are not really practical"
- "I am strongly encouraged to report unsafe conditions"
- "I can influence health and safety performance here"
- "I am involved in informing management of important health and safety issues"
- "Health and safety is the number one priority in my mind when completing a job"
- "It is important to me that there is a continuing emphasis on health and safety"
- "I'm sure it's only a matter of time before I develop a work related health problem"
- "Production targets rarely conflict with health and safety measures"
- "I am always given enough time to get the job done safely".

The following figures (9.40 to 9.55) present the findings of this survey as a series of histograms, in which a more benign environment is reflected by a greater depth and proportion of green colouration. Orange or red indicates an area of possible conflict.

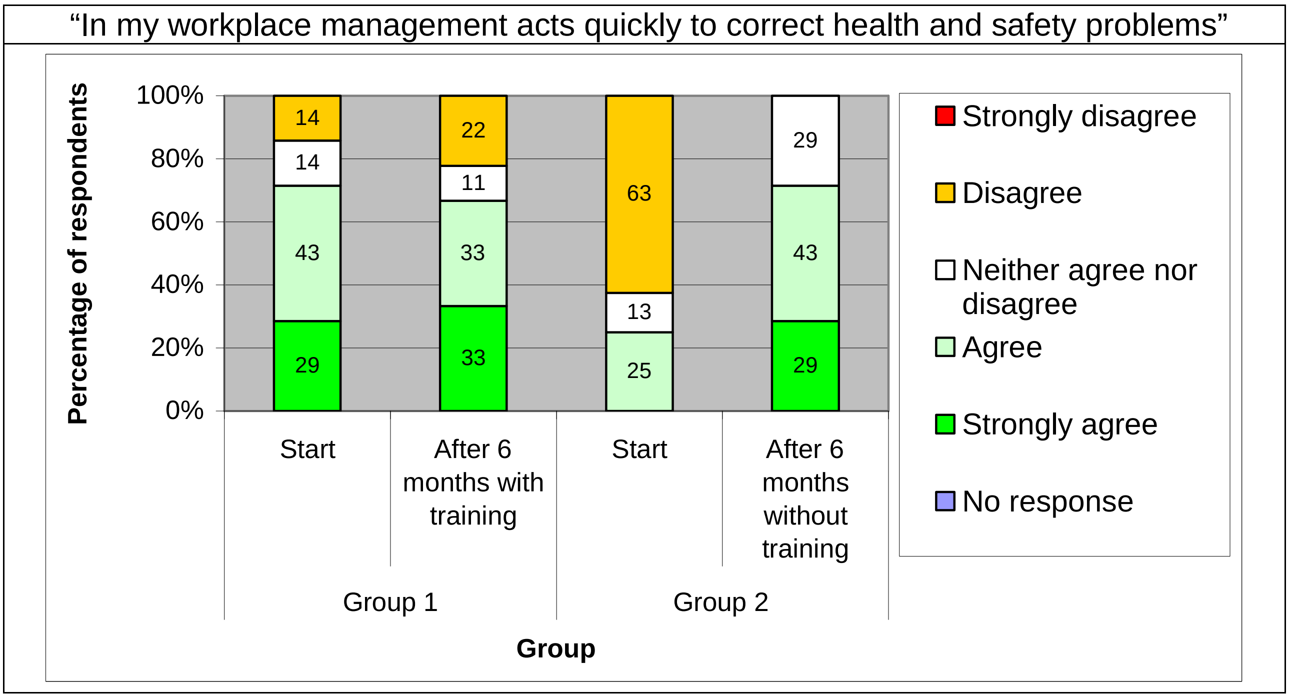


Figure 9.40 Response to speed of action statement over time by group

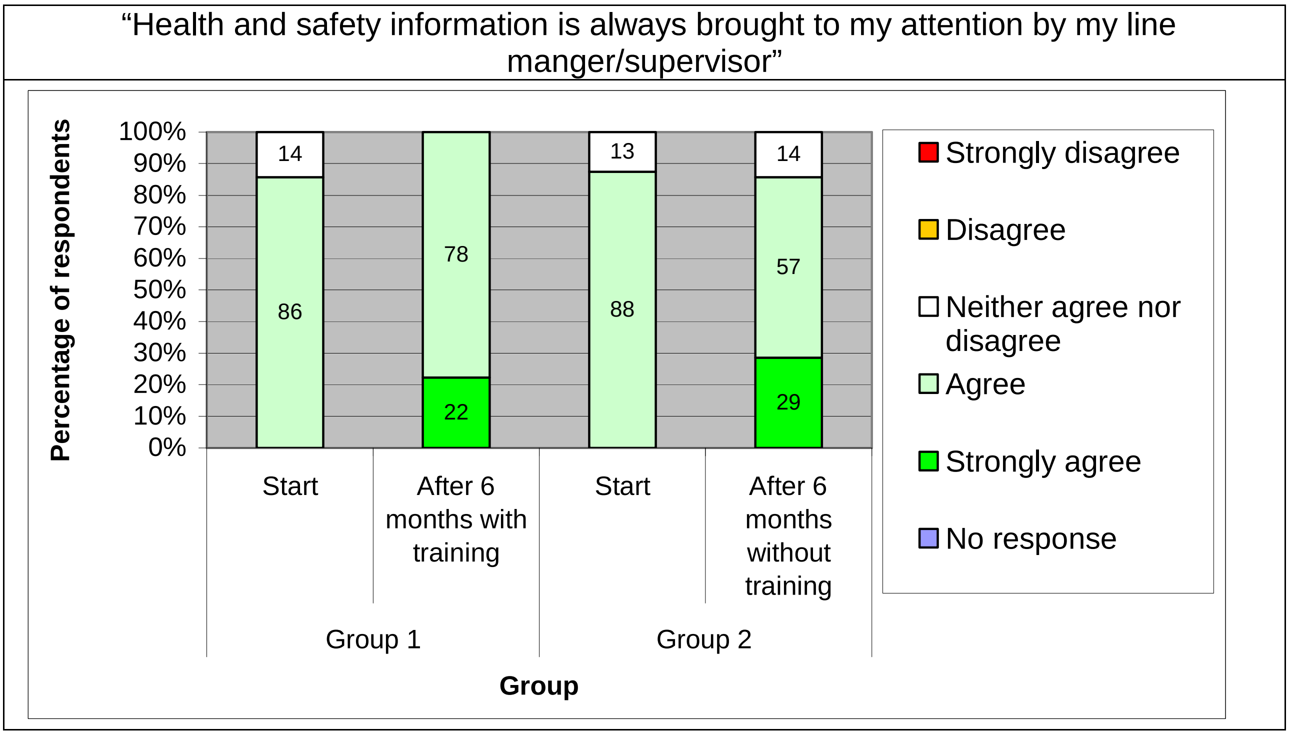


Figure 9.41 Response to health and safety attention statement over time by group

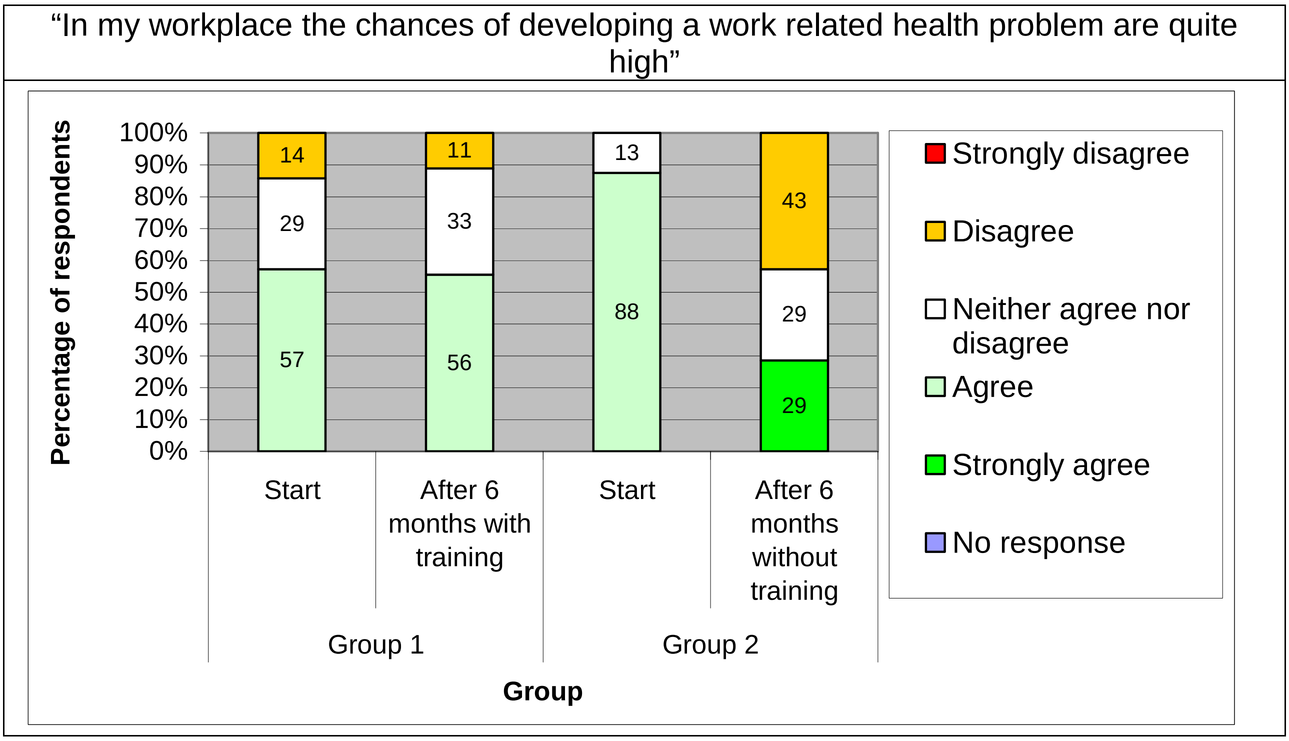


Figure 9.42 Response to health problem likelihood statement over time by group

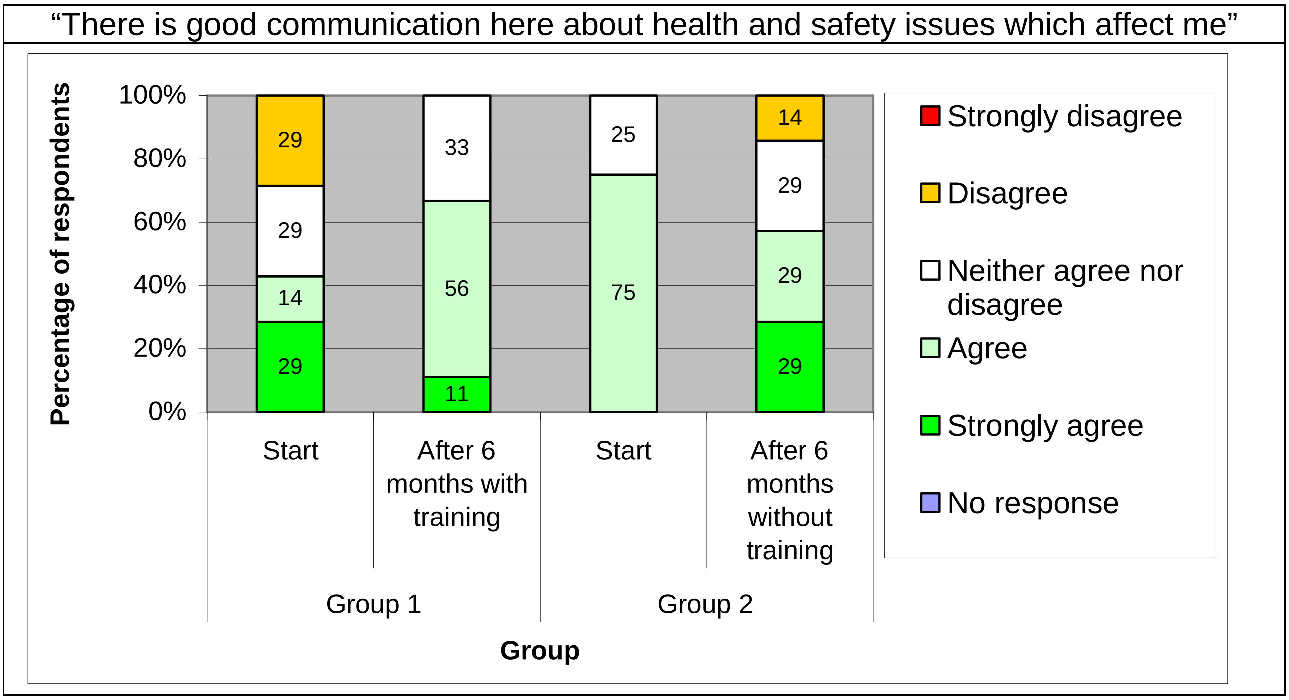


Figure 9.43 Response to communication statement over time by group

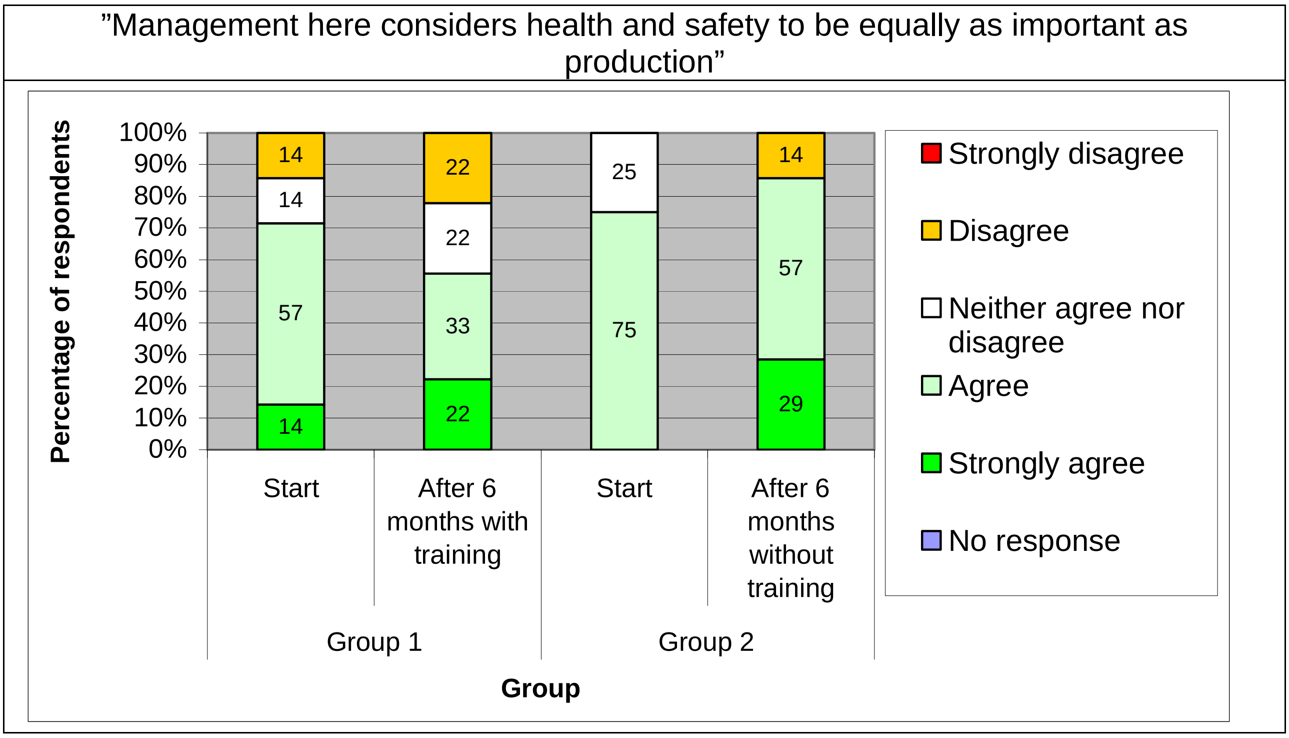


Figure 9.44 Response to health and safety importance statement over time by group

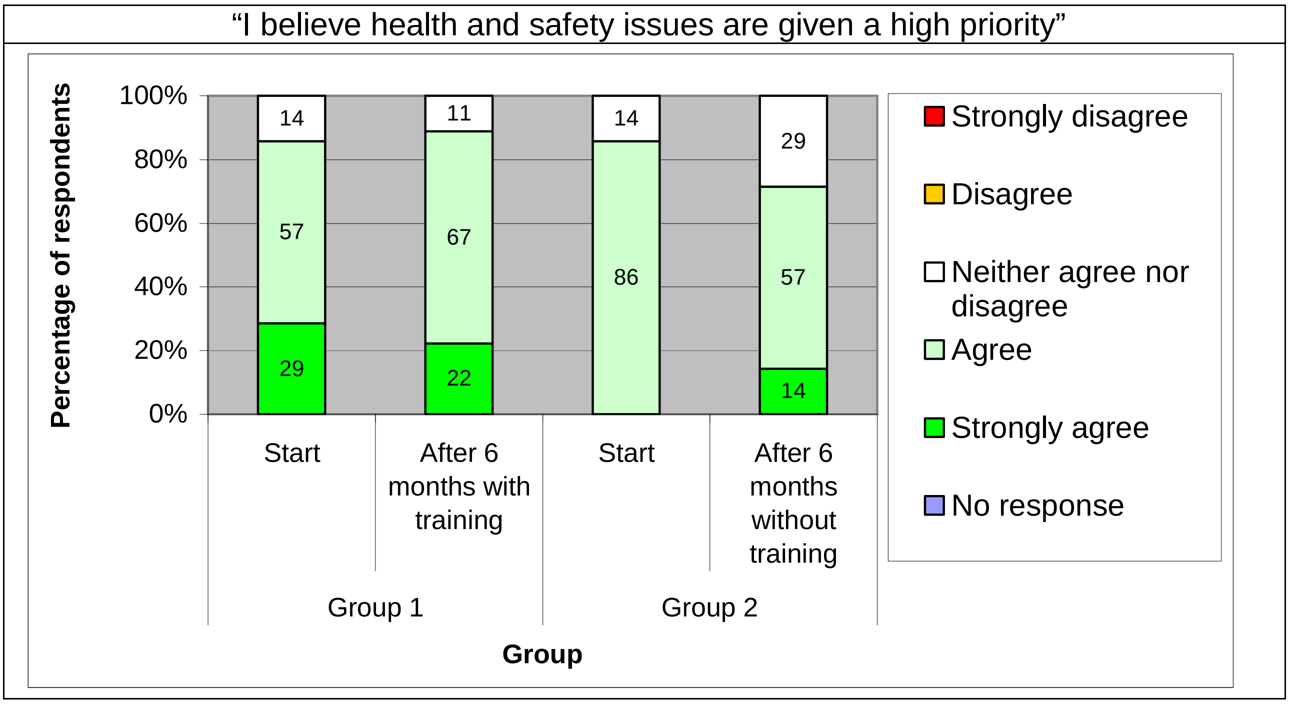


Figure 9.45 Response to health and safety priority statement over time by group

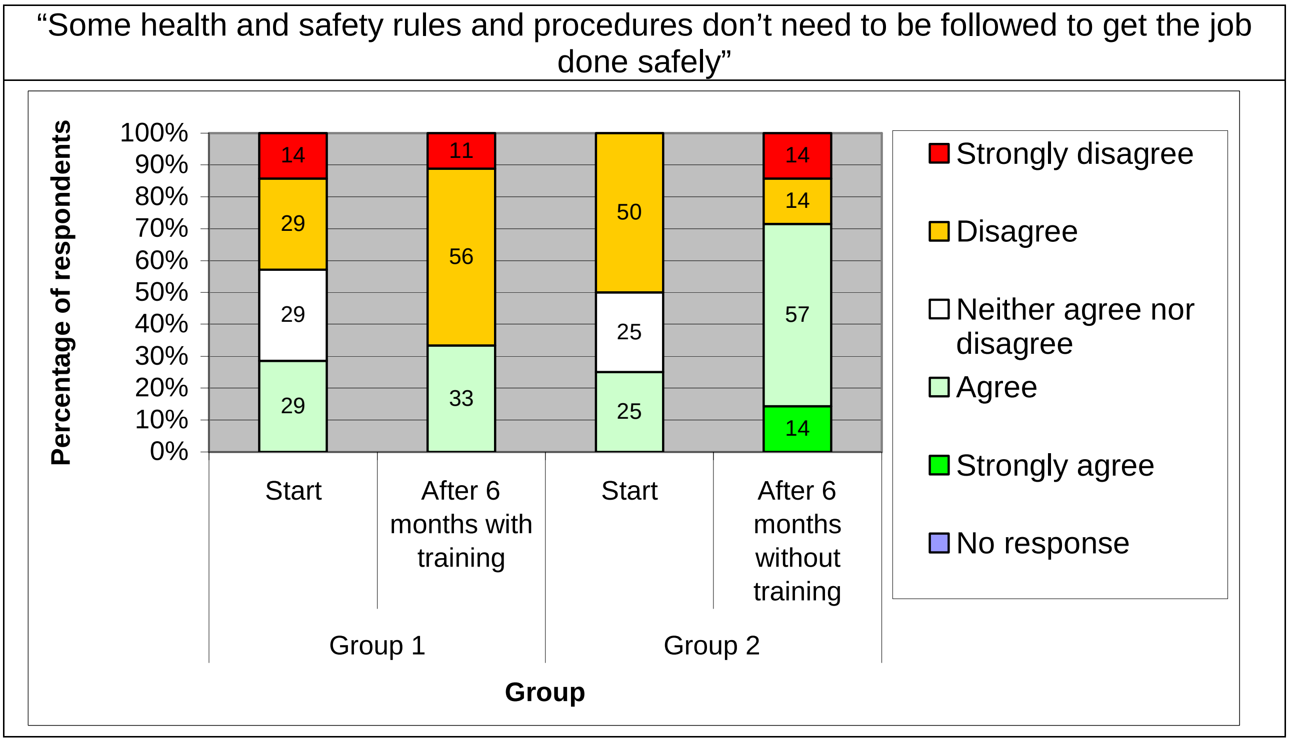


Figure 9.46 Response to safety rules statement over time by group

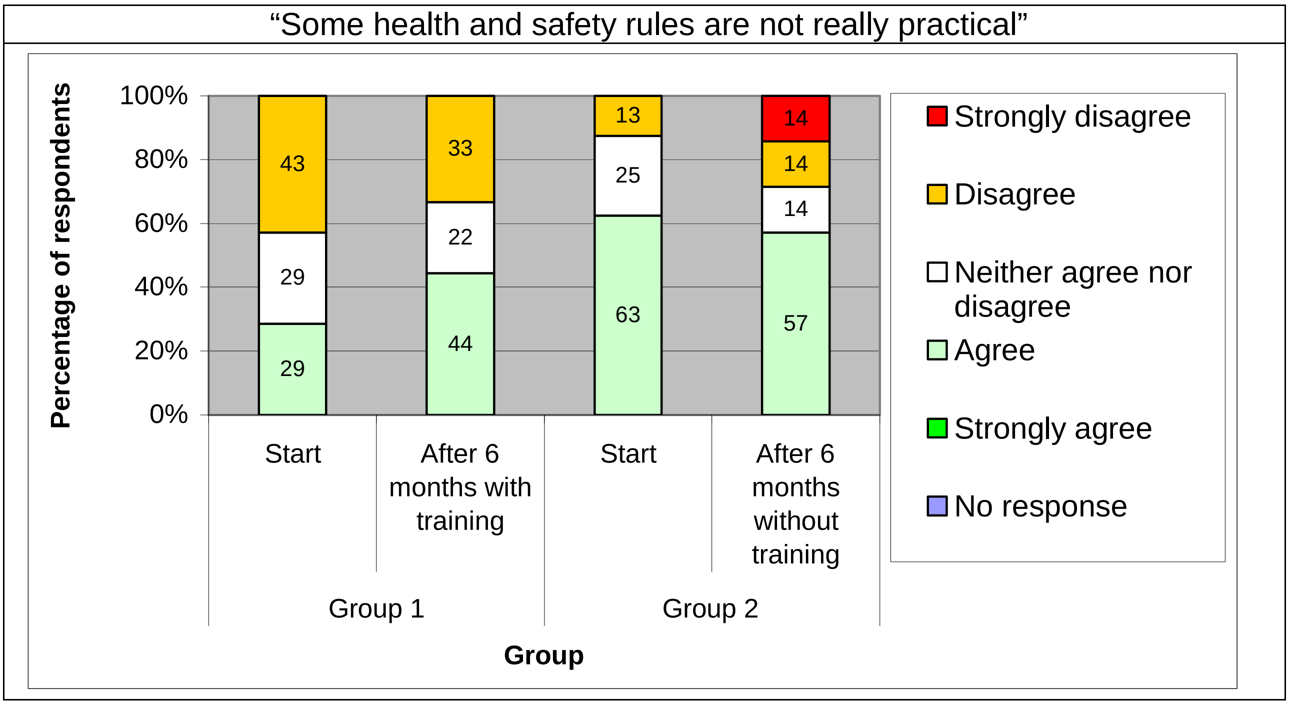


Figure 9.47 Response to health and safety practicality statement over time by group

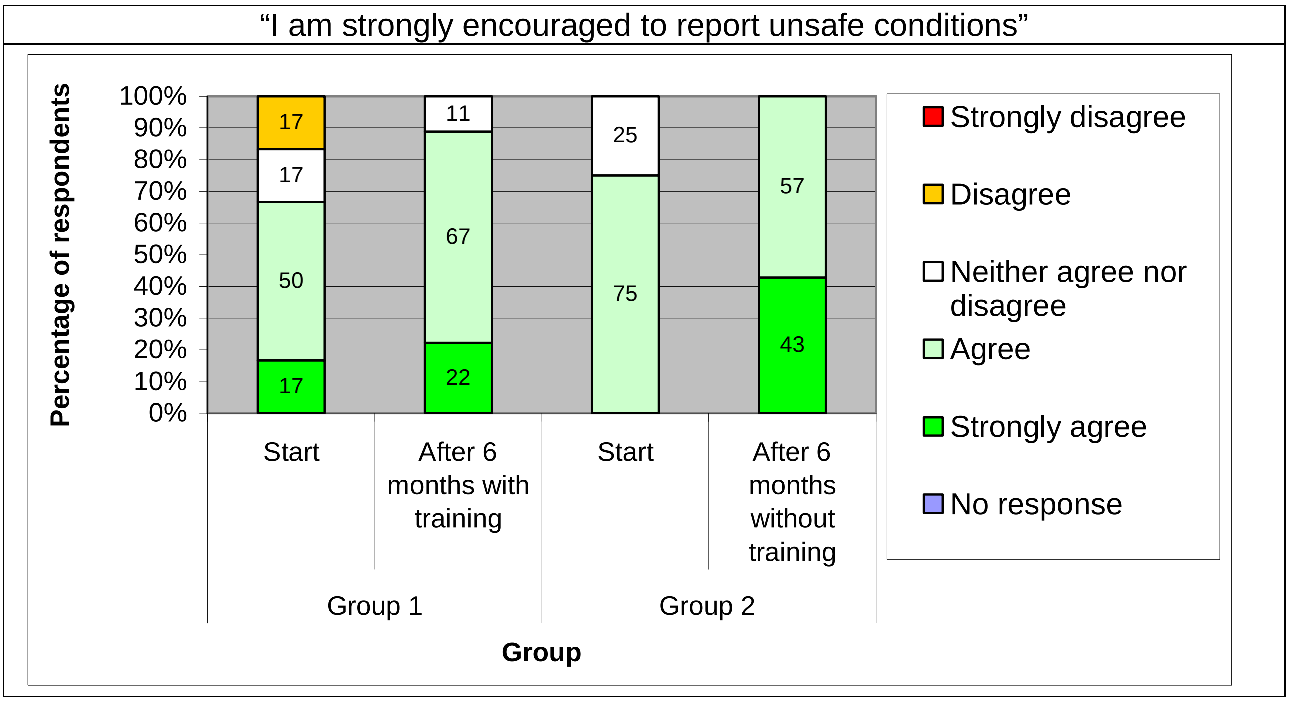


Figure 9.48 Response to reporting statement over time by group

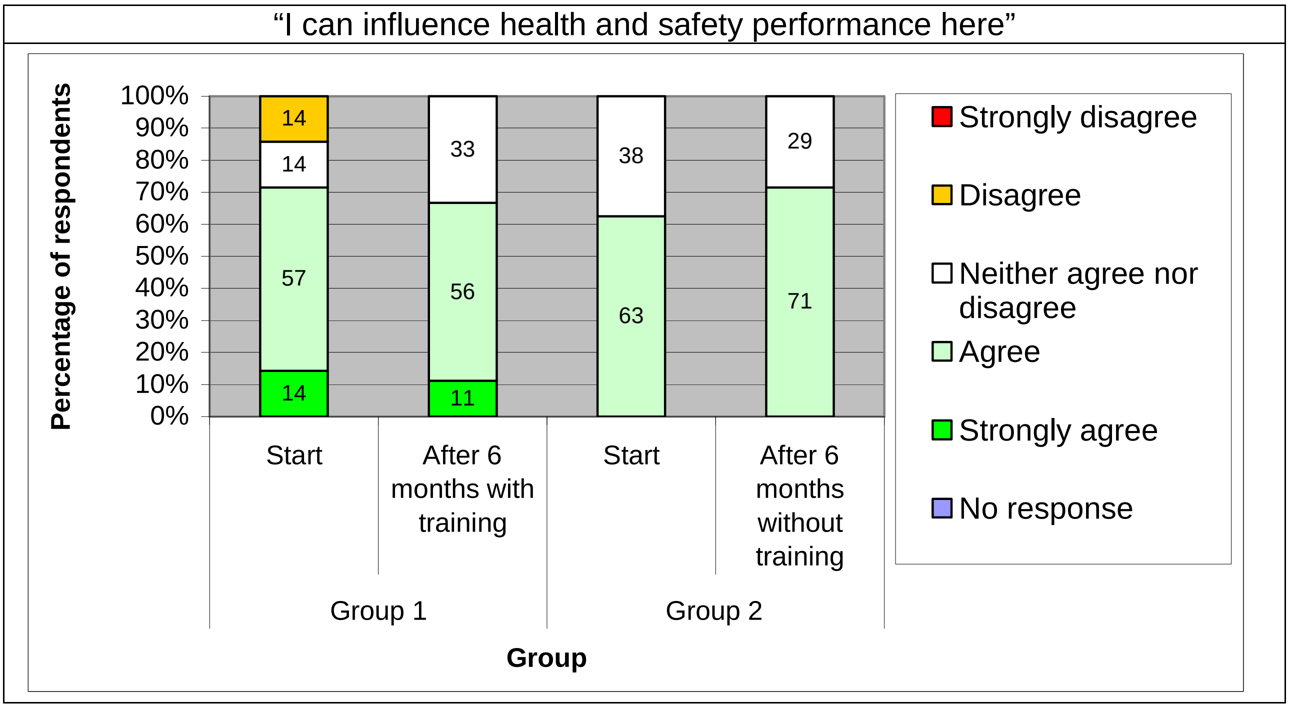


Figure 9.49 Response to health and safety influence statement over time by group

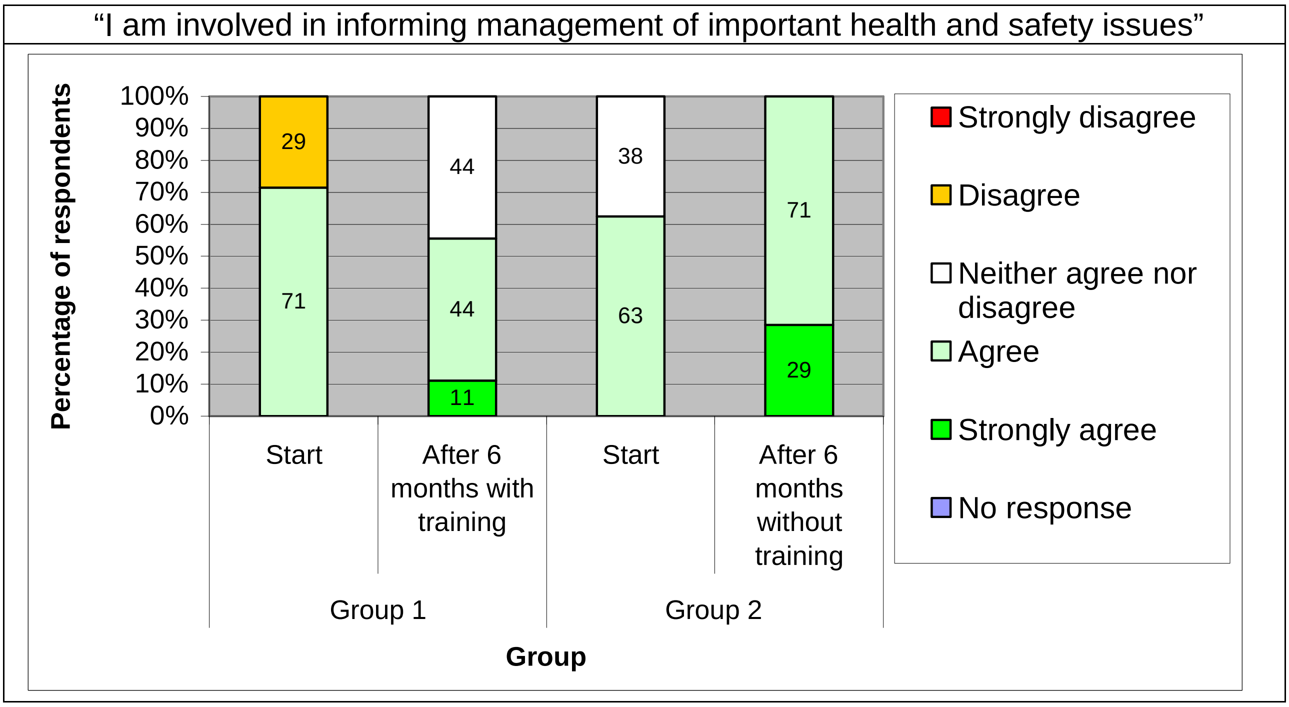


Figure 9.50 Response to health and safety management statement over time by group

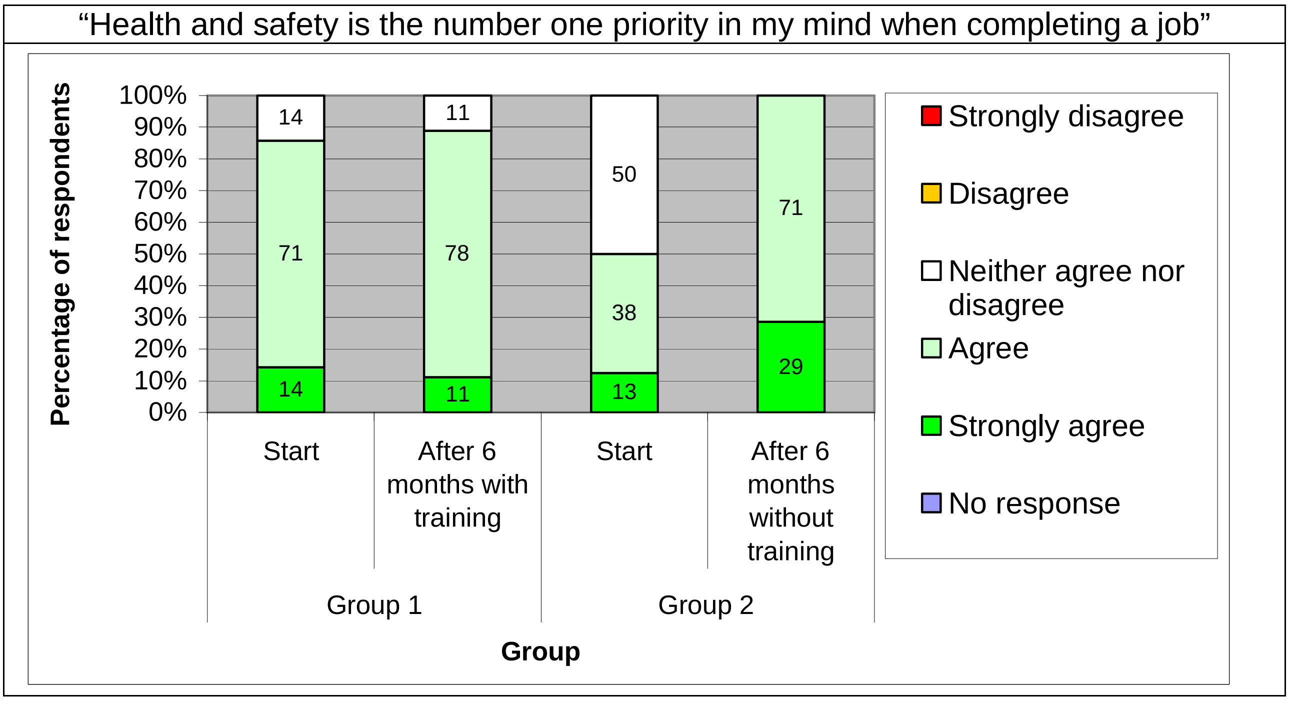


Figure 9.51 Response to health and safety priority statement over time by group

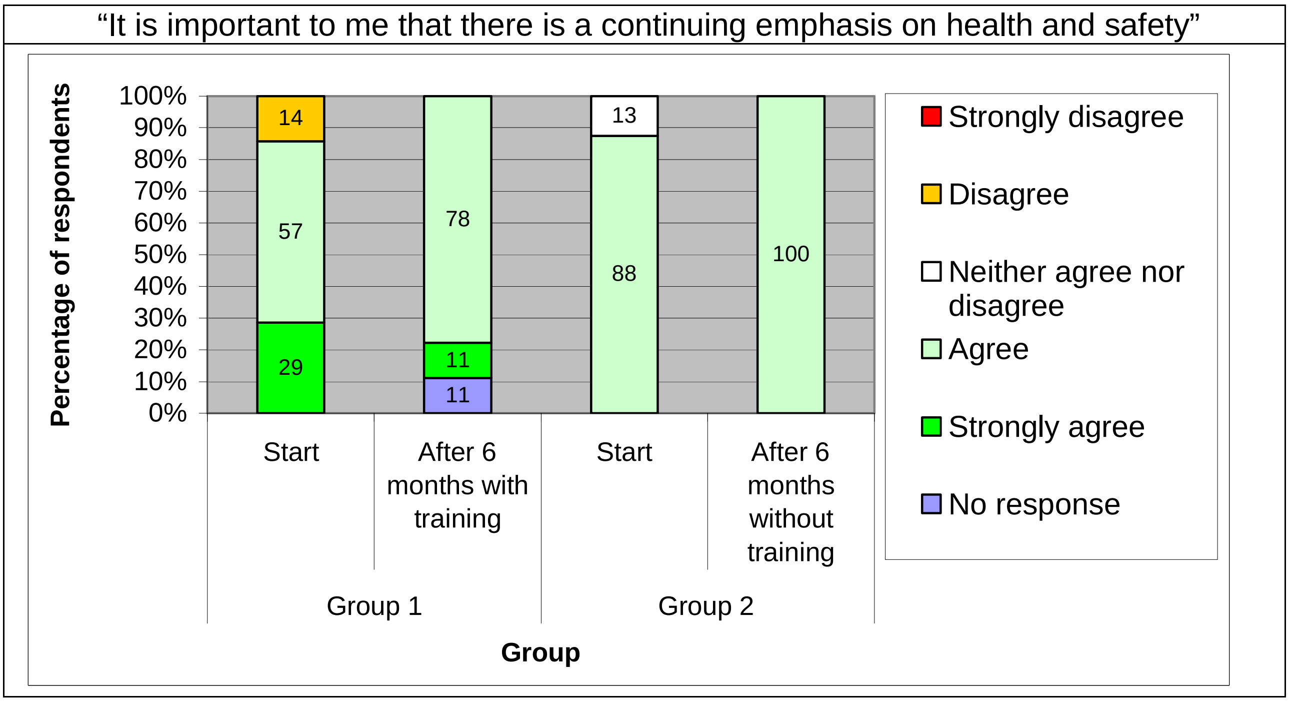


Figure 9.52 Response to health and safety emphasis statement over time by group

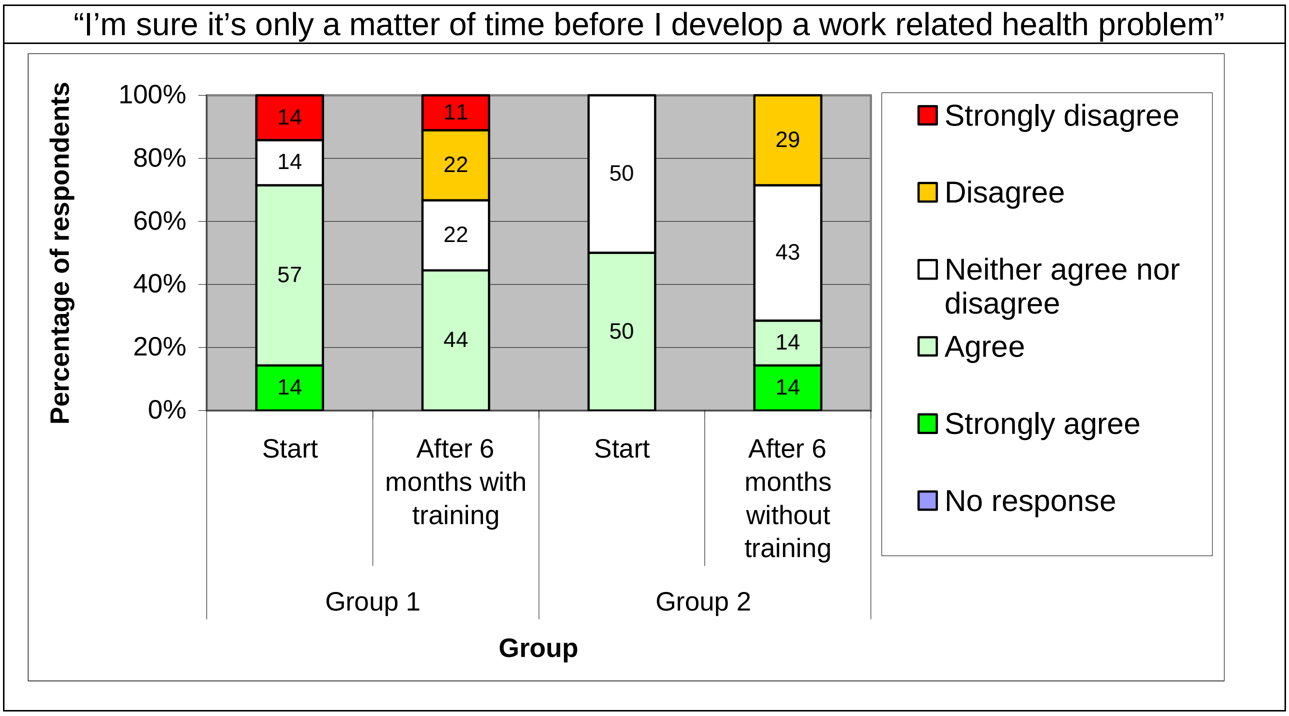


Figure 9.53 Response to health problem probability statement over time by group

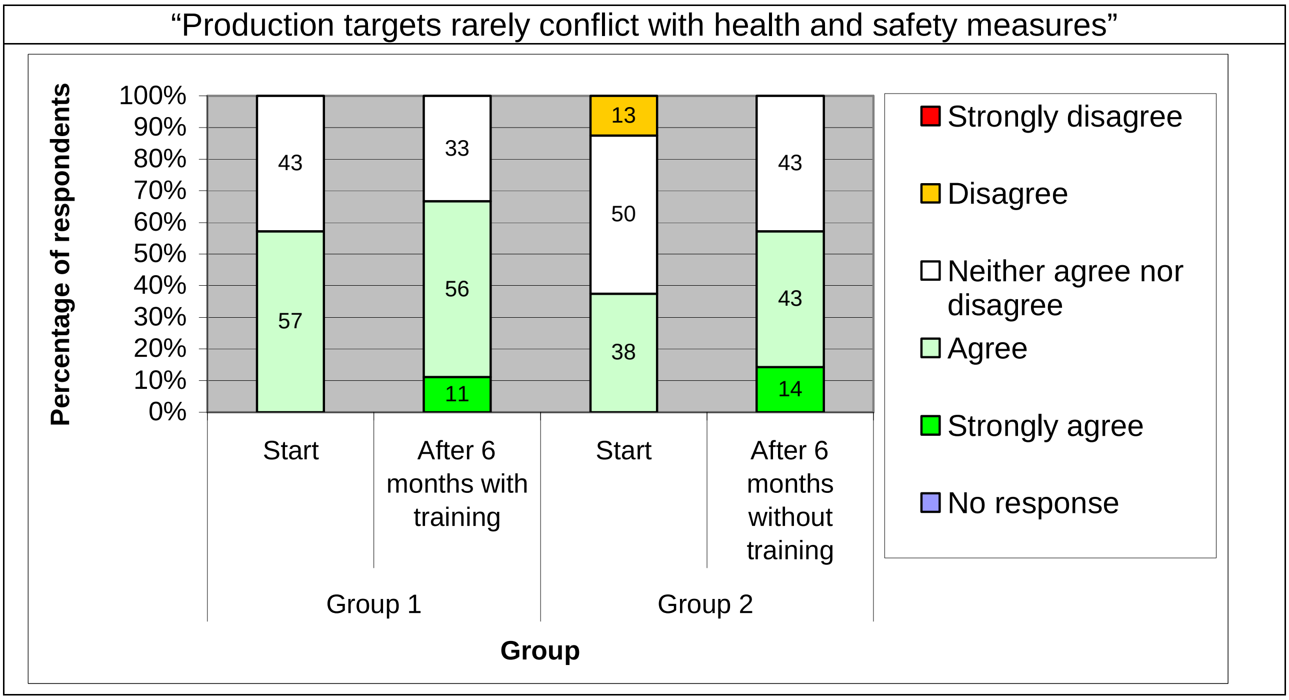


Figure 9.54 Response to production targets statement over time by group

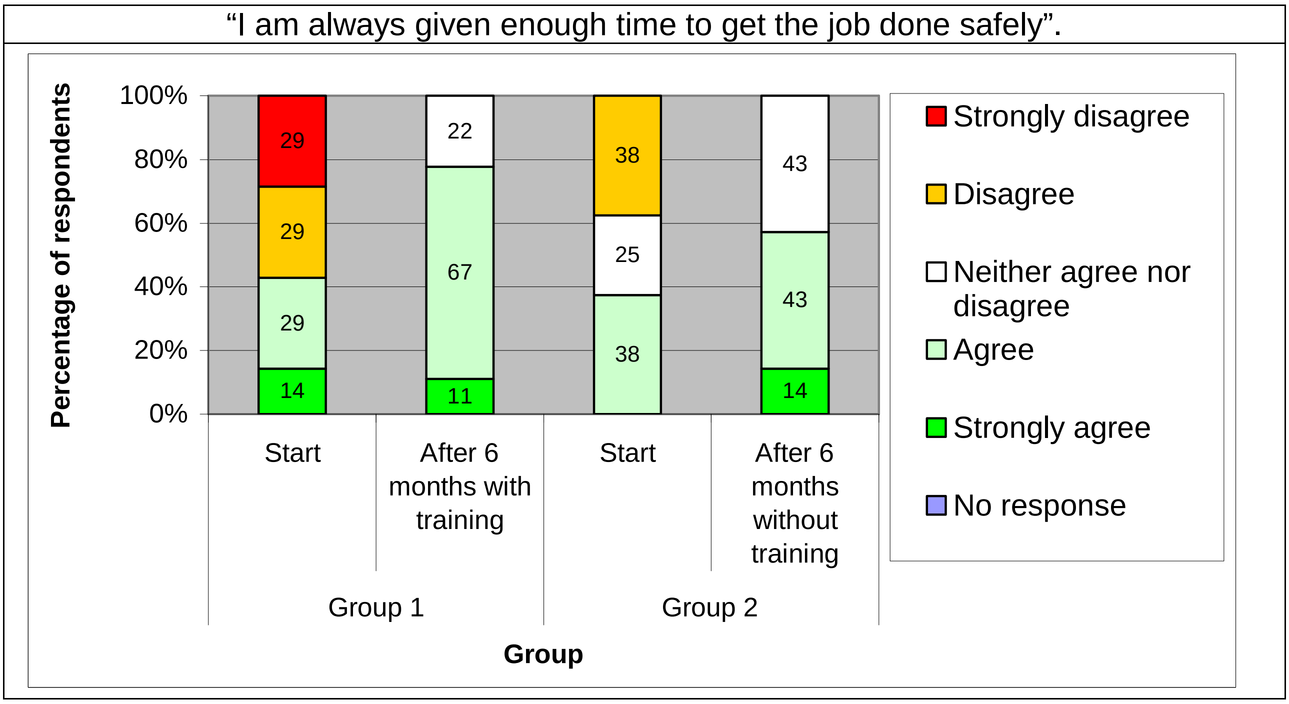


Figure 9.55 Response to time for safe work statement over time by group

Summary of attitude survey

The following table (Table 9.95) summarises the statements which generated the responses most likely to reflect potential conflict.

Table 9.95. Statements most likely to reflect potential conflict.

Probe statement	Conflicting groups
In my workplace management acts quickly to correct health and safety problems	Group 1 before and after training Group 2 before training.
In my workplace the chances of developing a work related health problem are quite high	Group 2 after training
It’s only a matter of time before I develop an MSD problem	Group 1 before training Group 2 after training
I am always given enough time to get my job done safely	Group 1 before training

9.4.3 Company 2 - Labs

Results

In total 18 participants from Company 2 completed the workplace questionnaire at the start of the study (Before) and 12 at the end of the study (After 6 months) (Table 9.96).

Table 9.96. Percentage of respondents and how they had heard of musculoskeletal problems (MSDs) or repetitive strain injury (RSI).

	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Number of respondents	10	5	8	7

Respondent's awareness and understanding of MSDs

Results from the questionnaire showed that over 75% of respondents from both sites had heard of RSI or Musculoskeletal disorders (Figure 9.56). The participants who had not heard of RSI or MSDs appeared in Group 1 and Group 2 before training.

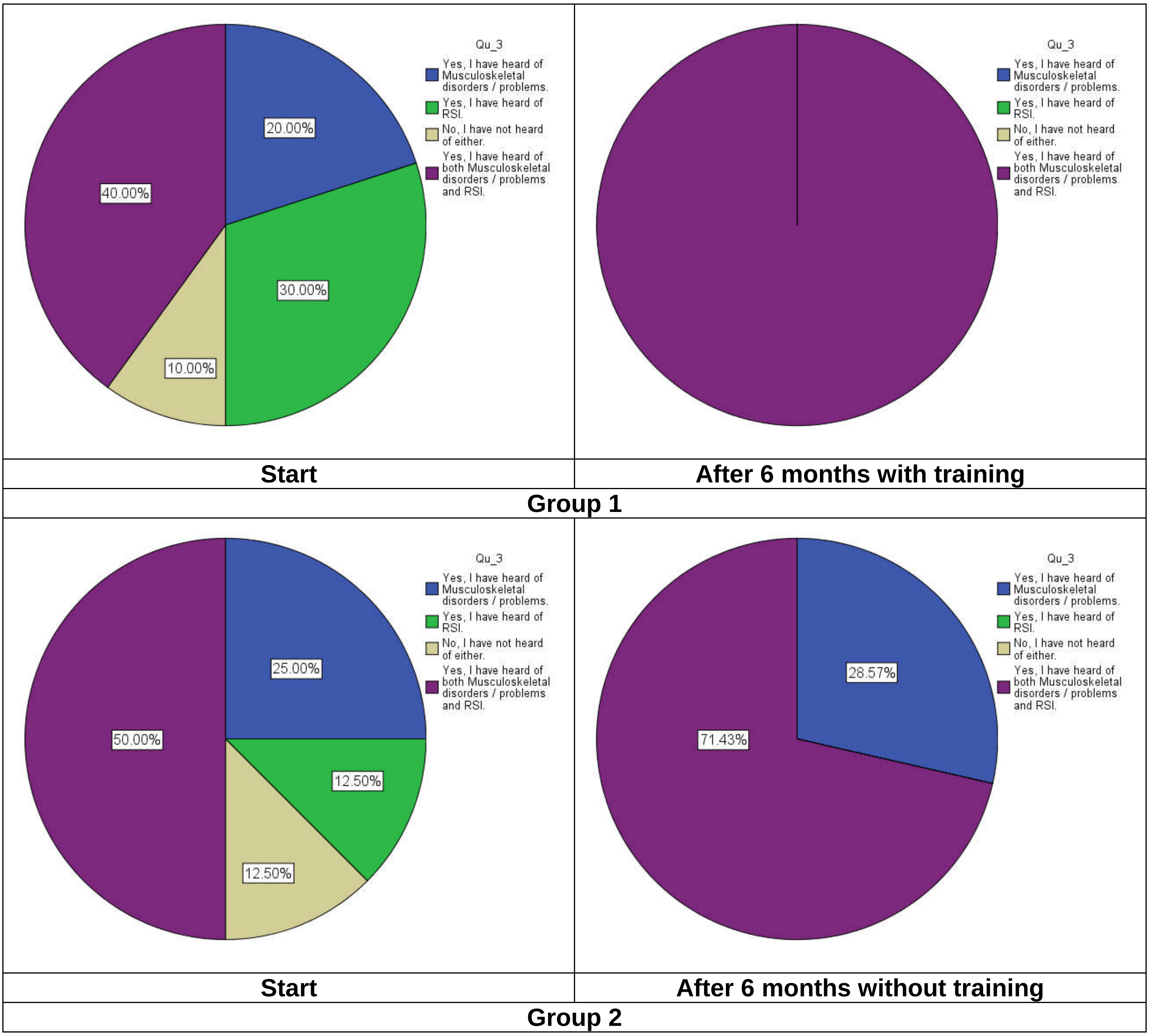


Figure 9.56. Pie charts depicting percentage of respondents from Groups 1 and 2 and their responses to having heard of either MSDs or RSI.

Origin of MSD knowledge

The participants were asked where they had heard of the RSI or MSD terms. Television and the media, work and training were the predominant agents for the before training participants from Group 1 and Group 2.

When asked after training the balance shifted such that work accounted for 60% and 57% for the two groups, with virtually all the other sources playing a large part in this message as well. The full results are shown in Table 9.97

Table 9.97. Percentage of respondents and how they had heard of musculoskeletal problems (MSDs) or repetitive strain injury (RSI).

	Percentage of respondents from each group			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Television	44%	80%	86%	43%
Radio	44%	60%	14%	14%
Books	44%	60%	43%	57%
Magazines	56%	80%	57%	14%
Websites	33%	40%	14%	29%
Work	44%	60%	57%	57%
Training course	44%	60%	0%	43%
Doctor	22%	40%	14%	29%
Physiotherapist	22%	40%	14%	43%
Other	33%	60%	0%	33%

Knowledge and understanding of MSD risk factors

Question 11 of the workplace questionnaire investigated peoples' understanding and knowledge of musculoskeletal problems, and asked respondents to list up to six risks/causes which may lead to musculoskeletal problems or RSI. Table 9.98 shows the mean number of correct risk factors/ causes reported by respondents. Training was only slightly raised this value for both groups.

Table 9.98. Descriptive statistics of the number of correct risk factors/causes reported for musculoskeletal problems.

	Responses for each group			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Number of respondents	10	5	8	7
Mean	3.10	5.6	3.63	4.14
Median	3.00	6	3.50	5
Mode	3	6	3	5
Std. Deviation	2.079	0.894	1.847	1.952
Minimum	0	4	0	0
Maximum	6	6	6	6

Figure 9.57 shows the responses as percentiles in graphical form .

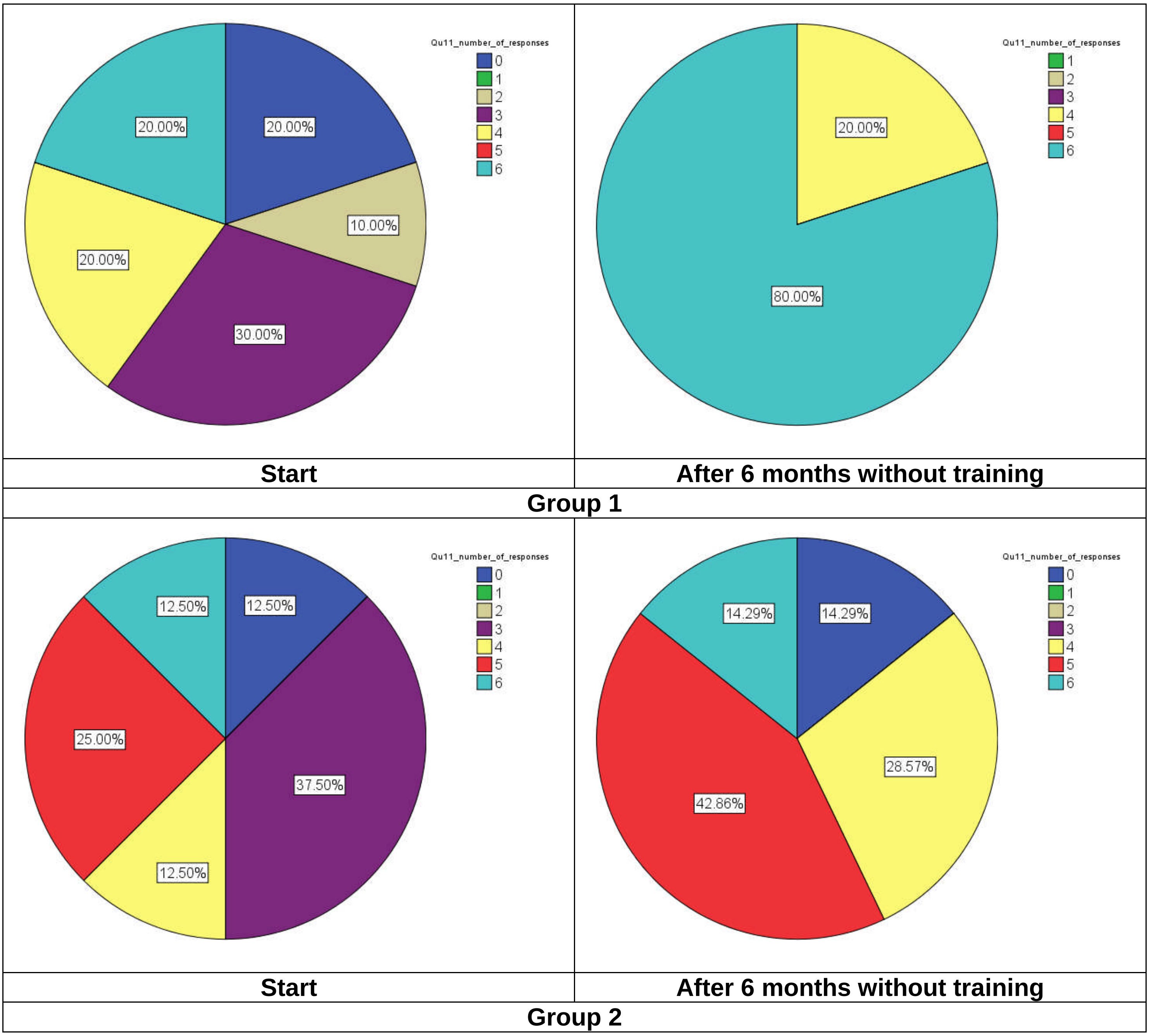


Figure 9.57. Pie charts depicting the percentage of respondents from Groups 1 and 2 and the number of correct risk factors/causes reported for musculoskeletal problems.

Reported pains, aches, discomfort relating to MSDs

Question 5 of the questionnaire described musculoskeletal problems as "affecting the muscles, tendons, ligaments of the neck, shoulders, back, arms, wrist, hands or legs. Symptoms can be feelings of pain, aches, numbness and/or discomfort in any of these body areas".

Respondents were asked if they had experienced any such pain, aches, or discomfort in any body area in the last 6 months or last 7 days. Table 9.99 shows the percentile responses.

Table 9.99. Percentage of respondents that had experienced pain, aches or discomfort.

	Percentage of respondents from each group			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
None	0%	20%	87.5%	71%
Yes, in the last 6 months	80%	40%	12.5%	29%
Yes in the last 7 days	60%	80%	0%	14%

This demonstrates that over three quarters of the respondents in Group 1 had experienced pain or discomfort in the last six months, with over half experiencing these symptoms in the last seven days. Group 2 had a much lower incidence of reported discomfort which increased slightly on training.

For those individuals who reported pain or discomfort, a further question explored the location of the symptoms. This is presented by Group in Tables 9.100 and 9.101.

Group 1

Table 9.100. Percentage of those Group 1 respondents that reported experiencing pain, aches or discomfort and the body part affected and the level of discomfort experienced.

Group 1 (Start), n= 4 Group 1 (After 6 months), n=									
		No problems	Minimal discomfort	2	3	4	5	6	Extreme discomfort
Neck	Start	30%	0%	10%	20%	10%	10%	10%	10%
	After 6 months	25%	0%	25%	0%	25%	0%	25%	0%
Shoulders	Start	80%	0%	0%	10%	0%	0%	0%	10%
	After 6 months	50%	0%	0%	0%	0%	50%	0%	0%
Upper arms	Start	90%	0%	0%	0%	0%	0%	0%	10%
	After 6 months	75%	0%	0%	0%	0%	0%	0%	25%
Elbows	Start	80%	0%	0%	10%	0%	0%	0%	10%
	After 6 months	75%	0%	0%	0%	0%	0%	0%	25%
Forearms	Start	90%	0%	0%	0%	0%	0%	0%	10%
	After 6 months	75%	0%	0%	0%	0%	0%	0%	25%
Wrist	Start	80%	0%	0%	0%	0%	10%	0%	10%
	After 6 months	25%	0%	0%	0%	25%	25%	0%	25%
Hands	Start	90%	0%	0%	0%	0%	0%	0%	10%
	After 6 months	50%	0%	0%	0%	0%	25%	0%	25%
Upper back	Start	70%	0%	0%	0%	10%	10%	10%	0%
	After 6 months	100%	0%	0%	0%	0%	0%	0%	0%
Lower back	Start	30%	0%	20%	0%	10%	0%	40%	0%
	After 6 months	25%	0%	25%	0%	0%	0%	25%	25%
Legs	Start	70%	0%	10%	0%	10%	10%	0%	0%
	After 6 months	25%	0%	0%	0%	50%	25%	0%	0%

Group 2

Table 9.101. Percentage of those Group 2 respondents that reported experiencing pain, aches or discomfort and the body part affected and the level of discomfort experienced.

Group 2 (Start), n=5 Group 2 (After 6 months), n=									
		No problems	Minimal discomfort	2	3	4	5	6	Extreme discomfort
Neck	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	100%	0%	0%	0%	0%	0%	0%	0%
Shoulders	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	50%	0%	0%	0%	50%	0%	0%	0%
Upper arms	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	100%	0%	0%	0%	0%	0%	0%	0%
Elbows	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	100%	0%	0%	0%	0%	0%	0%	0%
Forearms	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	100%	0%	0%	0%	0%	0%	0%	0%
Wrist	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	100%	0%	0%	0%	0%	0%	0%	0%
Hands	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	100%	0%	0%	0%	0%	0%	0%	0%
Upper back	Start	0%	0%	0%	0%	0%	100%	0%	0%
	After 6 months	100%	0%	0%	0%	0%	0%	0%	0%
Lower back	Start	0%	0%	0%	0%	0%	100%	0%	0%
	After 6 months	50%	0%	50%	0%	0%	0%	0%	0%
Legs	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	50%	0%	0%	0%	0%	50%	0%	0%

These data were further investigated to establish what action, if any, had been taken regarding this discomfort and what the participant considered to be the cause.

Table 9.102 explores whether the participant had seen a doctor ort had time off work because of the discomfort they had experienced..

Table 9.102. The actions of Group 1 and Group 2 respondents that reported experiencing pain, aches or discomfort.

	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Percentage who have consulted with a doctor about discomfort	40%	50%	100%	0%
Percentage who have taken time off work because of discomfort	20%	25%	0%	0%

It can be seen that at the start of the study nearly half of Group 1 and all of Group 2 had consulted a doctor about the discomfort experienced. This fell for both groups after training. Absence due to discomfort fell significantly for Group 1 post training but remained constant at zero for Group 2

Table 9.103 gives the participant's nominated cause of the discomfort, with virtually all respondents identifying work as the origin both before and after training..

Table 9.103. The reported cause pain, aches or discomfort for Group 1 and Group 2 respondents.

	Percentage of respondents that experienced discomfort			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Hobbies	10%	0%	25%	50%
Sport	20%	0%	50%	0%
Work tasks	70%	0%	75%	50%
House work	0%	0%	25%	0%

Future health concerns

A further question in the survey enquired whether the participants were concerned that they may develop MSD problems in the future. The results can be seen in Table 9.104. A greater percentage of Group 1 respondents (60%/80%) reported that they were concerned that they would develop a musculoskeletal problem from their work than Group 2 respondents (38%/29%.

Table 9.104. Percentage of respondents and whether they were concerned about developing musculoskeletal problems at work.

	Percentage of respondents from each group			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Yes	60%	80%	38%	29%
No	20%	20%	63%	71%
No response	20%	0%	0%	0%

Changes to the workplace

Respondents were asked if they would kike the layout of their workplace to be changed so that it was easier or more comfortable to do their job. The results are shown in Table 9.105. Less than a third of respondents from both groups stated that they would like the layout of their workplace changed, despite the apparently high rate of discomfort. This suggests that they may view the activities as more problematic than the immediate location.

Table 9.105. Percentage of respondents and whether they would like the layout of their workplace changed to make it easier or more comfortable to do the work.

	Percentage of respondents from each group			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Yes	30%	20%	25.0%	29%
No	60%	80%	75.0%	71%
No response	10%	0%	0%	0%

For those respondents that said they would like to make changes virtually all of Group 1 and Group 2 said they would like the changes to be made in the next 6 months (Table 9.106).

Table 9.106. Percentage of those respondents that said yes they would like to make changes and whether these changes should be made in the next 6 months.

	Percentage of respondents that said yes they would like to make changes			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Yes	67%	100	100%	100
No	0%	0	0%	0
No response	33%	0	0%	0

Table 9.107 goes on to present the type of changes respondents reported they would like to see.

Table 9.107. Description of changes respondents said they would to made to their workplace.

Group 1	Start	• More space in critical areas • Higher benches • Move around more • Change jobs often
	After 6 months with training	• Higher work benches
Group 2	Start	• More mechanisation (being tested at the moment) • A ramp in fridge on the lift
	After 6 months without training	• More comfortable fume cupboard • Proper seating

Employer changes to the workplace

Respondents were asked if they were aware if their employer had made any changes to reduce MSD risks. A mixed response was recorded varying from 100% to 25% between the groups indicating that this was the case.

Table 9.108. Percentage of respondents and whether they knew if their employer had made any changes to reduce the risks of musculoskeletal problems.

	Percentage of respondents from each group			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Yes	30%	100%	25%	43%
No	70%	0%	75%	57%
No response	0%	0%	0%	0%

Respondent changes to the workplace.

In comparison, it was noted that a similar spread of participants had undertaken changes to the workplace themselves, as seen in Table 9.109

Table 9.109. Percentage of respondents and whether they had done anything to reduce the risks.

	Percentage of respondents from each group			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Yes	60%	80%	50%	43%
No	30%	20%	37.5%	57%
No response	10%	0%	12.5%	0%

For those respondents who indicated that they had undertaken changes themselves, they were asked to provide further information on the nature of those changes. Details of the responses are given in Table 9.110, below.

Table 9.110. Description of changes respondents have made themselves to reduce the risks.

Group 1	Start	• Job rotation. • More self awareness. • Used my problem to advise others. • Taken a more stern approach to those who are failing in this area and should know better. • Identifying less obvious risk factors. • Stretching my back/legs. • Keep moving. • Doing swimming. • Sitting the right way in chairs. • Increased job rotation. • Lifting in the correct manner. • Exercise and yoga
	After 6 months with training	• Acquired sit/stand workstation. It slows down work but eases back pain • Made sure workstation is set up correctly for me. Vary work during the day • Liaised with HSO, company nurse, HSE and access to work to address my particular needs (Keinbachs) but changes should help other staff
Group 2	Start	• Job rotation
	After 6 months without training	• Vary work to stop repetitiveness • Manual handling course • Changed chair height to suit desk. Ensure lifted objects correctly. Used trolleys to move heavy items

Communication and attitudes relating to health and safety

The participant survey attempted to explore attitudes to health and safety in the workplace and the manner in which communication took place in the workplace. Table 9.111 shows the participant’s responses regarding communication between the operations or production department and company management.

The majority of both groups reported that they felt these communication links were satisfactory. This is encouraging since it suggests that this traditional barrier to improving health and safety is not realised in practice.

Table 9.111. Percentage of respondents and how they felt about communication links between operations/production and management.

	Percentage of respondents from each group			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
No response	0%	0%	0%	0%
Good and efficient	20%	0%	0%	29%
Satisfactory	70%	40%	100%	29%
Unsatisfactory	0%	40%	0%	43%
Very poor and inefficient	10%	20%	0%	0%

The final section of the questionnaire probed the attitudes of the workers with a series of statements against which the participants could record a level of agreement. The responses ranged from “Strongly Disagree” to “Strongly Agree”. The probes were:

- “In my workplace management acts quickly to correct health and safety problems”
- “Health and safety information is always brought to my attention by my line manger/supervisor”
- “In my workplace the chances of developing a work related health problem are quite high”
- “There is good communication here about health and safety issues which affect me”
- ”Management here considers health and safety to be equally as important as production”
- “I believe health and safety issues are given a high priority”
- “Some health and safety rules and procedures don’t need to be followed to get the job done safely”
- “Some health and safety rules are not really practical”
- “I am strongly encouraged to report unsafe conditions”
- “I can influence health and safety performance here”

- “I am involved in informing management of important health and safety issues”
- “Health and safety is the number one priority in my mind when completing a job”
- “It is important to me that there is a continuing emphasis on health and safety”
- “I’m sure it’s only a matter of time before I develop a work related health problem”
- “Production targets rarely conflict with health and safety measures”
- “I am always given enough time to get the job done safely”.

The following Figures (Figures 9.58 to 9.73) present the findings of this survey as a series of histograms, in which a more benign environment is reflected by a greater depth and proportion of green colouration. Orange or red indicates an area of possible conflict.

“In my workplace management acts quickly to correct health and safety problems”

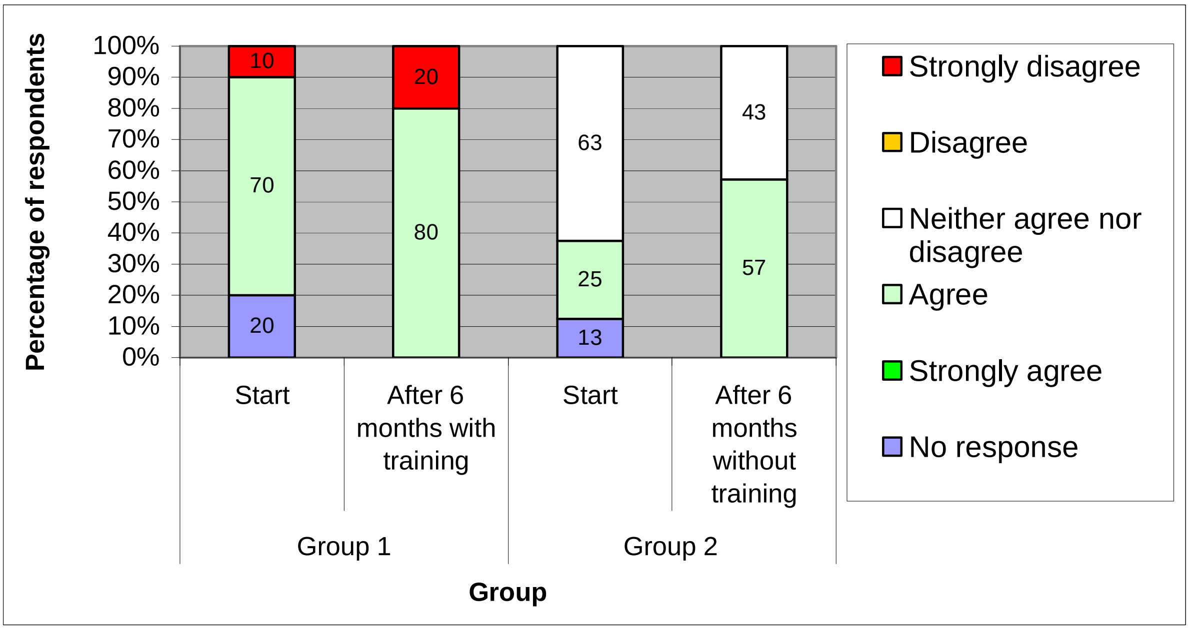


Figure 9.58 Response to speed of action statement over time by group

“Health and safety information is always brought to my attention by my line manger/supervisor”

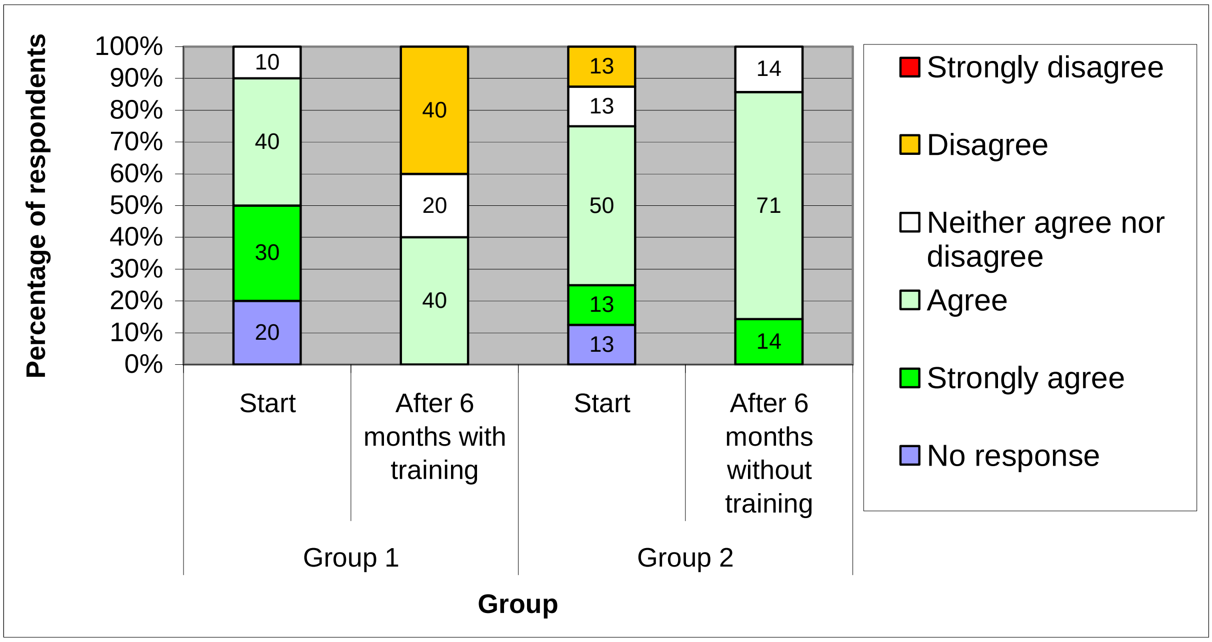


Figure 9.59 Response to health and safety attention statement over time by group

"In my workplace the chances of developing a work related health problem are quite high"

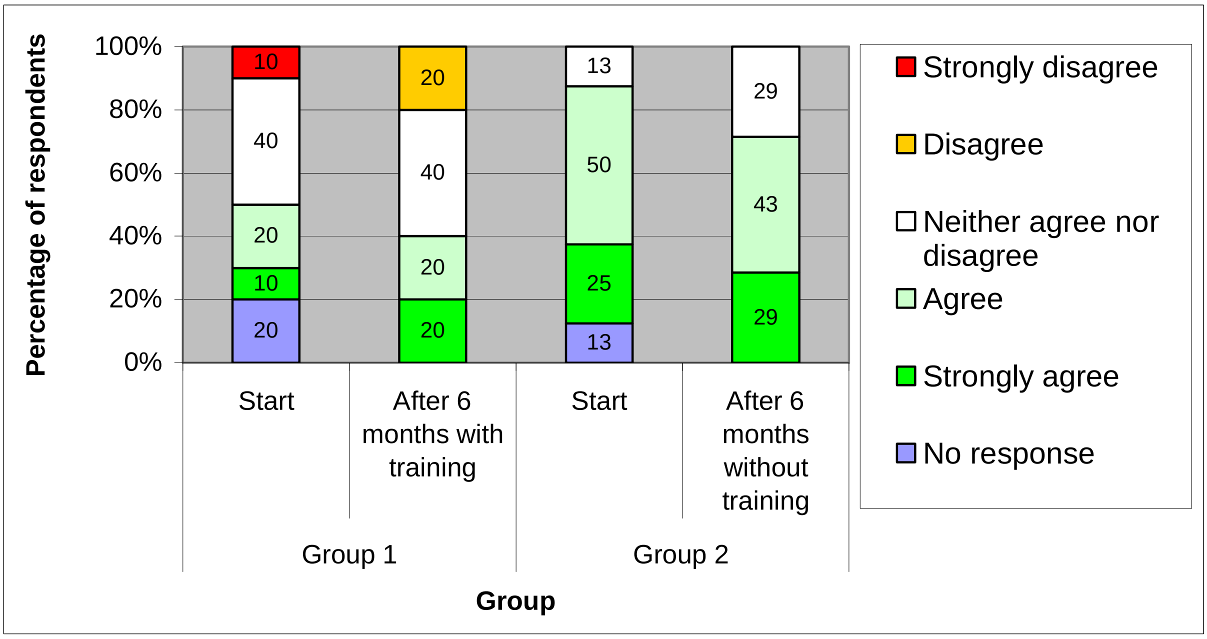


Figure 9.60 Response to health problem likelihood statement over time by group

"There is good communication here about health and safety issues which affect me"

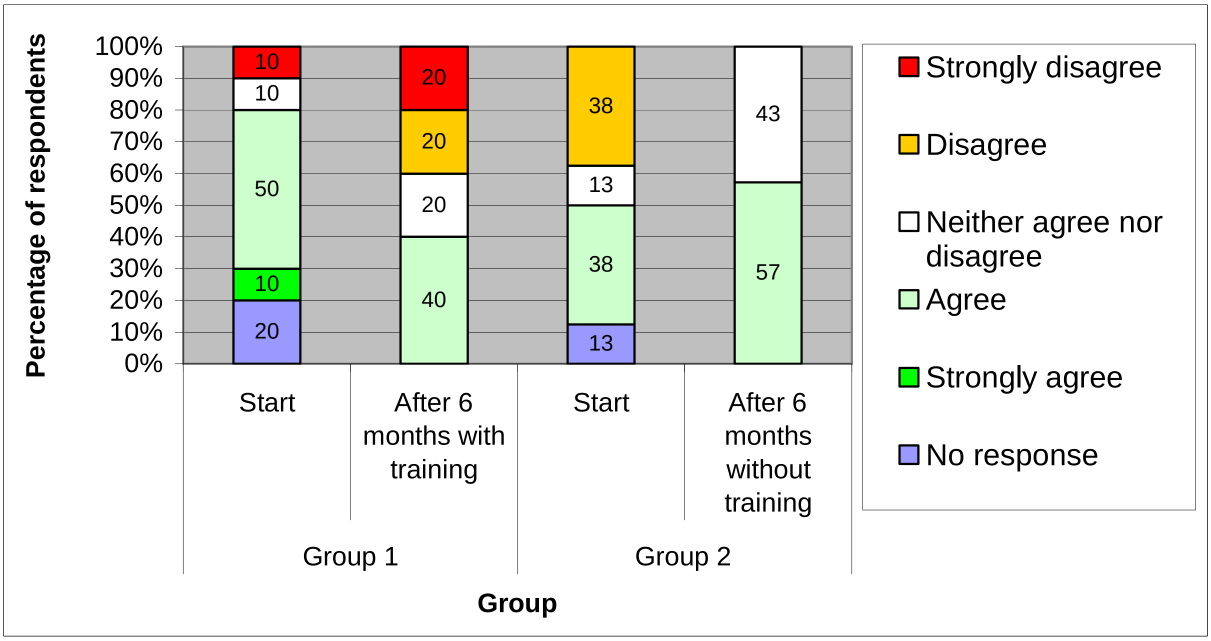


Figure 9.61 Response to communication statement over time by group

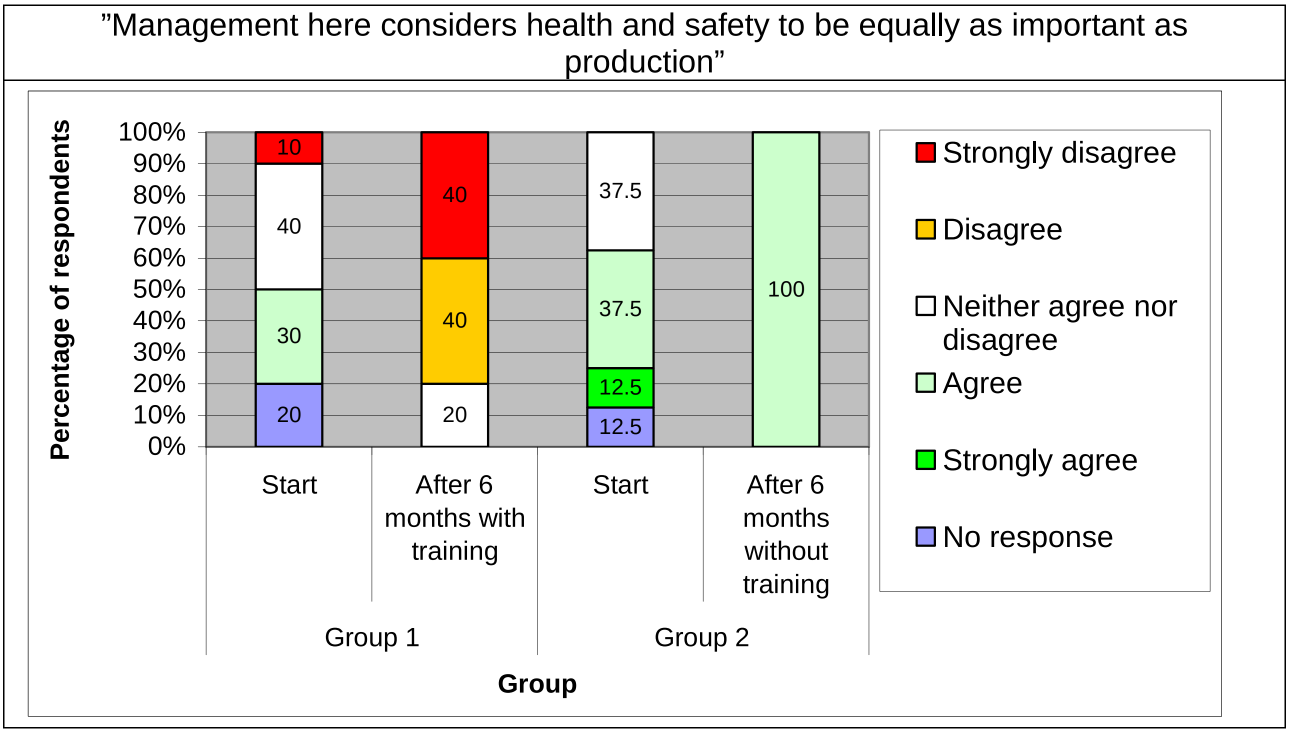


Figure 9.62 Response to health and safety importance statement over time by group

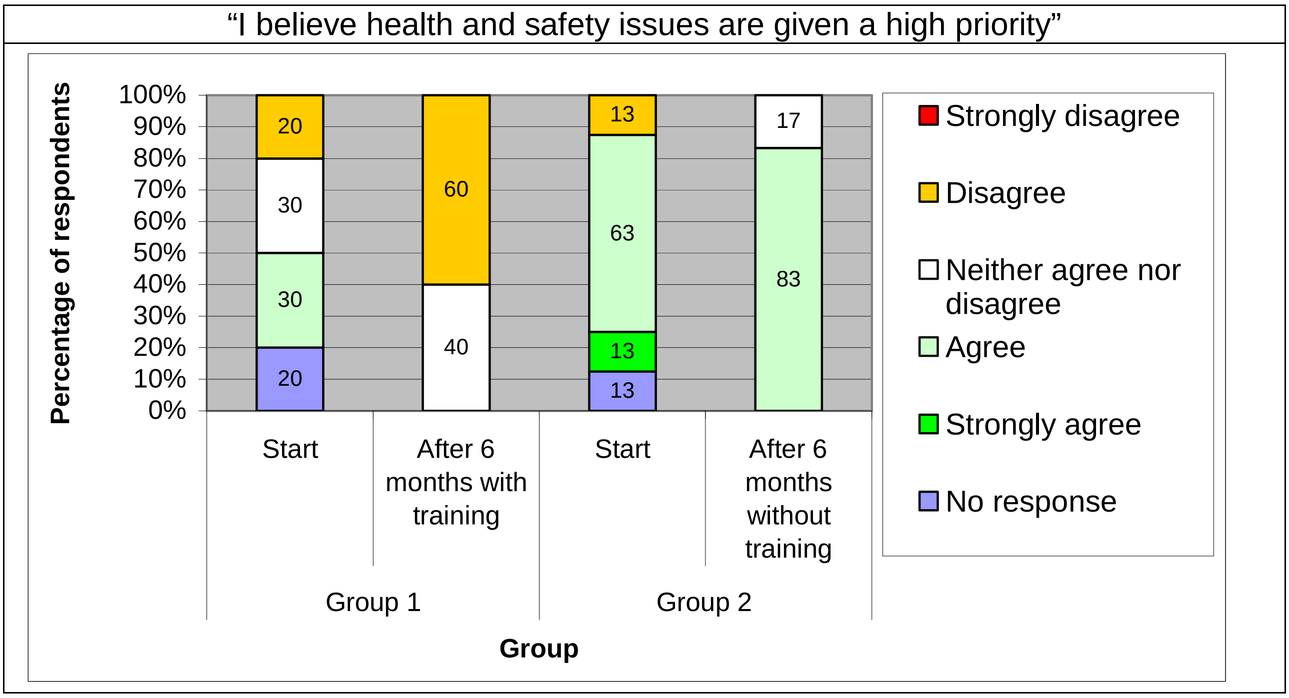


Figure 9.63 Response to health and safety priority statement over time by group

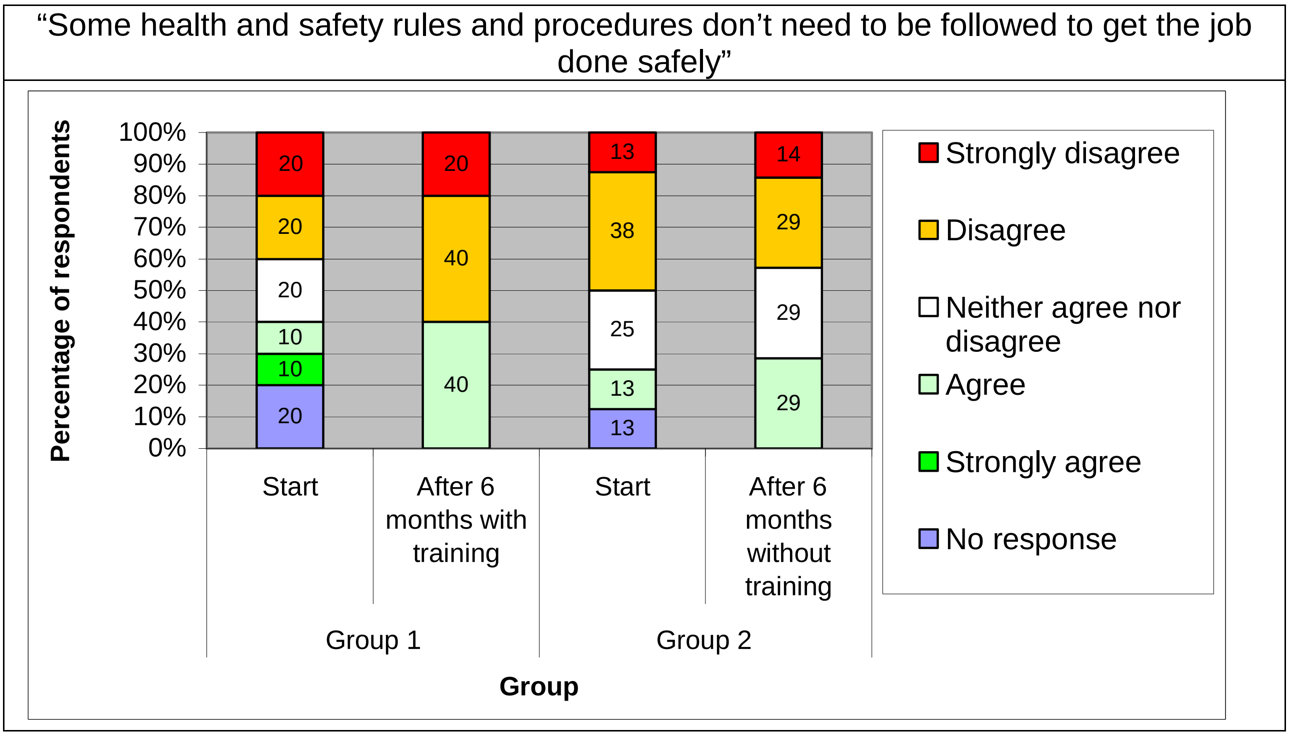


Figure 9.64 Response to safety rules statement over time by group

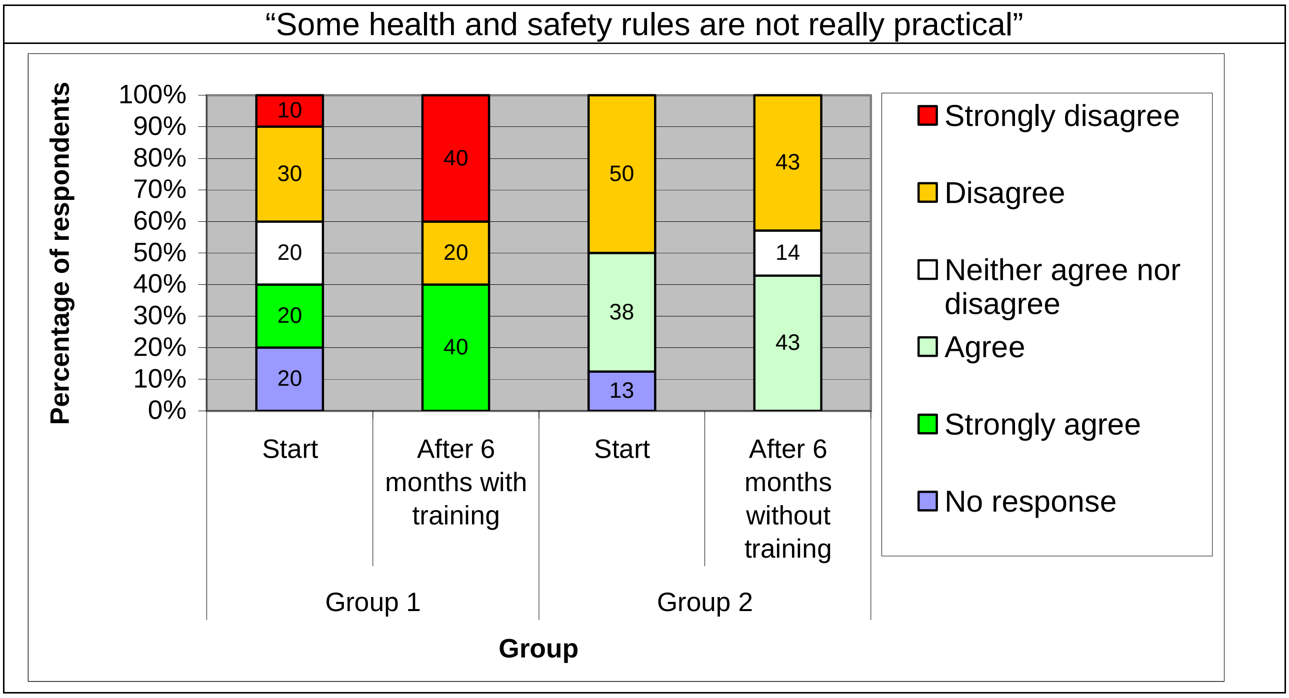


Figure 9.65 Response to health and safety practicality statement over time by group

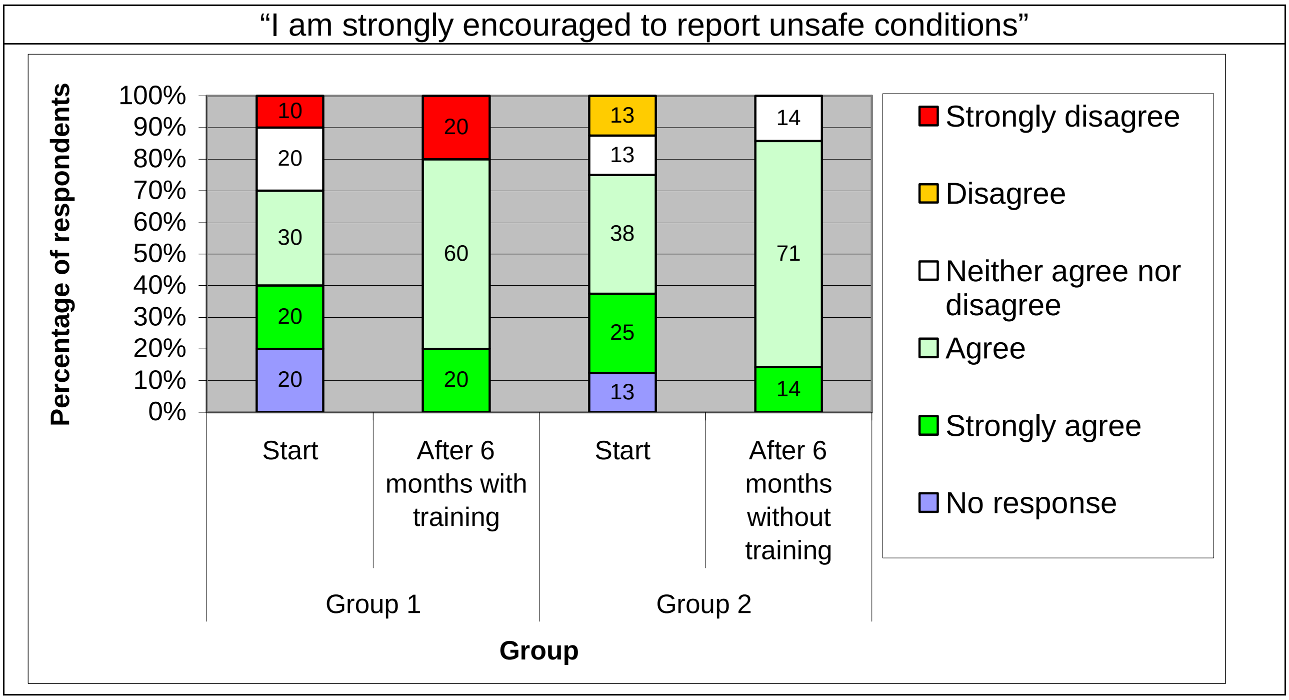


Figure 9.66 Response to reporting statement over time by group

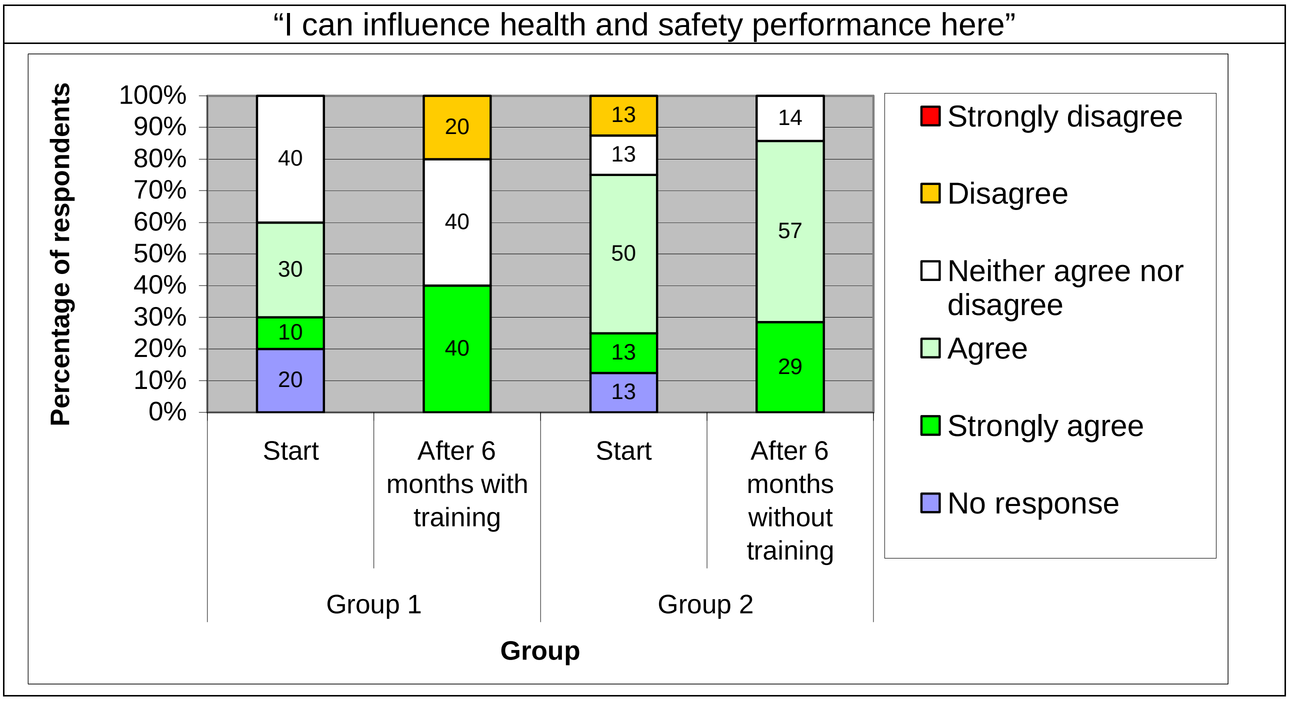


Figure 9.67 Response to health and safety influence statement over time by group

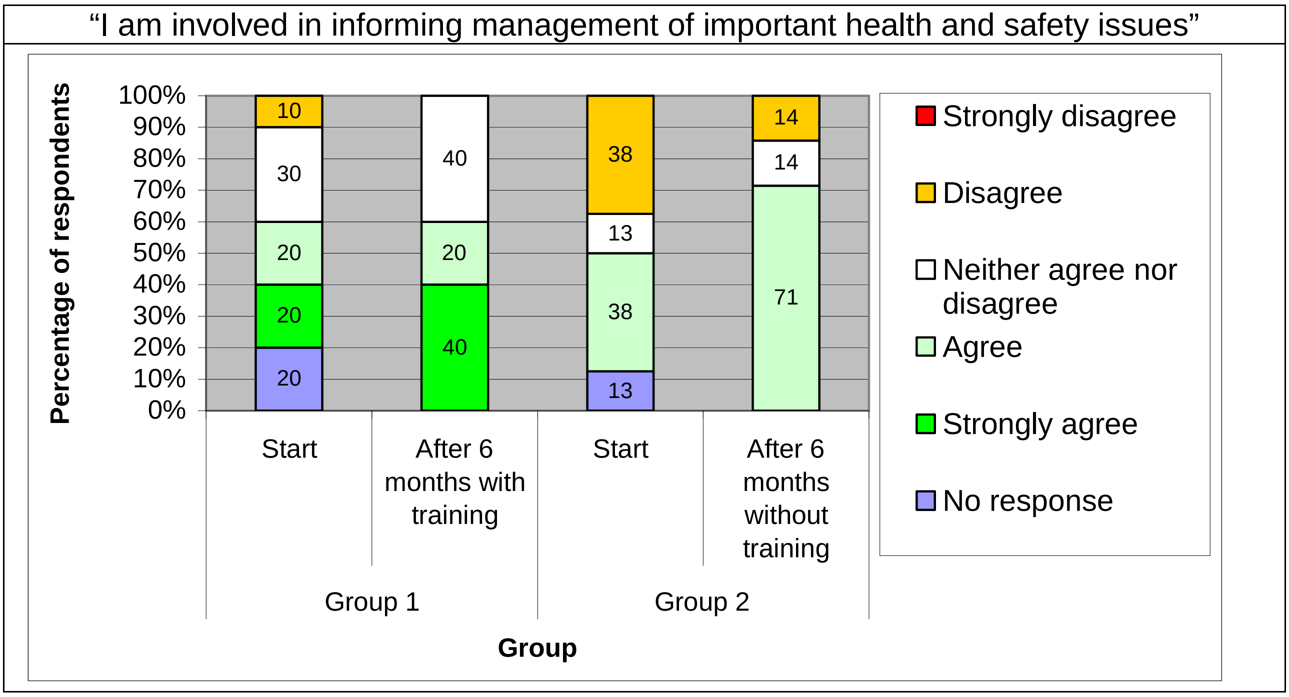


Figure 9.68 Response to health and safety management statement over time by group

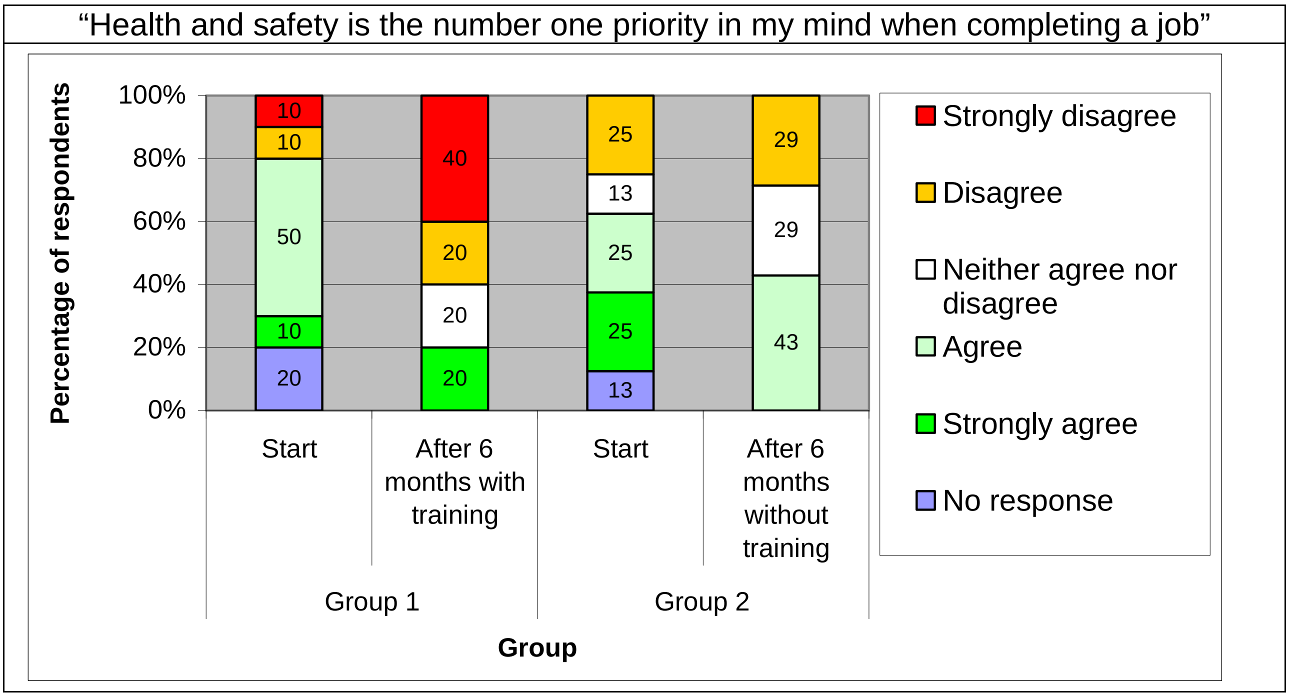


Figure 9.69 Response to health and safety priority statement over time by group

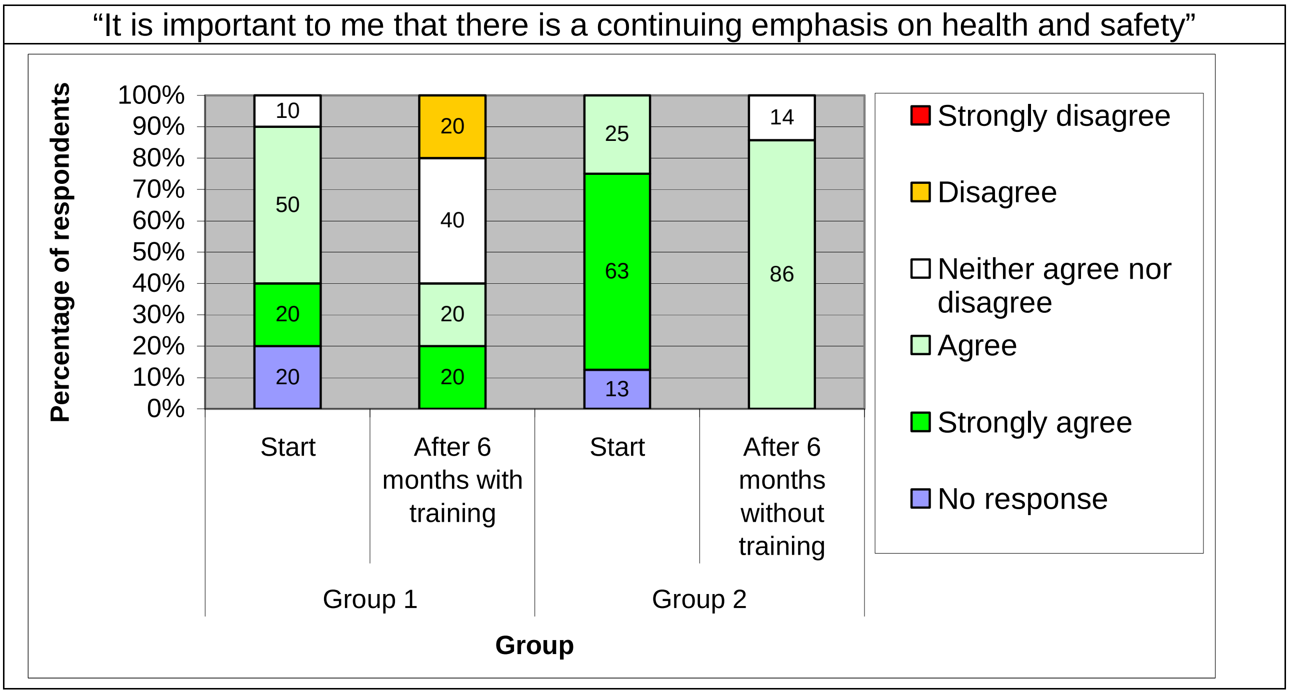


Figure 9.70 Response to health and safety emphasis statement over time by group

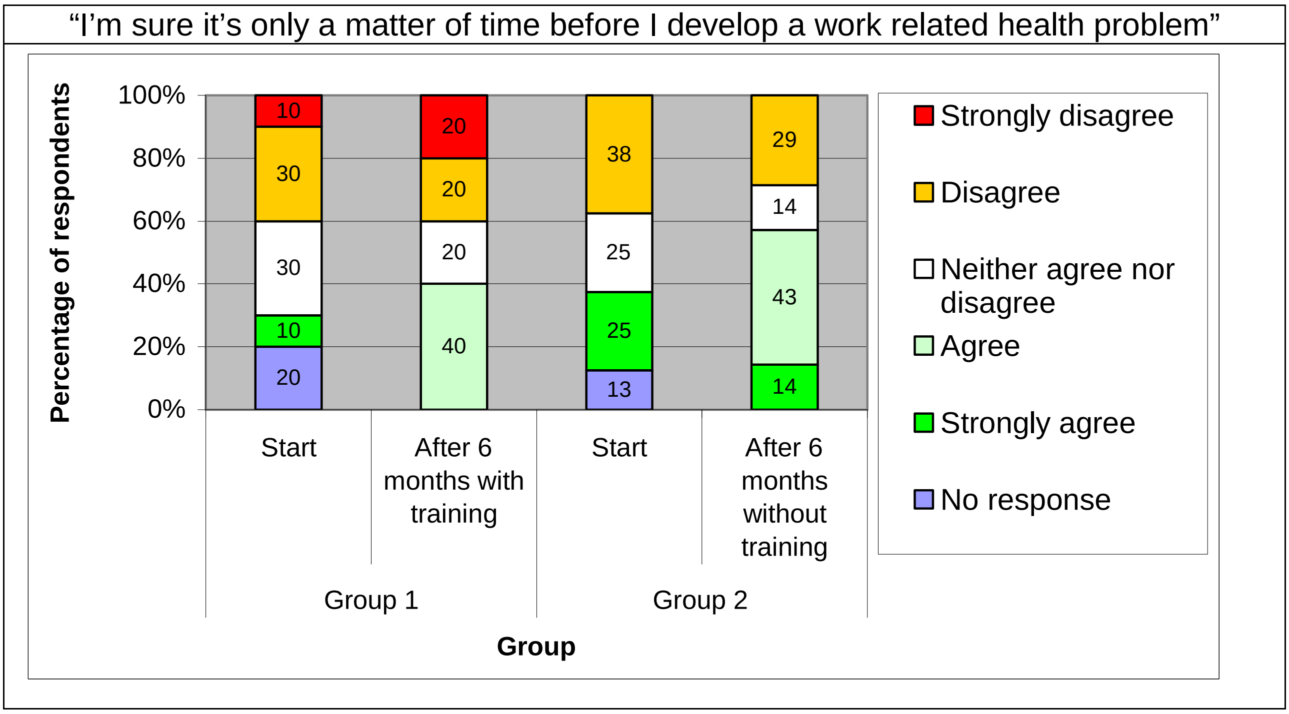


Figure 9.71 Response to health problem probability statement over time by group

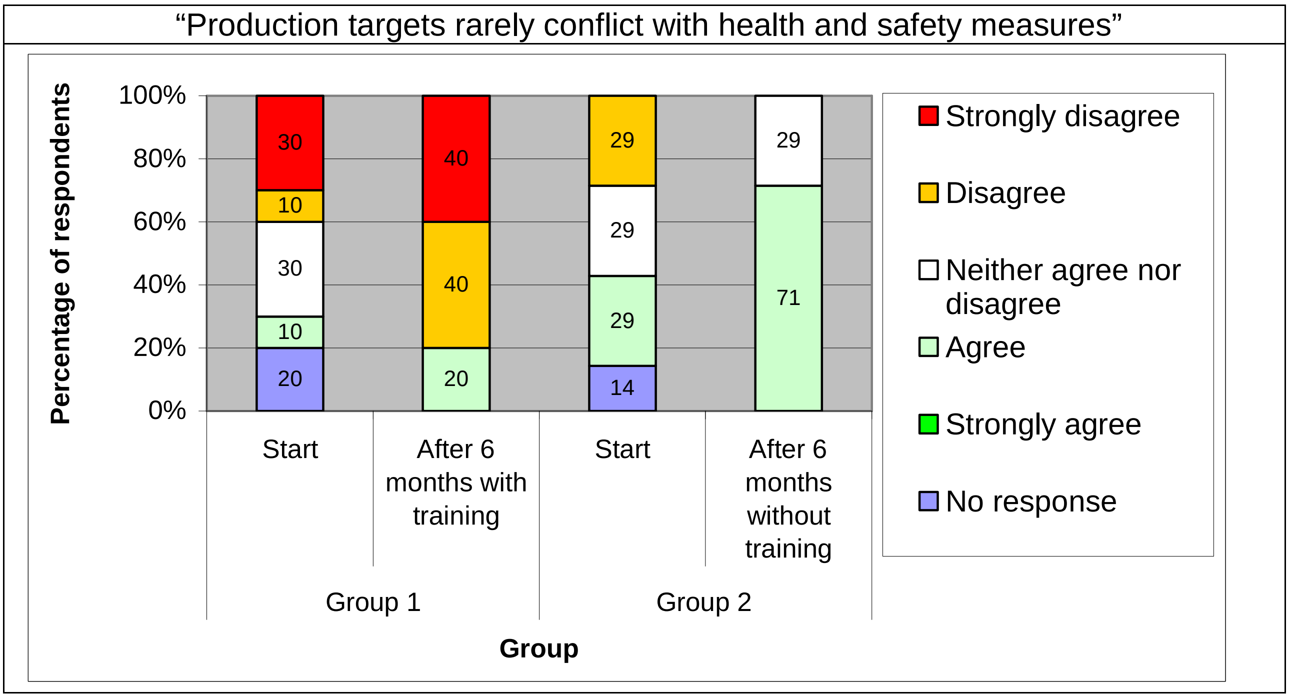


Figure 9.72 Response to production targets statement over time by group

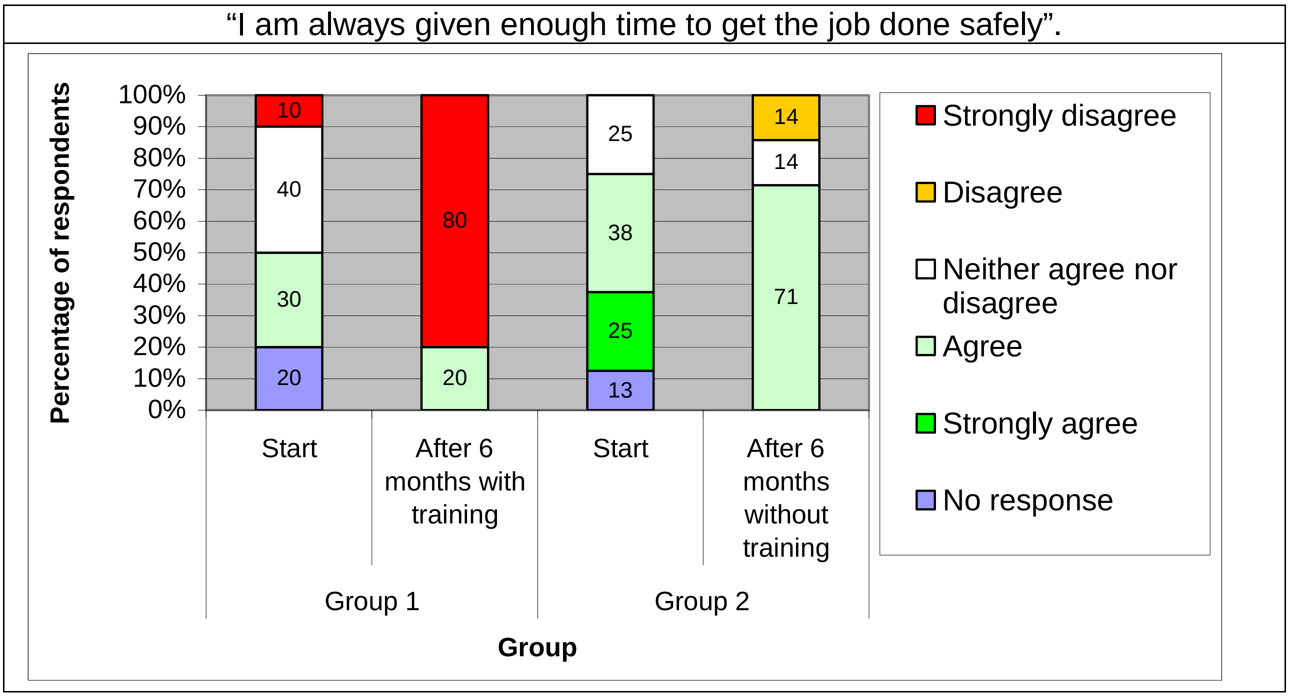


Figure 9.73 Response to time for safe work statement over time by group

Summary of attitude survey

Table 9.112 presents the statements which generated the responses most likely to reflect potential conflict.

Table 9.112. Statements most likely to reflect potential conflict.

Probe statement	Conflicting groups
In my workplace management acts quickly to correct health and safety problems	Group 1 before and after training
In my workplace the chances of developing a work related health problem are quite high	Group 1 before and after training Group 2 before and after training
There is good communication here about health and safety issues which affect me	Group 1 before and after training
Management here considers health and safety to be equally as important as production	Group 1 before and after training
Some health and safety rules are not really practical	Group 1 before and after training
I am strongly encouraged to report unsafe conditions	Group 1 before training
Health and safety is the number one priority in my mind when completing a job	Group 1 before and after training
I’m sure it’s only a matter of time before I develop a work related health problem	Group 1 before training Group 2 before and after training
Production targets rarely conflict with health and safety measures	Group 1 before and after training
I am always given enough time to get the job done safely	Group 1 before and after training

9.4.4 Company 3 - Salads

Results

The data from Company 3 is incomplete because the participants before training were unable to complete the post training questionnaire. This is primarily due to reductions in the level of staffing due to economic pressure and seasonal demand.

In total 6 participants from Company 3 completed the workplace questionnaire at the start of the study (Before) and none at the end of the study (After 6 months) (Table 9.113).

Table 9.113. Percentage of respondents and how they had heard of musculoskeletal problems (MSDs) or repetitive strain injury (RSI).

	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Number of respondents	3	0	3	0

Respondent's awareness and understanding of MSDs

Results from the questionnaire showed that over 65% of respondents from Group 1 had not heard of RSI or Musculoskeletal disorders (Figure 9.74). The remainder report only hearing of RSI and not MSDs. In comparison, in Group 2, over 65% of participants had heard of MSDs and a further 33% had heard of RSIs. There were no post training data.

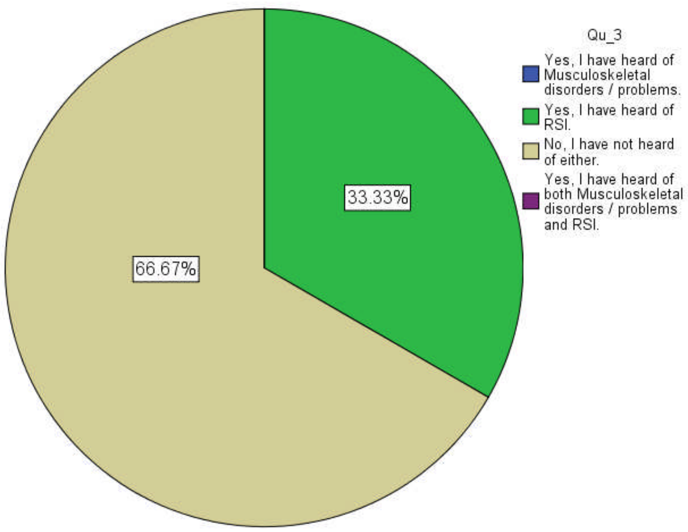
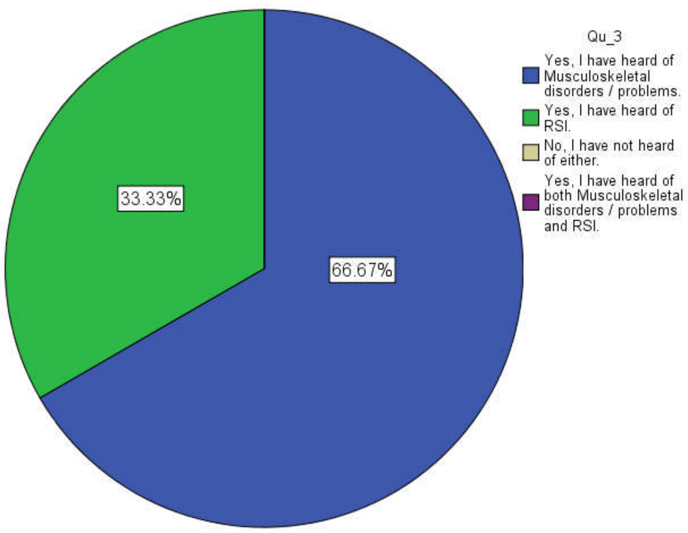
<table>
<tr><td>
</td><td>Not available</td></tr>
<tr><td>Start</td><td>After 6 months with training</td></tr>
<tr><td colspan="2">Group 1</td></tr>
<tr><td>
</td><td>Not available</td></tr>
<tr><td>Start</td><td>After 6 months without training</td></tr>
<tr><td colspan="2">Group 2</td></tr>
</table>

Figure 9.74. Pie charts depicting percentage of respondents from Groups 1 and 2 and their responses to having heard of either MSDs or RSI.

Origin of MSD knowledge

The participants were asked where they had heard of the RSI or MSD terms. Television and work were the predominant agents for the before training participants from Group 1whilst Group 2 demonstrated a much wider range of influences. Data was unavailable for post training. The full results are shown in Table 9.114

Table 9.114. Percentage of respondents and how they had heard of musculoskeletal problems (MSDs) or repetitive strain injury (RSI).

	Percentage of respondents from each group			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Television	100%	n/a	66.7%	n/a
Radio	0%	n/a	33.3%	n/a
Books	0%	n/a	0%	n/a
Magazines	0%	n/a	33.3%	n/a
Websites	0%	n/a	0%	n/a
Work	100%	n/a	33.3%	n/a
Training course	0%	n/a	0%	n/a
Doctor	0%	n/a	33.3%	n/a
Physiotherapist	0%	n/a	0%	n/a
Other	0%	n/a	0%	n/a

Knowledge and understanding of MSD risk factors

Question 11 of the workplace questionnaire investigated peoples' understanding and knowledge of musculoskeletal problems, and asked respondents to list up to six risks/causes which may lead to musculoskeletal problems or RSI. Table 9.145 shows the mean number of correct risk factors/ causes reported by respondents.

Table 9.115. Descriptive statistics of the number of correct risk factors/causes reported for musculoskeletal problems.

	Percentage of respondents from each group			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Number of respondents	3	n/a	3	n/a
Mean	2.33	n/a	1.33	n/a
Median	1	n/a	0	n/a
Mode	0	n/a	0	n/a
Std. Deviation	3.215	n/a	2.309	n/a
Minimum	0	n/a	0	n/a
Maximum	6	n/a	4	n/a

Figure 9.75 shows the responses as percentiles in graphical form.

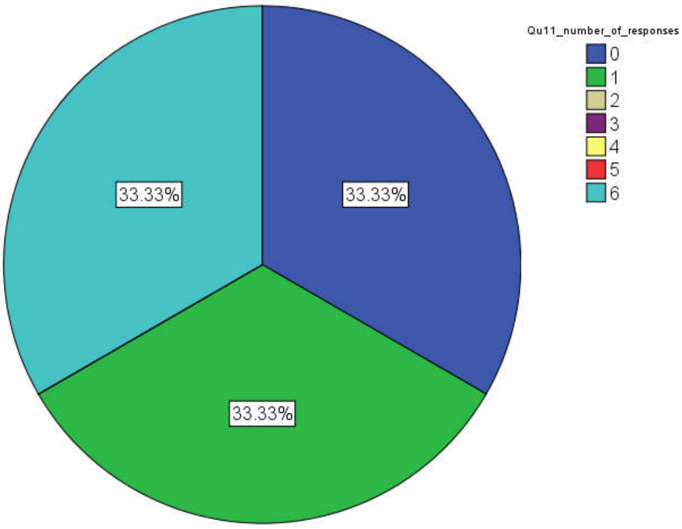
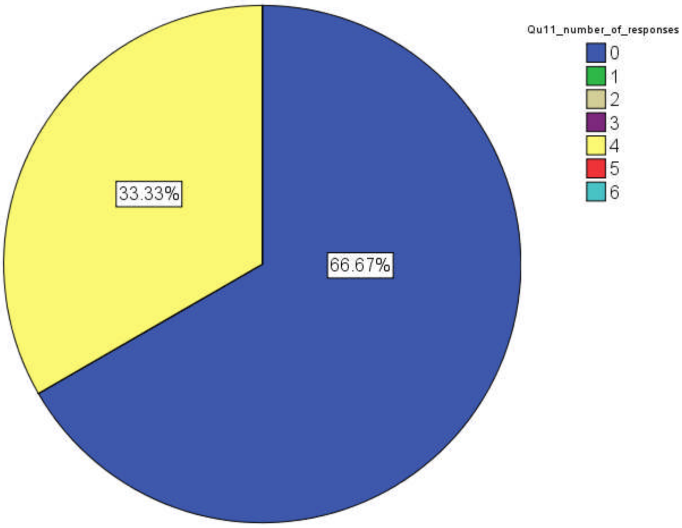
	Not available
Start	**After 6 months without training**
Group 1	
	Not available
Start	**After 6 months without training**
Group 2	

Figure 9.75. Pie charts depicting the percentage of respondents from Groups 1 and 2 and the number of correct risk factors/causes reported for musculoskeletal problems.

Reported pains, aches, discomfort relating to MSDs

Question 5 of the questionnaire described musculoskeletal problems as "affecting the muscles, tendons, ligaments of the neck, shoulders, back, arms, wrist, hands or legs. Symptoms can be feelings of pain, aches, numbness and/or discomfort in any of these body areas". Respondents were asked if they had experienced any such pain, aches, or discomfort in any body area in the last 6 months or last 7 days. Table 9.116 shows the percentile responses.

Table 9.116. Percentage of respondents that had experienced pain, aches or discomfort.

	Percentage of respondents from each group			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
None	33%	n/a	67%	n/a
Yes, in the last 6 months	67%	n/a	33%	n/a
Yes in the last 7 days	0%	n/a	0%	n/a

This demonstrates that over half of the Group 1 respondents had experienced pain or discomfort in the last six months, with nearly a third experiencing these symptoms in Group 2. Post training data is unavailable

For those individuals who reported pain or discomfort, a further question explored the location of the symptoms. This is presented by Group in Tables 9.117 and 9.118.

Group 1

Table 9.117. Percentage of those Group 1 respondents that reported experiencing pain, aches or discomfort and the body part affected and the level of discomfort experienced.

Group 1 (Start), n= 4 Group 1 (After 6 months), n=									
		No problems	Minimal discomfort	2	3	4	5	6	Extreme discomfort
Neck	Start	50%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	67%	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Shoulders	Start	25%	50%	0%	0%	0%	0%	0%	0%
	After 6 months	67%	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Upper arms	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	50%	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Elbows	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	50%	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Forearms	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	67%	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Wrist	Start	100%	0%	50%	0%	0%	0%	0%	0%
	After 6 months	33%	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Hands	Start	75%	0%	0%	50%	0%	0%	0%	0%
	After 6 months	67%	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Upper back	Start	75%	0%	50%	0%	0%	0%	0%	0%
	After 6 months	67%	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lower back	Start	25%	0%	50%	0%	0%	0%	0%	0%
	After 6 months	67%	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Legs	Start	50%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	67%	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Group 2

Table 9.118. Percentage of those Group 2 respondents that reported experiencing pain, aches or discomfort and the body part affected and the level of discomfort experienced.

Group 2 (Start), n=5 Group 2 (After 6 months), n=									
		No problems	Minimal discomfort	2	3	4	5	6	Extreme discomfort
Neck	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	75%	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Shoulders	Start	60%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	75%	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Upper arms	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	75%	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Elbows	Start	80%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	100%	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Forearms	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	100%	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Wrist	Start	60%	0%	100%	0%	0%	0%	0%	0%
	After 6 months	0%	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Hands	Start	60%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	50%	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Upper back	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	75%	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lower back	Start	80%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	50%	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Legs	Start	100%	0%	100%	0%	0%	0%	0%	0%
	After 6 months	75%	n/a	n/a	n/a	n/a	n/a	n/a	n/a

These data were further investigated to establish what action, if any, had been taken regarding this discomfort and what the participant considered to be the cause.

Table 9.119 explores whether the participant had seen a doctor ort had time off work because of the discomfort they had experienced..

Table 9.119. The actions of Group 1 and Group 2 respondents that reported experiencing pain, aches or discomfort.

	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Percentage who have consulted with a doctor about discomfort	0%	n/a	0%	n/a
Percentage who have taken time off work because of discomfort	0%	n/a	0%	n/a

It can be seen that none of the groups had consulted a doctor about the discomfort experienced. The Groups had no self-reported absence due to discomfort either. Data for the post training groups was unavailable.

Table 9.120 gives the participant's nominated cause of the discomfort, with all respondents identifying work as the origin both before and after training..

Table 9.120. The reported cause pain, aches or discomfort for Group 1 and Group 2 respondents.

	Percentage of respondents that experienced discomfort			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Hobbies	0	n/a	0	n/a
Sport	0	n/a	0	n/a
Work tasks	100	n/a	100	n/a
House work	0	n/a	0	n/a

Future health concerns

A further question in the survey enquired whether the participants were concerned that they may develop MSD problems in the future. The results can be seen in Table 9.121.

An equal percentage (33%) of Group 1 and Group 2 respondents reported that they were concerned that they would develop a musculoskeletal problem from their work.

Table 9.121. Percentage of respondents and whether they were concerned about developing musculoskeletal problems at work.

	Percentage of respondents from each group			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Yes	33%	n/a	33%	n/a
No	67%	n/a	67%	n/a
No response	0%	n/a	0%	n/a

Changes to the workplace

Respondents were asked if they would kike the layout of their workplace to be changed so that it was easier or more comfortable to do their job. The results are shown in Table 9.122. Less than a third of respondents from Group 2 stated that they would like the layout of their workplace changed, whilst none of Group 1 had this requirement. Post training data was unavailable.

Table 9.122. Percentage of respondents and whether they would like the layout of their workplace changed to make it easier or more comfortable to do the work.

	Percentage of respondents from each group			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Yes	0%	n/a	33%	n/a
No	100%	n/a	67%	n/a
No response	0%	n/a	0%	n/a

For those respondents that said they would like to make changes 33% of Group 2 said they would like the changes to be made in the next 6 months (Table 9.123).

Table 9.123. Percentage of those respondents that said yes they would like to make changes and whether these changes should be made in the next 6 months.

	Percentage of respondents that said yes they would like to make changes			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Yes	0%	n/a	33%	n/a
No	100%	n/a	67%	n/a
No response	0%	n/a	0%	n/a

Table 9.124 goes on to present the type of changes respondents reported they would like to see.

Table 9.124. Description of changes respondents said they would to made to their workplace.

Group 1	Start	n/a
	After 6 months with training	n/a
Group 2	Start	• More workspace in work environment so don`t over crowd.
	After 6 months without training	n/a

Employer changes to the workplace

Respondents were asked if they were aware if their employer had made any changes to reduce MSD risks. No participants from either Group 1 or 2 responded that this was the case.

Table 9.125. Percentage of respondents and whether they knew if their employer had made any changes to reduce the risks of musculoskeletal problems.

	Percentage of respondents from each group			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Yes	0%	n/a	0%	n/a
No	100%	n/a	100%	n/a
No response	0%	n/a	0%	n/a

Respondent changes to the workplace.

In comparison, a third of Group 1 and all of Group 2 participants had undertaken changes to the workplace themselves, as seen in Table 9.126.

Table 9.126. Percentage of respondents and whether they had done anything to reduce the risks.

	Percentage of respondents from each group			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Yes	33%	n/a	100%	n/a
No	67%	n/a	0%	n/a
No response	0%	n/a	0%	n/a

For those respondents who indicated that they had undertaken changes themselves, they were asked to provide further information on the nature of those changes. Details of the responses are given in Table 9.127, below.

Table 9.127. Description of changes respondents have made themselves to reduce the risks.

Group 1	Start	• Varied work pattern to regulate time spend on specific jobs.
	After 6 months with training	n/a
Group 2	Start	• Limited the amount of utensils to produce product. • Keep the floor dry if possible and work in a safe environment. • Keep floor as dry as possible.
	After 6 months without training	n/a

Communication and attitudes relating to health and safety

The participant survey attempted to explore attitudes to health and safety in the workplace and the manner in which communication took place in the workplace. Table 9.128 shows the participant's responses regarding communication between the operations or production department and company management.

The majority of both groups reported that they felt these communication links were satisfactory. This is encouraging since it suggests that this traditional barrier to improving health and safety is not realised in practice.

Table 9.128. Percentage of respondents and how they felt about communication links between operations/production and management.

	Percentage of respondents from each group			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
No response	0%	n/a	0%	n/a
Good and efficient	33.3%	n/a	0%	n/a
Satisfactory	33.3%	n/a	66.7%	n/a
Unsatisfactory	33.3%	n/a	33.3%	n/a
Very poor and inefficient	0%	n/a	0%	n/a

The final section of the questionnaire probed the attitudes of the workers with a series of statements against which the participants could record a level of agreement. The responses ranged from “Strongly Disagree” to “Strongly Agree”. The probes were:

- “In my workplace management acts quickly to correct health and safety problems”
- “Health and safety information is always brought to my attention by my line manger/supervisor”
- “In my workplace the chances of developing a work related health problem are quite high”
- “There is good communication here about health and safety issues which affect me”
- ”Management here considers health and safety to be equally as important as production”
- “I believe health and safety issues are given a high priority”
- “Some health and safety rules and procedures don’t need to be followed to get the job done safely”
- “Some health and safety rules are not really practical”
- “I am strongly encouraged to report unsafe conditions”
- “I can influence health and safety performance here”

- “I am involved in informing management of important health and safety issues”
- “Health and safety is the number one priority in my mind when completing a job”
- “It is important to me that there is a continuing emphasis on health and safety”
- “I’m sure it’s only a matter of time before I develop a work related health problem”
- “Production targets rarely conflict with health and safety measures”
- “I am always given enough time to get the job done safely”.

The following Figures (Figures 9.96 to 9.91) present the findings of this survey as a series of histograms, in which a more benign environment is reflected by a greater depth and proportion of green colouration. Orange or red indicates an area of possible conflict.

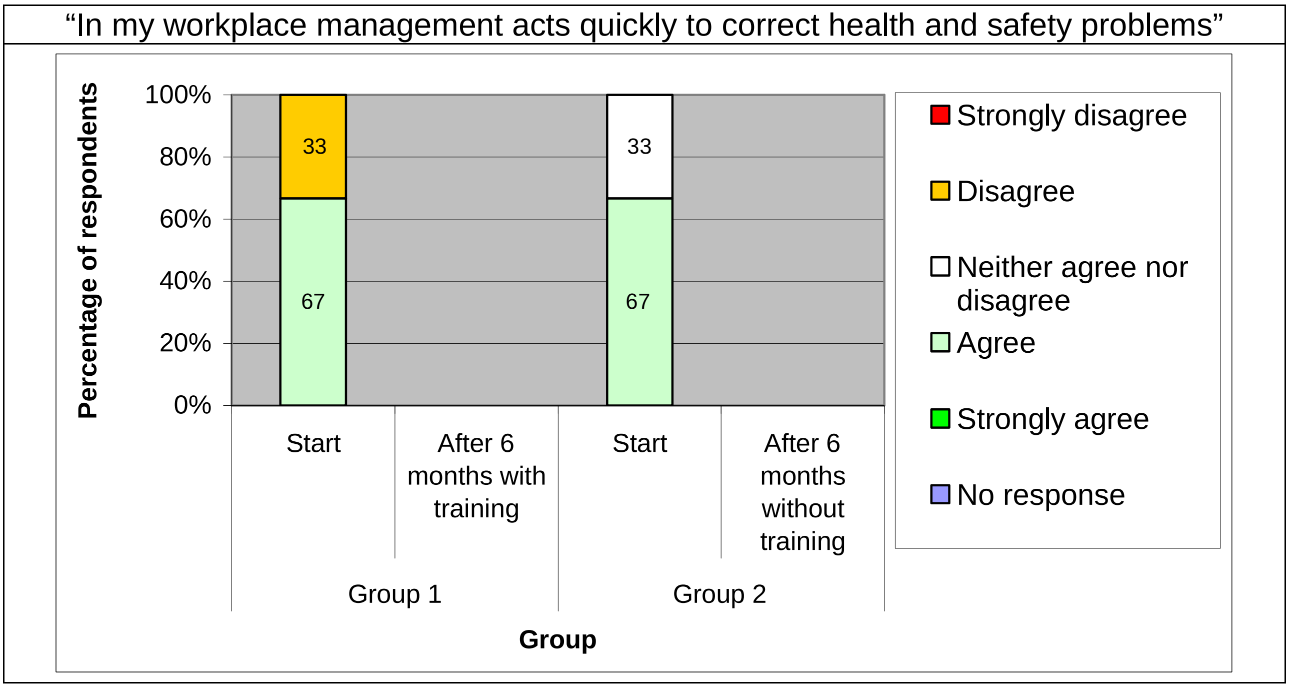


Figure 9.76 Response to speed of action statement over time by group

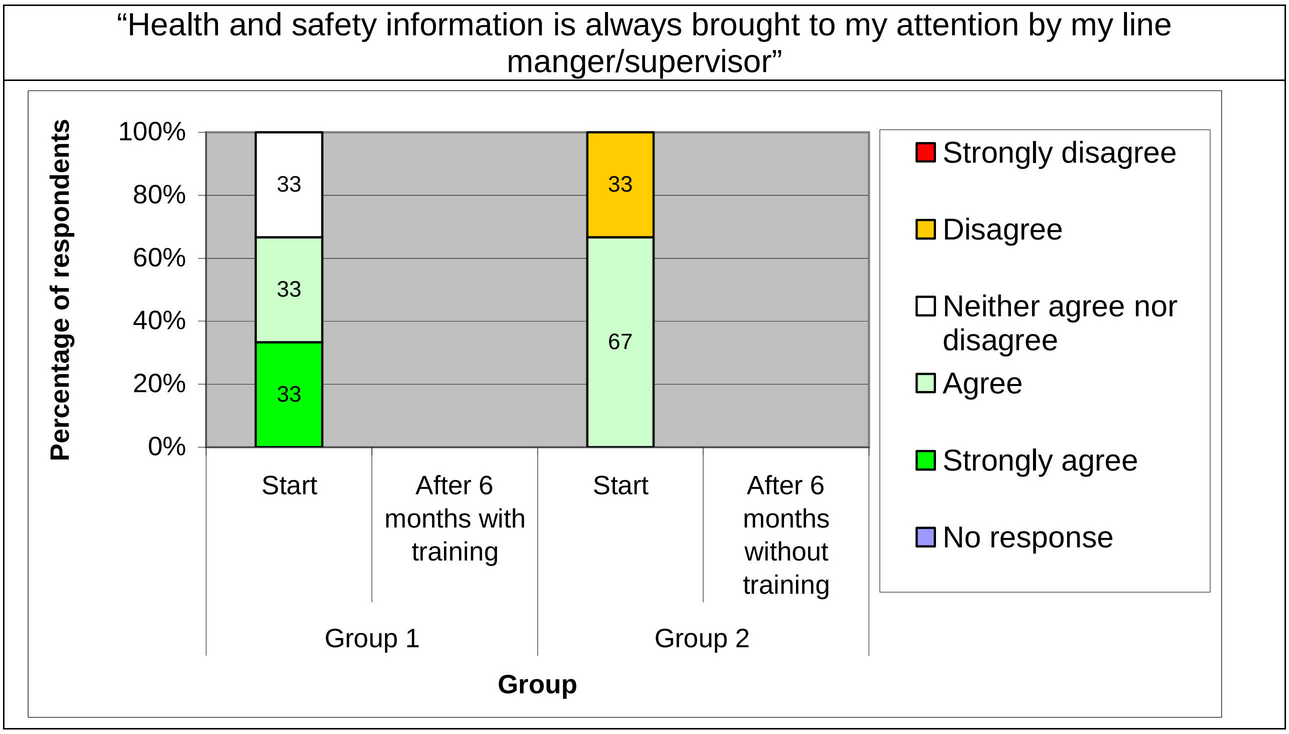


Figure 9.77 Response to health and safety attention statement over time by group

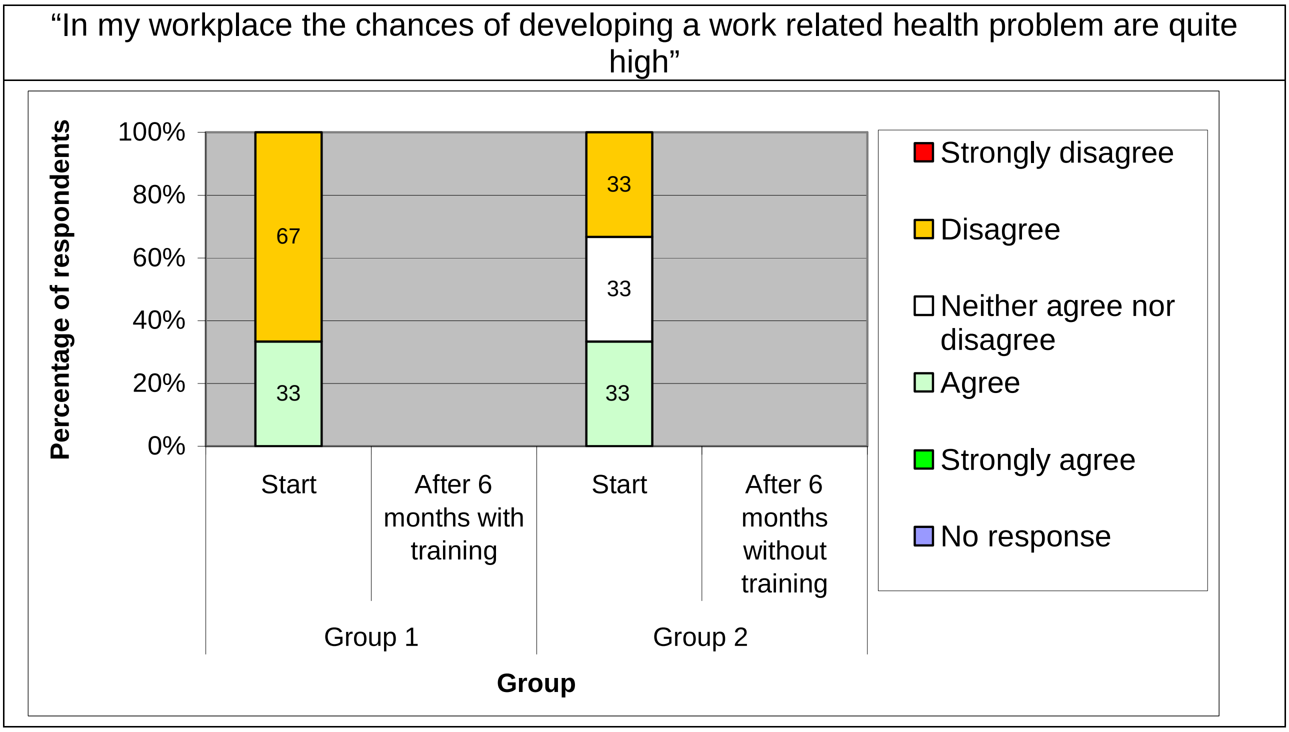


Figure 9.78 Response to health problem likelihood statement over time by group

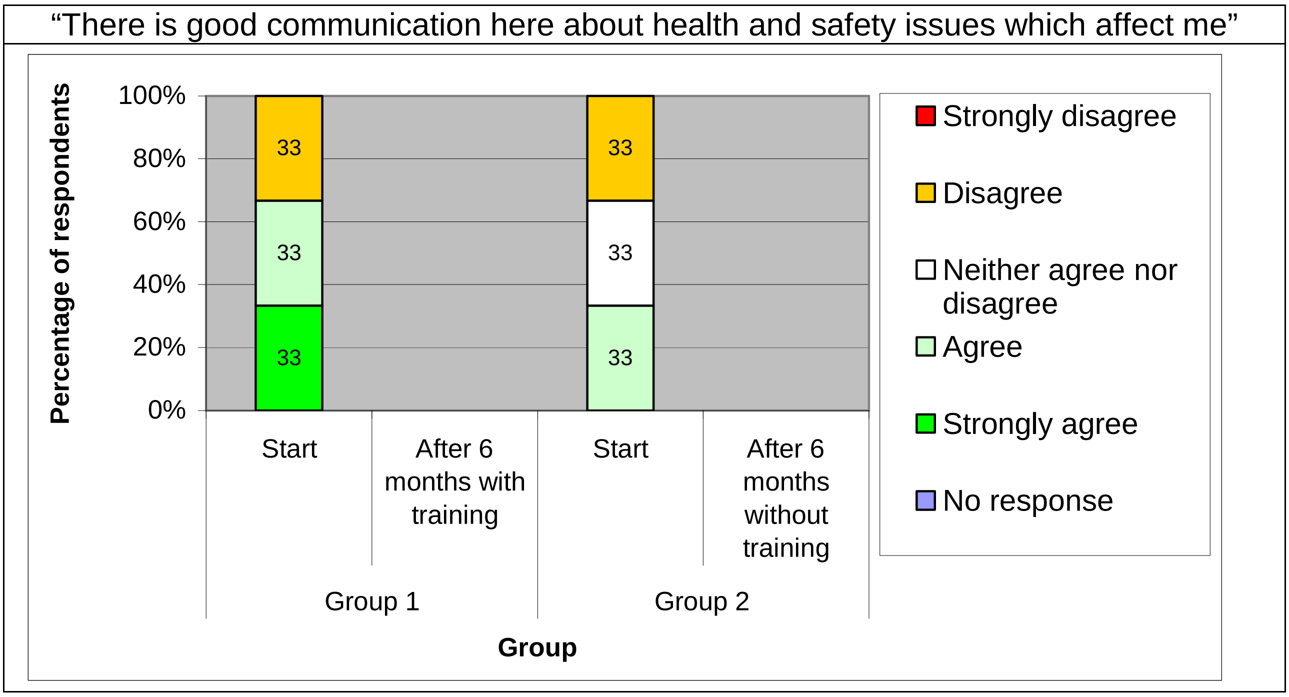


Figure 9.79 Response to communication statement over time by group

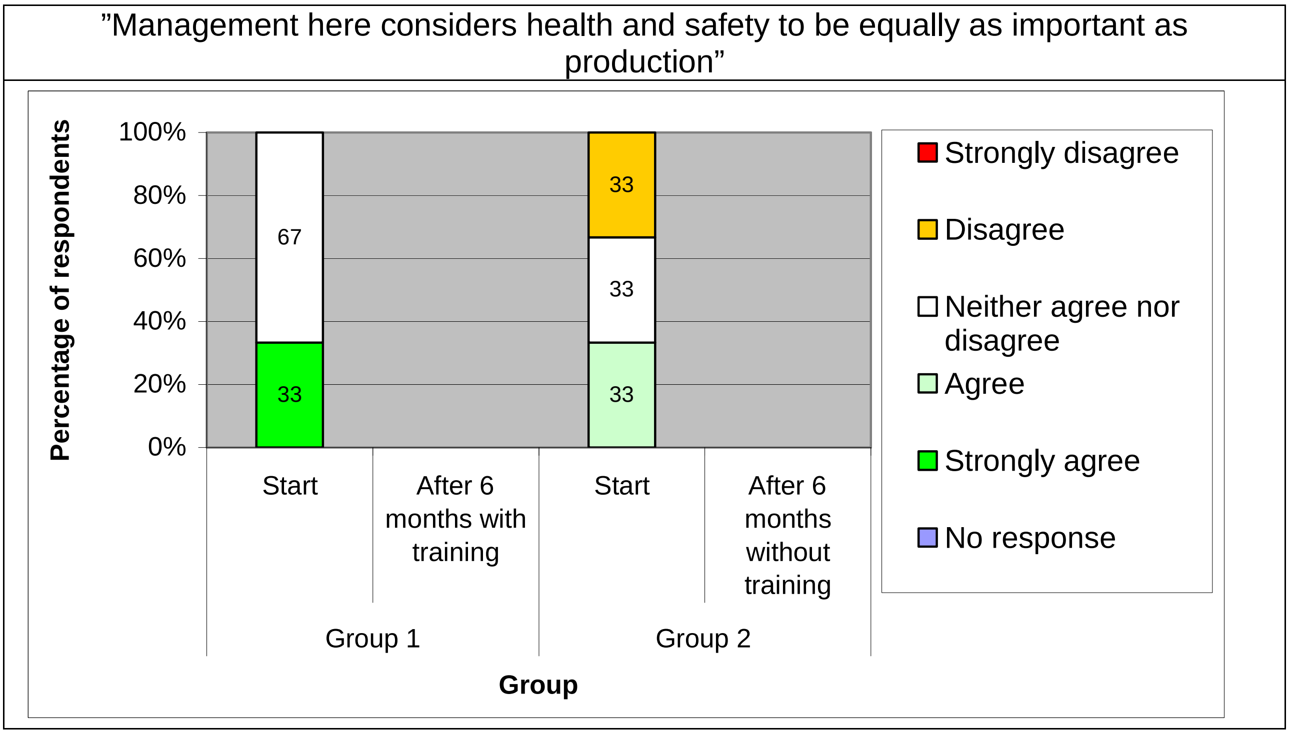


Figure 9.80 Response to health and safety importance statement over time by group

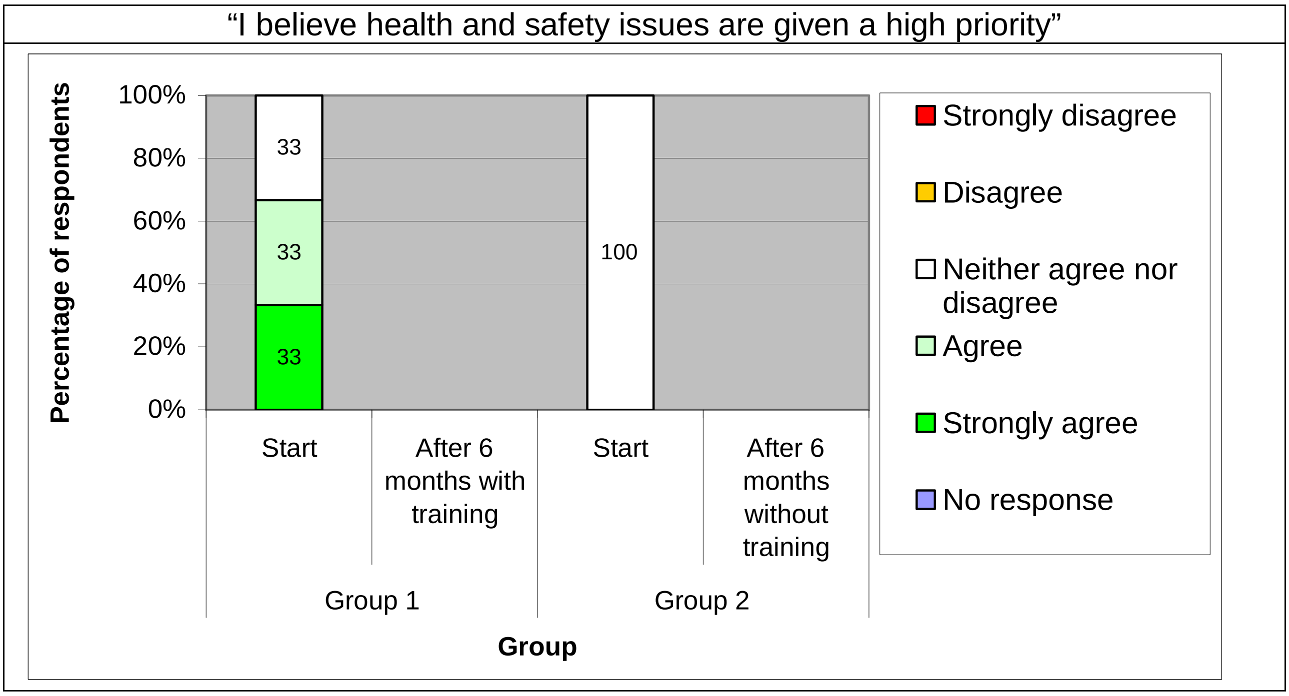


Figure 9.81 Response to health and safety priority statement over time by group

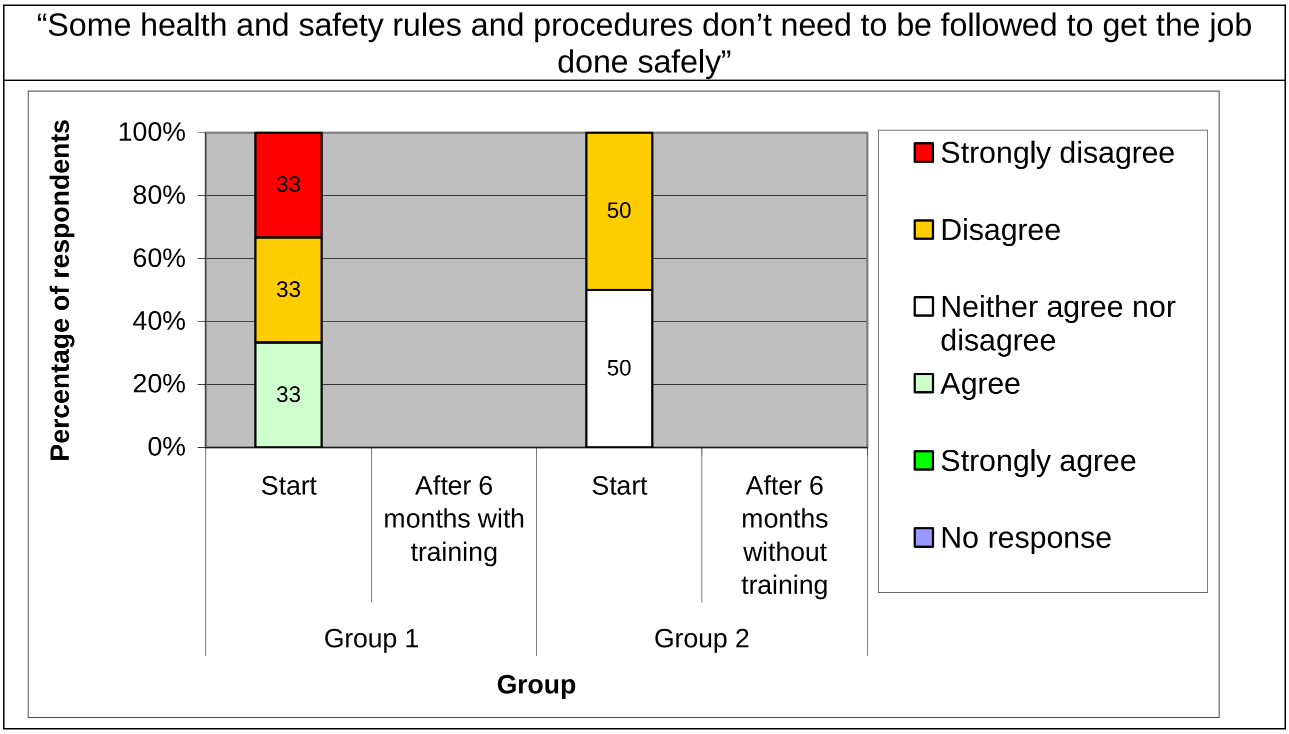


Figure 9.82 Response to safety rules statement over time by group

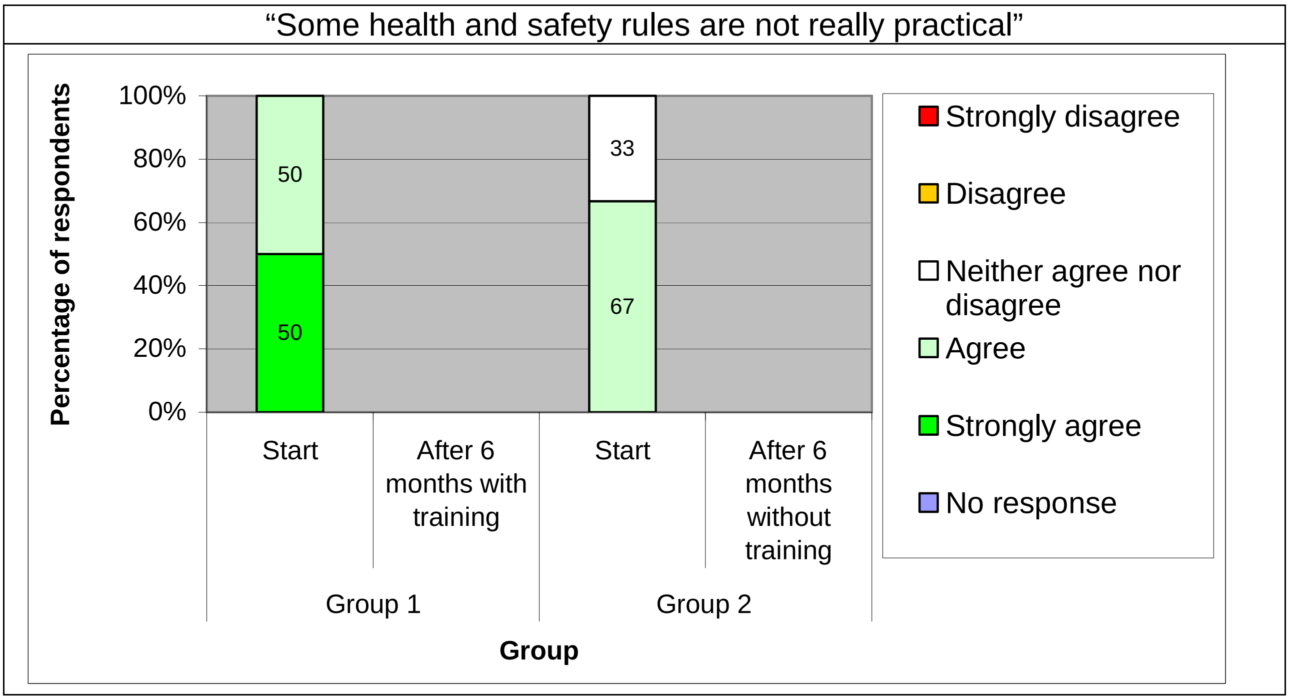


Figure 9.83 Response to health and safety practicality statement over time by group

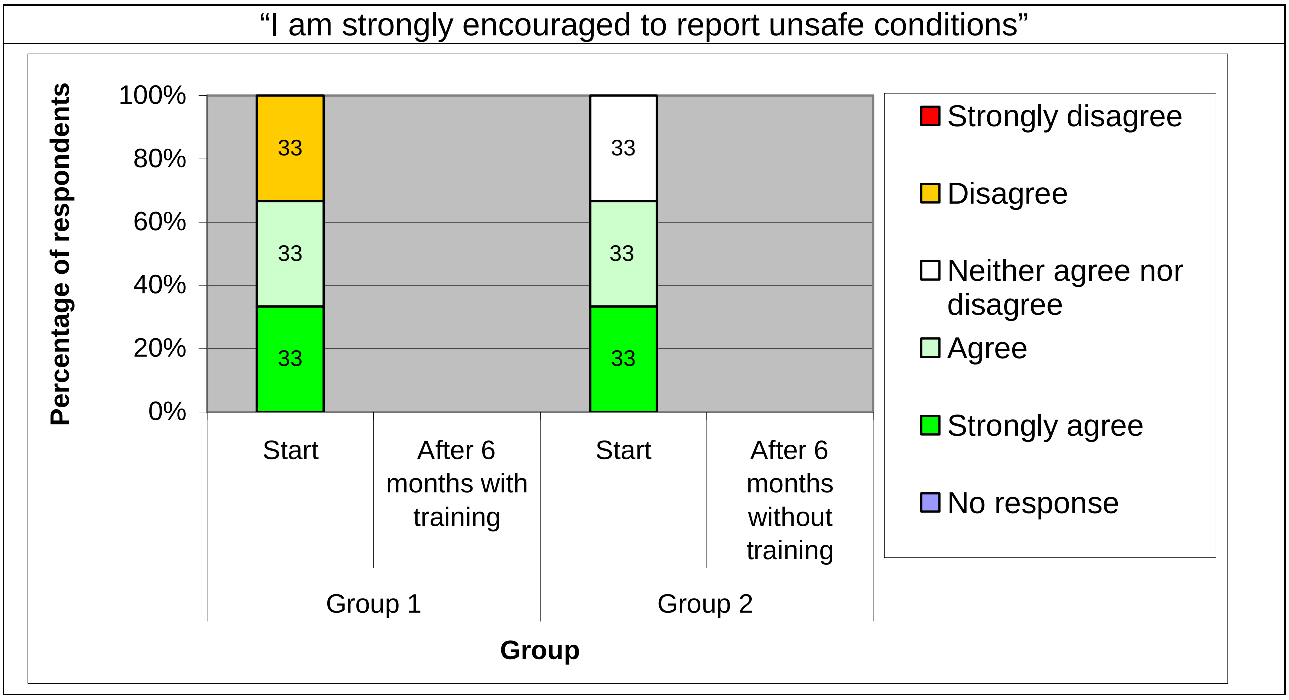


Figure 9.84 Response to reporting statement over time by group

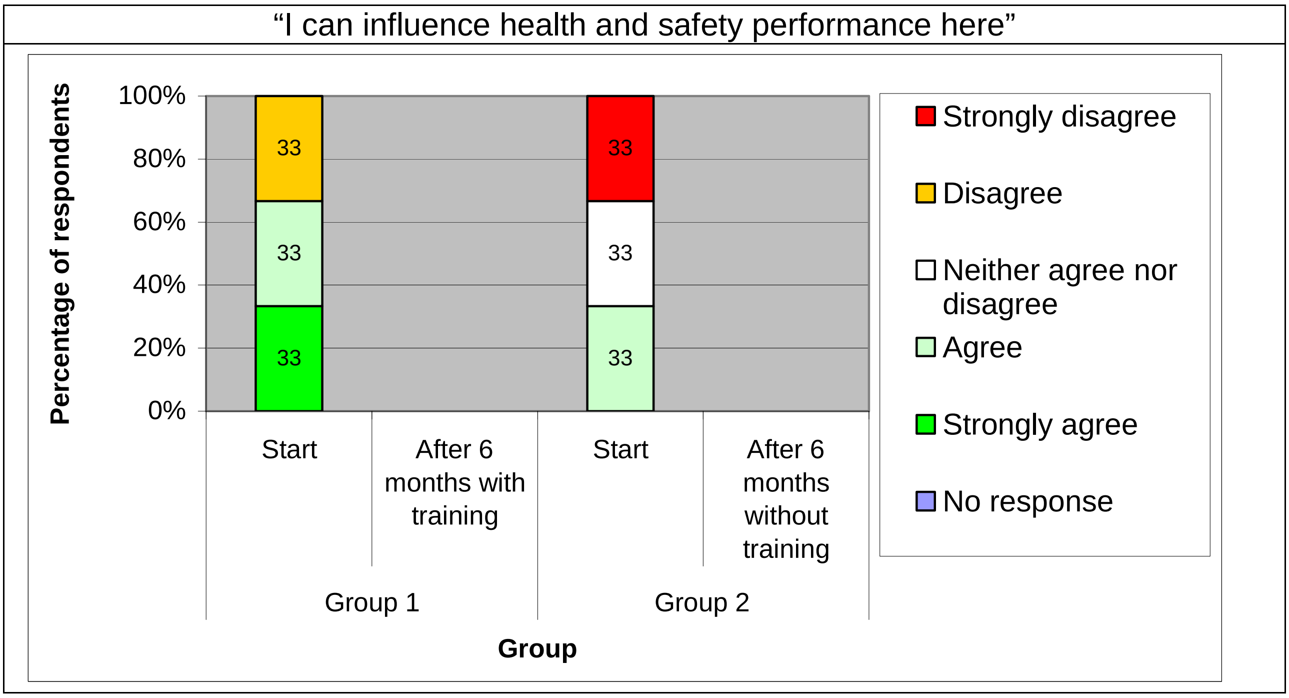


Figure 9.85 Response to health and safety influence statement over time by group

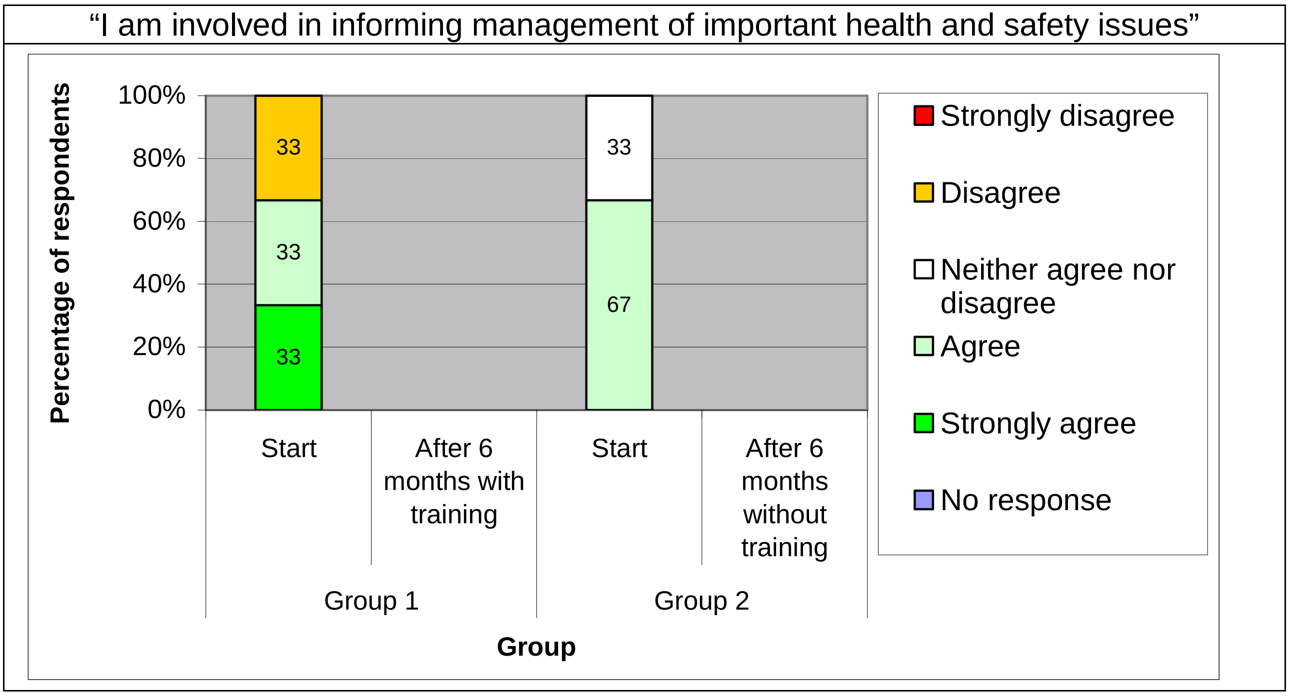


Figure 9.86 Response to health and safety management statement over time by group

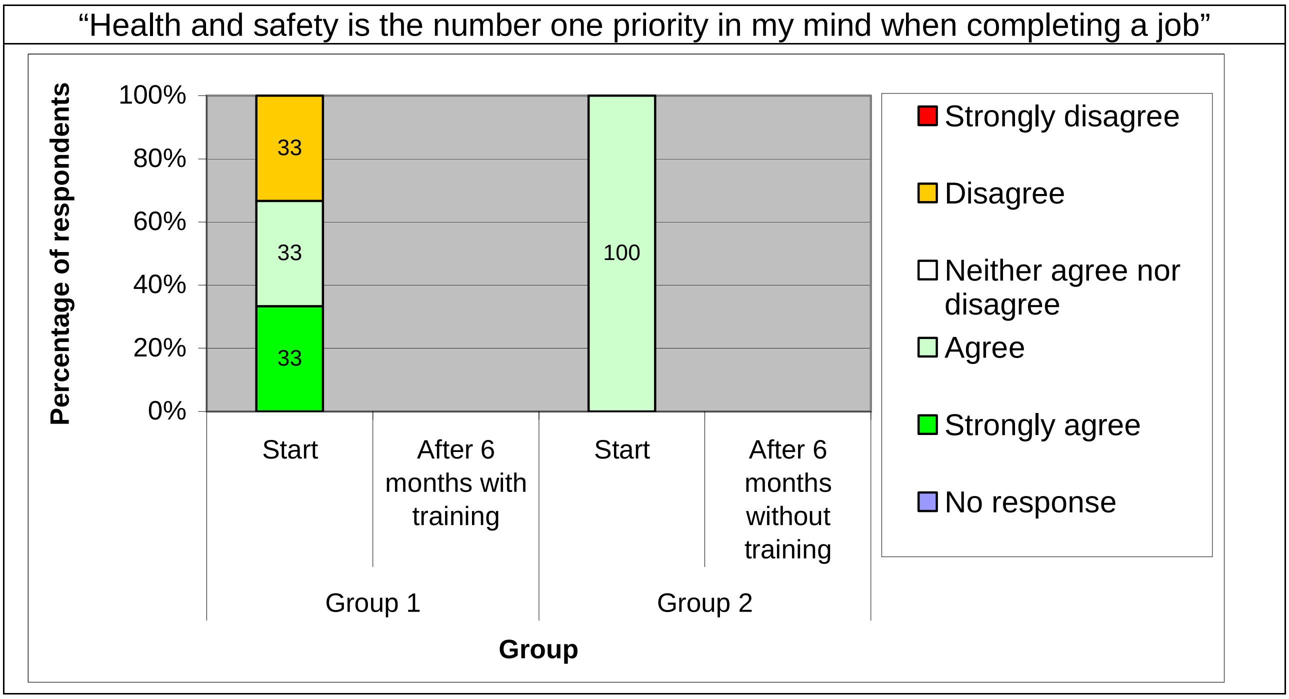


Figure 9.87 Response to health and safety priority statement over time by group

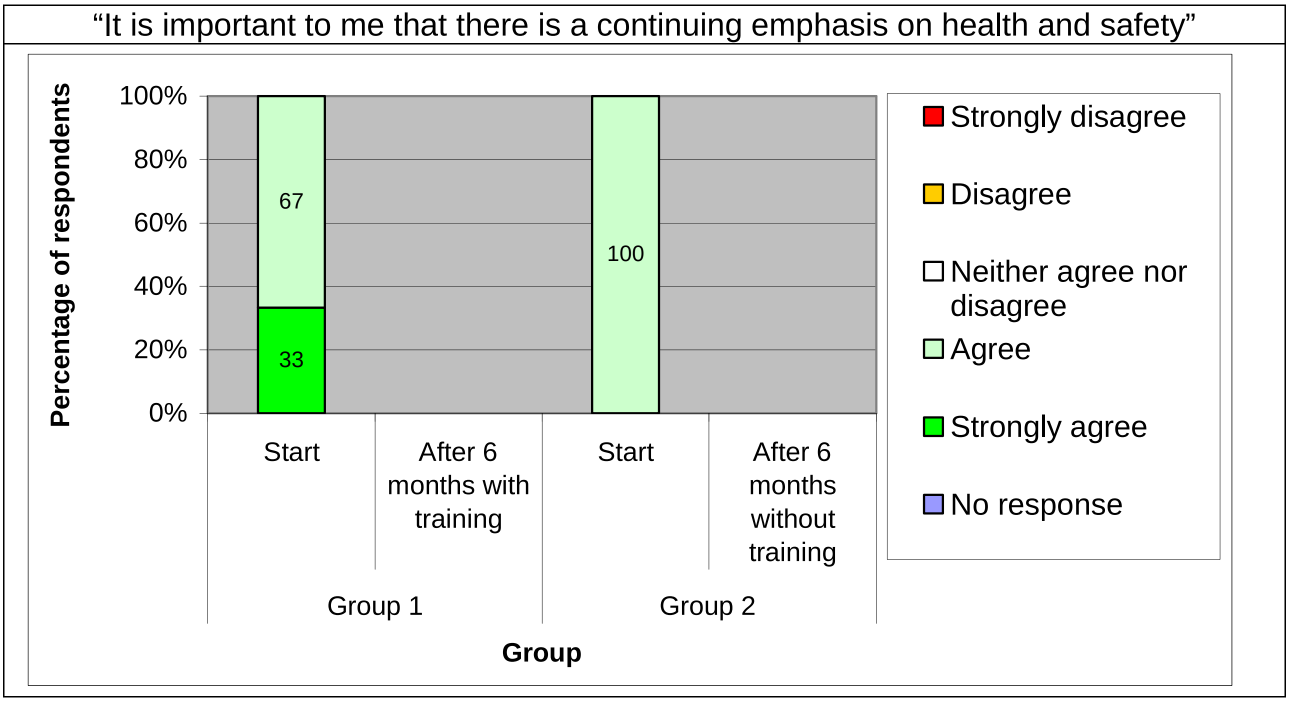


Figure 9.88 Response to health and safety emphasis statement over time by group

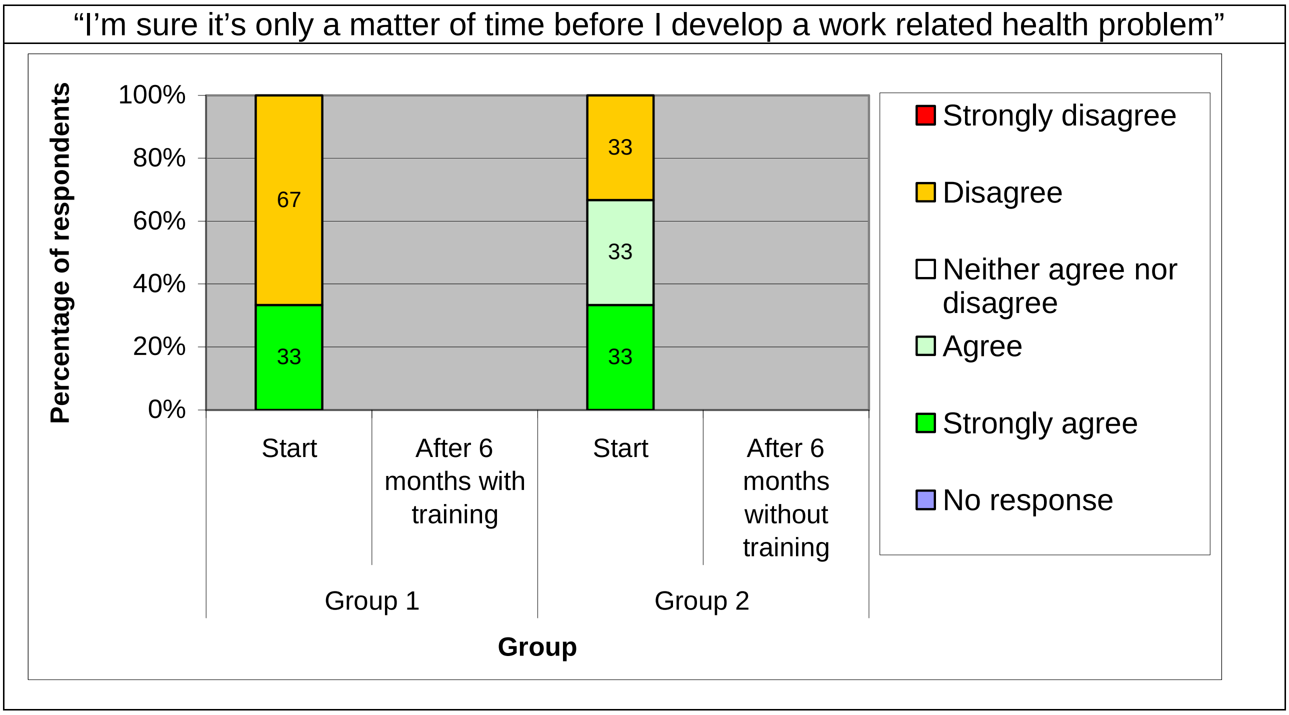


Figure 9.89 Response to health problem probability statement over time by group

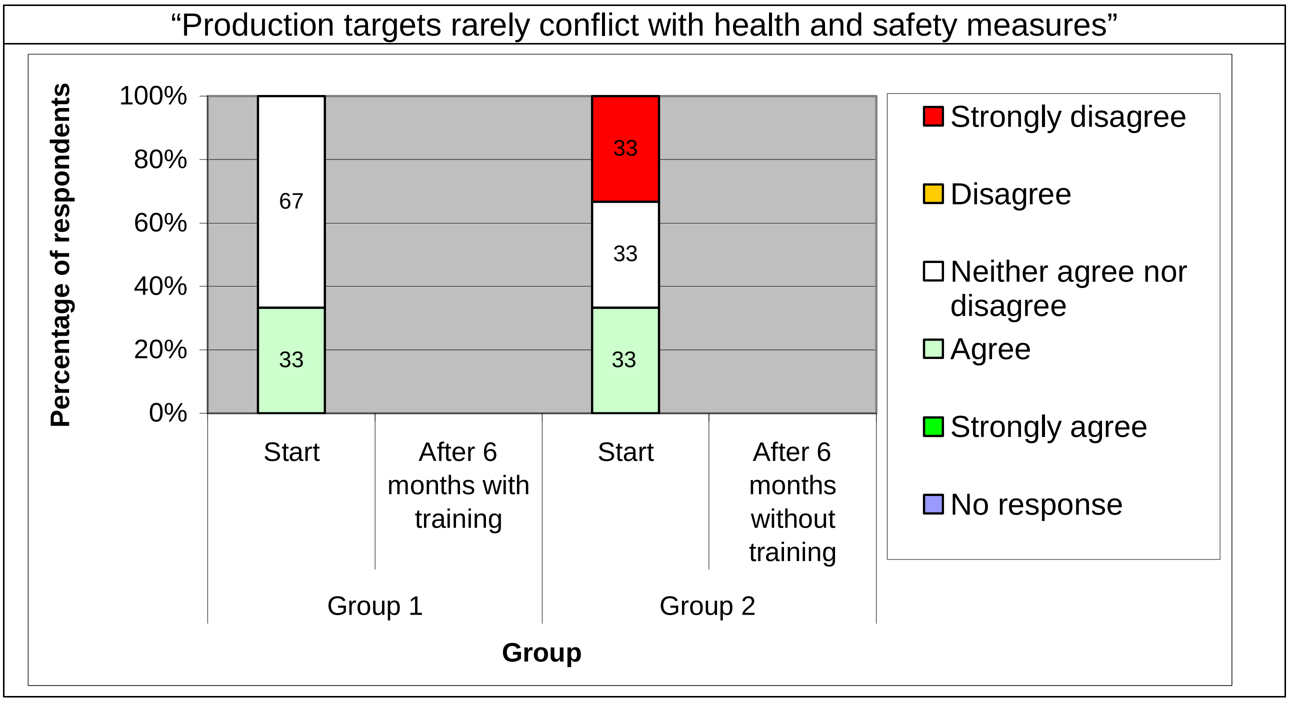


Figure 9.90 Response to production targets statement over time by group

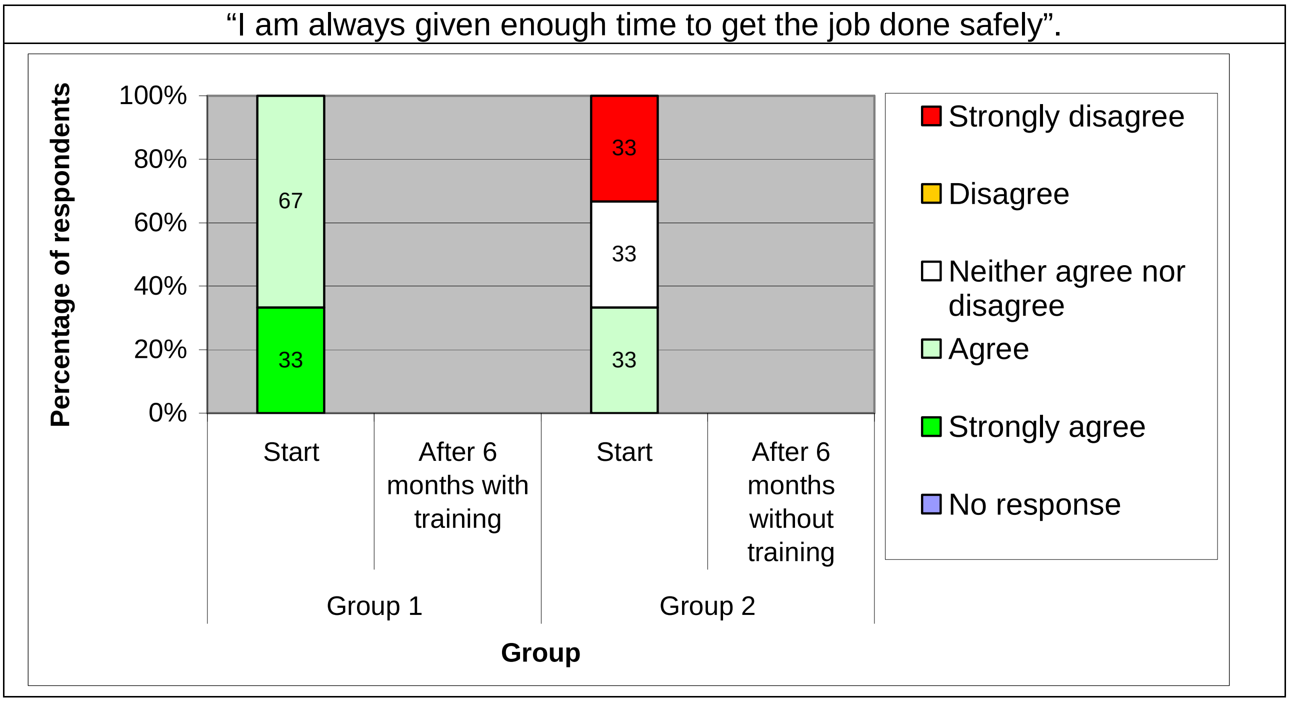


Figure 9.91 Response to time for safe work statement over time by group

Summary of attitude survey

Table 9.129 presents the statements which generated the responses most likely to reflect potential conflict.

Table 9.129. Statements most likely to reflect potential conflict.

Probe statement	Conflicting groups
Some health and safety rules are not really practical	Group 1 before training
I can influence health and safety performance here	Group 2 before training
Production targets rarely conflict with health and safety measures	Group 2 before training
I am always given enough time to get the job done safely	Group 2 before training

9.4.5 Company 4 - Cakes

Results

In total 8 participants from Company 4 completed the workplace questionnaire at the start of the study (Before) and 18 at the end of the study (After 6 months) (Table 9.130).

Table 9.130. Percentage of respondents and how they had heard of musculoskeletal problems (MSDs) or repetitive strain injury (RSI).

	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Number of respondents	4	4	4	4

Respondent's awareness and understanding of MSDs

Results from the questionnaire showed that 100% of respondents from both sites had heard of RSI or Musculoskeletal disorders (Figure 9.92).

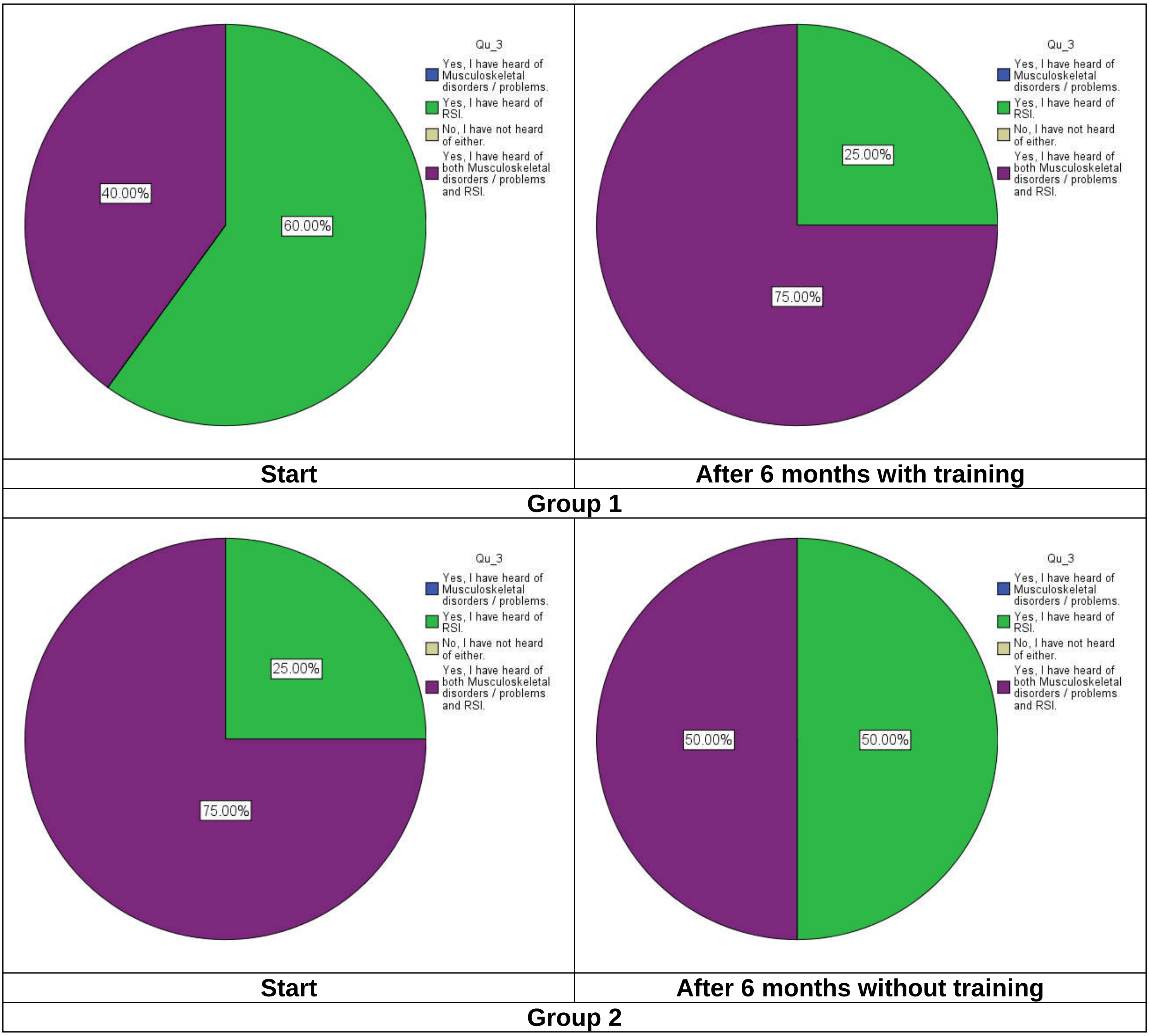


Figure 9.92. Pie charts depicting percentage of respondents from Groups 1 and 2 and their responses to having heard of either MSDs or RSI.

Origin of MSD knowledge

The participants were asked where they had heard of the RSI or MSD terms. There was an even spread of sources for both groups before training. When asked after training the percentages increased for the majority of possible sources, suggesting that overall awareness had been raised by the training process. The full results are shown in Table 9.131

Table 9.131. Percentage of respondents and how they had heard of musculoskeletal problems (MSDs) or repetitive strain injury (RSI).

	Percentage of respondents from each group			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Television	20%	75%	50%	75%
Radio	20%	25%	0%	50%
Books	0%	0%	0%	50%
Magazines	40%	25%	25%	75%
Websites	0%	0%	0%	50%
Work	40%	75%	50%	25%
Training course	20%	75%	0%	100%
Doctor	40%	25%	50%	50%
Physiotherapist	40%	25%	0%	50%
Other	20%	0%	25%	50%

Knowledge and understanding of MSD risk factors

Question 11 of the workplace questionnaire investigated peoples' understanding and knowledge of musculoskeletal problems, and asked respondents to list up to six risks/causes which may lead to musculoskeletal problems or RSI. Table 9.132 shows the mean number of correct risk factors/ causes reported by respondents. It is notable that this value was only raised for Group 1 by the training process.

Table 9.132. Descriptive statistics of the number of correct risk factors/causes reported for musculoskeletal problems.

	Responses for each group			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Number of respondents	5	4	4	4
Mean	2.6	5.5	4	3.5
Median	1	6	4	3.5
Mode	0 and 2	6	4	1
Std. Deviation	3.1	1	0.8	2.887
Minimum	0	4	3	1
Maximum	6	6	5	6

Figure 9.93 shows the responses as percentiles in graphical form .

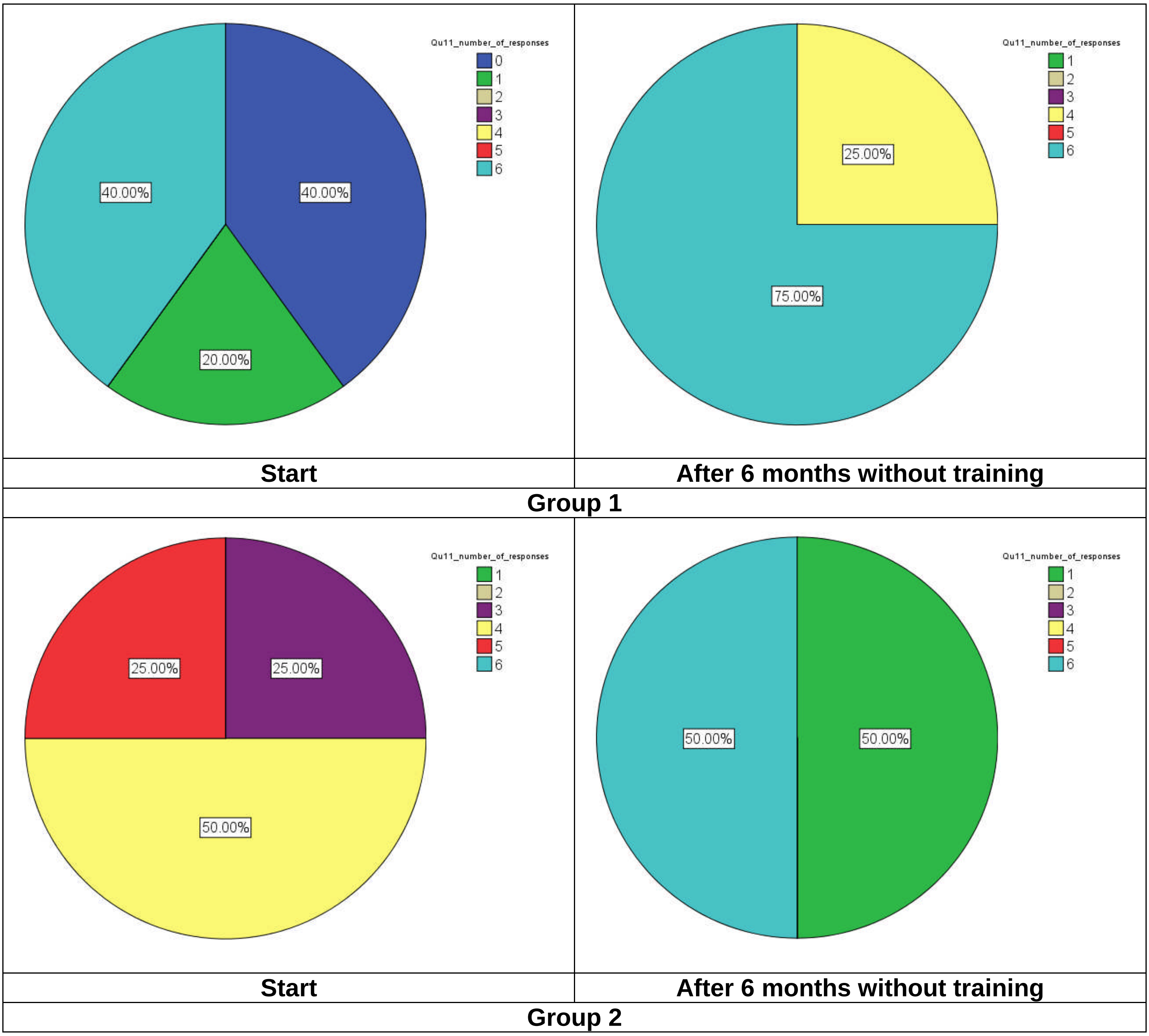


Figure 9.93. Pie charts depicting the percentage of respondents from Groups 1 and 2 and the number of correct risk factors/causes reported for musculoskeletal problems.

Reported pains, aches, discomfort relating to MSDs

Question 5 of the questionnaire described musculoskeletal problems as "affecting the muscles, tendons, ligaments of the neck, shoulders, back, arms, wrist, hands or legs. Symptoms can be feelings of pain, aches, numbness and/or discomfort in any of these body areas". Respondents were asked if they had experienced any such pain, aches, or discomfort in any body area in the last 6 months or last 7 days. Table 9.133 shows the percentile responses.

Table 9.133. Percentage of respondents that had experienced pain, aches or discomfort.

	Percentage of respondents from each group			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
None	20%	75%	50%	75%
Yes, in the last 6 months	60%	25%	50%	25%
Yes in the last 7 days	40%	25%	0%	0%

This demonstrates that nearly two thirds of the respondents in Group 1 had experienced pain or discomfort in the last six months, with nearly half experiencing these symptoms in the last seven days. Group 2 had a much lower incidence of reported discomfort which decreased by half on training.

For those individuals who reported pain or discomfort, a further question explored the location of the symptoms. This is presented by Group in Tables 9.134 and 9.135.

Group 1

Table 9.134. Percentage of those Group 1 respondents that reported experiencing pain, aches or discomfort and the body part affected and the level of discomfort experienced.

Group 1 (Start), n= 4 Group 1 (After 6 months), n=									
		No problems	Minimal discomfort	2	3	4	5	6	Extreme discomfort
Neck	Start	75%	0%	0%	25%	0%	0%	0%	0%
	After 6 months	0%	0%	0%	100%	0%	0%	0%	0%
Shoulders	Start	25%	0%	0%	0%	50%	0%	0%	25%
	After 6 months	0%	0%	100%	0%	0%	0%	0%	0%
Upper arms	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	100%	0%	0%	0%	0%	0%	0%	0%
Elbows	Start	75%	0%	0%	0%	0%	25%	0%	0%
	After 6 months	0%	0%	0%	0%	100%	0%	0%	0%
Forearms	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	100%	0%	0%	0%	0%	0%	0%	0%
Wrist	Start	50%	0%	0%	25%	25%	0%	0%	0%
	After 6 months	100%	0%	0%	0%	0%	0%	0%	0%
Hands	Start	75%	0%	0%	0%	25%	0%	0%	0%
	After 6 months	100%	0%	0%	0%	0%	0%	0%	0%
Upper back	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	100%	0%	0%	0%	0%	0%	0%	0%
Lower back	Start	0%	0%	25%	0%	25%	0%	25%	25%
	After 6 months	0%	0%	0%	0%	100%	0%	0%	0%
Legs	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	100%	0%	0%	0%	0%	0%	0%	0%

Group 2

Table 9.135. Percentage of those Group 2 respondents that reported experiencing pain, aches or discomfort and the body part affected and the level of discomfort experienced.

Group 2 (Start), n=5 Group 2 (After 6 months), n=									
		No problems	Minimal discomfort	2	3	4	5	6	Extreme discomfort
Neck	Start	50%	0%	0%	50%	0%	0%	0%	0%
	After 6 months	100%	0%	0%	0%	0%	0%	0%	0%
Shoulders	Start	50%	0%	0%	50%	0%	0%	0%	0%
	After 6 months	0%	0%	0%	100%	0%	0%	0%	0%
Upper arms	Start	50%	0%	0%	0%	50%	0%	0%	0%
	After 6 months	100%	0%	0%	0%	0%	0%	0%	0%
Elbows	Start	50%	50%	0%	0%	0%	0%	0%	0%
	After 6 months	100%	0%	0%	0%	0%	0%	0%	0%
Forearms	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	100%	0%	0%	0%	0%	0%	0%	0%
Wrist	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	100%	0%	0%	0%	0%	0%	0%	0%
Hands	Start	50%	0%	50%	0%	0%	0%	0%	0%
	After 6 months	0%	0%	0%	100%	0%	0%	0%	0%
Upper back	Start	100%	0%	0%	0%	0%	0%	0%	0%
	After 6 months	100%	0%	0%	0%	0%	0%	0%	0%
Lower back	Start	50%	0%	0%	0%	0%	50%	0%	0%
	After 6 months	0%	0%	100%	0%	0%	0%	0%	0%
Legs	Start	0%	0%	0%	50%	0%	0%	50%	0%
	After 6 months	0%	0%	0%	100%	0%	0%	0%	0%

These data were further investigated to establish what action, if any, had been taken regarding this discomfort and what the participant considered to be the cause.

Table 9.136 explores whether the participant had seen a doctor or had time off work because of the discomfort they had experienced..

Table 9.136. The actions of Group 1 and Group 2 respondents that reported experiencing pain, aches or discomfort.

	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Percentage who have consulted with a doctor about discomfort	50%	100%	0%	0%
Percentage who have taken time off work because of discomfort	25%	0%	0%	0%

It can be seen that at the start of the study nearly half of Group 1 had consulted a doctor about the discomfort experienced. This fell after training. Absence due to discomfort fell significantly for Group 1 post training but remained constant at zero for Group 2

Table 9.137 gives the participant's nominated cause of the discomfort, with virtually all respondents identifying work as the origin both before and after training.

Table 9.137. The reported cause pain, aches or discomfort for Group 1 and Group 2 respondents.

	Percentage of respondents that experienced discomfort			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Hobbies	0%	0%	50%	0%
Sport	0%	50%	0%	100%
Work tasks	100%	100%	100%	100%
House work	50%	0%	0%	0%

Future health concerns

A further question in the survey enquired whether the participants were concerned that they may develop MSD problems in the future.

The results can be seen in Table 9.138. A greater percentage of Group 1 respondents (80%/75%) reported that they were concerned that they would develop a musculoskeletal problem from their work than Group 2 respondents (25%/25%).

Table 9.138. Percentage of respondents and whether they were concerned about developing musculoskeletal problems at work.

	Percentage of respondents from each group			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Yes	80%	75%	25%	25%
No	20%	25%	75%	75%
No response	0%	0%	0%	0%

Changes to the workplace

Respondents were asked if they would kike the layout of their workplace to be changed so that it was easier or more comfortable to do their job. The results are shown in Table 9.139. Less than a half of respondents from both groups stated that they would like the layout of their workplace changed, despite the apparently high rate of discomfort. This suggests that they may view the activities as more problematic than the immediate location.

Table 9.139. Percentage of respondents and whether they would like the layout of their workplace changed to make it easier or more comfortable to do the work.

	Percentage of respondents from each group			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Yes	40%	0%	50%	0%
No	60%	100%	50%	100%
No response	0%	0%	0%	0%

For those respondents that said they would like to make changes virtually all of Group 1 and Group 2 said they would like the changes to be made in the next 6 months (Table 9.140).

Table 9.140. Percentage of those respondents that said yes they would like to make changes and whether these changes should be made in the next 6 months.

	Percentage of respondents that said yes they would like to make changes			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Yes	100%	0%	100%	0%
No	0%	0%	0%	25%
No response	0%	100%	0%	75%

Table 9.141 goes on to present the type of changes respondents reported they would like to see.

Table 9.141. Description of changes respondents said they would to made to their workplace.

Group 1	Start	• Change duties rota people daily. • Pallets of butter flour and sugar in work zone.
	After 6 months with training	• n/a
Group 2	Start	• Make tables higher so not have to bend over and make chairs higher. • Clear gangways , more machinery available in stand and ride.
	After 6 months without training	• n/a

Employer changes to the workplace

Respondents were asked if they were aware if their employer had made any changes to reduce MSD risks. No participants believed this to be the case prior to training, but 25% had changed this view after training for both groups.

Table 9.142. Percentage of respondents and whether they knew if their employer had made any changes to reduce the risks of musculoskeletal problems.

	Percentage of respondents from each group			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Yes	0%	25%	0%	25%
No	100%	75%	100%	50%
No response	0%	0%	0%	25%

Respondent changes to the workplace.

In comparison, it was noted that a wider spread of participants had undertaken changes to the workplace themselves, as seen in Table 9.143.

Table 9.143. Percentage of respondents and whether they had done anything to reduce the risks.

	Percentage of respondents from each group			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
Yes	60%	25%	0%	25%
No	40%	75%	100%	50%
No response	0%	0%	0%	25%

For those respondents who indicated that they had undertaken changes themselves, they were asked to provide further information on the nature of those changes. Details of the responses are given in Table 9.144, below.

Table 9.144. Description of changes respondents have made themselves to reduce the risks.

Group 1	Start	• Swap duties every other day. • Using baths and deep heat and exercise. • Changing staff around to different jobs.
	After 6 months with training	• Take a break • Shake arms/hands
Group 2	Start	• n/a
	After 6 months without training	• Rotation of staff

Communication and attitudes relating to health and safety

The participant survey attempted to explore attitudes to health and safety in the workplace and the manner in which communication took place in the workplace. Table 9.145 shows the participant's responses regarding communication between the operations or production department and company management.

The majority of both groups reported that they felt these communication links were satisfactory. This is encouraging since it suggests that this traditional barrier to improving health and safety is not realised in practice.

Table 9.145. Percentage of respondents and how they felt about communication links between operations/production and management.

	Percentage of respondents from each group			
	Group 1		Group 2	
	Start	After 6 months with training	Start	After 6 months without training
No response	0%	0%	0%	0%
Good and efficient	20%	25%	0%	33%
Satisfactory	40%	75%	75%	67%
Unsatisfactory	20%	0%	0%	0%
Very poor and inefficient	20%	0%	25%	0%

The final section of the questionnaire probed the attitudes of the workers with a series of statements against which the participants could record a level of agreement. The responses ranged from “Strongly Disagree” to “Strongly Agree”. The probes were:

- “In my workplace management acts quickly to correct health and safety problems”
- “Health and safety information is always brought to my attention by my line manger/supervisor”
- “In my workplace the chances of developing a work related health problem are quite high”
- “There is good communication here about health and safety issues which affect me”

- ”Management here considers health and safety to be equally as important as production”
- “I believe health and safety issues are given a high priority”
- “Some health and safety rules and procedures don’t need to be followed to get the job done safely”
- “Some health and safety rules are not really practical”
- “I am strongly encouraged to report unsafe conditions”
- “I can influence health and safety performance here”
- “I am involved in informing management of important health and safety issues”
- “Health and safety is the number one priority in my mind when completing a job”
- “It is important to me that there is a continuing emphasis on health and safety”
- “I’m sure it’s only a matter of time before I develop a work related health problem”
- “Production targets rarely conflict with health and safety measures”
- “I am always given enough time to get the job done safely”.

The following Figures (Figures 9.94 to 9.109) present the findings of this survey as a series of histograms, in which a more benign environment is reflected by a greater depth and proportion of green colouration. Orange or red indicates an area of possible conflict.

"In my workplace management acts quickly to correct health and safety problems"

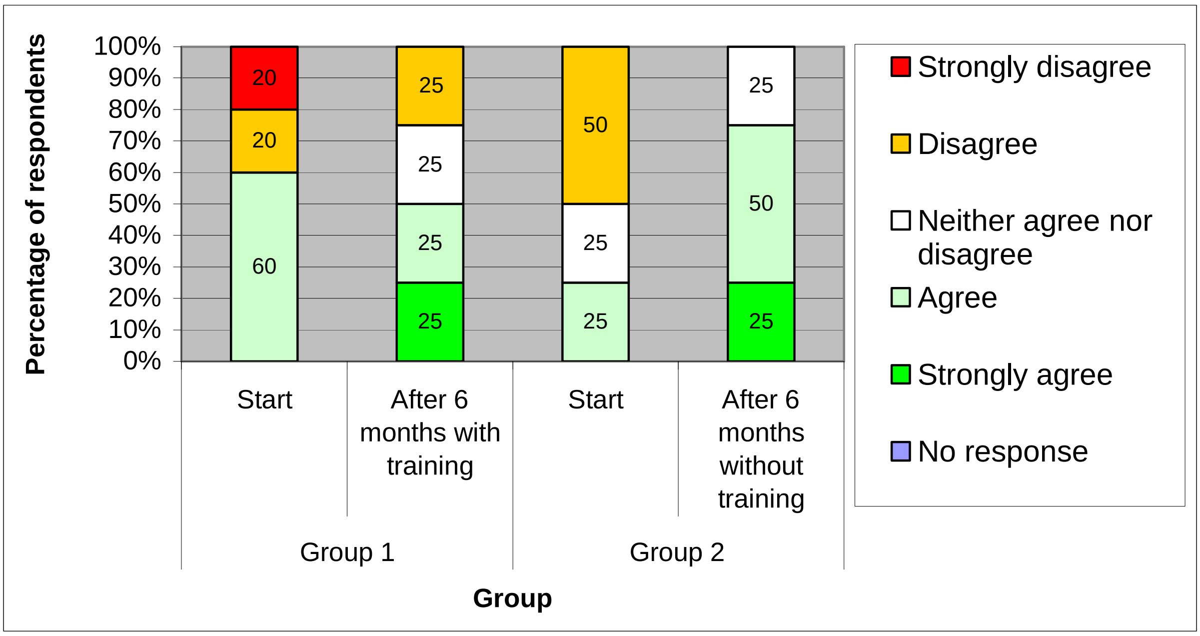


Figure 9.94 Response to speed of action statement over time by group

"Health and safety information is always brought to my attention by my line manger/supervisor"

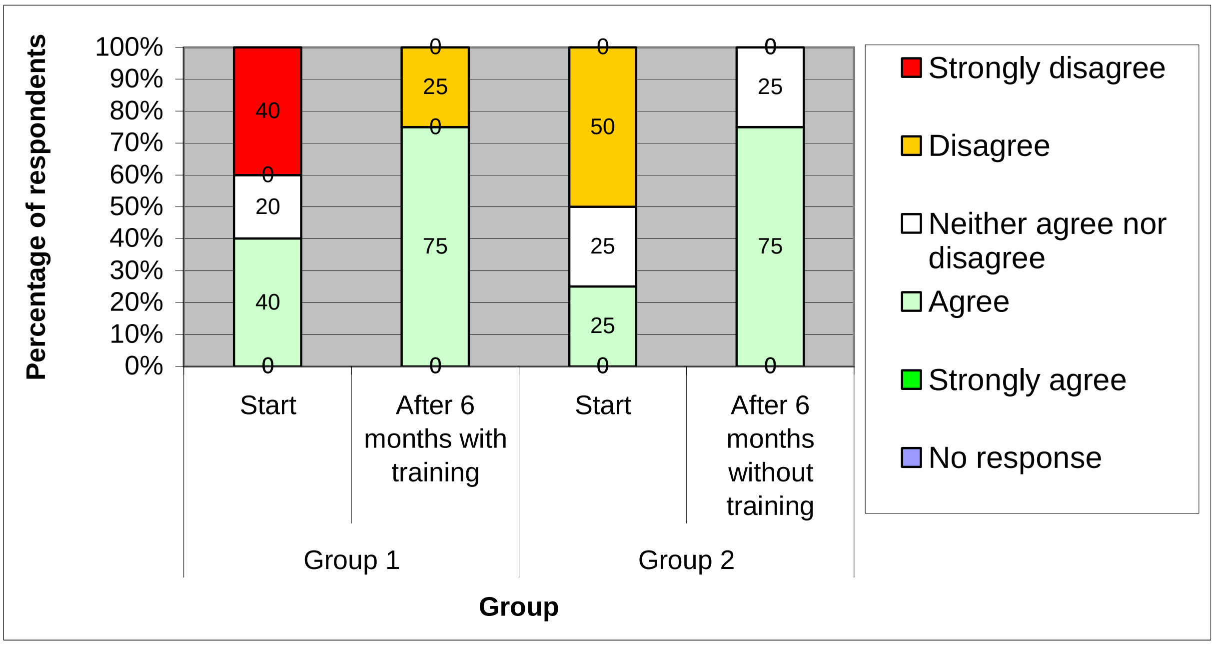


Figure 9.95 Response to health and safety attention statement over time by group

"In my workplace the chances of developing a work related health problem are quite high"

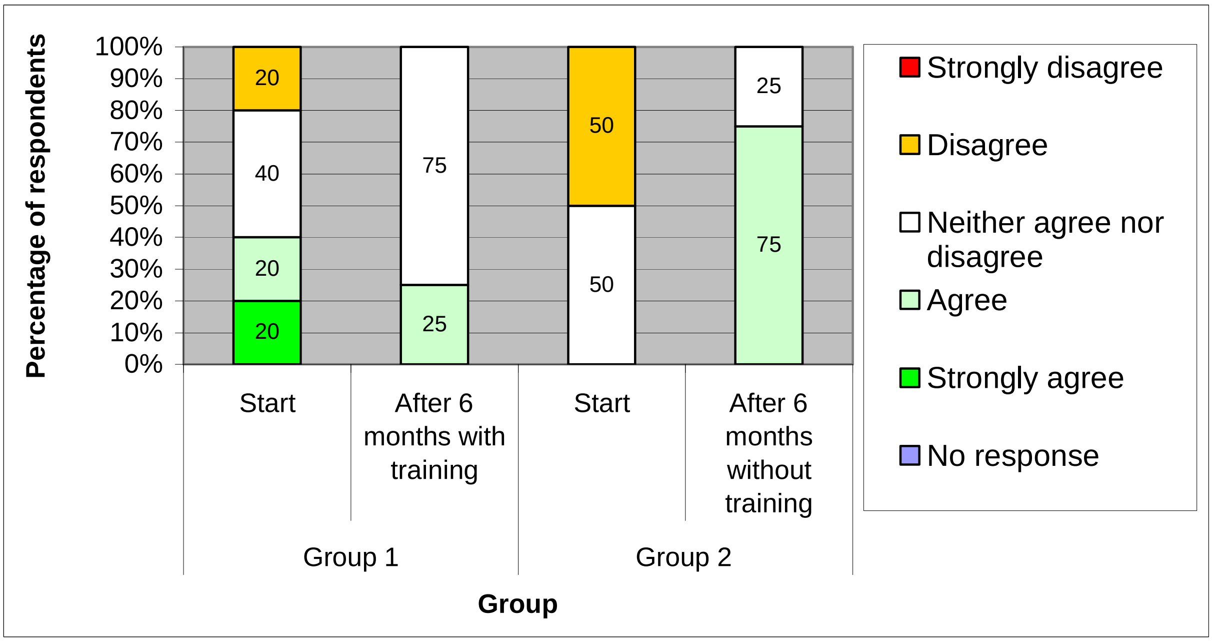


Figure 9.96 Response to health problem likelihood statement over time by group

"There is good communication here about health and safety issues which affect me"

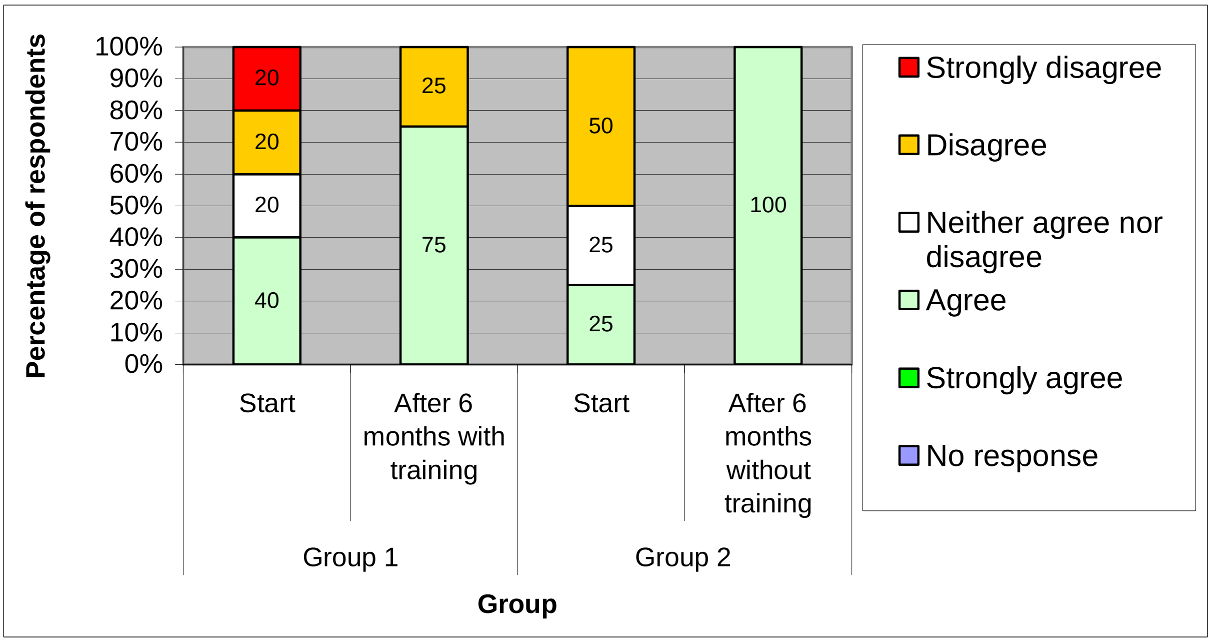


Figure 9.97 Response to communication statement over time by group

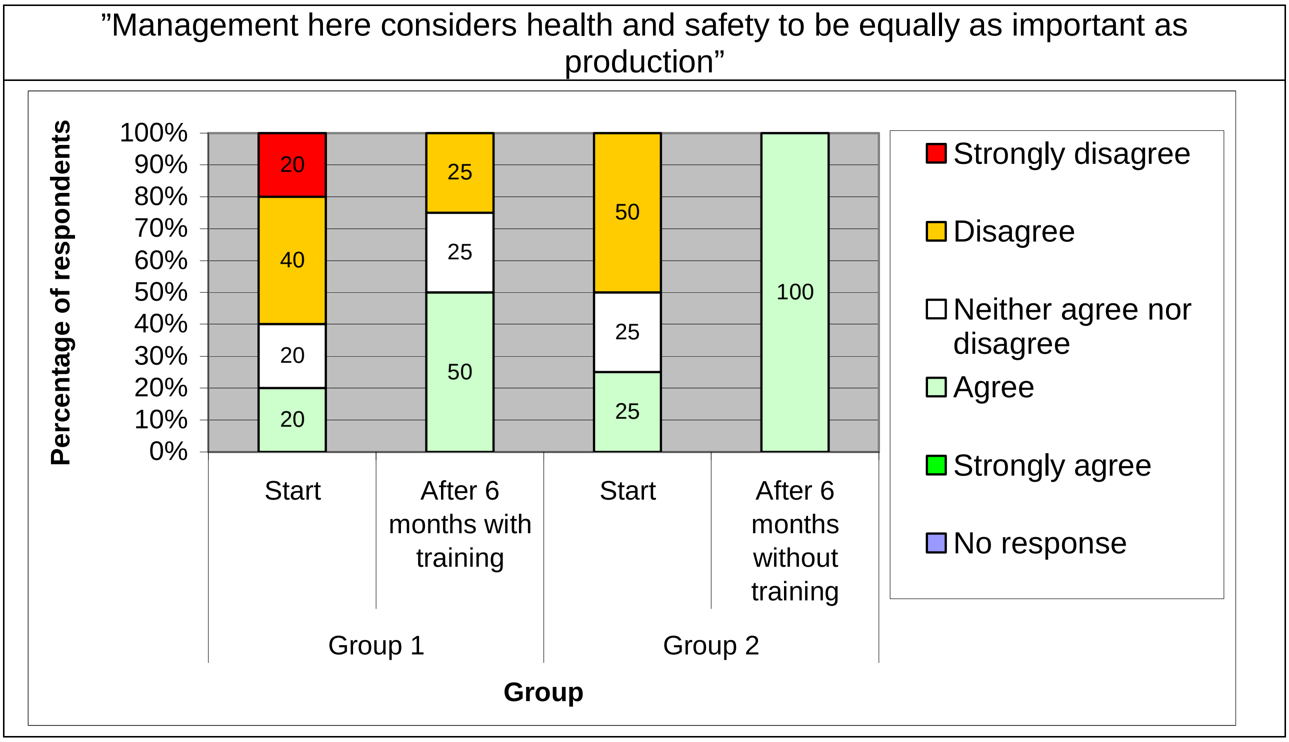


Figure 9.98 Response to health and safety importance statement over time by group

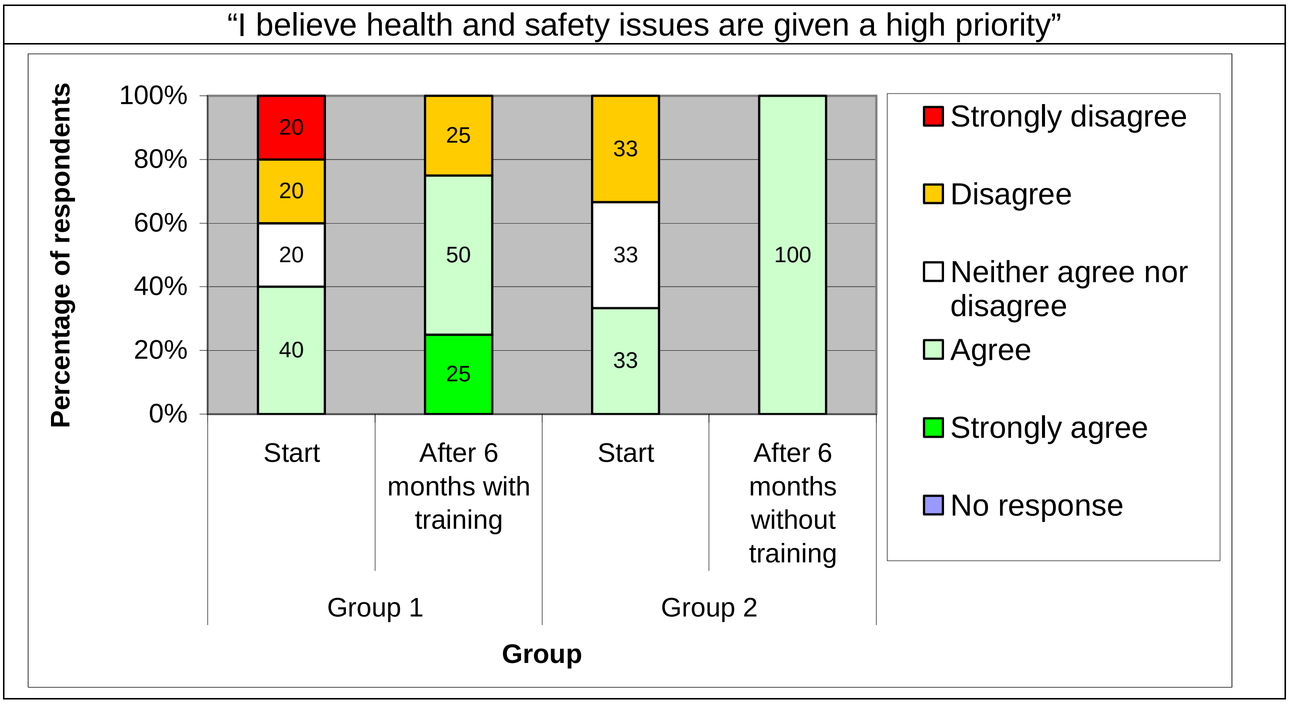


Figure 9.99 Response to health and safety priority statement over time by group

"Some health and safety rules and procedures don't need to be followed to get the job done safely"

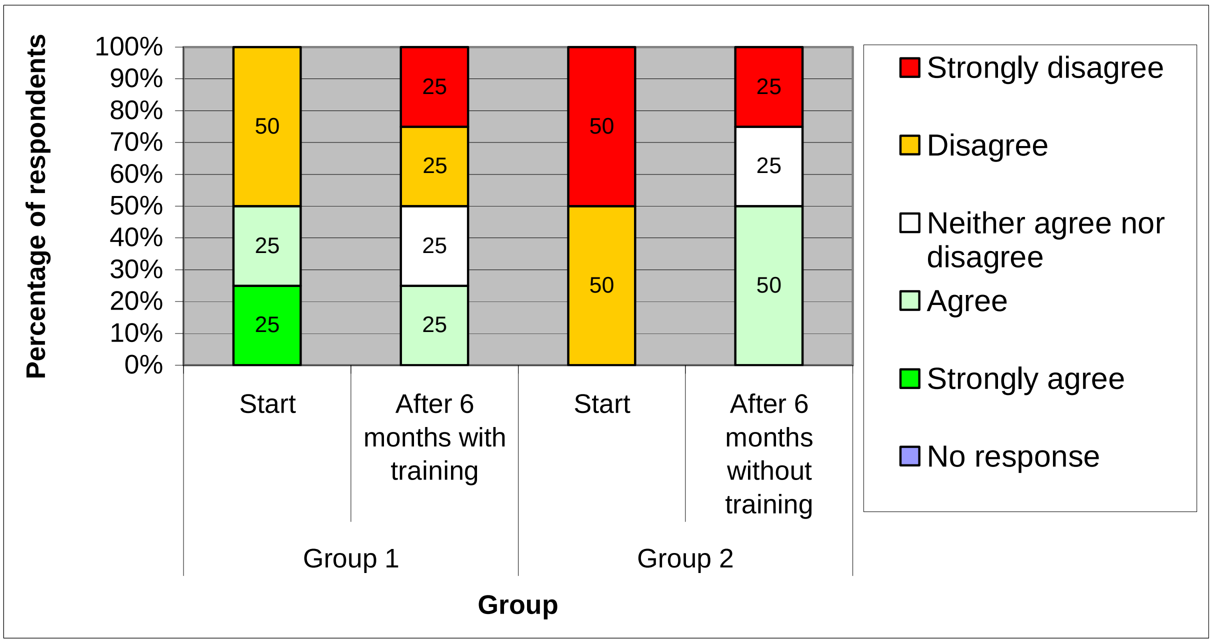


Figure 9.100 Response to safety rules statement over time by group

"Some health and safety rules are not really practical"

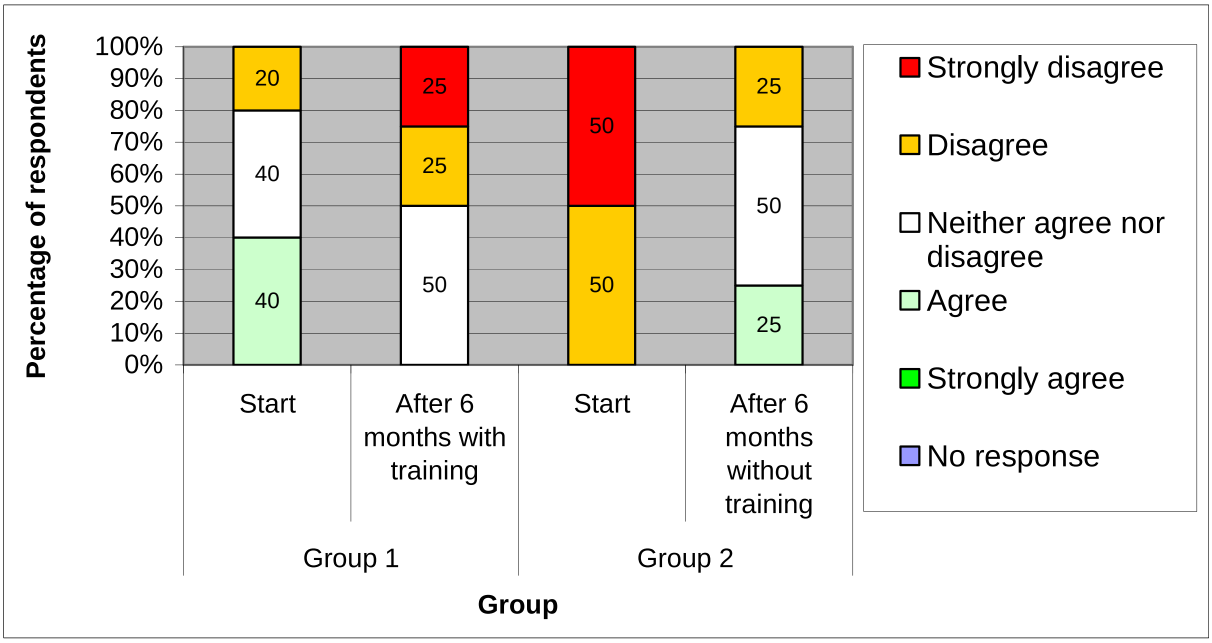


Figure 9.101 Response to health and safety practicality statement over time by group

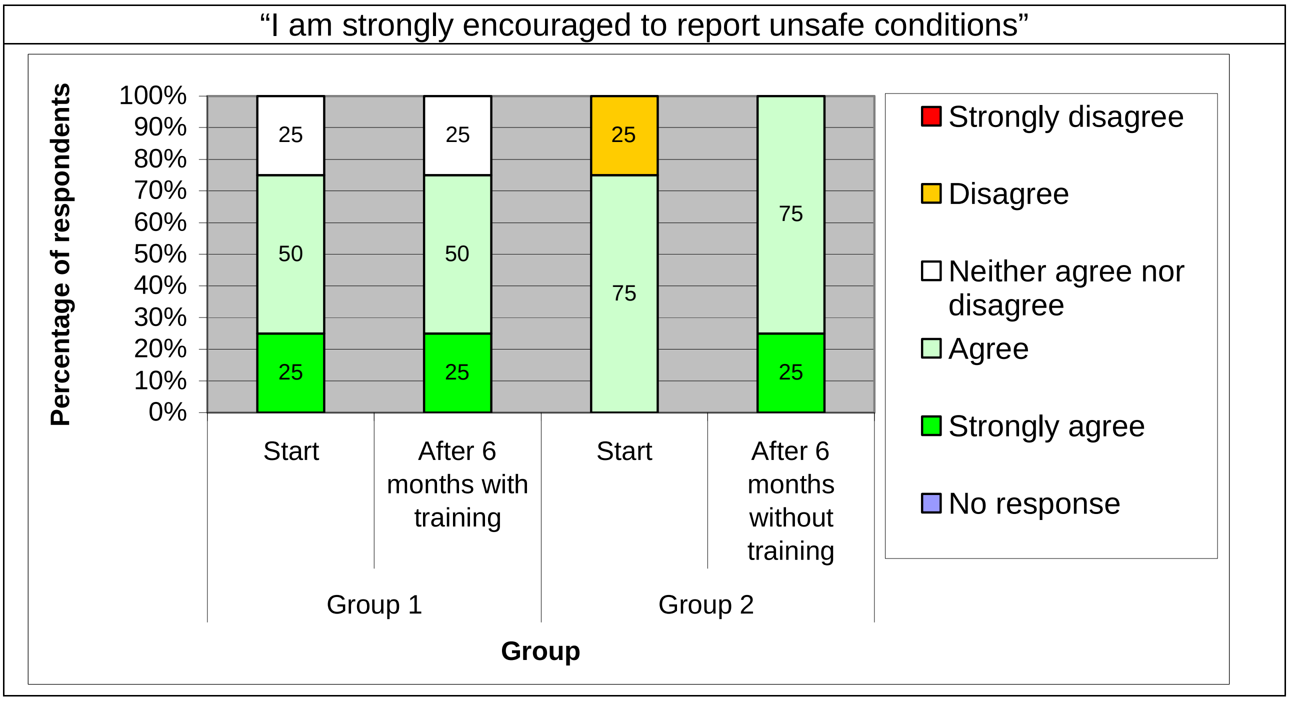


Figure 9.102 Response to reporting statement over time by group

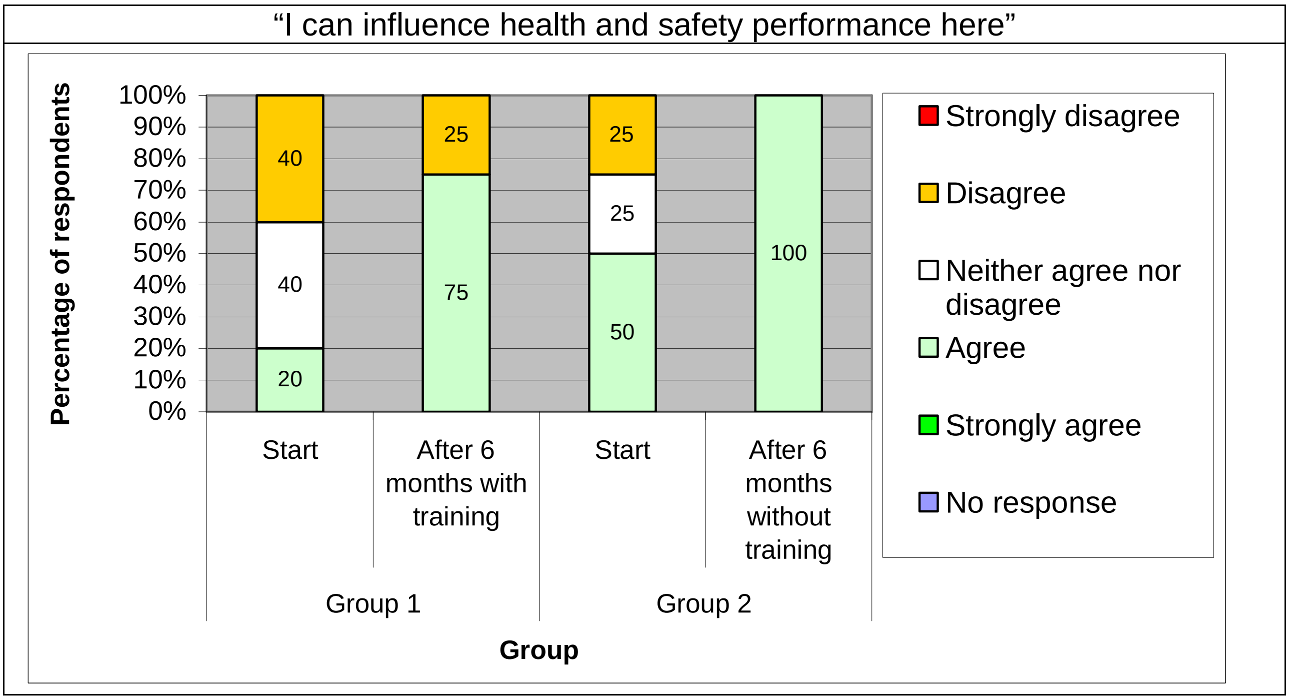


Figure 9.103 Response to health and safety influence statement over time by group

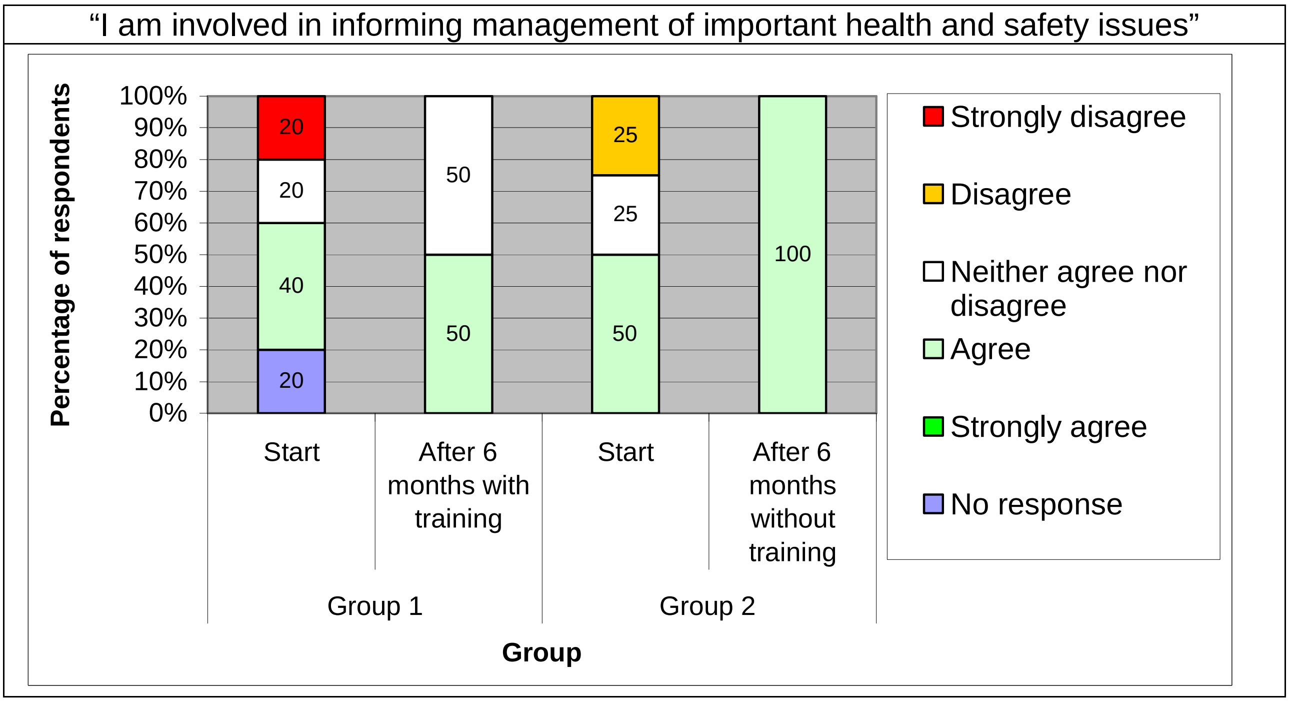


Figure 9.104 Response to health and safety management statement over time by group

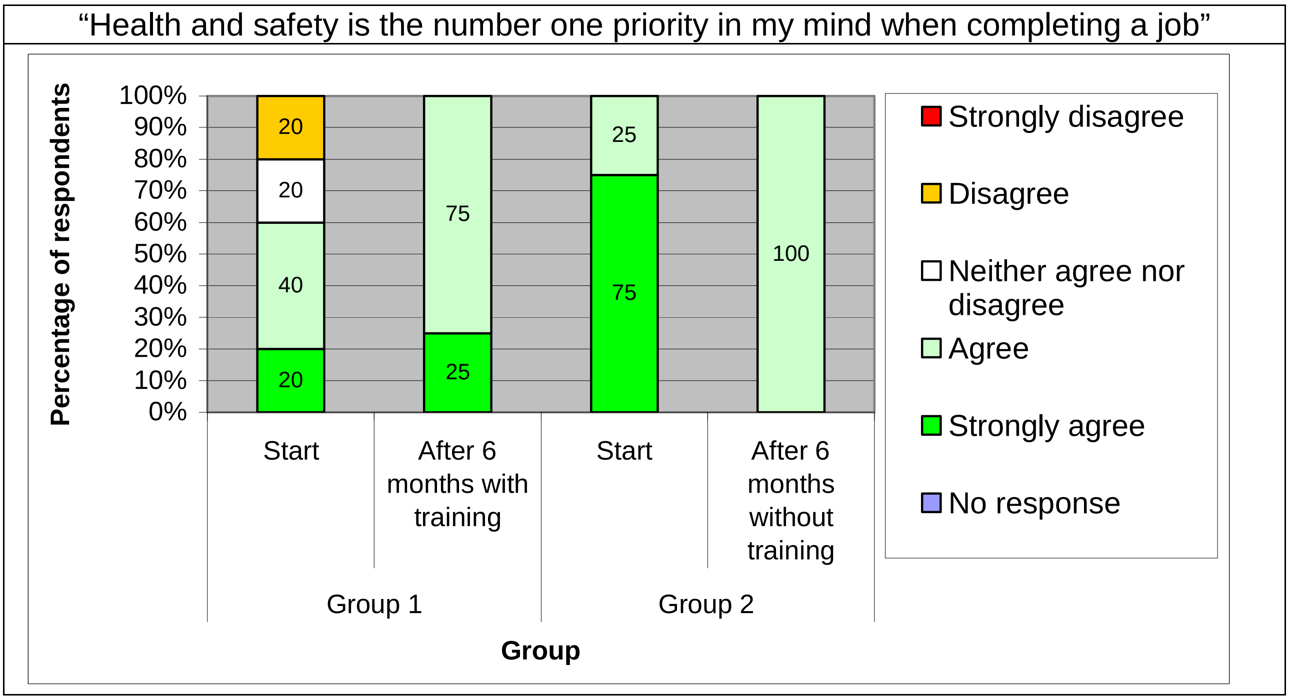


Figure 9.105 Response to health and safety priority statement over time by group

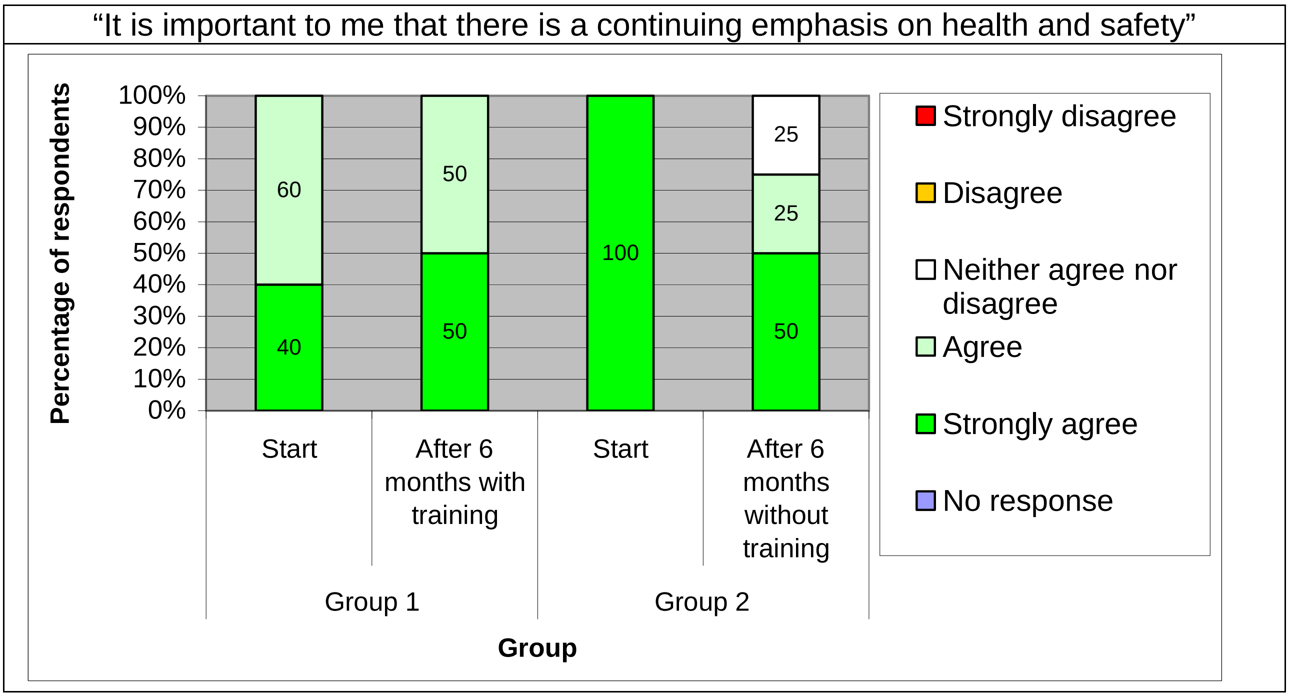


Figure 9.106 Response to health and safety emphasis statement over time by group

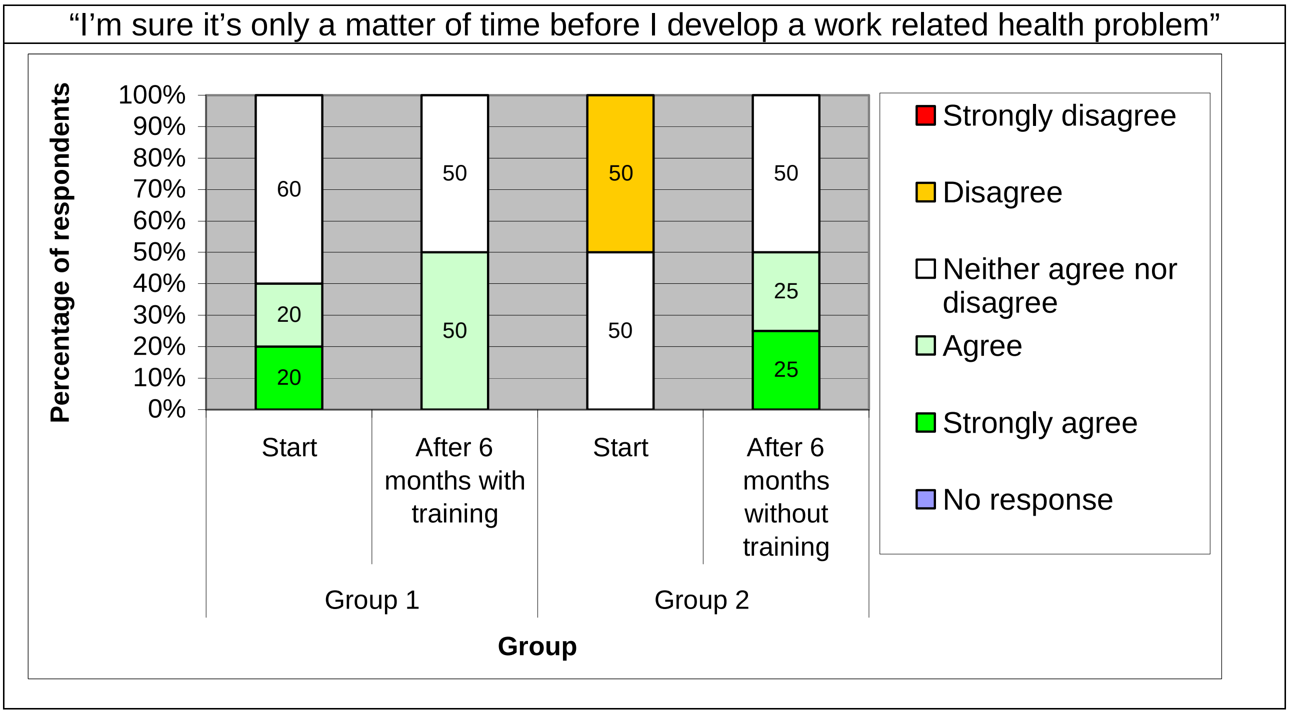


Figure 9.107 Response to health problem probability statement over time by group

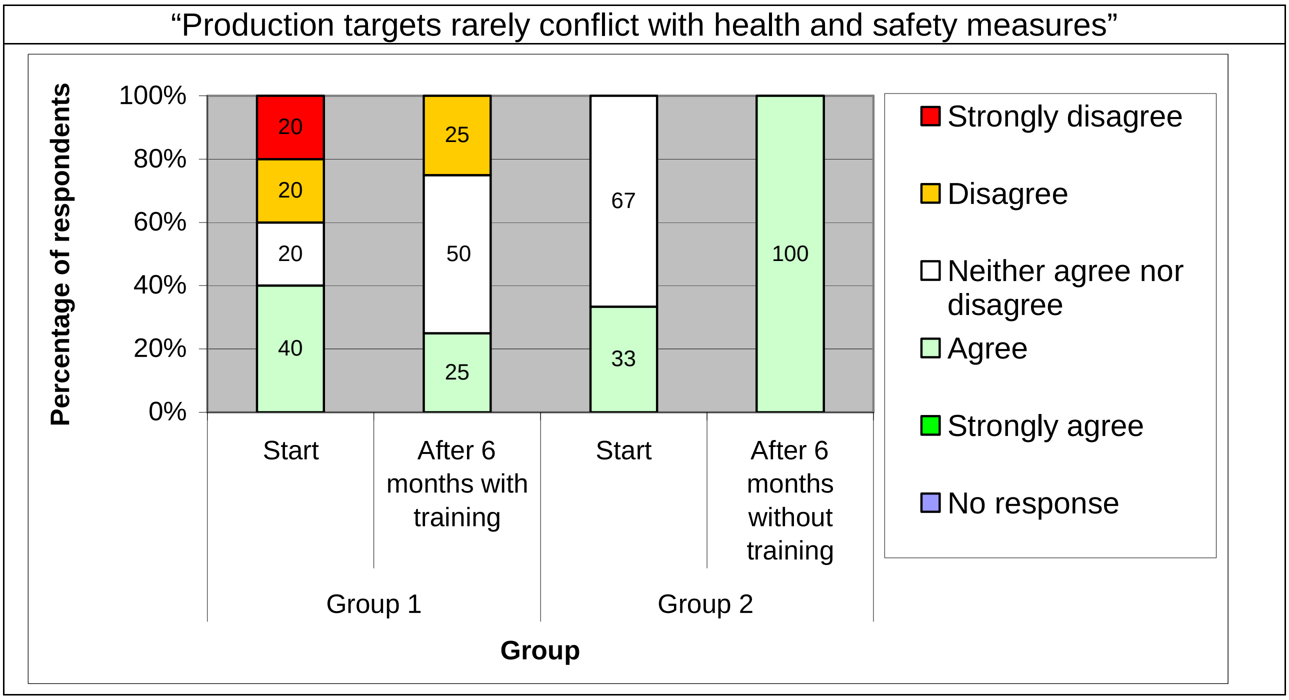


Figure 9.108 Response to production targets statement over time by group

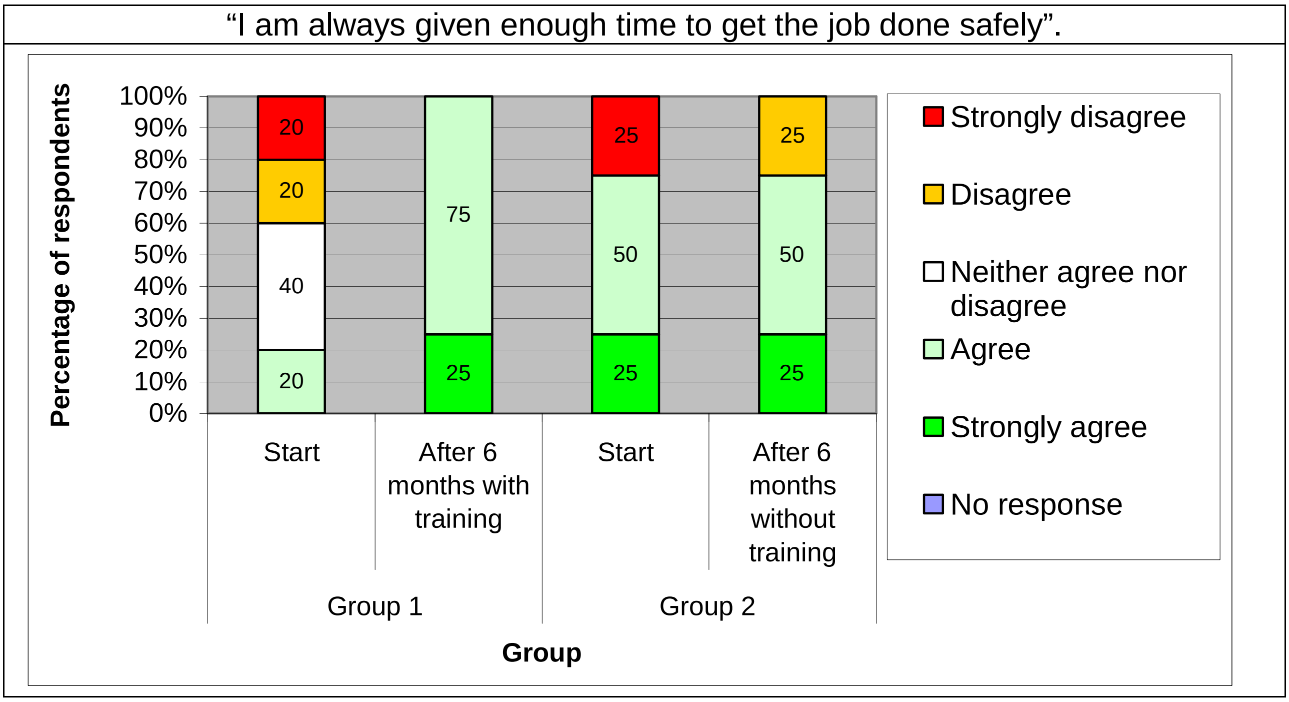


Figure 9.109 Response to time for safe work statement over time by group

Summary of attitude survey

Table 9.146 presents the statements which generated the responses most likely to reflect potential conflict.

Table 9.146. Statements most likely to reflect potential conflict.

Probe statement	Conflicting groups
In my workplace management acts quickly to correct health and safety problems	Group 1 before training
Health and safety information is always brought to my attention by my line manger/supervisor	Group 1 before training
In my workplace the chances of developing a work related health problem are quite high	Group 1 before training
There is good communication here about health and safety issues which affect me	Group 1 before training
Management here considers health and safety to be equally as important as production	Group 1 before training
I believe health and safety issues are given a high priority	Group 1 before training
Some health and safety rules and procedures don't need to be followed to get the job done safely	Group 1 before training
I am involved in informing management of important health and safety issues	Group 1 before training
I'm sure it's only a matter of time before I develop a work related health problem	Group 1 before training Group 2 after training
Production targets rarely conflict with health and safety measures	Group 1 before training
I am always given enough time to get the job done safely	Group 1 before training Group 2 before training

9.4.6 Interview and walk through with Health and Safety Manager

The final component of the study was to revisit the participating companies to undertake a further walk through with the Health and Safety Manager followed by an interview to assess any changes planned or made during the study process. In particular, this activity was intended to establish;

- where the request for change had originated from
  e.g. in response to reports made by workers, engineers, production staff, client demands,
- why they had been made
  e.g. to improve health and safety, to improve productions rates, in response to product changes, demands from external clients,
- what the changes were,
- whether the changes had been effective in achieving the aforementioned goal(s),
- whether health and safety in relation to MSDs had been improved or worsened by the changes

In practice, this component of the study was less productive than had been hoped. It had been hoped that any health and safety changes would have been integrated into the normal working practices of the participating companies and that the cultural backdrop would remain constant so as to allow those changes to be appraised. In reality, the rapid changes to the economic climate during the second half of the study had impacted significantly upon all of the organisations.

For some companies this had resulted in reduced production, a corresponding shrinking of the workforce and a restriction on investment in changes to working practices. This extended to restricting any additional training or the introduction of new innovations due to the need to control budgets.

Additionally there was not only a reduction in the overall staff complement but a rapid change in the makeup of the staff themselves.

This was partly due to seasonal factors (an annual and relatively predictable event) but also an increase in the flux of foreign workers as an increased proportion used the financial difficulties as a prompt to leave the UK.

This meant that the individuals who had made up much of the early participant set were no longer employed in the participating companies, so changes in their skills, experience, expectations and knowledge were lost to the study. Additionally, for those organisations that had retained a significant proportion of their original staff, few changes (if any) had moved beyond the concept stage since the health and safety budgets had been capped, frozen or reduced.

This perspective was a common thread amongst all of the managers who were interviewed, and seemed to be a genuine reason for little change in the status quo, as opposed to an excuse.

A summary of the information gained from the interviews and walk through activities is presented below.

Company 1 - Flowers

Company 1 had suffered considerably from the economic changes resulting in the closure of the site where the study had been undertaken. This was impending at the time of the interview and walk through. Some of the staff were to be transferred to other sites, but the employment of some would not be extended.

The Health and Safety Manager role was fulfilled by an external consultant who also had to restructure their working practices, with less time spent on site.

Because of these limitations no changes had been undertaken in the organisation during or after the study at the site where the participants had been located.

However, it was stated that some changes were being carried forward into other sites in order to improve worker health. The proposed changes are identified below in Table 9.147.

Table 9.147. Company 1 health and safety changes during and after the study.

Change	Who requested	Why requested	Change effective?	MSD H&S improved?
Reduction in weight of bulk containers for flowers to 25kg	H&S manager	H&S – reduce risk of manual handling injury	Yes	Yes
Further reduction in weight of bulk containers for flowers (proposed)	H%S manager	H&S – further reduce risk of manual handling injury	Yes	Yes
Evaluation of potential means of mechanising some of the more repetitive tasks (proposed)	H&S manager, staff	H&S & productivity - Reduce risks of repetitive actions	Yes	Yes
Introduction of more carousels which would hold flower bunches whilst they were assembled	H&S manager, Staff	H&S - Reduce amount of static grip tasks	Yes	n/k
Ongoing evaluation of working practices (proposed)	Staff	Improve H&S - Seek out potential improvements	n/k	n/k

In other respects there had been no changes within the production lines and the working culture.

The same infrastructure had been maintained, there had been no noticeable rise or fall in accident rates and there had been no new cases of reported MSDs.

Company 2 - Laboratories

Company 2 had managed to resist the workplace changes with the most effect. The majority of the staff had been continuously employed throughout the duration of the study. The Health and Safety manager was also highly motivated to improve the safety culture, and was supported by the employer.

It is also the case that this organisation employed individuals who had attained a higher level of academic achievement that the other participating companies. This had been apparent during the earlier activities, where there was a high level of interaction between the workers and the research study representatives. This increased academic experience is likely to have accounted for this company identifying and implementing more interventions.

Table 9.148 shows the changes that had been implemented or planned during the study. The main changes, namely the provision of sit/stand work stations and stools with a greater range of adjustability, were sponsored by the discomfort affecting a single member of staff. This individual was unusually tall and stooping to reach the workbench had caused discomfort. Whilst a height adjustable workstation would be a more appropriate solution, the ability to sit at a more comfortable height had relieved the pain that this individual suffered.

A further intervention of evaluating the feasibility of multiple nozzle pipettes would significantly reduce the number of repetitive actions. This had cost and work rate implications so had not yet been implemented so different patterns of work rotation were being explored to effect a more immediate improvement

These actions had also prompted the introduction of a wider ranging review of health and safety practice which it was planned to undertake to introduce a more coordinated approach to health and safety.

Table 9.148. Company 2 health and safety changes during and after the study.

Change	Who requested	Why requested	Change effective?	MSD H&S improved?
Introduction of sit/stand workstation	Line worker	Improve H&S - Discomfort from stooping	Yes	Yes
Provision of adjustable stools	Line worker	Improve H&S - Discomfort from stooping and when seated	Yes	Yes
Increase staff rotation	H&S manager, staff	Improve H&S - Reduce risks of repetitive actions	Yes	Yes
Evaluating multiple output pipettes (proposed)	Staff	Improve H&S - Reduce number of repetitions	Yes	n/k
Ongoing evaluation of working practices (proposed)	Staff	Improve H&S - Seek out potential improvements	n/k	n/k

In other respects there had been little change during and after the study. Accident rates and complaints of discomfort did not appear to have changed and remained at a low level. No additional cases of MSDs had been reported.

Company 3 – Salad preparation

Company 3 had also suffered significantly from the economic downturn that had occurred during the latter part of the study. This coincided with the normal slump in sales that occurred during the winter period. The result was a significant reduction in staff, many of whom had been involved in the early stages of the study. This had resulted in knowledge loss, a lack of continuity and interruption to planned improvements to systems and equipment.

The problems identified by Company 3 in implementing and monitoring changes were endorsed by the fact that they were unable to secure any individuals who could complete the post training questionnaire. This in itself led to difficulties in appraising the effectiveness of the study and the training in particular, but also suggested at the magnitude of the problems facing the organisation.

In discussion it was noted that no new initiatives had been implemented, although the Health and Safety Manager was confident that more improvements could be contemplated when the seasonal trade picked up. Additionally, the Health and Safety Manager was keen to develop new training packages and was looking to involve elements of the study into this. This is summarised in Table 9.149 below.

Table 9.149. Company 2 health and safety changes during and after the study.

Change	Who requested	Why requested	Change effective?	MSD H&S improved?
Development of new training packages (proposed)	H&S Manager	Improve H&S - Seek out potential improvements	n/k	n/k

Company 3 noted that there had been no apparent rise in accident rates (allowing for reduced staff complement), and no additional MSD related incidents had been noted.

Company 4 -Cakes

Company 4 had also moved through normal seasonal changes during the latter part of the study, with two peaks in production separated by a lull. This had resulted in variation in the staff complement, including some individuals who had contributed to the early stages of the study. This had in turn impacted upon the continuity of knowledge and ideas that may have been developed from the study.

Company 4 had very robust training programs and these had continued without change. They also continued to be receptive to suggestions for change from any quarter. However, no specific new policies or interventions had been taken up during the study duration, partly due to the financial caution that reflected the general economic climate (summarised in Table 9.150).

It was noted that the Health and Safety Manager took an active interest in the study and was keen to retain some of the material (checklists, teaching material) which was hoped to be included in future safety initiatives.

Table 9.150. Company 4 health and safety changes during and after the study.

Change	Who requested	Why requested	Change effective?	MSD H&S improved?
Development of new training packages (proposed)	H&S Manager	Improve H&S - Seek out potential improvements	n/k	n/k

No specific changes in health and safety practice were noted from Company 4, but they had not recorded any increase in accident or incident rates over the study period. No additional MSD issues had been raised during the study.

10 Phase 4 and 5 - Statistical analysis

A thorough statistical analysis of the results derived from Phases 4 and 5 of the research was undertaken by an expert statistician. The results of this analysis are presented in summary form in the following sections.

General notes

Some key principles are applied to the data analysis. These include the following:

- The significance criterion has been set at 0.05. At this level, it was noted that none of the Task 2 tests gave any significance.
- The data relating to the detection of errors is essentially ordinal. Because of this, low scores are required since they imply a low difference to the expert recorded score.
- The data relating to with and without training was row-ranked, because samples were related, and tested using repeated measures analysis of variance (ANOVA). The outcome was that too many ANOVA assumptions were violated so non-parametric inferential testing was used instead. However, ANOVA graphs (which continue to be valid for showing any experimental effect) have been retained, but the ordinate values of these graphs do not correspond directly to values shown in the non-parametric test output.
- Graphs have been provided only for significant or near-significant results. The bar heights for tests for main effects should be equal to the mean ranks of test outputs.
- The ordinal non-parametric tests regarding the detection of errors rank raw error detection data and then do calculations using those ranks. Accordingly, the corresponding bar charts must use the appropriate ranked variable.

10.1 Results for data relating to Task 1

For each of the analyses the results are presented by the variable under scrutiny and paraphrased as the meaningful research question.

Task 1 - Main effect of company on risk factor detection ability.

Proposition:

"On average, does the type of work make any significant difference to the risk factor detection difference-to-expert scores?"

Result

Significant correlation

A Kruskal-Wallis test revealed that it seems highly likely that the significance was being produced by a difference in detection ability between those who worked in laboratories and those who did not. The results are presented below in Table 10.1:

Table 10.1. Effect of company on risk factor detection ability.

Ranks

	Company	N	Mean Rank
DiffToExp_DV	Flowers	5	14.10
	Labs	7	5.50
	Salads	5	11.90
	Cakes	5	16.90
	Total	22	

Note: low Mean Rank implies high risk-factor detection ability.

Test Statistics[a,b]

	DiffToExp_DV
Chi-Square	10.336
df	3
Asymp. Sig.	.016

a. Kruskal Wallis Test

b. Grouping Variable: Company

This was checked by conducting a Kruskal-Wallace test with lab workers excluded, and this produced a non-significant result. Accordingly, a new variable was constructed which differentiated workers as being either Non-Lab or Lab and the Kruskal-Wallis test was rerun. This showed a significant difference in risk factor detection ability between lab workers and non-lab workers. It can be seen, therefore, that a significant main effect is the company when it is defined in this way with lab workers being significantly better than non-lab workers. The results are given in Table 10.2. and Figure 10.1

Table 10.2. Effect of company on risk factor detection ability - revised.

Ranks

	Comp_NL_L	N	Mean Rank
DiffToExp_DV	Non-Lab	15	14.30
	Lab	7	5.50
	Total	22	

Test Statistics[a,b]

	DiffToExp_DV
Chi-Square	8.835
df	1
Asymp. Sig.	.003

a. Kruskal Wallis Test

b. Grouping Variable: Comp_NL_L

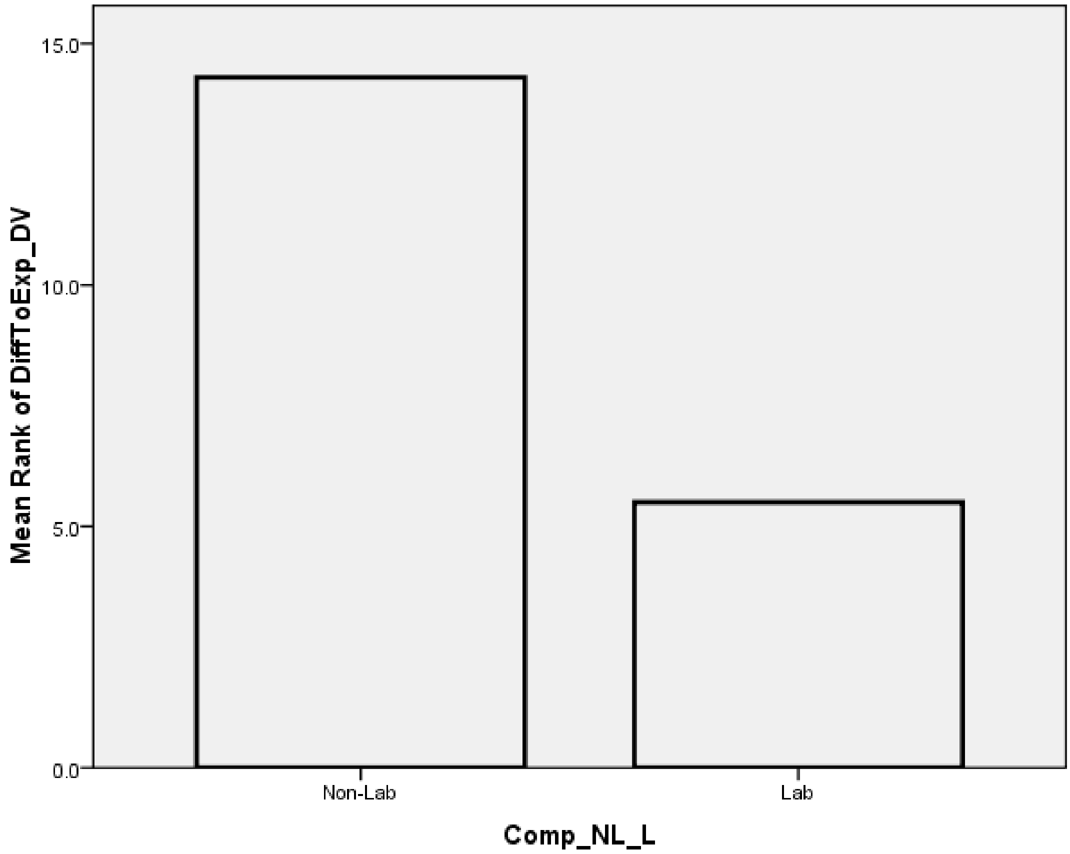


Figure 10.1 Effect of company on risk detection ability

Task1 - Main Effect of Position on Risk Factor Detection Ability,

Proposition

“On average, does the worker status (worker, leader) make any significant difference to the risk factor detection difference-to-expert scores?”

Result

No significant correlation

A Kruskal-Wallis test using Position as the independent variable was conducted and found to be non-significant. Thus the data does not give acceptable evidence of a main effect of status on the ability to detect risk factors. The results are given in Table 10.3.

Table 10.3. Effect of position on risk factor detection ability.

Ranks

	Position	N	Mean Rank
DiffToExp_DV	Team leader/Line leader/Line manager	9	13.44
	Line worker/operative	13	10.15
	Total	22	

Test Statistics[a,b]

	DiffToExp_DV
Chi-Square	1.377
df	1
Asymp. Sig.	.241

a. Kruskal Wallis Test

b. Grouping Variable: Position

Task1 - Main Effect of Training on Risk Factor Detection Ability

Proposition:

"On average, does the worker training (untrained, trained) make any significant difference to the risk factor detection difference-to-expert scores?"

Result:

No significant correlation.

A Friedman Test was conducted using both trained and untrained risk factor detection as independent variables. Friedman testing was used since the dependent variable samples are related and the data is essentially ordinal. The output was found to be non-significant therefore the data does not give acceptable evidence of a main effect of training on risk factor detection ability. Te results are shown in Table 10.4.

Table 10.4. Effect of training on risk factor detection ability.

Ranks

	Mean Rank
ABS_UT_DV	1.39
ABS_T_DV	1.61

Test Statistics[a]

N	22
Chi-Square	1.471
df	1
Asymp. Sig.	.225

a. Friedman Test

Task 1 - Main Effect of Checklist on Risk Factor Detection Ability

Proposition:

“On average, does the checklist (A, B) used make any significant difference to the risk factor detection difference-to-expert scores?”

Result:

Significant correlation

A Kruskal-Wallis test was conducted and found to be marginally non-significant. Thus, strictly, the data does not give acceptable evidence of a main effect of status on the ability to detect risk factors. However, it is clear that the results would have been significant had there been a few more participants, and those results would have shown that checklist A had an effect which is better than that of checklist B for risk factor detection. This is shown in Table 10.5 and Figure 10.2.

Table 10.5. Effect of checklist on risk factor detection ability.

Ranks

	Checklist	N	Mean Rank
DiffToExp_DV	A	12	9.08
	B	10	14.40
	Total	22	

Test Statistics[a,b]

	DiffToExp_DV
Chi-Square	3.686
df	1
Asymp. Sig.	.055

a. Kruskal Wallis Test

b. Grouping Variable: Checklist

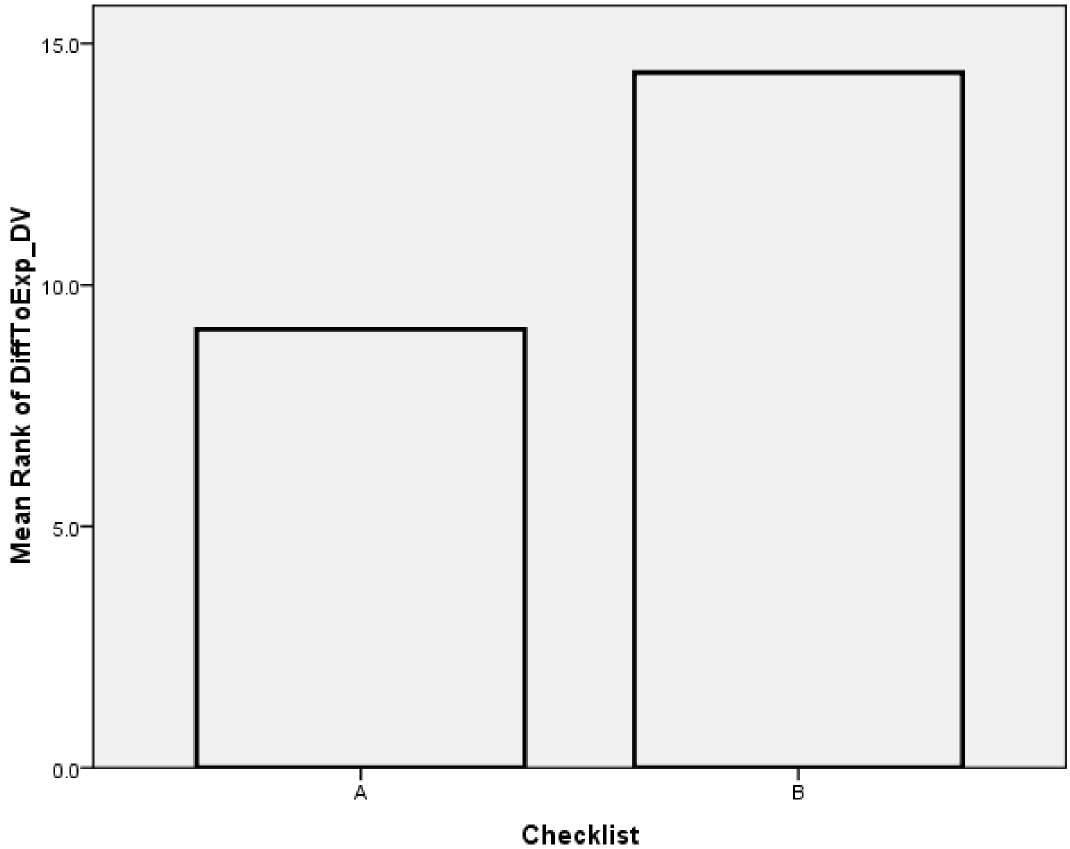


Figure 10.2 Effect of checklist on risk detection ability

Task 1 - Interaction of Company and Position on Risk Factor Detection Ability

Proposition:

"On average, is the effect of Company (Non-Lab and Lab) on risk factor detection ability significantly modified by worker status?"

Result:

No significant correlation.

The ranked dependent variable data violates ANOVA assumptions, so a Kruskal-Wallis test was used with Position as the independent variable. This proved to be non-significant indicating that this data is not acceptable as evidence of interaction between Company and Position on Risk Detection Ability. The results are shown in Table 10.6.

Table 10.6. Interaction of company and position on risk factor detection ability.

Ranks

	Co_Pos_Int	N	Mean Rank
DiffToExp_DV	1	8	10.19
	2	14	12.25
	Total	22	

Test Statistics[a,b]

	DiffToExp_DV
Chi-Square	.518
df	1
Asymp. Sig.	.472

a. Kruskal Wallis Test

b. Grouping Variable: Co_Pos_Int

Task 1 - Interaction of Company and Training on Risk Factor Detection Ability,

Proposition:

"On average, is the effect of Company (Non-Lab and Lab) on risk factor detection ability significantly modified by training?"

Result:

Significant correlation.

Absolute trained-untrained row differences were calculated and column-ranked before being tested for with Company (lab and Non-lab) in univariate ANOVA. This was found to violate too many assumptions. However, unranked absolute differences when used with Kruskal-Wallis testing were as found significant, so this data is acceptable as evidence that effect of (non-lab, lab) work type on risk factor detection ability is modified by training. Alternatively, the effect of training on risk factor detection ability is modified (non-lab, lab) work-type. The results are given in Table 10.7.

Table 10.7. Interaction of company and training on risk factor detection ability.

Ranks

	Comp_NL_L	N	Mean Rank
TrainAbsDiff_DiffsToE_DV	Non-Lab	15	13.87
	Lab	7	6.43
	Total	22	

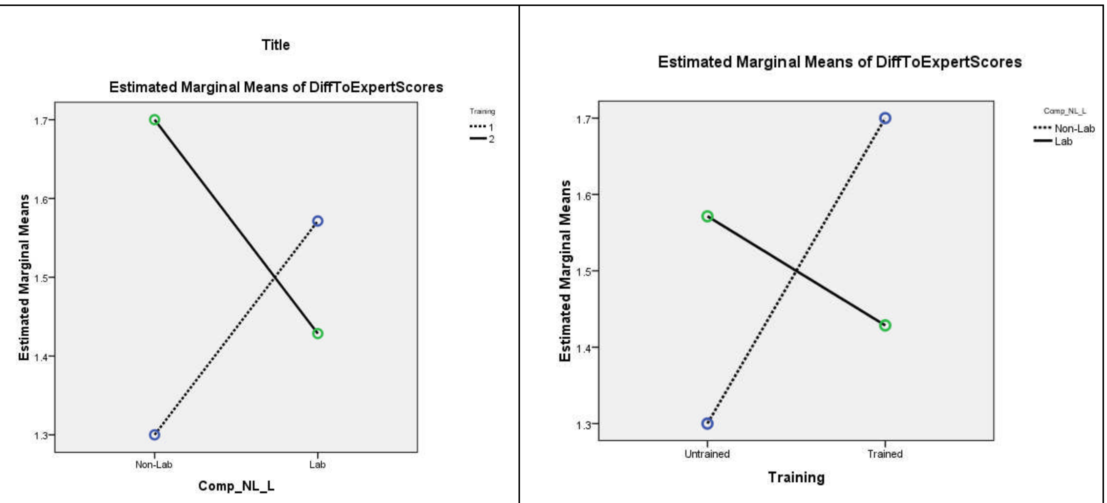
Test Statistics[a,b]

	TrainAbsDiff_DiffsToE_DV
Chi-Square	6.520
df	1
Asymp. Sig.	.011

a. Kruskal Wallis Test

b. Grouping Variable: Comp_NL_L

Although the inferential analysis of a repeated measures ANOVA is not valid, the graphical output supports a significant interaction (Figure 10.3 below, noting that the graphs give the same information).



1 = Untrained
2 = Trained

Figure 10.3 Interaction of company and training on risk detection ability

Task1 - Interaction of Company and Checklist on Risk Detection Ability

Proposition:

"On average, is the effect of Company (Non-Lab and Lab) on risk factor detection ability significantly modified by the checklist used?"

Result

This data was unsuitable for any test since there was a missing category: No lab worker has used checklist B.

Task 1 - Interaction of Position and Training on Risk Detection Ability

Proposition:

"On average, is the effect of worker status (worker, leader) on risk factor detection ability significantly modified by training?"

Result:

No significant correlation.

This data was not suitable for ANOVA testing. A Kruskal-Wallis test using Position as the independent variable and absolute trained-untrained row differences gives non-significance. However, the obtained significance is fairly low, suggesting that a doubling or tripling of participant numbers would show an effect. Although the data is unsuitable for the inferential part of ANOVA testing, the ANOVA graphs suggest that significance would be obtained with a slight increase in slope. However, the current data is not acceptable as evidence of an interaction between Position and training on risk detection ability. The results are given in Table 10.8. and Figure 10.4.

Table 10.8. Interaction of position and training on risk factor detection ability.

Ranks

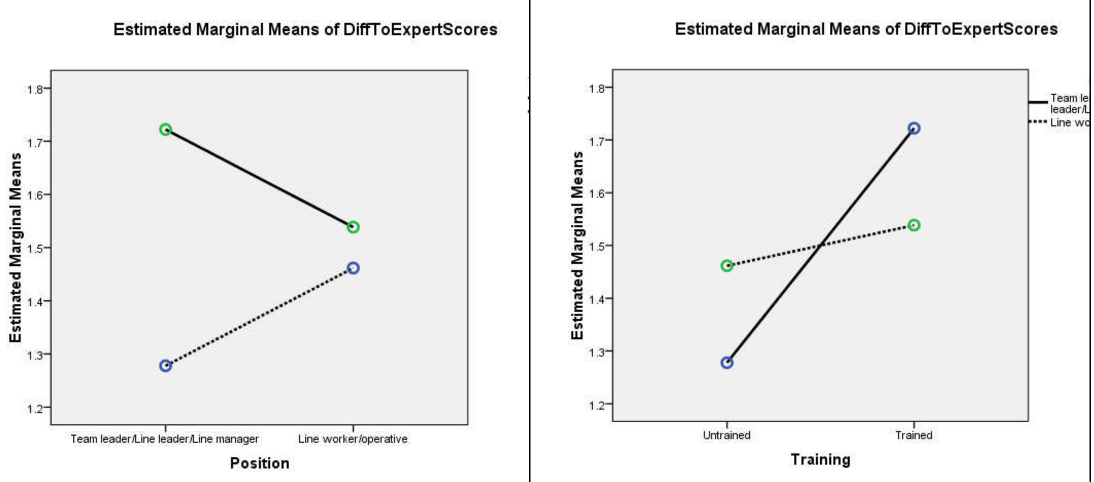
	Position	N	Mean Rank
TrainAbsDiff_DiffsToE_DV	Team leader/Line leader/Line manager	9	13.94
	Line worker/operative	13	9.81
	Total	22	

Test Statistics[a,b]

	TrainAbsDiff_DiffsToE_DV
Chi-Square	2.247
df	1
Asymp. Sig.	.134

a. Kruskal Wallis Test

b. Grouping Variable: Position



1 = Untrained
2 = Trained

Figure 10.4. Interaction of position and training on risk detection ability

Task1 - Interaction of Position and Checklist on Risk Detection Ability

Proposition:

"On average, is the effect of worker status (worker, leader) on risk factor detection ability significantly modified by the checklist used?"

Result:

No significant correlation.

The data was unsuitable for ANOVA tests. Interaction analysis is very non-significant indicating that the data is not acceptable as evidence of an interaction between Position and Checklist on Risk Detection Ability. The results are given in Table 10.9.

Table 10.9. Interaction of position and checklist on risk factor detection ability.

Ranks

	Pos_Checkl_Int	N	Mean Rank
DiffToExp_DV	1	10	11.75
	2	12	11.29
	Total	22	

Test Statistics[a,b]

	DiffToExp_DV
Chi-Square	.027
df	1
Asymp. Sig.	.869

a. Kruskal Wallis Test

b. Grouping Variable: Pos_Checkl_Int

Task 1 - Interaction of Training and Checklist on Risk Detection Ability,

Proposition:

"On average, is the effect of training (untrained, trained) on risk factor detection ability significantly modified by the checklist used?"

Result:

Significant correlation

This data is unsuitable for the inferential part of ANOVA testing, so Kruskal-Wallis was used with Checklist as the independent variable.

Here the data shows significance, indicating that the data is acceptable as evidence of the effect of training on risk detection ability is modified by the checklist used or, alternatively, that the effect of the checklist used on risk detection ability is modified by whether or not training has been received. The results are shown in Table 10.10, with ANOVA graph output in Figure 10.5.

Table 10.10. Interaction of training and checklist on risk factor detection ability.

Ranks

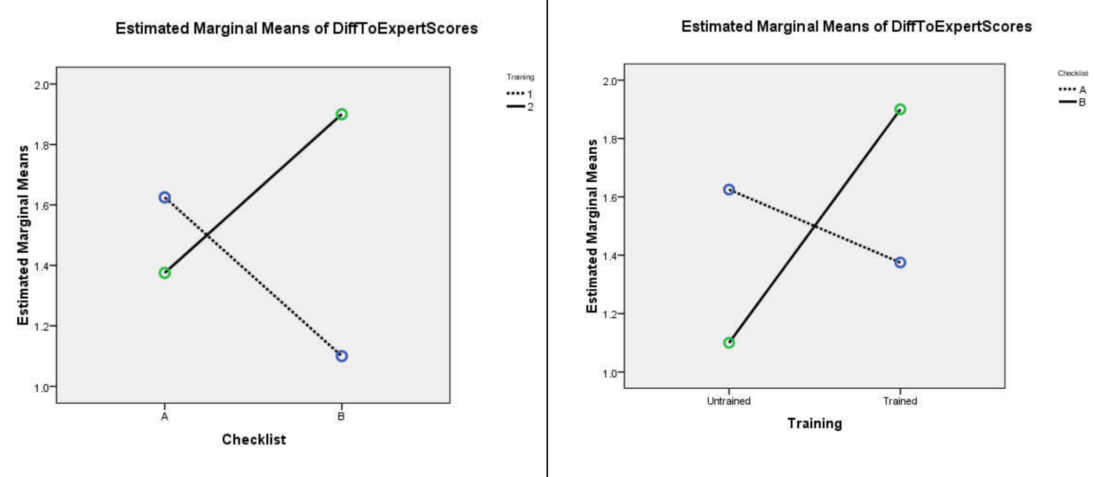
	Checklist	N	Mean Rank
TrainAbsDiff_DiffsToE_DV	A	12	8.04
	B	10	15.65
	Total	22	

Test Statistics[a,b]

	TrainAbsDiff_DiffsToE_DV
Chi-Square	7.796
Df	1
Asymp. Sig.	.005

a. Kruskal Wallis Test

b. Grouping Variable: Checklist



1 = Untrained
2 = Trained

Figure 10.5. Interaction of training and checklist on risk detection ability

10.2 Results for data relating to Task 2

These results are presented in a similar fashion with the variable under scrutiny stated and paraphrased as the meaningful research question.

Task 2 - Main Effect of Company on Risk Factor Detection Ability

Proposition:

"On average, does the type of work (as defined by the 4 types in the variable Company) make any significant difference to the risk factor detection difference-to-expert scores?"

Result:

No significant correlation.

The data was found to violate too many ANOVA assumptions, so a Kruskal-Wallis test was used with Company as the independent variable. These results were also non-significant, so the data is not acceptable as evidence of a main effect of work-type on risk factor detection ability. The results are shown in Table 10.11.

Table 10.11. Effect of company on risk factor detection ability (Task 2).

Ranks

	Company	N	Mean Rank
ABS_DV	Flowers	12	18.50
	Labs	16	26.56
	Salads	8	20.25
	Cakes	8	22.62
	Total	44	

Test Statistics[a,b]

	ABS_DV
Chi-Square	3.187
df	3
Asymp. Sig.	.364

a. Kruskal Wallis Test

b. Grouping Variable: Company

Task 2 - Main Effect of Position on Risk Factor Detection Ability

Proposition:

"On average, does the worker status (worker, leader) make any significant difference to the risk factor detection difference-to-expert scores?"

Result:

No significant correlation.

The data was column-ranked to and this was used with a univariate ANOVA analysis, with Position as the independent variable. Cases with a data value of 0 were filtered out. The data was found to violate too many ANOVA assumptions, so a Kruskal-Wallis test was used with Position as the independent variable. The results (Table 10.12) were non-significant, so this data is not acceptable as evidence of a main effect of work-type on risk factor detection ability.

Table 10.12. Effect of position on risk factor detection ability (Task 2).

Ranks

	Position	N	Mean Rank
ABS_DV	Team leader/Line leader/Line manager	14	17.96
	Line worker/operative	27	22.57
	Total	41	

Test Statistics[a,b]

	ABS_DV
Chi-Square	1.453
Df	1
Asymp. Sig.	.228

a. Kruskal Wallis Test

b. Grouping Variable: Position

Task 2 - Main Effect of Training on Risk Detection Ability

Proposition:

"On average, does the worker training (untrained, trained) make any significant difference to the risk factor detection difference-to-expert scores?"

Result:

No significant correlation.

The data was column-ranked and this was used with a univariate ANOVA analysis, with Training as the independent variable. The data was found to be consistent with ANOVA assumptions. Also, a Kruskal-Wallis test was used with Training as the independent variable. Results were very close but non-significant, so this data is not acceptable as evidence of a main effect of training on risk factor detection ability. Results from the Kruskal-Wallis test are shown in Table 10.13.

Table 10.13. Effect of training on risk factor detection ability (Task 2).

Ranks

	Any_Training	N	Mean Rank
ABS_DV	With training	24	21.50
	Without training	20	23.70
	Total	44	

Test Statistics[a,b]

	ABS_DV
Chi-Square	.339
Df	1
Asymp. Sig.	.561

a. Kruskal Wallis Test

b. Grouping Variable: Any_Training

Task 2 - Main Effect of Checklist on Risk Factor Detection Ability

Proposition:

“On average, does the checklist (A, B) used make any significant difference to the risk factor detection difference-to-expert scores?”

Result:

No significant correlation.

The data was column-ranked and this was used with a univariate ANOVA analysis, with Checklist as the independent variable.

The data was found to violate too many ANOVA assumptions, so a Kruskal-Wallis test was used with Checklist as the independent variable. The results (Table 10.14) were non-significant, so this data is not acceptable as evidence of a main effect of checklist on risk factor detection ability.

Table 10.14. Effect of checklist on risk factor detection ability (Task 2).

Ranks

	Checklist	N	Mean Rank
ABS_DV	A	27	22.72
	B	16	20.78
	Total	43	

Test Statistics[a,b]

	ABS_DV
Chi-Square	.254
df	1
Asymp. Sig.	.615

a. Kruskal Wallis Test

b. Grouping Variable: Checklist

Task 2 - Interaction of Company and Position on Risk Factor Detection Ability

Proposition:

"On average, is the effect of Company (i.e. the 4 types of work) on risk factor detection ability significantly modified by worker status?"

Result:

No significant correlation.

This data was column-ranked and this was used with a univariate ANOVA analysis, with Company and Position as independent variables and with rows with Position=0 filtered out. The data was found to violate too many ANOVA assumptions, so adapted Kruskal-Wallis tests were used to get a conservative estimate.

The output of all tests was non-significant (0.737 for the ANOVA and 0.455-0.904 for the Kruskal-Wallis tests) so the data is not acceptable as evidence of an interactive effect of work-type (Company) and Position (worker, leader) on risk factor detection ability. The results for the best Kruskal-Wallis tests are shown in Table 10.15.

Table 10.15. Interaction of company and position on risk factor detection ability (Task 2).

Ranks

	CoPosIV4	N	Mean Rank
CoPosDV4	1	27	21.98
	2	14	19.11
	Total	41	

Test Statistics[a,b]

	CoPosDV4
Chi-Square	.558
df	1
Asymp. Sig.	.455

a. Kruskal Wallis Test

b. Grouping Variable: CoPosIV4

Task 2 - Interaction of Company and Training on Risk Factor Detection

Proposition:

"On average, is the effect of Company (Non-Lab and Lab) on risk factor detection ability significantly modified by training?"

Result:

No significant correlation.

The data was column-ranked and this was used with a univariate ANOVA analysis, with Company and Training as independent variables. The data was found to violate too many ANOVA assumptions, so adapted Kruskal-Wallis tests were used to get a conservative estimate.

The output of all tests was non-significant (0.093 for the ANOVA and 0.161-0.377 for the Kruskal-Wallis tests) so this data is not acceptable as evidence of an interactive effect of work-type (Company) and Training (untrained, trained) on risk factor detection ability. Results for the best Kruskal-Wallis test are shown in Table 10.16 and Figure 10.6.

Table 10.16. Interaction of company and training on risk factor detection ability (Task 2).

Ranks

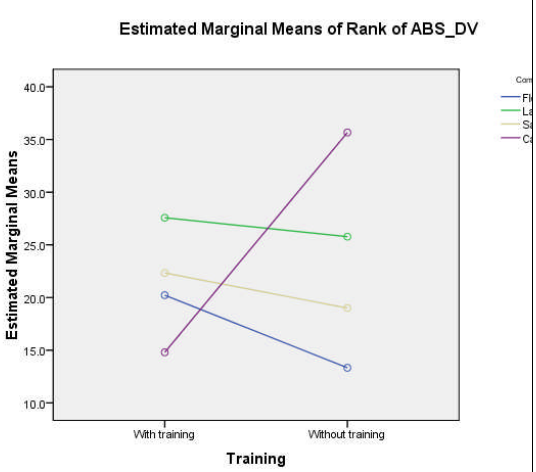
	CoTrain_IV1	N	Mean Rank
CoTrain_DV1	1	26	24.73
	2	18	19.28
	Total	44	

Test Statistics[a,b]

	CoTrain_DV1
Chi-Square	1.961
df	1
Asymp. Sig.	.161

a. Kruskal Wallis Test

b. Grouping Variable: CoTrain_IV1



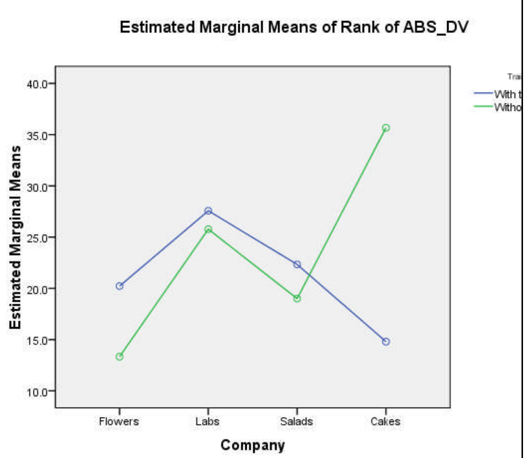


Figure 10.6. Interaction of company and training on risk detection ability (Task 2)

Task 2 - Interaction of Company and Checklist on Risk Detection Ability

Proposition:

"On average, is the effect of work-type (Company) on risk factor detection ability significantly modified by the checklist used?"

Result:

The interaction could not be assessed because the data was unsuitable – checklists A and B were not used by each company (Flowers and Labs used only checklist A, Salads and cakes used only checklist B).

Task 2 - Interaction of Position and Training on Risk Detection Ability

Proposition:

"On average, is the effect of worker status (worker, leader) on risk factor detection ability significantly modified by training?"

Result:

No significant correlation.

The cases for which Position = 0 were filtered out. The dependent variable data was column-ranked and this was used with a univariate ANOVA analysis, with Position and Training as independent variables. The data was found to violate too many ANOVA assumptions, so adapted Kruskal-Wallis tests were used to get a conservative estimate. The output of all tests was non-significant (0.255 for the ANOVA and 0.257 for the Kruskal-Wallis) so this data is not acceptable as evidence of an interactive effect of Position (worker, leader) and Training (untrained, trained) on risk factor detection ability. The results for the Kruskal-Wallis test are shown in Table 10.17 and Figure 10.7.

Table 10.17. Interaction of position and training on risk factor detection ability (Task 2).

Ranks

	PosTrain_IV	N	Mean Rank
ABS_DV	1	24	19.27
	2	17	23.44
	Total	41	

Test Statistics[a,b]

	ABS_DV
Chi-Square	1.283
df	1
Asymp. Sig.	.257

a. Kruskal Wallis Test

b. Grouping Variable: PosTrain_IV

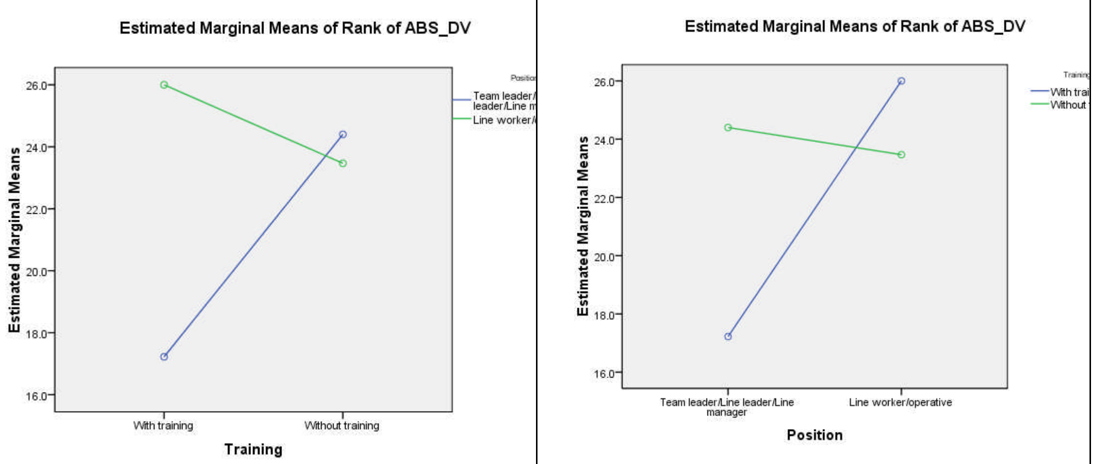


Figure 10.7. Interaction of position and training on risk detection ability (Task 2)

Task 2 - Interaction of Position and Checklist on Risk Detection Ability

Proposition:

"On average, is the effect of worker status (worker, leader) on risk factor detection ability significantly modified by the checklist used?"

Result:

No significant correlation.

Initially, cases for which Position = 0 were filtered out. The data was then column-ranked and this was used with a univariate ANOVA analysis, with Position and Checklist as independent variables.

The data was found to violate too many ANOVA assumptions, so adapted Kruskal-Wallis tests were used to get a conservative estimate. The output of all tests was non-significant (0.538 for the ANOVA and 0.751 for the Kruskal-Wallis test) so this data is not acceptable as evidence of an interactive effect of Position (worker, leader) and Checklist (A,B) on risk factor detection ability. The results for the Kruskal-Wallis test are shown in Table 10.18.

Table 10.18. Interaction of position and checklist on risk factor detection ability (Task 2).

Ranks

	PosCheck_IV	N	Mean Rank
ABS_DV	1	15	21.23
	2	25	20.06
	Total	40	

Test Statistics[a,b]

	ABS_DV
Chi-Square	.100
df	1
Asymp. Sig.	.751

a. Kruskal Wallis Test

b. Grouping Variable: PosCheck_IV

Task 2 - Interaction of Training and Checklist on Risk Detection Ability

Proposition:

"On average, is the effect of training (untrained, trained) on risk factor detection ability significantly modified by the checklist used?"

Result:

No significant correlation.

The dependent variable data was column-ranked and this was used with a univariate ANOVA analysis, with Training and Checklist as independent variables. The data was found to violate too many ANOVA assumptions, (although for this test, the decision was marginal) so an adapted Kruskal-Wallis test was used to get a conservative estimate.

The output of the test was non-significant (0.261 for the ANOVA and 0.317 for the Kruskal-Wallis test) so this data is not acceptable as evidence of an interactive effect of Training (untrained, trained) and Checklist (A,B) on risk factor detection ability. Results for the Kruskal-Wallis test are shown in Table 10.19 and Figure 10.8.

Table 10.19. Interaction of training and checklist on risk factor detection ability (Task 2).

Ranks

	TrainCheck_IV	N	Mean Rank
ABS_DV	1	23	23.74
	2	20	20.00
	Total	43	

Test Statistics[a,b]

	ABS_DV
Chi-Square	1.002
df	1
Asymp. Sig.	.317

a. Kruskal Wallis Test

b. Grouping Variable: TrainCheck_IV

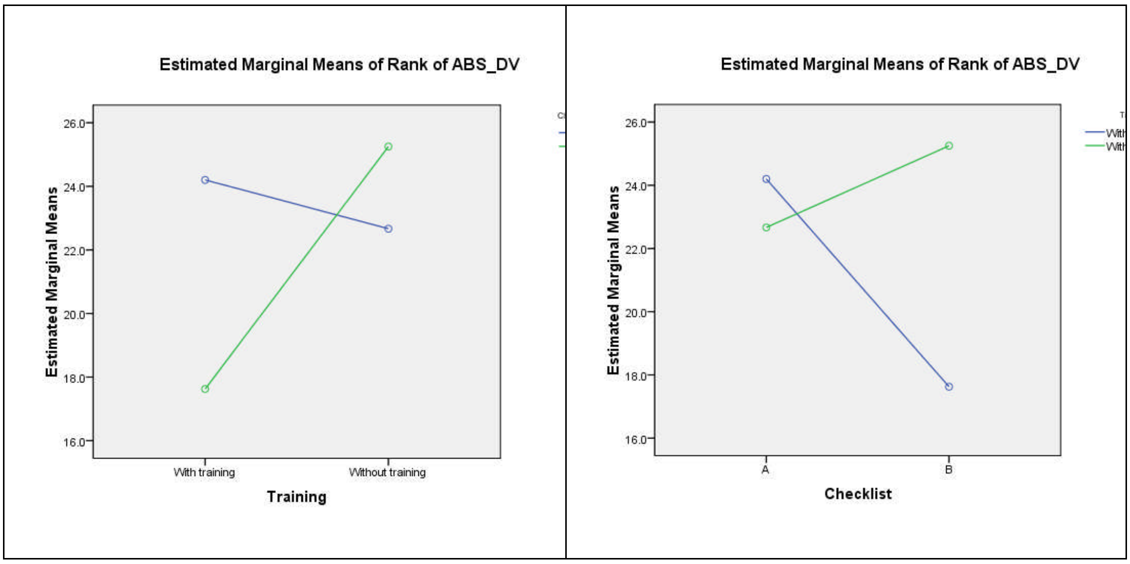


Figure 10.8. Interaction of training and checklist on risk detection ability (Task 2)

10.3 Summary of statistical findings

The findings of the statistical testing are summarised in the following Sections, giving the relevance of the outcomes to the research programme.

Risk Factor Detection Ability for Task1 (for tests showing significance)

- Overall, laboratory workers were better than others.
- Overall, checklist A was better than checklist B
- When training is not given, non-laboratory workers are much better than laboratory workers,
- When training is given, laboratory worker become better than non-laboratory workers.
- When training is not given, checklist B is better than checklist A
- When training is given, checklist A is better than checklist B

Risk Factor detection Ability for Task2 (all tests show non-significance)

No conclusions could be drawn because all tests gave non-significant results. As a rough intuitive estimate, about 4 times the number of participants would have been needed to give significance.

Effects Suggested by Tests Showing Non-Significance

Comment is made only for those tests giving p-values where $p <= 0.4$ because above this level, the numbers of participants required would be very large and the experimental effects are likely to be very small.

Risk Factor Detection Ability for Task1

- Overall, workers are better than leaders/managers.
- Overall, untrained people are better than trained people.
- When training is not given, leaders/managers are better than workers
- When training is given, workers are better than leaders/managers.

Risk Factor Detection Ability for Task 2

- Overall, people working with flowers were much better than those working with salads, cakes or in laboratories. People working in laboratories were much worse than those working with flowers, salads or cakes.
- Overall, leaders/managers were better than workers
- People working with flowers, salads and in laboratories are better without training, but people working with cakes are better with training
- Untrained workers were better than untrained leaders/managers but trained leaders/managers were better than trained workers.
- For untrained people, checklist A is better than checklist B but for trained people, checklist B is better than checklist A.

10.4 Additional testing

Further checks were undertaken to determine if there were any transformations which could be used to make the data usable with ANOVA tests. Unfortunately, conventional transformations revealed no greater possibility for the use of ANOVA tests and consequently the findings reported previously remain the best available.

Additional testing was undertaken to include Multistage Bonferroni Correction. In total 18 tests were conducted, 9 for the Task 1 participants and 9 for the Task 2 participants. It should be noted that there was no significance for a 5% criterion for the Task 2 tests, so there was no value in applying the criterion to those tests. However, there was significance for a 5% criterion for some of the Task 1 tests; when the correction was applied. The results are shown in Table 10.20.

Table 10.20. Multistage Bonferroni Correction (Task 1).

P-value	Significance Criterion	Significant?
0.003	0.05/9 = 0.0056	Yes
0.005	0.05/8 = 0.0062	Yes
0.011	0.05/7 = 0.0071	No
0.055	0.05/6 = 0.0083	No
0.134	0.05/5 = 0.0100	No
0.225	0.05/4 = 0.0125	No
0.241	0.05/3 = 0.0167	No
0.472	0.05/2 = 0.0250	No
0.869	0.05/1 = 0.0500	No

Task2

Correction not applied – nothing significant to start with

This correction leaves only the tests giving p-values of 0.003 and 0.005 as being truly significant, so, strictly, conclusions should be drawn only in respect of those results. However, for the remaining tests, there is no harm in indicating the effects that they suggest.

Accordingly, the tests and corresponding conclusions divide themselves into 3 classes;

(a) those which are non-significant when run

(b) those which are significant when run

(c) those which are significant with Bonferroni Correction.

The main body of the statistical findings deals only with (a) and (b). Following the Bonferroni Correction a few of the conclusions relating to (a) should be moved to (c)

One way for reducing the negative impact of the Bonferroni Correction would be to rule out a set of tests as a complete class - e.g. all interactions, or all tests involving a specific variable because they do not relate to the experimental hypotheses that were specified a priori (given that it would be incorrect to specify them post-hoc). This might change the status of some of the tests and conclusions from (b) to (c) but it would have no effect on (a).

Another approach might be to treat the overall findings as an exploratory study which paves the way to a later more targeted study which could recruit much larger participant samples and offer a higher degree of consistency within specific organisations.

It is possible to argue that these findings are specific to the study that has been undertaken and that conclusions are not necessarily to be generalised to the overall population. In this case, the significance criterion could be set at a level that was felt appropriate. A value of 0.4 has been suggested to rule out very small experimental effect sizes. This would increase the number and scope of the investigation variables which were observed to be significant within the context of this research rather than reflecting the whole working population.

11 Discussion

This motivation behind this research project was to establish the key variables in the nature of checklists intended for aiding risk assessment and to scrutinise the role of training in the effectiveness of checklist application. Effectiveness was determined as the ability to correctly identify risk factors when they were present and to select appropriate interventions to help reduce the effects of those risk factors. These are the prime elements which make up the practical value of the risk assessment process.

The problem that industry faces is that of competition for resources. Whist it is entirely reasonable to anticipate that no company intentionally wishes harm upon its workforce, there are clearly tensions between profitability, efficiency and safe working practices. The balance struck between these variables will differ between companies and even between departments in the same company. How that balance is decided upon may be through design or chance, but once chosen there will clearly be a motivation to substantiate the correctness of that stance. This is one of the inherent problems with risk assessment – because it contains subjective elements then the results can be engineered if so desired.

It may be argued that the mantra that safety if the first priority is somewhat distorted. Current practice is evidently to manufacture safely rather than to safely manufacture – the emphasis being on the paramount need to produce viable product but to try and do so safely, rather than to ensure safe practices are laid down and then evaluate whether the product can be manufactured for reasonable cost. It would not necessarily be unfair to say that the interests of the shareholders still dominate over the interests of the workforce – as can be substantiated by the working practices employed on the grounds of economy. Automation, slower production rates, higher staffing levels and numerous other investment-heavy variables could be employed to provide a safer working environment but are not because of the costs involved.

Whilst this may be the reality it does not necessarily have to be acceptable. This is particularly true when site visits reveal both chronic and acute occupational problems for which the company cannot apparently find resources, yet they still return share dividends and bonuses. This is, to some degree, understandable given the immediacy of profit statement versus the longer term costs of occupational welfare. However, once this situation becomes apparent then the 'safety first' culture can be revealed to be a misguided presumption.

Legal obligations on employers should ensure that safe working practices are financed and employed, but poor intervention knowledge and enforcement, alongside the a lack of financial resources result in inferior levels of safety on a day to day level for many workers.

It is important to establish the current cultural climate before attempting to evaluate the effectiveness of procedures such that erroneous assumptions are avoided. In evidence, despite the assurances from all the companies that participated in the study that safety was there highest priority, all had factors present in their working practices (some of which were quite hazardous) which could readily be made safer if more money was spent on the design of the work system. In some instances this was not readily apparent, and assistance may have been required to help the company identify the areas for improvement. However, in other instances the activities being undertaken were bordering on completely unacceptable. In these cases is it likely that the health and safety practitioner responsible was working without the full support of their Board, but also may have lost sight of some of the problems due to routine exposure.

On other occasions it could be seen that safety benefits had been consumed as performance benefits, rendering the levels of safety lower again. Alternatively, safe practice was observed to have been overruled by more subtle influences such as the brand image or personal preference of senior employees.

The message here is strong. There is an awareness of safety at all levels within the manufacturing sector, but it is not clearly seem as an obligation, more as an interpretative option. Accordingly, scientific evaluation of modifications to safety practice is unlikely to be easy.

In addition there is also an issue with recognition that there is a problem to solve. Safety practitioners may be unaware that the activities in their company present an unacceptable level of risk due to poor education, poor evaluation or misleading behaviour (whereby the workers change behaviour when they are being assessed). These circumstances may be easier to address through the provision of better quality risk assessment tools. However, unless there is an awareness raising exercise and a political will to change then there is unlikely to be an improvement in individuals recognising their own limitations. In this fashion it is likely that defective systems will be considered adequate, that problems will be considered conventions and that injuries are considered inevitable not due to deliberate action but due to default – those with responsibility simply are not aware that an issue exists.

Risk assessment is intended to alleviate this situation and consequently forms a main component of both legislation and guidance. The wording of the legislation and guidance is clear and the expectation of the actions which should result apparent. However, the assumption that all stakeholders will willingly ‘buy into’ the philosophy is perhaps optimistic. Unfortunately, this assumption leads to the provision of numerous risk assessment tools, many of them checklist based, intended to be used by enthusiastic safety practitioners, for the benefit of a responsible and motivated workforce and with the support of an empathetic board. It is almost inevitable that this will fail.

The result is that risk assessment becomes a formality, undertaken by under resourced and under supported practitioners, seen by the workforce as ineffective and devious and viewed by the board as leverage for unnecessary expenditure.

In this light it is no surprise that the simplest risk assessment tools are often considered the best and those tools which fail to interrogate the processes particularly effectively will also be preferred, since they are unlikely to illuminate problems which need to then be resolved. This may explain the popularity of proprietary of free risk assessment tools over bespoke versions. It may also be the case that practitioners wish to use the tools that are likely to be used by any enforcement agency such that they can avoid later confrontation. This might be despite the tools being inappropriate or compromised in their effectiveness.

It can be seen therefore that the presumption that risk assessment is a good thing relies on a number of flawed assumptions, largely related to the perversity of human nature and the primary focus of manufacturing industry to be commercially viable.

Despite this, risk assessment is arguably the only thing that can be legally required and consistently applied. However, by acknowledging the limitations and conflicting motives in safety practice then better assessment tools can be derived. This project set out to evaluate the performance of such tools and to identify the critical elements with them when they are applied in the manner in which current legislation and guidelines envisage – namely across a diversity of staff all of whom are motivated to use them effectively.

The findings should inform the development of better risk assessment tools, at least in theory, for this application. However, it is probable that the effectiveness of the tools through their design is dwarfed by the compromises made by other factors. Chief amongst these are financial restrictions and motivation of participating staff. It is clear that the assumption that all staff collaborating in a harmonious fashion towards the highest levels of safety is not supported and some workers clearly either do not want to contribute or are unable to contribute. This has significant impact on the nature of effective risk assessment design: If it is intended to be used by a more select group of individuals it can be tailored more effectively.

In order to be able to apply the findings of this work it is important for that distinction to be made. A recognition that workers might be involved in the process, for instance by discussion or observation rather than by actually using the assessment tools, means that the content and structure of the tools can be better suited to the practitioners. Similarly, if the tools are better designed for those practitioners then the results will be more accurate (and therefore more trusted by the other stakeholders) and be of more value in attempting to get boardroom engagement for funds. Ideally it could lead to a situation as is currently found in road safety where safety interventions could be justified by more accurate financial modelling of health costs.

The alternative is that the current situation is retained, albeit with the design of the tools improved for general comprehension. This inclusive approach will mean that the tools lose effectiveness in their drive to be comprehended by the educated and uneducated, English speaking and other native tongues, the safety aware and the safety resistant.

A prime tenet of ergonomics is that in order to produce optimised systems one must first be able to precisely define the population who will interact with it. It is clear that in the current scenario the mismatch between the task the tools and the user is leading to not only an ineffective system whereby poor results are achieved, but to a potentially harmful one where the presumption is that the process has been followed so inevitable the system must be right.

11.1 General study conduct

Several key observations where made early in the study when the site visits were being undertaken. These went on to inform and influence the nature of the later investigations.

Principal amongst these were that the industrial partners who volunteered to take part fell into two distinct groups.

One group was made up of organisations who felt they had some serious occupational problems but were unable to identify solutions or interventions which would work within the constraints they had acting upon them. For this group it was often the case that the constraints were the issue rather than finding solutions to the occupational problems. For instance, trying to resolve complex manual handling problems where automation was the only viable solution. The constraint was an unwillingness to invest the necessary capital expenditure.

The second group were those organisations who felt they already had robust systems in place and that they worked effectively. In these cases this confidence was almost universally misplaced. This usually resulted from a poor assessment of the occupational risks or a heavy reliance on processes rather than practice. In both scenarios there was support from poor tools. The poor assessment largely stemmed from inappropriate tool choice or from poor completion of an appropriate tool. The process reliance occurred where individuals slavishly followed a protocol which required the use of specific assessment. There were few controls to ensure that the assessment actually achieved the desired effect, but this was overlooked since the system was prescriptive. Better risk assessment tools would serve both of these groups well.

An additional problem was observed whereby most companies believed that their workforce was doing something that professional observes considered they were not. In most cases this was revealed as a corporate view that there were few manual handling activities involving repetitive actions, but many erroneously viewed tasks as not manually intensive when they actually were. Both these situations led to poor risk evaluation – either by failure to undertake risk assessment or by the use of inappropriate risk assessment tools (manual handling tools for repetitive activities, for example). Training and improved tools could assist both groups.

Finally, and arguably of most importance, most companies believe they do not have a problem where expert assessors believe they do. This leads to a failure to take any steps, good or bad, due to an assumption that there is no issue to address. This may be due to a limited outlook or a misguided confidence, but both possible causes could be mitigated by better training and through more intelligent tool design, particularly for scoping or initial assessment tools.

11.2 Limitations and future study recommendations

Whilst the study was intended to be as robust as possible, several limitations were observed which served to compromise accuracy and effectiveness. Most of these affected the later stages of the work, which caused the greatest impact, and they all resulted from the dependant relationship with the industrial partners.

Paramount amongst the issues was the commitment of the industry partners. The study is indebted to the partners for the investment they have made, but there is a significant gap between the demands of a scientifically rigorous study and the day to day demands of a responsive commercial concern.

This gap was evidenced by the conflict between the needs of the study to gain consistency in participants and to undertake certain components of the study at specific times. These were compromised by largely unavoidable factors such as staff turnover, seasonal changes and pressures of work, but also by potentially avoidable ones had the partners bought into the scientific protocol more actively. This is a valuable lesson for future studies that no matter how big the sample size intended to minimise population errors there is significant value in 'selling' the scientific requirements thoroughly and effectively. This will undoubtedly put off some potential partners, but will ensure that those who do take part are able to make the commitments necessary to realise a meaningful outcome.

In practice, an entire study such as this could be rendered meaningless by one or two organisations suffering commitment fatigue or being unaware of the importance of their contribution, so efforts made early on to secure robust engagement will be well rewarded. In the case of this study, the fact that Company 3 was unable to provide post training questionnaire responses compromised the validity of the findings – removing 25% of the data – and potentially meant that the efforts of the other three companies were wasted.

In this instance this was partly due to staff turnover, but also to the motivation of the remaining staff to take part. Commitment is needed at all levels for such a study to work. It is clear that a better communication at the outset of the implicit value of each participant would have greatly aided the quality of the final data.

The selection of industry partners meant that they had similar working practices. Unfortunately this also meant they were influenced by seasonal variations as well as a number of more covert factors such as a high percentage of migrant workers, high percentage of workers for whom English was a second language, workers that were mobile within the organisation so unavailable for long term commitment and workers who did not value the opportunity to participate.

Many of these factors are a normal part of a naturalistic study and are attenuated through the recruitment of sufficient numbers of participants. However, due to the ‘long thin’ nature of this evaluation, small drop out number had significant effects. This is indicative of the cost of trying to undertake such comprehensive research. Whist the research questions is vital and far reaching, the requirement for independent bodies to finance it (as opposed to state agencies) means that financial resources will be restricted and stretched. In practice this means that participant numbers are pared back and consequently abandonment has significant impact. Future work might require larger collaborations of funding agencies in order to generate larger participant numbers which could ameliorate this effect.

Lastly, it is noted that a between subject experimental design appears to be much less sensitive than a within subject design. This is primarily attributable to the factors noted above – staff retention and commitment of partners. It is recommended that future studies focus on this study methodology to improve the quality of the stat that is collected.

12 Conclusions

It is clear from each phase of this research project that the elements which affect the effectiveness of risk identification and the selection of interventions are high variable and liable to change over time. This variability makes studying the critical elements difficult but also suggests that the conflicting elements within the choice, design and application of checklists are unlikely to result in simple solutions being effective. Despite the complexity, a number of consistent messages emerged from the activities undertaken in this study, and they are indicated below.

- It is not necessarily possible to include all worker types in the risk assessment intellectual process despite this being popular and widely promulgated as good practice.
- Different worker types have different preferences for assessment tools, suggesting that assessors might wish to choose the type of tool they use from a range rather than have a single corporate form.
- Different worker types have different risk detection performance with different assessment tools. This suggests that there might be the possibility of optimising worker type and tool combinations. However, the complexity for this relationship within and between companies and over time makes it difficult to be prescriptive about good performance.
- Preference and performance may not be synonymous and may change over time with training and experience. This is problematic since workers are less receptive to assessment types that do not appeal to them, which may lead to self selection of inferior assessment tools. Similarly, implementation of effective assessment aids may be hampered by resentment or abandonment by worker groups.
- Different training approaches are likely to be required by different worker groups. Whilst unsurprising given the different roles and probable differences in educational backgrounds, this would be costly and is unlikely to be accommodated by companies.

This suggests that training will either be inferior in efficacy or that some worker groups may be eliminated from the assessment activities due to non-availability of, or limited interest in, the training given.

- Motivation is more of a problem than the tools or training. Workers need to actively wish to participate and see a reason for doing so in order to embrace the challenges presented by risk assessment. Involvement and contribution in order to avoid other duties, or solely for reasons such as status will be counterproductive. The prevalence of such practices reflects the worker view of health and safety activities in general. Finding the correct triggers to promote health and safety as a desirable activity in which to be involved will require an investment of time for individual companies.
- Safety needs to be seen as an end in itself rather than a reason not to do something else. Current scepticism and cynicism over the role and practice of health and safety is hugely counterproductive and stands as a major obstacle to both effectively studying these activities and implementing new strategies.
- Multi-national/multilingual workforce presents numerous challenges which cannot be effectively addressed by conventional means. This was the most consistent problem facing the companies taking part in the study and even those with robust strategies faced logistical problems that were almost insurmountable. Issues such as translation of important information, trustworthiness of translations, composition of workforce, and effective communication left the majority of companies feeling that they were unable to demonstrate compliance with their legal obligations. Most felt that legal requirements that could not be reasonably met were counterproductive and led to more significant failures in safety practice.
- Identifying appropriate training is a challenge in and of itself. Standard packages may well be ineffective or unpopular and consequently bespoke resources might be needed for individual companies.

This may challenge the established view of the provision of nationally approved packages, but offers great opportunity for training professionals.

- Similarly, the identification and provision of appropriate checklists may be an activity that needs to be undertaken by third parties with suitably qualified professionals developing appropriate checklist resources for specific companies. This conflicts with the current appeal of checklists as readily available and generically approved.
- A further problem exists in ensuring that checklists are correctly interpreted. Whilst changes in risk factor detection can be brought about by the implementation of appropriate checklists for workers and companies, there is a significant hurdle between this achievement and correctly identifying appropriate interventions. Not only are there difficulties in matching interventions to risk factors in practice, but the conflict with other commercial factors such as cost and productivity may not be comprehended or accommodated. Failure to adopt recommendations by risk assessors will also ultimately lead to disenfranchisement with the safety system and probable abandonment.
- An important activity is ensuring that message from checklists are properly disseminated to all appropriate staff. This communication faces numerous difficulties from the obvious ones such as language barriers, temporal demands of shift working and handover and staff churn, through to more complex and pervasive issues such as encouraging senor management participation and endorsement. Rather than adopting a ground up approach, most participating companies felt that a top down strategy, reflecting true boardroom commitment to safety, would be more effective.
- In the modern multicultural and multi-national workforce, cultural differences and rivalries may override good practice. Whilst it is easy to dismiss these issues as trivial, the extensive use of these labour resources makes such problems very real and challenging in the workplace.

Companies trying to discharge their legal responsibilities with regard to risk management are largely unable to identify a means of dealing with such issues without other forms of discrimination being cited.

- Honesty still appears to have a perceived price – whistleblowers and other forms of covert information sharing are seen as champions by the workforce but traitors by the management. This makes reporting of poor practices and standards a perilous activity and conflicts with most companies stated safety first policy. It is observed that rather than ‘safely make things’, the priority is to ‘make things safely’ and this change in emphasis places production values over safety ones.
- It is apparent that companies should be more ready to employ professional assistance in the area of risk management since they often ‘do not know what they do not know’. Because of this, the provision of easily accessible, ‘endorsed’ risk assessment resources can lead to poor judgements and bad practice. A shift is needed from the closed shop approach where safety is kept in-house and somewhat secret to a more open approach welcoming external involvement, which should be seen as part of a constructive safety policy by enforcement agencies. Extensive safety strategies in-house are meaningless unless they are effective but currently detail seems to prevail over efficiency. It is also the case that most companies are very defensive – usually declaring their systems fully robust despite injury statistics indicating otherwise. Removing the stigma associated with safety issues would lead to outside consultation being more welcome.
- Risk assessment is only the starting point not the finishing point, and may work against improving the safety culture if permitted to be undertaken badly.

  The universal reliance on risk assessment as a means of despatching legal obligations has led to a formulaic set of solutions (such as accessible checklists) which clearly cannot meet the needs of all.

- Litigation culture might be a greater motivator for change. If the resistance to good safety practice is the cost, then the cost of poor safety practice needs to be more clearly spelt out in financial terms such that the benefits can be more readily used to motivate change. Including financial costs in risk assessment checklists may be an effective means of helping to prioritise interventions, select the right intervention for an activity and engage the enthusiasm of the boardroom.

13 Guidelines

Section 7.1 identifies the key areas of the two checklists used in this evaluation and highlights those areas where one checklist was more effective than the other. Section 7.2 goes on to consider the critical elements of the checklist design and makes recommendations for changes and improvements which would improve the effectiveness of each checklist style.

13.1 Assessment of the checklist facets offering greatest potential

Overleaf there is a presentation in Table 13.1 of the facets of Checklist A and Checklist B that the findings of Trial 1 suggest work the best. It will be noted that Checklist A has a higher percentage of such features.

Table 13.1. Characteristics of Checklist A and B that Trial 1 suggest work best

		Checklist A	Checklist B
Format			
Flow chart		☒	☒
List format		☑	☑
Multiple choice		☑	☒
Dichotomous		☒	☑
Phrasing definitions			
Uses numerical figures to define joint angles		☑	☒
Uses only words to describe joint angles		☒	☑
Uses numerical figures to define frequency rates		☑	☒
Uses only words to describe frequency rates		☒	☑
Uses numerical figures to define duration		☒	☑
Uses only words to describe duration		☑	☒
Uses numerical figures to describe weight/force		☑	☒
Uses words to describe weights/force		☒	☑
Visual aids			
Illustrations of postures		☒	☑
Word descriptor of postures		☑ (particularly hand grip, item 9)	☒
Recording risk details			
Space for notes on reported problems		☒	☑
Space and notes on risk /probable cause		☒	☑
Ratings			
Means of rating individual items	Colour coding	☑	☒
	Symbol coding	☒	☒
	Numerical	☑	☒
	Words i.e. high, medium and low, good, satisfactory	☑	☒
Means of prioritising specific aspects of concern within a single task		☑	☒
Means of calculating an overall scores		☑	☑
Means of prioritising tasks for action		☑	☑
Controls / interventions			
Asks whether action is required		☒	☑
Space for notes on potential actions		☒	☑
Provides hints/suggestions for control actions	In checklist	☒	☑
	In accompanying guidance	☒	☒
	Provides reference to other sources of information.	☑	☑

13.2 Review of design and layout assessment tools

An expert appraisal was undertaken of the two checklists devised for, and used in, this study. Where possible this was in comparison to published best practice guidelines.

The two checklists used in the study embodied a significant number of features that are found in leading checklist based risk assessment tools, such as 'traffic light' colour coding, text or image based advisory panels, prompts for interventions, task specific as well as overall scoring protocols and generic risk categorisation (high, medium, low). It is unlikely that future checklist based resources will deviate greatly from these types of features, so the relative benefits of each were assessed as an indication of improvements to these skeletal forms. The assessment also

13.2.1 Introduction

The two assessment tools were reviewed in terms of organisation and layout, typography, colour, contrast, language, sentence construction and readability statistics. A summary of the main principles is given below:

Organisation and layout: The information should have a clear structure with items presented in a logical order. This makes it easy for the reader to see where to start and how to proceed through the document with key items such as tick boxes or sections to complete clearly visible.

Typography: This is the art and technique of arranging characters on a page. A clear font style and size should be selected so that the text can be read comfortably, thus assisting people with poorer eyesight. For passages of text lower case text is easier on the eyes than upper case because of the greater variety of shapes of lower case letters as compared with upper case. Lines lengths should also not be overly long since readers have to move their heads slightly or strain their eye muscles to track the whole line. Similarly reading columns of text with short lines is tiring.

Text is normally displayed left justified to enable comfortable reading but it is recommended that the right margin is ragged rather than right justified to avoid unequal spacing between letters and words which causes reading discomfort.

Colour and contrast: Colour should be used effectively whether for coding information (e.g. red text for critical information) or to reinforce information grouping and structure. The use of bright saturated colours can cause visual discomfort while the use of too many colours (e.g. more than 4) adds complexity to information. The contrast between the text and the background should also be sufficiently high to aid readability.

Language and sentence construction: Textual information can be complex if sentences are long, if they contain technical jargon or less common words and if their logical meaning is difficult to understand. However wording needs to be precise if it represents an instruction to follow. More than one related sentence should be presented in a consistent way to maintain ease of reading and avoid errors. Sentences should also be unbiased and where the user community is varied, consideration should be given to multilingual versions.

Readability indices: Readability indices or scores have been designed to show how easy text is to read. They are based upon factors such as the number of words in each sentence and the number of syllables in each word. However the tests do not indicate whether the correct words have been used so can only give an indication of the ease of reading of a passage of text.

13.2.2 Review of assessment tools against principles

Based on the above principles, 23 guidelines were specified and applied to the two Assessment Tools A and B. These are based on established recommendations for the creation of user instructions for consumer products (DTI, 1988).

Table 13.2 shows an evaluation of the Assessment Tools against each of the guidelines. Where a Tool meets one of the guidelines this is indicated by the word ‘Yes’ in the column, ‘Met?’. If the guideline is not met or only partially met, this is shown by the word ‘No’. For the guidelines not met, recommendations are made for the modification of the Assessment Tool in order to meet it. Occasionally although a guideline is met, a suggestion is made to enhance the Tool further.

For each Tool some additional minor recommendations are also made, at the end of the table that cannot be categorised under the guidelines.

13.2.3 Readability indices

The readability of the Assessment Tool text is measured using the following two tests:

- The Flesch Reading Ease test (Wiki, 2008) rates text on a scale of 0 to 100. The higher the score, the easier it is for the reader to understand the document. For most standard documents, a score of 70 to 80 should be achieved. Reader's Digest magazine has a readability index of about 65, Time magazine scores about 52, and the Harvard Law Review has a general readability score in the low 30s. **The criterion for the Assessment Tools is set at 80 to cater for a wide range of literary skills or English language knowledge among the user population.**

- The Flesch–Kincaid Grade Level Formula relates text to United States grade-school level. For example, a score of 5.0 means that a fifth grader, i.e. a British year 6 child or an average ten year old, can understand the document. For most standard documents, a score of 5.0 can be achieved by using short sentences. **The reading level criteria is thus set at 5.0, the expected reading level for 10-11 year olds in the UK. This is to ensure readability for those adults with poor literacy skills.**

Readability indices are normally applied to text composed of sentences. The tests were therefore applied only full sentences in each Tool and not the headings, lists, single words etc. The Instructions for each Assessment Tool were also tested but separately from the Tool itself.

Table 13.2. Comparison of the assessment tools against document design and layout guidelines

GUIDELINE	MET?	ASSESSMENT TOOL A	MET?	ASSESSMENT TOOL B
Organisation and layout				
1. Page number present	No	**Recommendation 1A**: Add at the bottom of each page (if possible when printed in 2 pages per page format).	No	**Recommendation 1B**: Add at the bottom of each page (if possible when printed in 2 pages per page format).
2. Margins of sufficient width to frame each page	Yes		Yes	A blue frame around each section helps group questions together.
3. Grouping and spacing show structure clearly	Yes	The yellow frames help to group questions together well. **Recommendation 3A:** Consider whether, for consistency, similar frames should be placed around the score sheet table and overall risk section at the end of the Tool.	Yes	The questions, problems and improvements are structured in a clear and consistent way. The white background for the questions and the No/Yes checkboxes gives them less prominence than the 'potential improvement' list on the yellow background. **Recommendation 3B**: For consistency, consider putting a similar yellow background behind the questions and the No/Yes tick boxes (but not the diagrams).
4. Text appears spacious	No	Lack of additional spacing between some red, amber, green options creates the effect of dense blocks of text. **Recommendation 4A**: Insert a little more line or paragraph spacing between options for questions 4, 5, 7, 9, 10 and 13. Also put the explanatory notes shown in brackets into italics to break it up.	Yes	The text is spacious enough given the length of the list of improvement options that needs to be displayed for some questions.
5. Sections in a logical order	?	**Issue 5A**: Should 'postural' factors be considered before 'repetition' and 'force'?	?	**Issue 5B**: Should 'postural' factors be considered before 'repetition' and 'force'?
Typography				
6. Text characters have a height of at least 1.5mm (10 – 11 point)	Yes	14 point text is used for most of the assessment tool which, when printed as' two pages per page', appears in 11 point.	Yes	14 point text is used for most of the assessment tool which, when printed as' two pages per page', appears in 11 point.
7. Few different typefaces and sizes are used.	Yes	A single font style is used (Arial).	Yes	A single font style is used (Arial).
8. Normal lower case lettering is used with initial letter upper case	Yes	All headings and text is shown in upper and lower (sentence) case.	Yes	All headings and text is shown in upper and lower (sentence) case.
9. Use of all capitals, italics, bold or underlining over several lines of text is avoided	Yes		Yes	

10. Line lengths are all between 35 and 65 characters	Yes	Line lengths are between 50 and 60 characters.	Yes	Line lengths are between 45 and 60 characters.
11. A ragged right hand margin is used	Yes		Yes	
Colour and contrast				
12. Colour is used sparingly	Yes	Although the Tool contains brightly coloured sections, this is for coding purposes. **Recommendation 12A:** Put the traffic light colours behind the tick boxes rather than the whole statement. However the result may reduce the visual impact of the three options.	Yes	Only three colours in addition to white are used for titles and highlighting. (Since colour is not used for coding, the Tool can be printed and used in black and white.)
13. Colour is used consistently	Yes	Colour is used for coding the three risk options for each question and as a background for groups of questions in a consistent way. **Recommendation 13A**: For consistency, consider putting a yellow background box around the score sheet table and overall risk section.	Yes	**Recommendation 13B**: For consistency, consider putting blue frames around the score sheet table and overall risk section.
14. There is good contrast between text and background	No	The contrast between black text and the coloured backgrounds is reasonable. However the black text on red or green may be hard to read in poor lighting. **Recommendation 14A**: Make all background colours slightly paler to increase contrast.	Yes	**Recommendation 14B**: Consider making the blue and yellow colours slightly paler to increase contrast.
Language and sentence construction				
15. All sentences less than 30 words.	No	Within assessment tool all sentences have less than 30 words. Within the *Instructions*, 5 sentences have more than 30 words (see Section 13.2.7).	No	Within assessment tool all sentences have less than 30 words. Within the *Instructions*, 6 sentences have more than 30 words (see Section 13.2.7).
16. Wording not overly technical.	Yes	The assessment tool is technical in nature but the Tool tries to present them in an accessible way.	Yes	The assessment tool is technical in nature but the Tool tries to present them in an accessible way.
17. Wording is precise	Yes	User may find judgement of the angles 15 degrees and 20 degrees hard without visual representation. **Recommendation 17A**: Consider whether a visual representation of angles can be provided alongside the statement options for Q4, 5, 8 or within the Instructions.	Yes	In questions 3, 4, 5, 6, 8, and 9 the user may find it difficult to judge 15%. **Recommendation 17B**: Provide an example in the Instructions or a question to help the user judge the 15% limit e.g.” 15% = about 10 minutes within an hour”.

18. Wording is consistent	No	**Recommendation 18A(i):** In Q2, insert the word 'are' to make each statement a complete sentence to be consistent with the rest of the Tool. **Recommendation 18A(ii):** In Q9, change the amber and red options to be statements rather than questions. **Recommendation 18A(iii):** In Q13, 'a. Gloves' should perhaps have more explanation e.g. 'Gloves are worn and may hinder manipulation'.	No	**Recommendation 18B(i):** Questions 11, 12 and 13 should be formulated as questions to be consistent with the rest of the Tool. (Note: Item 13h. is a phrased as a question). **Recommendation 18B(ii):** In Q13, 'a. Gloves' should perhaps have more explanation e.g. 'Are Gloves are worn which may hinder manipulation?'. **Recommendation 18B(iii):** In Q3, 4, 5, 6, 8, change 'more' to 'for more' e.g. "for more than 15% of the time". **Recommendation 18B(iv):** In Q7, add 'held' before 'in a static position'.
19. Unbiased language is used e.g. not gender specific.	Yes	Neutral language used throughout the Tool.	Yes	Neutral language used throughout the Tool.
20. Sentences are simple to understand.	No	Generally the sentences are clear. However, in trying to be precise and consistent, some of the statements become slightly repetitive and complex. The similarity of groups of sentences adds to the complexity – for example see questions 4 to 11. **Recommendation 20A(i)**: Review and try to simplify some of the wording e.g. in Q1, "intermittent" = "occasional", in Q2, 'motion patterns' = "movements". **Recommendation 20A(ii):** Consider whether some of the repeated wording in each group of statements can be replaced by dots. For example Q2 could be reworded as: "Similar motion patterns are repeated 10 times per minute or less", "… more than 11-20 times per minute", "…more than 20 times per minute". **Recommendation 20A(iii):** Consider highlighting (emboldening or italicising) the words that are different in similar statements, e.g. in Q1 (green) "infrequently", (amber) "frequently", (red) "very frequently".	No	Generally the sentences are clear and their formulation as yes/no questions make them simple to comprehend. However in trying to describe the criteria, some of may appear hard to assimilate e.g. "Q7 Is one or both shoulders in a static position (i.e. infrequently moved) for more than 1 hour. **Recommendation 20B**: Review questions 1, 7 and 10 and 13h and try to simplify some of the wording and logic.

21. Availability of multi-lingual versions	No	There may be a case for producing versions in different languages for users for whom English is their second language.	No	There may be a case for producing versions in different languages for users for whom English is their second language.
Readability statistics				
Assessment Tool: 22. Flesch readability index is 80 or above. Flesch-Kincaid grade level is no more than 5.0 (reading level for 10 to 11 year old students).	No	70.4 Simplification and rewording following recommendations **20A(i) and (ii)** will increase the score. 7.0 Simplification and rewording would reduce level. (An electronic copy of the text used for testing is available.)	No	73.7 The relatively short sentences within the tool mean that target is close to achievement. Simplification following **20B** will increase the score. 6.2 Simplification and rewording would reduce level. (An electronic copy of the text used for testing is available.)
Instructions 23. Flesch readability index is 80 or above. Flesch-Kincaid grade level is no more than 5.0 (reading level for 10 to 11 year old students).	No	58.2 9.9 **Recommendation 23A:** Reduce the length of the longest sentences (over 30 words) and consider whether text can be simplified.	No	55.3 10.4 **Recommendation 23B:** Reduce length of longest sentences (over 30 words) and consider whether text can be simplified.
Other comments				
24. Full stops and question marks	n/a	**Recommendation 24A**: Full stops are needed after each sentence.	n/a	**Recommendation 24A**: Full stops or question marks are needed after each sentence.
25. Use of slashes	n/a	Use of slashes in some parts of the Tool is ambiguous e.g. 'Awkward hand / finger grip'. **Recommendation 25A**: Use of 'and' and 'or' is preferred to '/' for precision.	n/a	Use of slashes in some parts of the Tool is ambiguous e.g. 'Awkward head / neck posture'. **Recommendation 25B**: Use of 'and' and 'or' is preferred to '/' for precision.
26. Minor typos	n/a	**Recommendation 26A(i):** In Q4, the selection square for the Red option should be lowered slightly to be in line with the test and the 'R' code should be added. In Q1, red option, move words in brackets upwards. **Recommendation 26A(ii):** In Q3 make statements for second and third options a single continuous sentence. **Recommendation 26A(iii):** In Q6, remove stray character at start of red option.	n/a	**Recommendation 26B(i)**: Within instructions where example of problems is written, change (1) 'may' to 'a', (2) 'has' to 'have', and (3) insert 'to' before 'flick'. **Recommendation 26B(ii):** Missing bullet in Q5 improvements list.

27. 'No Yes' columns	n/a		n/a	For each question, the 'No' then 'Yes' column order could lead to errors. **Recommendation 27B(i)**: Swap columns headings to be 'Yes' then 'No'. **Recommendation 27B(ii)**: In each statement 'If you have ticked any yes boxes..', put word yes in quotes or capitalised i.e. 'Yes' or YES.
28. Underlining	n/a		n/a	For Q6 – 10, the statement, 'Describe any problems' is underlined but not elsewhere. **Recommendation 28B**: Remove underlining and add following dots to make consistent with other questions.
29. Summarising the assessment and completing the score sheet or table	n/a	There are limited prompts to complete the score sheet. **Recommendation 29A(i)**: Add a general instruction as given in Assessment tool B.. "In the table below…". **Recommendation 29A(ii)**: In the score sheet table, add the prompt '(G, R, A)' under Colour Band, and '(0 to 6)' under Numerical Score. **Recommendation 29A(iii):** In the Instructions for the Tool, show an example of a completed score sheet and selected overall risk level.	n/a	**Recommendation 29B(i)**: Where user enters the total number of ticks, put 'out of 21' to show the total number in relation to the maximum. **Recommendation 29B(ii):** A specific prompt would be useful for completing the table e.g. after the heading 'Priority action: High, Medium, Low' add '(Enter H, M or L)'. **Recommendation 29B(iii):** Consider providing guidance for deciding the overall risk (L, M or H), such selecting most common table entry? **Recommendation 29B(iv):** In the Instructions for the Tool, show example of completed summary table and overall score.

13.2.4 Summary of compliance to guidelines

Table 13.3 shows that both Assessment Tools comply with the majority of the 23 guidelines.

Table 13.3. Number of guidelines met by each assessment tool

	Assessment Tool A (Red / Amber / Green)	**Assessment Tool B (Yes / No)**
Number of guidelines met (Yes)	13	15
Number of guidelines not met (No)	9	7
Issues open to discussion (?)	1	1
Other changes recommended?	Yes	Yes

For the guidelines where recommendations are offered, it is proposed that they be considered for implementation. While the recommendations should help to improve the Assessment Tools, it may be decided some of the recommended changes are not effective or necessary.

13.2.5 Discussion for Assessment Tool A (Red/Amber/Green)

This section summarises the review for Assessment Tool A and presents the recommendations for change.

Organisation and layout: In general, Assessment Tool A offers a simple and straightforward process. It is only when the user reaches the summary scoring sheet that they may need additional guidance and prompts. This would be further assisted by providing an example of the table completed and the overall risk level circled within the Instructions for the Tool.

Typography: The text font and text size is clear and should not present any major problems in terms of reading comfort.

Colour and contrast: The use of colour coding for the different risk options is effective. However the use of saturated background colours gives the Assessment Tool a slightly gaudy appearance which reduces the contrast between text and background. Making the colours paler would enable more comfortable reading and improve the contrast between text and background. Alternatively the background for the each statement could be made white and the red, amber, green colour could just be retained behind the box containing the score. It should also be mentioned that the reliance upon colour coding would reduce the effectiveness of the Tool if it were photocopied or printed in black and white. However the letters G, A and R next to each score do provide additional coding for greyscale versions.

Language and sentence construction: In general the statements describing each of the different options are clear and precise. The wording is not overly technical and is unbiased.

For each set of three options within the Tool much of the wording is repeated which is necessary to make each statement self contained. However this tends to add to the complexity of each question as a whole and in distinguishing each option. The use of ways to simplify the statements will be beneficial such as:

(1) using easier wording where possible (see for example the Dale-Chall word list, 2008),
(2) reducing the repetition of wording within each set of three statements, and
(3) distinguishing between the statements by highlighting key words (e.g. ‘infrequent’, ‘frequent’, ‘very frequent’).

There is a minor degree of inconsistency in the wording of statements which could be removed.

Readability statistics: These show that the reading level for the Assessment Tool is satisfactory but for the Instructions it is a little too high if text is to be easily understood by a large proportion of people. This could however be achieved by simplification of some of the words and reducing the length of some of the longer sentences.

Other comments: Additional suggestions for change include providing more guidance on completing the summary score sheet at the end of the Assessment. Experience during the trials showed a potential benefit in producing versions of the questionnaire in different languages.

A summary list of recommendations is provided in Table 13.4, below:

Table 13.4. Recommendations for Assessment Tool A

Assessment A - Recommendations	Considered?
Recommendation 1A: Add page numbers at the bottom of each page (if possible when printed in 2 pages per page format).	☐
Recommendation 3A: Consider whether, for consistency, similar frames should be placed around the score sheet table and overall risk section at the end of the Tool.	☐
Recommendation 4A: Insert a little more line or paragraph spacing between options for questions 4, 5, 7, 9, 10 and 13. Also put the explanatory shown in brackets into italics to break it up.	☐
Issue 5A: It may be argued that the 'postural' factors would be the initial factor to look at before 'repetition' and 'force'. (Comment for consideration.)	☐
Recommendation 12A: Put the traffic light colours behind the tick boxes rather than the whole statement. However the result may reduce the visual impact of the three options.	☐
Recommendation 13A: For consistency, consider putting a yellow background box around the score sheet table and overall risk section.	☐
Recommendation 14A: Make all background colours slightly paler to increase contrast.	☐
Recommendation 17A: Consider whether any visual representation of angles can be provided alongside the statement options for Q4, 5, 8 or within the Instructions.	☐
Recommendation 18A(i): In Q2, insert the word 'are' to make each statement a complete sentence to be consistent with the rest of the Tool.	☐
Recommendation 18A(ii): In Q9, change the amber and red options to be statements rather than questions.	☐
Recommendation 18A(iii): In Q13, 'a. Gloves' should perhaps have more explanation e.g. 'Gloves are worn and may hinder manipulation'.	☐
Recommendation 20A(i): Review and try to simplify some of the wording e.g. in Q1, "intermittent" = "occasional", in Q2, 'motion patterns' = "movements". *See the Dale-Chall simple word list (2008).*	☐
Recommendation 20A(ii): Consider whether some of the repeated wording in each group of statements can be replaced by dots. For example Q2 could be reworded: "Similar motion patterns are repeated 10 times per minute or less", "… more than 11-20 times per minute", "…more than 20 times per minute".	☐
Recommendation 20A(iii): Consider highlighting (emboldening or italicising) the words that are different in similar statements, e.g. in Q1 (green) "infrequently", (amber) "frequently", (red) "very frequently".	☐
Recommendation 23A: Reduce length of longest sentences (over 30 words) and consider whether text can be simplified following 20A (i) to (iii). (An electronic copy of the text used for testing is available.)	☐
Recommendation 24A: Full stops are needed after each sentence.	☐
Recommendation 25A: Use 'and' and 'or' instead of '/' to clarify meaning.	☐
Recommendation 26A(i): In Q4, the selection square for the Red option should be lowered slightly to be in line with the test and the 'R' code should be added. In Q1, red option, move words in brackets upwards.	☐
Recommendation 26A(ii): In Q3 make statements for second and third options a single continuous sentence.	☐
Recommendation 26A(iii): In Q6, remove stray character at start of red option.	☐
Recommendation 29A(i): Add a general instruction to help complete the summary table as given in Assessment tool B.. "In the table below…".	☐
Recommendation 29A(ii): In the score sheet table, add the prompt '(G, R, A)' under Colour Band, and '(0 to 6)' under Numerical Score.	☐
Recommendation 29A(iii): In the Instructions for the Tool, show an example of a completed score sheet and selected overall risk level.	☐

13.2.6 Discussion for Assessment Tool B (Yes/No)

This section summarises the review for Assessment Tool B and presents the list of recommendations for change.

Organisation and layout: Assessment Tool B presents a simple and consistent structure based around answering yes or no questions. More guidance could be provided to complete the summary table and to decide on the overall risk level. It would also be useful to provide an example of the completed table and risk level with in the Instructions.

Typography: This selection of text font and text size is clear and meets the guideline requiring at least 10 or 11 point size.

Colour and contrast: The use of coloured title bars and background for the improvement lists is helpful. However this perhaps demotes the prominence of the questions themselves. The designers could experiment with providing the same coloured background for the questions and tick box sections and in making both the blue title bar and yellow background colour paler. Interestingly printing the tool out in black and white provides an effective toned down appearance showing that the Tool can still be read when printed in greyscale.

Language and sentence construction: In general the statements describing each of the different options are clear and precise. The wording is not overly technical and is unbiased.

However as with Assessment Tool A, it would be worth reviewing the wording so see whether simpler words can be used in any parts of the Tool.

Readability statistics: These show that the reading level for the Assessment tool is satisfactory but for the Instructions it is too high. This could be reduced by simplification of some of the words and reducing the length of some of the longer sentences.

Other comments: Other suggestions for change include providing more guidance on completing the summary score sheet at the end of the Assessment. As for Assessment Tool A, there could be potential benefit in producing versions of the questionnaire in different languages

A summary list of recommendations is provided in Table 13.5, below:

Table 13.5. Recommendations for Assessment Tool B

Assessment B - Recommendations	Considered?
Recommendation 1B: Add page numbers at the bottom of each page (if possible when printed in 2 pages per page format).	☐
Recommendation 3B: For consistency, consider putting a similar yellow background behind the questions and the Yes, No tick boxes (but not the diagrams).	☐
Issue 5B: It may be argued that the 'postural' factors would be considered first before 'repetition' and 'force'. (Comment for consideration.)	☐
Recommendation 13B: For consistency, consider if blue frames are needed around the score sheet table and overall risk section.	☐
Recommendation 14B: Consider making the blue and yellow colours and slightly paler to increase contrast.	☐
Recommendation 17B: Provide an example in the Instructions or a question to help the user judge the 15% limit e.g. "15% = about 10 minutes within an hour".	☐
Recommendation 18B(i): Formulate questions 11, 12 and 13 to be consistent with the rest of the Tool. (Note: Item 13h. is phrased as a question).	☐
Recommendation 18B(iii): In Q3, 4, 5, 6, 8, change 'more' to 'for more' e.g. "for more than 15% of the time".	☐
Recommendation 18B(iv): In Q7, add 'held' before 'in a static position'.	☐
Recommendation 18B(ii): In Q13, 'a. Gloves' should perhaps have more explanation e.g. 'Are Gloves are worn which may hinder manipulation?'.	☐
Recommendation 20B: Review questions 1, 7 and 10 and 13h and try to simplify some of the wording and logic.	☐
Recommendation 23B: Reduce length of longest sentences (over 30 words) and consider whether text can be simplified following 20B. (An electronic copy of the text used for testing is available.)	☐
Recommendation 24B: Full stops or question marks needed after each sentence.	☐
Recommendation 25B: Use 'and' and 'or' instead of '/' where needed.	☐
Recommendation 26B(i): Within instructions where example of problems is written change (1) 'may' to 'a', (2) 'has' to 'have', and (3) insert 'to' before 'flick'.	☐
Recommendation 26B(ii): Add missing bullet in Q5 improvements list.	☐
Recommendation 27B(i): Swap columns headings to be 'Yes' then 'No'.	☐
Recommendation 27B(ii): In each statement 'If you have ticked any yes boxes..', put word yes in quotes or capitalised i.e. 'Yes' or YES.	☐
Recommendation 28B: Remove underlining and add following dots to make consistent with other questions.	☐
Recommendation 29B(i): Where user enters the total number of ticks, put 'out of 21' to show the number of yes' in relation to the maximum.	☐
Recommendation 29B(ii): A specific prompt would be useful for completing table e.g. after the heading 'Priority action: High, Medium, Low' add '(Enter H, M or L)'.	☐
Recommendation 29B(iii): Consider providing guidance for deciding the overall risk (L, M or H), such as selecting most common table entry?	☐
Recommendation 29B(iv): In the Instructions for the Tool, show example of completed summary table and overall score.	☐

13.2.7 Longer sentences within the Assessment Tool Instructions that could be split up or reduced

Long sentences of more than 30 words within the Assessment A Instructions. These could be considered for shortening or dividing up to increase the readability score to over 80 and reduce grade level to 5.0 or below:

1) A repetitive task is made up of a sequence of actions of fairly short duration, which are repeated over and over again and almost always use the same or very similar actions (e.g. stitching a piece of cloth, manufacturing one part, packaging items). (43 words)
2) For each risk factor there are at least three different choices of answer, and each possible response is categorised as either Green, Amber or Red and has a corresponding numerical score. (31 words)
3) The tool can be used to highlight areas (i.e. individual risk factors) of concern and it can also be used to gain a single overall risk score for the whole task by adding the numerical scores for each risk factor together at the very end of the assessment. (48 words)
4) For each risk factor there is a table with green, amber and red rows please circle one square (containing a letter and a number) for the statement that best describes the action involved in the task. (36 words)
5) At the end you need to transfer each score onto to the score sheet on the last page and rate each risk factor in terms of Low, Medium and High priority for action. (33 words)

Long sentences of more than 30 words within the Assessment B Instructions that could also be considered for modification to increase readability:

1) A repetitive task is made up of a sequence of actions of fairly short duration, which are repeated over and over again and almost always use the same or very similar actions (e.g. stitching a piece of cloth, manufacturing one part, packaging similar items). (44 words)

2) The tool can be used to highlight areas (i.e. individual risk factors) of concern and it can be used to gain a single overall risk score for the whole task by counting up the total number of YES ticks. (39 words)
3) Look across to the end column ('Tick potential improvements which may be useful for this task and which should be investigated further') and tick improvements you think might be useful in reducing that particular risk factor in this task. (39 words)
4) At the end of the assessment count up the total number of YES ticks to gain a single overall risk score for the whole task and write the score in the box provided at the end of the assessment. (39 words)
5) At the very end please write (in the box provided) any ideas you have as to what changes could be made to reduce the risks of musculoskeletal disorders from this task. (31 words)
6) To do this you might want to flick back through your assessment of the task and see which boxes you have ticked in ''Tick potential improvements which may be useful for this task and which should be investigated further" this might give you more ideas on what sort of changes could be made. (53 words)

Note that to test the readability for any changes to the text, it would be necessary to change the electronic version of the Instructions or Assessment Tool and to regenerate the Microsoft Word 'document statistics'. The instructions for displaying the readability statistics for a document within Word are as follows:

- On the Tools menu, click Options, and then click the Spelling & Grammar tab.
- Select the Check grammar with spelling check box.
- Select the Show readability statistics check box, and then click OK.
- On the Tools menu, select Spelling and Grammar (first option).
- When Microsoft Word finishes checking spelling and grammar, it displays information about the reading level of the document.

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15 Appendices

Appendix A: Initial Questionnaire

Dear Health and Safety professional,
The Ergonomics and Safety Research Institute (ESRI), which is part of Loughborough University, has been commissioned by the Institute of Occupational Safety and Health (IOSH) to investigate the effectiveness of risk assessment in the workplace.

This study, lasting over 16 months, is designed to explore the link between risk identification and risk control. The initial stages are to capture current practice in manufacturing industry, including who is undertaking risk assessments and what tools they use to do them.

This questionnaire is inviting you, as a health and safety professional, to contribute to the understanding of current practice and hence help to improve the effectiveness of health and safety practice in the British workforce. The questionnaire itself should only take a few minutes to fill in and will be invaluable in helping to clarify what is actually occurring in the workplace.

In the later stages of the project, partner organisations will be selected from those who have submitted questionnaires and they will be invited to take an active part in evaluating the tools used in undertaking risk assessments. These organisations will receive, as an incentive, free professional training from an IOSH accredited trainer. An invitation to be involved further in the project is provided at the end of this questionnaire.

Please be assured that any information you supply will be strictly confidential and that the project is being conducted under the ethical and confidentiality guidelines of Loughborough University. More information about the project and ESRI can be found at http://www.lboro.ac.uk/research/esri in the 'News' section article called 'Effect of training on the application and effectiveness of checklist-based risk assessments'.

We appreciate that you are busy and that providing this information will be another task to add to your 'to do' list, but by contributing you will be providing critical information which will help make risk assessment more effective and simpler in the future. So why not get a drink and take a few minutes to answer the questions – you can then cross another thing off your 'to do' list!

Thank you for reading this and we hope you will be able to find just a few minutes to provide answers to the following questions.

General information

1. Does your organisation have a standard Risk Assessment which is used for musculoskeletal risks?

Yes	☐ 1
No	☐ 2

If 'YES' please (if possible) send a copy of this Risk Assessment to us when you return this questionnaire

About your organisation

2. How many people are employed by your organisation?

Small – 1 - 49	☐ 1
Medium – 50 to 299	☐ 2
Large - 300 or more	☐ 3

3. Is your organisation ….

Based on a single site	☐ 1
Part of a larger group	☐ 2

4. Approximately, how many employees work on your site?

5. Please tick the industry sector that best applies to your organisation.

Chemical Manufacturing	☐ 1	Mining & Quarrying	☐ 10
Consumer Goods	☐ 2	Optical & Precision Instruments	☐ 11
Electrical & Electronics	☐ 3	Packaging	☐ 12
Food & Drink Manufacturing	☐ 4	Paper Manufacturing	☐ 13
Fuel	☐ 5	Refrigeration	☐ 14
Glass, Ceramic & Brick	☐ 6	Rubber & Plastics	☐ 15
Machinery Manufacturing	☐ 7	Textile Manufacturing	☐ 16
Manufacturing Tools	☐ 8	Timber Manufacturing	☐ 17
Metal & Metal Goods	☐ 9	Transport Manufacturing	☐ 18
Other, please state:			19

Type of work tasks conducted by employees

6. This is intended to show how much of your workforce is involved in various types of task. On the scales below, please circle the approximate percentage of the workforce that is engaged in each of the tasks as part of their work.

a) Manual handling

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

b) Repetitive tasks with short cycle times (1 second to 2 minutes)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

c) Repetitive tasks with long cycle times (greater than 2 minutes)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

d) Seated (mainly tasks that don't require a lot of physical activity)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

e) Standing (mainly tasks that don't require a lot of physical activity)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

f) Machine-paced tasks (where the rate of work is dictated by a machine)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

g) Using hand-held tools

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

h) Using a computer/computer screen (VDU)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

i) Tasks which frequently require bending, twisting or reaching

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

About you

7. What is your job title?:______________________________________

8. How long have you been working in this position?

Less than 1 year	☐ 1
1 to 3 years	☐ 2
4 to 7 years	☐ 3
8 to 12 years	☐ 4
13 years +	☐ 5

9. Have you previously worked in a position with a Health and Safety role?

Yes	☐ 1
No	☐ 2

10. On average, what percentage of your work time is spent conducting Health and Safety responsibilities (please circle)?

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

11. Have you received specific training in Risk Assessment?

Yes	☐ 1	
No	☐ 2	If No, go to Question 16

12. How long ago did you receive this training?

13. What form did this training take?

Workplace "toolbox talk" of no more than 1 hour	☐ 1
'Teach yourself' booklet	☐ 2
Computer-based interactive course	☐ 3
One/two day face-to-face training	☐ 4
Other, please state: 5	

14. If the training was organised, who delivered the training you received?

Your organisation	☐1
A consultant (training held in your workplace)	☐2
A consultant (training held in another location)	☐3
A training company	☐4

15. Did this specifically cover risks for musculoskeletal problems?
Musculoskeletal problems refer to problems affecting workers' muscles, tendons, ligaments of either the neck, shoulders, back, arms, wrist, hands or legs also known as MSD, upper limb disorders (ULD), work-related upper limb disorders (WRULD) or repetitive strain injury (RSI).

Yes	☐1
No	☐2

Health and safety staff

16. How many health and safety officers are responsible for your site?

17. How many health and safety representatives are permanently located on your site?

18. Is there an external contractor (i.e. Health and Safety consultant / advisor/ Ergonomist) involved in the management of health and safety on site?

Yes	☐1	
No	☐2	If No, go to Question 19

If 'YES', what role do they play in the management of Health and Safety on your site?

Musculoskeletal problems

19. To what extent do you agree with the following statement: "Reducing the number of musculoskeletal risks is a priority for this company"

Strongly agree | Agree | Disagree | Strongly disagree

20. Do you have a clear idea of what you are going to do to reduce the risk of musculoskeletal problems in this company?

Yes	☐ 1
No	☐ 2

If 'YES', where did you get the information to enable you to formulate an action plan?

21. Please indicate on the scales below how supported you feel by the following personnel in tackling musculoskeletal problems in your company

a) Workers

0% (no support) | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% (complete support)

b) Supervisors

0% (no support) | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% (complete support)

c) Management

0% (no support) | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% (complete support)

d) Engineers/equipment designers

0% (no support) | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% (complete support)

Risk assessment for musculoskeletal problems

22. Have risk assessments for musculoskeletal problems been conducted for any work tasks?

Yes – all	☐1	
Yes – some	☐2	
No	☐3	If No, Go to Question 40

23. Do the risk assessments include completing a checklist to identify the risk factors?

Yes – all	☐1
Yes – some	☐2
No	☐3

24. Who conducts the risk assessments for musculoskeletal risks? (tick more than one if required and their level of training)

	For each person who conducts risk assessment please tick if they have had……….		
	Training in general Health and Safety	Training in risk assessment	No training
You	☐1	☐2	☐3
Health and Safety Officer	☐1	☐2	☐3
Health and Safety representative	☐1	☐2	☐3
External consultant	☐1	☐2	☐3
Supervisor	☐1	☐2	☐3
Manager	☐1	☐2	☐3
Workers	☐1	☐2	☐3
No one	☐1	☐2	☐3

25. Have the people who conduct the risk assessment received specific training in completing the musculoskeletal risk assessment that is used by your company?

Yes – All	☐1
Yes – some	☐2
No	☐3

26. Overall how satisfied are you with the training people have received to complete your company's risk assessment for musculoskeletal risks? (please circle)

Very satisfied	Satisfied	Neither satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	Not applicable

27. Are supervisors involved in the risk assessment of musculoskeletal problems?

Yes	☐ 1
No	☐ 2
Not applicable	☐ 3

If 'YES', please describe how they are involved

28. Are workers involved in the risk assessment of musculoskeletal problems?

Yes	☐ 1
No	☐ 2

If 'YES', please describe how they are involved

29. Do supervisors in your company receive training in risk assessment for musculoskeletal risks?

Yes	☐ 1
No	☐ 2
Not applicable	☐ 3

30. Were any of the following resources used to assess the musculoskeletal risks? (please tick more than one if necessary)

Resource	**Tick ✓**
Checklist - developed in house	☐1
Checklist - provided by external consultant / advisor	☐2
HSE's 'Five Steps to risk assessment' Leaflet	☐3
HSE's Health and Safety (Display Screen Equipment) Regulations 1992	☐4
HSE Manual Handling Operations Regulations 1992	☐5
HSE HSG 60 – Work related upper limb disorders: a guide to prevention.	☐6
HSE Manual Handling Assessment Charts (MAC)	☐7
NIOSH lifting equation	☐8
Rapid upper limb assessment (RULA)	☐9
Quick exposure check (QEC)	☐10
Other (please describe):…………………………………… …………………………………………………………… ……………………………………………………………	☐11
Don't know	☐12

31. Who decides which method is used to assess musculoskeletal risks? (please tick more than one if necessary)

Decision maker	**Tick ✓**
You	☐1
Health and Safety Officer	☐2
Health and Safety representative	☐3
Boardroom level	☐4
External consultant	☐5
Supervisor	☐6
Manager	☐7
Workers	☐8
Other (please specify)…………………………… …………………………………………………….	☐9

32. How confident do you feel that the risk assessment used to assess musculoskeletal risk factors in your company is capturing all the risks? (please circle)

0% (not at all confident)	10%	20%	30%	40%	50%	60%	70%	80%	90%	100% (completely confident)

33. How confident do you feel that the risk assessment to assess musculoskeletal risk factors in your company is in prioritising areas for improvement/action?

0% (not at all confident)	10%	20%	30%	40%	50%	60%	70%	80%	90%	100% (completely confident)

34. How confident do you feel that the risk assessment used to assess musculoskeletal risk factors in your company is accurate in differentiating between high / medium and low risk tasks?

0% (not at all confident)	10%	20%	30%	40%	50%	60%	70%	80%	90%	100% (completely confident)

35. How confident do you feel that you (or whoever conducts the risk assessment) are using the musculoskeletal risk assessment correctly?

0% (not at all confident)	10%	20%	30%	40%	50%	60%	70%	80%	90%	100% (completely confident)

36. How confident do you feel that you (or whoever conducts the risk assessment) have sufficient time to conduct the risk assessment correctly?

0% (not at all confident)	10%	20%	30%	40%	50%	60%	70%	80%	90%	100% (completely confident)

37. Overall how satisfied are you with the current risk assessment your company uses for assessing musculoskeletal risks?

Very satisfied	Satisfied	Neither satisfied nor dissatisfied	Dissatisfied	Very dissatisfied

38. What do you like most about the risk assessment that your company uses to assess musculoskeletal risk factors?

39. What do you dislike most about the risk assessment that your company uses to assess musculoskeletal risk factors?

40. Do you feel that you need additional training in order to undertake musculoskeletal risk assessments effectively?

Yes	☐1
No	☐2

41. When musculoskeletal risks have been identified, how likely is it that changes to reduce the risk will be identified?

0% (not at all likely) | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% (completely certain)

42. When musculoskeletal risks have been identified, how likely is it that changes to reduce the risk will be implemented?

0% (not at all likely) | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% (completely certain)

43. What are the main obstacles to making changes?

Further information and participation

Your name:……………………………………………………………………….

Your phone number:………………………………………………………………

Your email address:………………………………………………………………

Your company's name:……………………………………………………………

Your company's address:…………………………………………………………
……………………………………………………………………………………….
……………………………………………………………………………………….
………………………………………………………………………………………..

Thank you for your contribution to this valuable project. The next stage will be to select organisations to take part in testing different risk assessment models. Selected organisations will receive **free risk assessment training** as part of this process and in recognition of their support.
We will include your organisation in this selection process unless you tick this box to indicate that you <u>do not</u> want to contribute further. ☐

Please return the completed questionnaire

as soon as possible and no later than 31st October 2007.

Return to:
Clare Lawton
Ergonomics and Safety Research Institute (ESRI)
Holywell Building, Holywell Way
Loughborough, LE11 3UZ

THANK YOU

Any further questions please contact:

Clare Lawton Tel: 01509 226909 email: c.lawton@lboro.ac.uk

Appendix B: Survey Results

	Question - 2 Company size					
	Small (5 to 49)		Medium (50 to 299)		Large (300 or more)	
	Number of respondents	%	Number of respondents	%	Number of respondents	%
Checklist developed in house	10	42	14	58	25	63
Checklist provided by external consultant/advisor	4	17	6	25	9	23
HSE five steps to RA leaflet	10	42	14	58	24	60
Health and Safety (Display Screen Equipment) regulations 1992	7	29	16	67	25	63
HSE Manual handling operations regulations 1992	10	42	15	63	28	70
HSE HSG60 Work related upper limb disorders: a guide to prevention	3	13	8	33	12	30
HSE Manual handling assessment charts (MAC)	3	13	11	46	23	58
NIOSH lifting equation	1	4	1	4	3	8
Rapid Upper Limb Assessment (RULA)	0	0	0	0	1	3
Quick Exposure Check (QEC)	0	0	0	0	6	15
Other	0	0	0	0	0	0
Don't know	0	0	1	4	1	3

Question 38 and 39.
What do you like and dislike most about the risk assessment that your company uses to assess musculoskeletal risk factors?

Most liked aspects of risk assessment used assessing for MSD risks	Most disliked aspects of risk assessment used assessing for MSD risks
I developed it so am familiar with it.	Persons completing don't always put in accurate information, takes managers ages to follow up.
I like the methodology behind the MAC assessments I like how the MAC assessments incorporates a numerical and colour coding score system to highlight high risk manual handling tasks.	There is no-where on the form to document how you come to the numerical score. The form doesn't allow a description on how you come to the score.
Pragmatic.	N/A
It triggers areas to check	
Straight forward and simple	
It is simple and relatively easy to demonstrate results	None
Simple to fill in paperwork	In our industry it is very difficult to eliminate manual handling due to the variety of materials and products we produce.
The checklist based on either set of regulations and consultations it practices.	
It covers all areas as per the HSE guidance and its unambiguous.	Time factor
It is easy to use and yet thorough.	The different levels of understanding of assessors, however, we do have occupational health or SHE Managers for further advice if any problems highlighted.
MAC tool developed by HSE- quick and easy and provides confirmation of risk.	Not enough time spent on this particular risk.
It is simple to understand and it is difficult to forget to perform any of the required steps.	It takes up valuable time from my other work areas but it is necessary.
The documentation	Being able to access the results.
To get the workers involved.	Time taken to do a risk assessment. If somebody does a risk assessment without asking the person who does the job.
The assessment is easy to use and required little training. It covers all areas specified in the manual handling guidance and assesses the task as a whole providing a clear numerical score for comparison.	The assessment leaves the level of risk for each question completely up to subjective judgement. This can result in differences in rating between different assessors; however the training for using this assessment helps reduce this problem.
Nothing	Lacks formal training for assessors
Easy to complete	Could be more comprehensive.

You can work through the check list to ensure that each assessment is done in the same manner.	There are no separate columns for the target dates and responsibilities for each individual action, which makes it difficult to ensure that all actions are carried out to target.
We have developed a hazard identification check sheet and an aid memoir of control measures.	Quite an involved document which needs trimming down.
I have a condition that affects my spine so I understand the importance of the risk assessment and how to deliver it.	Nothing other than lack of time.
Simple to understand, involves everyone	Time
Quick risk (level 1 in-house proforma. MAC charts (level 2). Checklists (level1) is preferred by managers.	Risk assessment may not exist in 90% of cases.
Nothing	Too simple. No depth. Incorporated with general risk assessment.
	Lack of awareness of the problem
Any changes made to existing work practices or the introduction of new processes, are assessed immediately and affected staff informed the same day.	
Assess factors on a task and location factor, not just generically.	Not specific enough when applied to other risk assessments.
No real MSD assessment in place general task assessments.	Trying to identify the easiest but best method of assessment in the business.

Question 43.
Main obstacles to implementing change or interventions to reduce the risk and MSDs.

Obtaining more information and enforcing changes.
Cost
Senior management budgetary constraints.
Time/money
Budget
Time scale. Running a small business involves doing almost everything from office to shop floor.
Cost and communication
Time
Cost and time
Resistance to change
ii) Time ii) Financial iii) other priorities iv) production demands.
None. Health and Safety is taken very seriously
Space is a limiting factor in positioning pallets for stacking and lifting equipment. Also reluctance of the workforce to accept change.
The difficulty to find machinery to be able to perform a varied amount of products and materials.
Cost
Money
Money, we have an ongoing program to remove certain manual handling tasks in our operation, but can only progress one thing a year as the machinery required is expensive.
Peoples' attitudes and behaviours. If the employee, supervisor and manager all 'buy in' to the control measures then they're usually successful.
Time, competing pressures from other risks, e.g. COSHH, COMAH, noise, vibration, working at height, etc.
Employees disliking the effects changes may have on their ability to do the work efficiently and without increasing demand on them.
Being able to hold a meeting with management.
Put workers first when making all risk assessments.
Custom and practice. Macho Attitude. Lack of suitable equipment.
Lack of practical solutions, cost versus risk.
Capital investment
People
Inertia and/or lack of communication or involvement.
Sometimes customer requirements. Not technically possible.
people and reluctance to change
Cost of implementation - manual handling aids 50/50 or 60/40
Cultural and budgetary.
The attitude of the people "I have been doing this for 30 years"
Method options
Money

Cost and practicality of retraining
Upfront costs
Meeting customers' demands for cloth of certain weight versus handling risk
Ensuring improvement actions are completed amongst all the other competing actions
Finding practical solutions
Management of the control measures, supervision.
Cost
Most of our workforce does not speak English as a first language; it is difficult to get understanding especially through a translator.
Cost.
Financial restraints. Convincing employees to change long standing practices.
Knowledge, we are very keen to progress.
Training
Cost
Getting all staff to follow the advice.
People have a reluctance to change the way they carry out tasks.
Lack of time/resources
Resources.
Blinkered attitudes of workers. Will carry out procedures when watched - take short cuts - put them at risk when unsupervised).
Workers inertia to change practice.
Time (production and planning) Staff opposite.
Lack of interest/motivation/time and specific guidance of most managers. No perceived problems for most. Lack of awareness in manual handling (not DSE) risk assessment needs. Other priorities such as falls, stress, transport, asbestos.
Changes to production/ performance.
Custom and practice - we have always done it this way. Also cost.
Money
Identifying manageable and cost effective solutions
Costs and operational restrictions.
Convincing people we are making change for their benefit. Often staff believe we only do it to protect company
Equipment changes, cost.
Convincing general operatives that risk assessments are in place for their benefit as much as a legal requirement.
More training and greater awareness
Lack of structure in company
Very little manual handling and mainly office based tasks.
Finance and lack of understanding, the methods employed (i.e. the manual handling) has always been done this particular way.
Space, time, cost
Flexible labour force which changes frequently
Costing - location - space - nature of the task
Cost & attitude
Lack of time to implement changes/paperwork.
Time. Support. Money.

Question 27
Supervisor Involvement.

By identifying hazards and helping assess risk and input into controls.
Consulted on specific jobs/equipment
Supervisors are consulted on the nature and the task.
RA's are a team process.
Problem/resolutions are discussed with them.
Trained to conduct risk assessments
They get invited and help with the assessment in their area
We are a small company and everybody has a 'Hands-on' approach although most tasks done on site do not involve manual handling.
Part of the risk assessment team.
Trained in risk assessment and monitor team.
Being aware of results/possible results of activities.
They advise as to the requirement for the type of handling
Consulted on problems/work practices discussed.
Risk assessments are generic and are completed by a team which includes the departmental manager, supervisors and workers.
They are advised of the controls required and then they review the controls to ensure they remain sufficient.
Joint risk assessment - full consultation.
They are supposed to be involved, however this varies.
Informed of assessment and expected to act on any recommendations.
Help with assessments and reviews
Assessing the tasks
Assess the tasks
As part of the assessment process the job is discussed with supervisors. Their contributions are considered whilst carrying out the assessment and reporting the associated risks.
Part of the risk assessment teams
Trained assessors working with health and safety officer.
Trained
Link between management and employees identifying risk.
Conduct both individual and joint risk assessments with operators.
They assist in looking at the activity to ensure the assessor sees what really happens.
They are supposed to carry them out
Only trainers and managers at present can do assessments. Eventually when trained key safety reps from each department will be involved
Quality check of the assessments and sign off on actions
They conduct Risk Assessments and input a range of controls.
The group management and onsite management work together as it is a training process and safety management is new to the group
Supervisors carry out assessments
as part of the task they are consulted along with the staff doing the job

Provide information on how tasks are carried out.
They conduct some of the assessments
Risk assessor is works supervisor
Consulted & asked for their opinion on tasks & if any of their staff have complained about pain, discomfort
Asked about own experience and perceived risk factors
consultant asks them to describe the processes
Consulted on task requirements and action plans.
They have been trained to carry out the risk assessments.
There is always a supervisor on the RA team
They are consulted and then are required to sign their agreement to the assessment content.
They get involved in the corrective actions or control measures.

Question 28.
Worker involvement

WORKERS ARE DIRECTLY INVOLVED AND ARE ASKED TO DEMONSTRATE THE POSTURES THEY ADOPT IN UNDERTAKING A LIFTING TASK.
RA's are a team process.
Problems/resolutions are discussed with them.
Trained in manual handling
They get invited and help
They put suggestions on how their jobs could be made easier.
Risk assessments are generic and are completed by a team which includes the departmental manager, supervisors and workers.
They're asked to input their views during the risk assessment process.
Consultation during observation of work tasks.
The worker is present during the assessment to answer questions regarding work methods and existing problems.
Being involved in assessing the tasks
To show the assessor how tasks affect different movement in the body
As part of the assessment process the job is discussed with the workers that are observed. Their contributions are considered whilst carrying out the assessment and reporting the associated risks.
Part of the risk assessment teams
Trained assessors working with health and safety officer.
Risk assessed with all employees involved.
Identifying problem jobs/areas.
Conduct both individual and joint risk assessments with operators.
They assist in looking at the activity to ensure the assessor sees what really happens.
They do it with the supervisor
Often undertake them and are observed and questioned
Workers have manual handling training and good awareness of the risks involved in the tasks they are involved in and understand that it is part of their responsibility to risk assess continually.
They are allowed to comment and involved in discussions as to what and how their activities can effect health
Via safety representatives and shop stewards
They participate fully in discussing the task under assessment
Provide information on how tasks are carried out.
They conduct some of the assessments
Consulted & asked for their opinion on tasks & if any of their staff have complained about pain, discomfort
Consultant asks them to describe the processes
Safety reps have been trained to carry out the risk assessments and work with the supervisors.
There is always a worker on the RA team
Again, consultation is conducted initially.
Carry out risk assessment as reps.

Tasks are talked through when analysis is being done.
Interviewed on the musculoskeletal aspects of their jobs.
By asking for suggestions on how they can improve the tasks they must do. Offering information if they feel a cause for concern while performing tasks.
By assisting in carrying out the assessment.
Asked about the task in hand. Task based.
Training on how to sit at a workstation, DSE.
Workers from every area take part in risk assessment to ensure all activities covered.
Asked questions at point of assessment
Persons doing the job are involved in the assessment.

Appendix C: Audit walk-through case studies

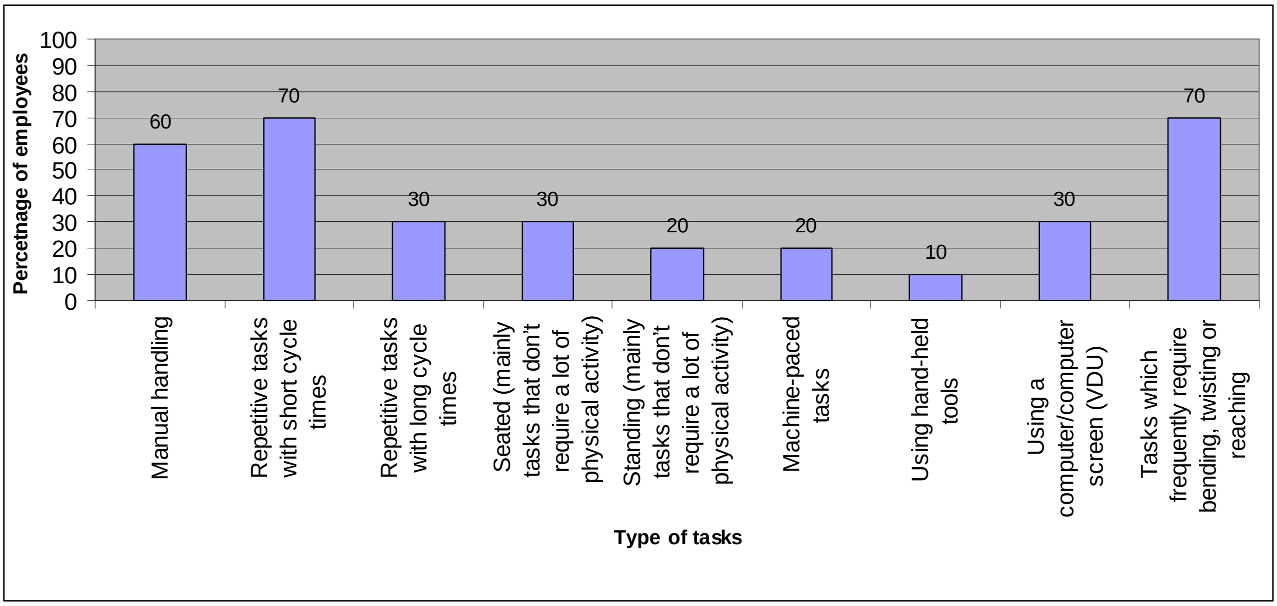
15.1 Case study 1 – Ink manufacturer

15.1.1 The company

The company manufactures and blends ink. The company employs approximately 70 people. Employees are paid by salary (not piece rate). There are three areas of work, the office, production and warehousing.

15.1.2 Type of work tasks

The figure below shows the Health and Safety Officer's estimates of the percentage of employees that are engaged in certain types of tasks. The Health and Safety Officer estimated that approximately 70% of the workforce conducted repetitive tasks with short cycle times and 30% with long cycle times. These estimates were supported by the researcher's observations. A high number of repetitive tasks were observed by the researcher to occur on site and these would require an assessment of the upper limbs (a ULD assessment).



Office workers
20 employees work at computer workstations. Tasks include; writing down orders received from the telephone, inputting orders into computers, printing orders and placing them into envelopes.

Production workers
The company has 30 employees. Tasks include: manual handling ink barrels, manually blending bespoke ink colors, loading and operating machines to fill cartridges with ink. Production workers rotate to different tasks.
This is organised and enforced by the supervisor. Typically this equates to each worker rotating to a different task half way through the day.

Warehouse workers
30 employees. Tasks include picking and packing tasks to order.

15.1.3 Risk Assessment of musculoskeletal risk factors

Number of MSD risk assessments conducted

Manual handling: Yes, some.
ULDs: Yes, some.

Some of the assessments for manual handling and ULDs are conducted using checklist based risk assessment and these have been developed in house.

Resources used

- Checklist for manual handling - developed in house
- HSE's 'Five Steps to risk assessment' Leaflet
- HSE's Health and Safety (Display Screen Equipment) Regulations 1992
- HSE Manual Handling Operations Regulations 1992
- HSE HSG 60 – Work related upper limb disorders: a guide to prevention.

Procedure
A risk assessment filter has not been used to conduct an initial assessment of all manual work tasks in production or in the warehouse. Although HSG 60 was provided in the list of resources used to assess musculoskeletal risks in the workplace, the Health and Safety Manager did not use this risk assessment proforma/checklist for assessing the upper limbs or other manually intensive tasks. To assess musculoskeletal risks two different types of assessment proforma/checklists are used,

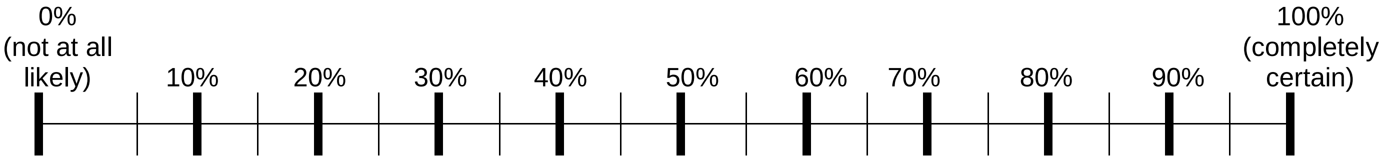
1. An in-house developed DSE hazard checklist
2. An in-house developed manual handling assessment checklist.

These risk assessments are conducted by the Health and Safety Manager and the health and safety representatives. Safety reps conducting the risk assessment for MSDs have not received specific training in the use of the checklist.

Only some tasks in this area have had a full manual handling risk assessment completed. All tasks within Office areas have been fully assessed using HSE DSE assessment checklist.

15.1.4 Identifying and implementing changes/solutions

The Health and Safety Manager reported that on the following scale it is 50% likely that solutions will be identified and 60% likely that changes will be implemented.



15.1.5 Injury surveillance

There is no active surveillance. However all employees complete an accident/sickness form following any period of sick leave. Where appropriate these are forwarded to the Health and Safety Manager who then conducts any follow up if required, i.e. interview with employee, investigation of work relatedness, work station/task design etc.

15.1.6 Cases of MSDs

In the last 3 years there have been 2 cases of MSDs reported (Carpal tunnel and Tynosynosivitis), both required surgery. Reported cases occurred in employees working in the office.

15.1.7 Health and Safety Support

Approximately 70% of the Health and Safety Manager's work time is spent conducting health and safety responsibilities.

Three Health and Safety Representatives (one in offices, one in production and one in the warehouse) assist onsite in health and safety responsibilities. Once a week the Safety Representatives conduct a 15 minute walk round, and complete a diary highlighting problem areas. The safety representatives and manager meet up at least once a month to talk through the diaries and identify and prioritize areas for action.

The Health and Safety Manger was asked to state how supported they felt by; workers, supervisors, managers and engineers/equipment designers in tackling MSD problems within the workplace. The Health and Safety Manager reported feeling the following levels of support:

- 40% level of support from workers,
- 40% level of support from supervisors,
- 40% level of support from managers.

15.1.8 Training

- **Health and Safety Officer**
  IOSH registered and about to complete NEBOSH diploma.

- **Managers/directors**
  The Health and Safety Manager is currently informing and educating the company managers and the director in health and safety, its importance and the cost/benefits.

- **Supervisors**
  Receive training from the Health and Safety Manager about musculoskeletal disorders - symptoms, risk factors and general good practice.

- **Health and safety representatives**
  Receive training from the Health and Safety Manager. This training covers; understanding what risk assessment is all about, regulations, explaining the function of safety representatives and basic health and safety.

- **Shop floor workers**
  All newly recruited staff receive training in general health and safety as part of their induction from the Health and Safety Manager. They are also given a PowerPoint presentation about the risks relating to their specific job tasks. Each member of staff is then provided with a set of review questions. This review questions includes true and false questions relating back to the PowerPoint presentation and is designed to check that employees have taken onboard (and hopefully apply) the issues and training instruction presented previously.

  All office workers are given a checklist to complete after a few days working. The checklist items check that the DSE is setup correctly and if the employee is adopting good working practices and postures. The checklist should be completed with their supervisor, however in practice this rarely occurs and staff normally complete the checklist by themselves.

  All staff are provided with HSE leaflets on Repetitive Strain Injury (RSI) and aching arms (HSE publications).

15.1.9 Additional comments from the health and safety manager

- **Health and safety in general**
  - ➢ Support from supervisors in the production and warehouse areas is currently lacking. Good practice is sometimes lax and not enforced by the supervisors. For example – members of staff repeatedly fail to wear their protective gloves and supervisors do not enforce it.

- Lack of support from colleagues and workers primarily due to lack of awareness and understanding of the risks.

- Lack of awareness and understanding from workers/supervisors of when the Health and Safety Manager should be consulted or when health and safety maybe an issue/concern. An example was provided by the Health and Safety Manager regarding a contract worker who came to fix the air conditioning but did not have sufficient equipment to access the area safely. Instead to gain access they used onsite company equipment for which they had not received training and for which a risk assessment for using the equipment in this manner had not been conducted.

- Currently the Health and Safety Manager is educating company managers and the director in health and safety to encourage support, new initiatives and improve safety culture.

- The Health and Safety manager is trying to engage a broader range of the work force in health and safety. The utilization of safety representatives is an important start. Ideally the Health and Safety Manager would like to train up all members of staff at all levels across all sections to conduct risk assessments. With the aim to increase understanding of the risks and the importance of applying good practice.

- **Risk assessment in general**

  Concerns about the amount of paper work
  The H and S manager reports that the amount of documentation required is a problem. The H and S manager is currently deciding if they should keep records for every employee. This would require completing a separate risk assessment for each task for each employee and a record of training for conducting each of those tasks. As each employee conducts more than one task the health and safety manager commented that this would result in a mountain of paper work.

  Problems with pre-existing equipment
  The H and S manager commented that it is a straight forward process to conduct risk assessments and keep records on employees training in the use of new equipment. However for already existing equipment it is harder to ensure that employees have received sufficient and correct safety training in the use of that particular piece of equipment. Furthermore, they stated that it is much harder to engage supervisors and workers to conform to newly identified safer working practices for existing equipment.

- **Risk assessment and checklists for musculoskeletal risk.**
  Risk assessments for musculoskeletal disorders have been developed in house. Problems encountered are that people don't always record accurate information.

15.2 Case study 2 – Floor tile manufacturer

15.2.1 The company

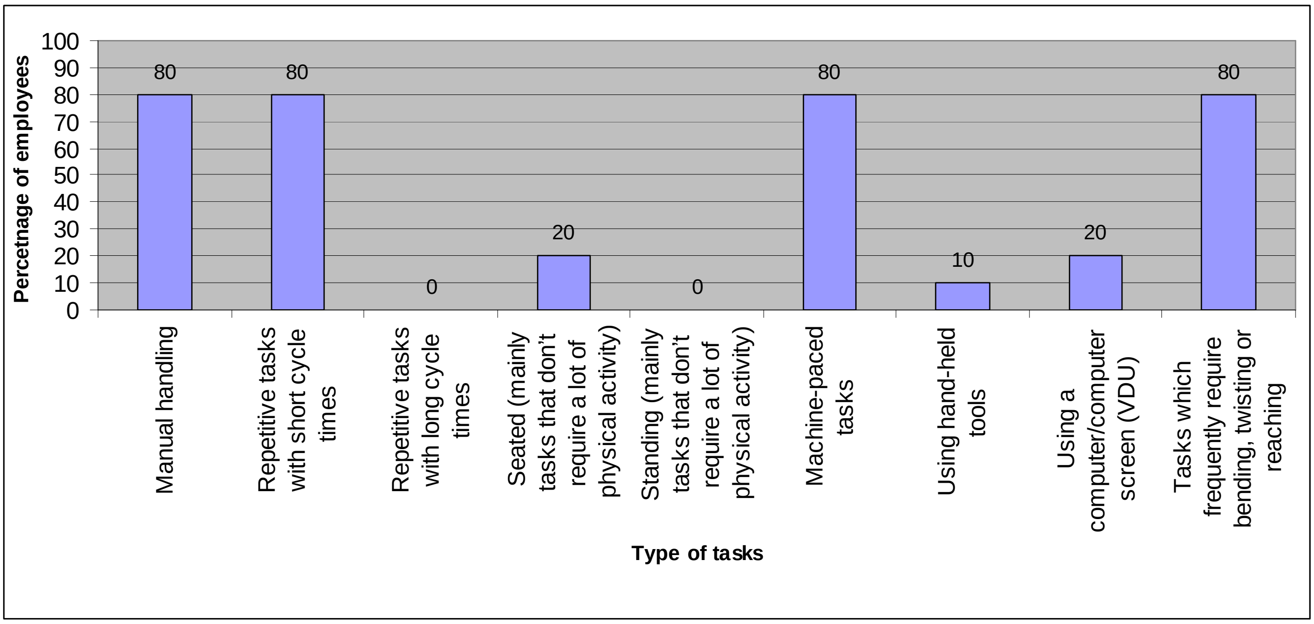
The company manufactures and fits gym floor tiles and also manufactures associated products of waxes and sealants. The company is a single site company with 140 employees. The company is split into four departments:

- floor fitting
- waxes
- adhesives
- manufacturing floor tiles.

Due to the size of the company the researcher was shown round two departments, these were the departments manufacturing adhesives and floor tiles.

15.2.2 Type of work tasks

The figure below shows the health and safety officer's estimates of the percentage of employees that are engaged in certain types of tasks. 80% of employees were engaged in repetitive tasks of short cycle times. This estimate was supported by observations made by the researcher. A number of repetitive tasks were observed by the researcher to occur on site that would require an ULD assessment.



Adhesive department (26 employees).
This department has just received new equipment and the majority of tasks have now been mechanized, although some manual tasks remain.
These tasks are mainly manual handling of cement bags and tubs of product (of various sizes and weights ranging from 16 kg to 20kg) to load and unload pallets for storage and to make up orders.

Floor tile department (21 employees).
This department consists of nine tasks. The researcher was informed that employees rotate between tasks except workers conducting 'Press' tasks as these are skilled tasks. All tasks in this section were highly repetitive in nature, hand intensive, machine paced and would require an ULD risk assessment.

Presses – Shuttler (5-6 employees)
The worker fills and operates the machine press. Cement mixture is constantly delivered via nozzle to the right hand side of the worker. The worker holds a plasterers palette and uses it to skim cement across a tile mold. The worker then pushes the mold into the press and operates the press. Cycle repeated.

Presses – Catcher (5-6 employees)
Employee removes tiles from press and stacks them onto a plastic board/spacer, and then covers with another plastic board and repeats until pallet is full.

Packing (1-2 employees)
Employee picks up the tiles and puts them into metal cages, removing the plastic spacers.

Drying ovens (Fork lift drivers)
Cages are transferred via forklift into ovens.

Linseed dip (Fork lift drivers)
Cages are removed from oven and loaded onto conveyor for dipping in hot linseed oil.

Grind loading (2 employees)
Two employees pick up finished tiles (in stacks of approx 12-15 tiles (2kg) and load into the grinding machine.

The side (inspection) (2 employees)
Finished tiles travel along a conveyor where employees conduct a visual inspection and remove faulty or damaged tiles.

Packing (2 employees)
2 employees construct a box and pick up the finished tiles (in stacks of approx 12-15 tiles (2kg)) as they come off the conveyor and pack them into the box. Then lift and push the box onto a conveyor for sealing. Boxes weigh 23 kg.

Load pallet (1 employee)
Lifts sealed boxes onto palette for storing.

15.2.3 Risk Assessment of musculoskeletal risk factors

Number of MSD risk assessments conducted

Manual handling: Yes, some.
ULDs: Yes, some.

All assessments of manual handling and ULDs are conducted using a checklist (MAC tool and a ULD checklist developed in-house).

Resources used

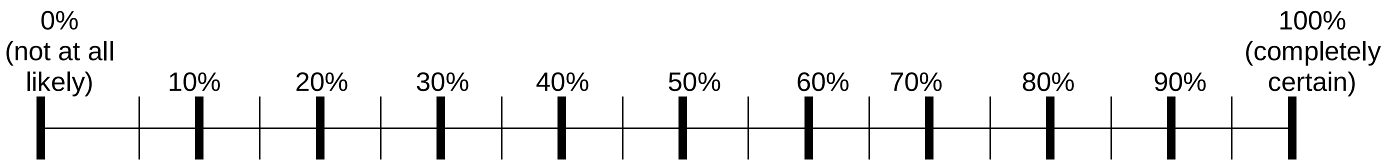
- Checklist for ULDs - developed in house
- HSE's 'Five Steps to risk assessment' Leaflet
- HSE's Health and Safety (Display Screen Equipment) Regulations 1992
- HSE Manual Handling Operations Regulations 1992
- HSE HSG 60 – Work related upper limb disorders: a guide to prevention.
- HSE Manual Handling Assessment Charts (MAC)

Procedure

For manual handling tasks the MAC tool and manual lifting regulations are used.
For MSD relating to the upper limbs HSG 60 is used as a guide however the company applies risk assessment checklists that have been developed in house. Only some tasks have been assessed these are tasks which the works manager considers high risk.

15.2.4 Identifying and implementing changes/solutions

The Health and safety manager reports that on the following scale it is 80% likely that solutions will be identified and 80% likely that changes will be implemented.



However during the walk through it became apparent that the works manager was very aware of problem areas but did not know how to resolve or reduce the risks. He commented on five tasks within the tile manufacturing department that had been identified as high risk but no changes had been made. The works managed reported that he had invited HSE to look at these tasks in an attempt to help come up with a cost effective solution but as yet no solutions have been implemented.

One of the key obstacles commented on was commitment from company directors. Several examples were given illustrating the placement of profit over health and safety.

Example 1.
A whole process was mechanized to eliminate repeated manual handling of 20kg sacks of adhesive products in paper bags. The machine was designed to bag up product in plastic bags which are then heat sealed and mechanically arranged on pallets. However after the installation of the new equipment the director decided that they preferred the use of the traditional paper bags with stitched seals. To accommodate this preference traditional bags are now manually loaded into the machine, filled bags are then suction lifted onto pallets which now have to be manually lifted off again for stitching and then manually lifted back onto palettes. This reintroduced repetitive manual handling into the task and completely defeated the safety benefits of mechanising the process.

Example 2.
A similar case involved company managers and directors reluctance to abolish a bonus scheme (piece rate) for floor fitters. Manual handling equipment had been purchased and provided to workers to assist with the lifting of four foot by eight foot boards of chip board. However to keep the work rate high workers choose not to use the equipment. Managers rather than abolish the bonus scheme or introduce a scheme to promote the good practice of using the equipment preferred to keep the bonus scheme to maintain the high work rate, falling back on the excuse that equipment to eliminate the risk was provided but that the workers chose not to use the equipment.

15.2.5 Staff turnover

Staff turnover was reported as high

15.2.6 Injury surveillance

None stated.

15.2.7 Cases of MSDs

Two to three people off sick a quarter with MSD related absence, typically less than three days absences and therefore not reported under RIDDOR. Accepted part of the job.

15.2.8 Health and Safety Support

The works manger was asked to state how supported they felt by workers, supervisors, managers and engineers/equipment designers in tackling MSD problems within the workplace. The works manager reported feeling the following levels of support:

- 50% level of support from workers,
- 60% level of support from supervisors,
- 30% level of support from managers.
- 90% engineers/equipment designers.

15.2.9 Training

- **Person responsible for Health and safety**

Health and safety duties are conduct by the works manager who spends approximately 20% of their time on health and safety responsibilities. Currently completing NEBOSH diploma.

- **Managers/directors**

No formal training

- **Supervisors**

None

- **Health and Safety representatives**

None (there are no safety representatives)

- **Shop floor workers**

None

External assistance
The company employs external consultants when areas are outside the knowledge of the onsite works manager (responsible for health and safety). Advice has also been sought from HSE who have visited the site since 2000.

15.2.10 Additional comments from the Health and Safety Manager

- **Health and safety in general**
  Old equipment, old process, management unsupportive towards change, workers accept current working conditions and also resist change.

  Management needs educating of the potential cost benefits on health and safety interventions. Currently 12% wastage in production due to damaged products typically arising through the amount of manual handling of the product throughout the process.

Reducing the wastage by reducing manual handling will pay for the cost of implementing changes.

Need to educate workforce to encourage acceptance of new work regimes.

- **Risk assessment and checklists for musculoskeletal risk.**
  Would like to see all work force trained in risk assessment particularly regarding MSDs.

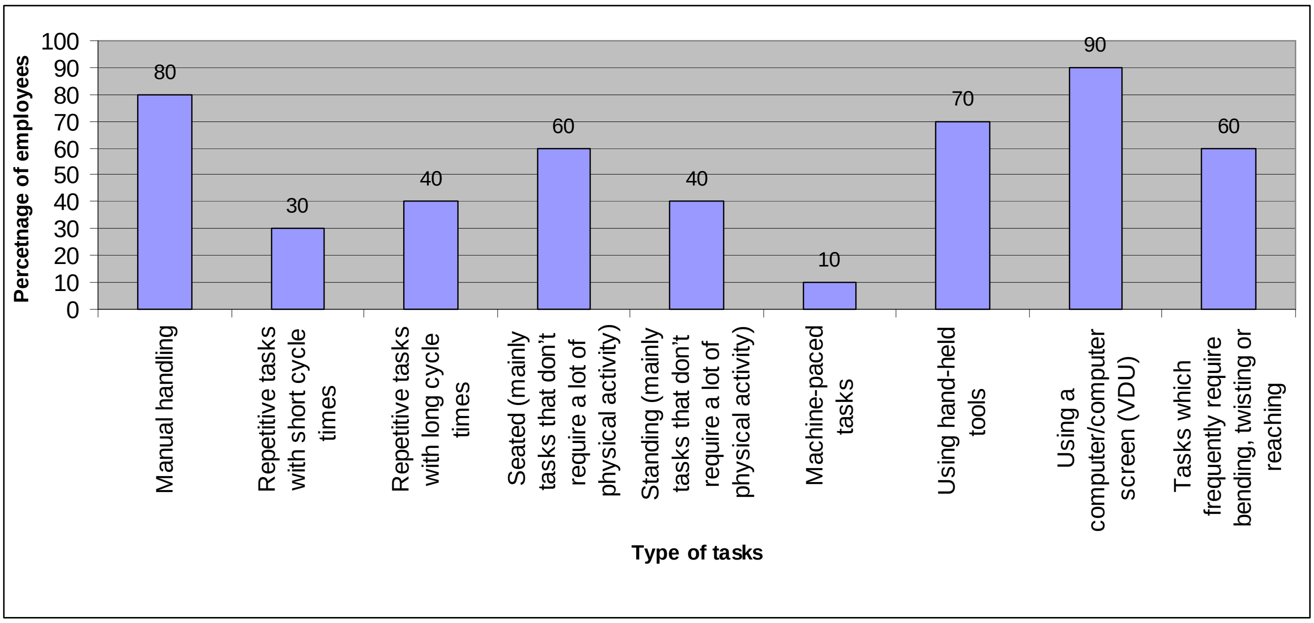
15.3 Case study 3 – Sample testing laboratory

15.3.1 The company

The company is a laboratory that tests soil, water and asbestos samples. The company employs approximately 110 people. Employees are paid by salary (not piece rate). There are five areas of work; cold store, sample preparation, sample reception/logging in, fume cabinets, and analysis.

15.3.2 Type of work tasks

The figure below shows the Health and Safety Officer's estimates of the percentage of employees that are engaged in certain types of tasks. It was estimated that 30% of employees were engaged in repetitive task of short cycle time and 40% of long cycle times. This was in contrast to observations made by the researcher who a high number of employees engaged in repetitive tasks on site and these tasks would require an ULD assessment.



Cold store
Four to five employees work in the cold store. There is no rotation with other sections. Tasks include; lifting and carrying sample trays from delivery trucks into the reception area. Lifting and placing trays onto storage shelves in the cold store. Holding a scanner gun and locating and retrieving sample trays from storage to order.

Sample reception and sample preparation
60 - 80 employees across all three shifts (approx 25 people per shift). Employees work at shared sit stand workstations (i.e. each day they could be working at a different work stations and conducting input tasks or preparation tasks).

Inputting tasks include: Lifting and carrying sample trays to workstations, lifting out individual sample containers from the trays, inputting data into a computer, returning samples into trays, and lifting trays back to reception to be placed into storage.
Preparation tasks include: Lifting out individual sample containers from the trays, unscrewing sample containers, sifting samples, weighing samples, inputting data into a computer, and returning samples into the trays.

Fume cabinet
20 – 25 employees work in this section across all three shifts (approximately 10 employees per shift). There is no rotation with other sections; however there is rotation within other tasks in the fume cabinet area.

Analysis
20 – 30 employees analysing data on computers. Sit stand shared workstations (i.e. each day they could be working at a different work stations). There is no rotation with other sections.

15.3.3 Risk Assessment of musculoskeletal risk factors

Number of MSD risk assessments conducted

Manual handling: yes, some.
ULDs: None.

All assessments of manual handling tasks are conducted using a checklist based risk assessment that has been developed in-house.

Resources used
- Checklist for general risk assessment - developed in house
- HSE's 'Five Steps to risk assessment' Leaflet
- HSE's Health and Safety (Display Screen Equipment) Regulations 1992
- HSE Manual Handling Operations Regulations 1992

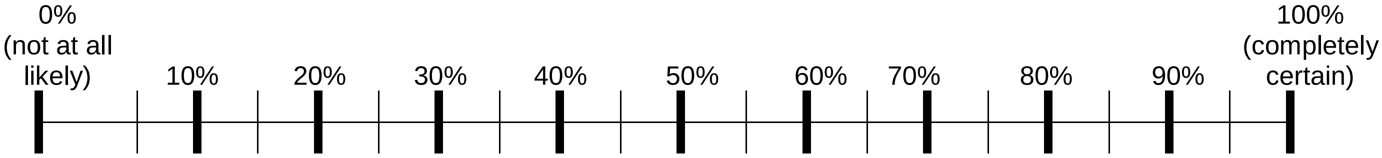
Procedure
A general risk assessment (developed in house) is completed for each task. Results from this risk assessment highlight specific areas where more detailed and more specific risk assessments are required e.g. manual handling, COSHH. The risk assessment sheet acts as a aid memoir as to what risk areas should be considered in any assessment and acts as a reference to other more detailed sources of risk assessment. There is no specific risk assessment referenced to assess for ULD risks although there is one for manual handling.

These general risk assessments are conducted by the Health and Safety Manager and the health and safety representatives. All assessors have received training in how to complete the general risk assessment.

Safety reps conducting the risk assessment for manual handling tasks have received specific training in the use of the in house developed checklist.

15.3.4 Identifying and implementing changes/solutions

The Health and Safety Manager reported that on the following scale it is 90% likely that solutions will be identified and 90% likely that changes will be implemented.



15.3.5 Staff turnover

Staff turnover is high this was reported as being due to the relatively low salary compared with other local, and similarly skilled, jobs.

15.3.6 Injury surveillance

There is active surveillance. Once a year all employees attend a medical, as part of this questions about any concerns of work problems are also discussed.

15.3.7 Cases of MSDs

In the last 12 months there have been 2 cases of MSDs reported (Carpal tunnel and Tynosynosivitis). Reported cases occurred in employees working in fume cabinet testing.

15.3.8 Health and Safety Support

Approximately 90% of the Health and Safety Manager's work time is spent conducting health and safety responsibilities.

There are five Health and Safety Officers and six Health and Safety Representatives.

The Health and Safety Manger was asked to state how supported they felt by; workers, supervisors, managers and engineers/equipment designers in tackling MSD problems within the workplace. The Health and Safety Manager reported feeling the following levels of support:

- 100% level of support from workers,
- 90% level of support from supervisors,
- 90% level of support from managers.

15.3.9 Training

- **Health and Safety Officer**
  Information not provided

- **Managers/directors**
  Information not provided

- **Supervisors**
  Receive training from the Health and Safety Manager about musculoskeletal disorders symptoms, risk factors and general good practice.

- **Health and Safety representatives**
  Receive training from the Health and Safety Manager. This training covers; understanding what risk assessment is all about, regulations, explaining the function of safety representatives and basic health and safety.

- **Shop floor workers**
  Attend an induction in which specific risk associate with their work tasks are discussed and explained.

15.3.10 Additional comments from the Health and Safety Manager:

- **Risk assessment in general**

Assuming things- about assessors – need for prompts to maintain consistency and validity.

15.4 Case study 4 – Brick manufacturer

15.4.1 The company

A brick making company which employs approximately 100 people onsite. The company is part of a large group, which has 24 sites across the U.K. Employees are paid by salary (not piece rate). However there is a monthly bonus system in which a bonus award is made to employees that meet prescribed targets. There are two main areas to the site one of which is heavily mechanized and the other is manually intensive. The researchers were shown round both areas however this report only presents observations made in the manually intensive area of the site. This area included observing the following tasks; brick cutting and slicing, making of sample boards and hand molding clay bricks. These tasks are identical across 12 other sites in the U.K.

15.4.2 Type of work tasks

The health and safety officer estimates the following percentages of employees are engaged in the following type of tasks;

- 60% manual handling tasks
- 50% repetitive tasks
- 10% in tasks which require excessive twisting and stooping

A number of repetitive tasks were observed by the researcher to occur on site that would require an ULD assessment.

Brick cutting
Two to four employees work in the brick cutting operation. This task requires bricks to be loaded and unloaded onto a conveyor which feeds into the cutting machine.

Brick slicing (Clipper saw)
One employee works on the clipper saw. The operator holds a brick and pushes it into the rotating saw. This is highly repetitive task.

Mounting samples onto sample boards (2 employees)
Workers operate a gluing gun and put glue on the back of the sample brick slice and mount onto a board.

Hand throwing bricks (2 employees)
Workers grasp the required amount of clay, knead it on a slab and cover the clay surface with a dusting of sand. The clay is then thrown in to a mold and the top surface is scraped off. The mold in then turned and the brick is removed and placed on a rack for drying.

There is no rotation between tasks.

15.4.3 Risk Assessment of musculoskeletal risk factors

Number of MSD risk assessments conducted

Manual handling: Not stated.
ULDs: Not stated.

Resources used
- Checklist - developed in house
- HSE's 'Five Steps to risk assessment' Leaflet
- HSE's Health and Safety (Display Screen Equipment) Regulations 1992
- HSE Manual Handling Operations Regulations 1992
- HSE HSG 60 – Work related upper limb disorders: a guide to prevention.
- HSE Manual Handling Assessment Charts (MAC)

15.4.4 Identifying and implementing changes/solutions

Every year all employees complete a questionnaire which probes issues relating to job satisfaction. This acts as an important facilitator of information and often identifies area for improvement. All results of the questionnaire are presented back to the workforce, with a list of consequential actions to follow based on the results. This questionnaire is used to make decisions at individual company level and also to compare results across all member sites.

15.4.5 Staff turnover

Staff turnover was described as low, with the staff typically staying 10 years plus.

15.4.6 Injury surveillance

There is no active surveillance. However all employees complete an accident/sickness form following any period of sick leave. Where appropriate these are forwarded to the Health and Safety Manager who then conducts any follow up if required, i.e. interview with employee, investigation of work relatedness, work station/task design etc.

15.4.7 Cases of MSDs

Not provided.

15.4.8 Health and Safety Support

The Health and Safety Manger was asked to state how supported they felt by; workers, supervisors, managers and engineers/equipment designers in tackling MSD problems within the workplace. The Health and Safety Manager reported feeling the following levels of support:
- 90% level of support from workers,
- 80% level of support from supervisors,

- 90% level of support from managers.
- 60% level of support from engineers.

15.4.9 Training

Information not provided

15.4.10 Additional comments from the Health and Safety Manager:

Health and safety in general

Five year health and safety plan
The company has won awards for its health and safety initiatives
They are currently focusing on 'Climate change' changing the safety climate culture of the workforce, particularly regarding manual handling.
The company yearly conducts an attitude questionnaire, which probes issues relating to job satisfaction. The results from the questionnaire are fed back to workers along with a list of consequent actions the company will be installing to combat any raised issues or problem areas.
The company keeps good accident, incident and injury records and uses these statistics to evaluate company performance.

Risk assessment in general

Language is now an increasing problem to communicating the risk to employees. There is an increase in migrant workers.

Risk assessment forms part of everyday activities. Every morning a meeting is held in each work area to discuss issues relating to health and safety and review any changes/additional risks.

Risk assessments are all presented next to, or as near to, machinery as possible and are reviewed regularly.

Involvement of staff is crucial in risk assessment. Risk assessments are always conducted in teams.

The company was having a particular problem with long term older workers. Accident data showed that this group in particularly had a high injury/accident rate compared to others. Older staff tended to use old work methods that were heavily ingrained and were unlikely to accept new safer ways of working. To focus on addressing this issue the company produced a video targeting this group of workers highlighting accident statistics and reasons.

In order to win new contracts it is important that the company can demonstrate good health and safety management.

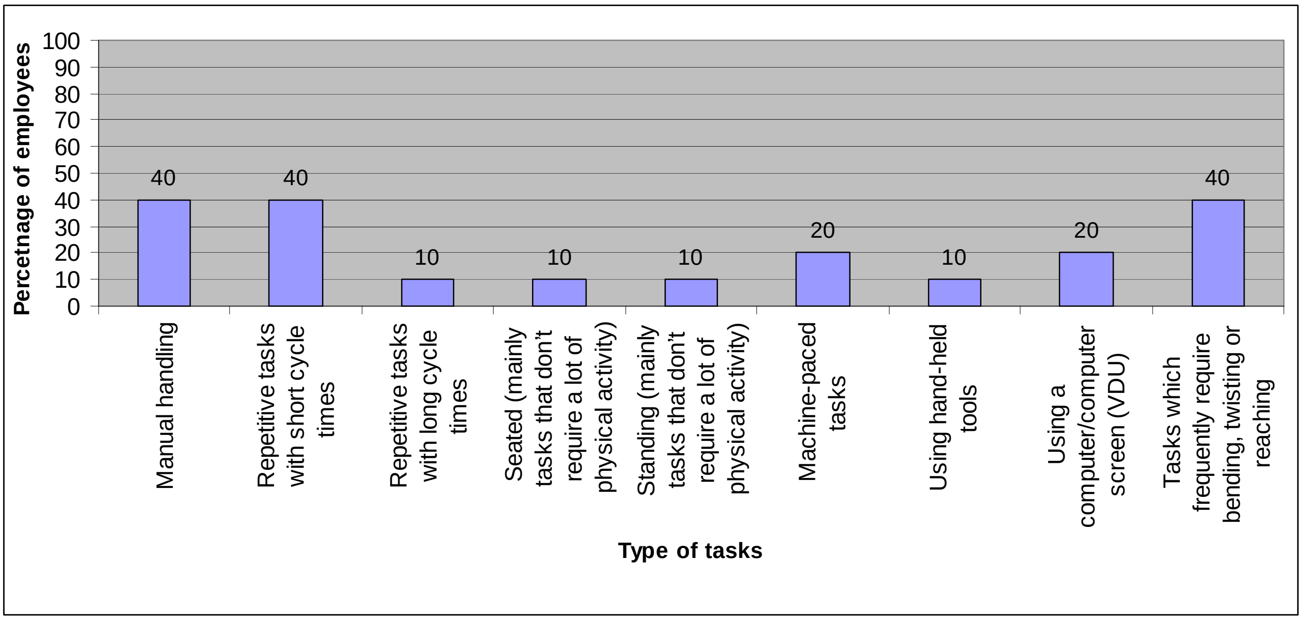
15.5 Case study 5 – Hand made brick manufacturer

15.5.1 The company

The company makes handmade bricks which are fired in traditional clamps. The company is part of a large group, which has 24 sites across the U.K. This is the only site that still uses the traditional clamp process for firing bricks (this process is the only way traditional bricks can be matched in terms of colour and style). The bricks produced are predominantly used to restore old buildings or to meet architectural specifications. This site employs 48 workers, 36 of these are production staff. Employees are paid by salary (not piece rate). However there is a team based monthly bonus system in which a bonus award is made to teams that meet prescribed targets. Employees work 12 hour shifts, four on and four off. Three areas of work were discussed and observed during the site visit these were; clay preparation, production, and pack forming. Staff turnover is low.

15.5.2 Type of work tasks

The figure below shows the health and safety officer's estimates of the percentage of employees that are engaged in certain types of tasks. A number of repetitive tasks were observed by the researcher to occur on site that would require an ULD assessment.



Clay preparation

A lump of clay is pulled from the clay stack and kneaded and rolled on a layer of sand. The worker ensures that the clay brick has a covering of sand. The clay is then picked up and thrown into a mold. Excess clay is then scraped off using a hand tool. The mold is them lifted and removed from around the clay. The clay brick is then moved to the side and placed on a tray stack to dry.

Production workers – setting
No information provided

Production workers – sorting
No information provided

Pack forming
No information provided

15.5.3 Risk Assessment of musculoskeletal risk factors

Number of MSD risk assessments conducted

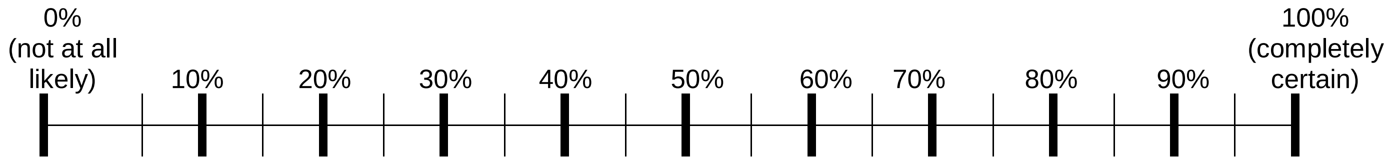
Manual handling: Yes, all.
ULDs: Yes, all.
All assessments of manual handling and ULD risks are conducted using a checklist based risk assessment (MAC tool and HSG 60).

Resources used

- Checklist - developed in house
- HSE's 'Five Steps to risk assessment' Leaflet
- HSE's Health and Safety (Display Screen Equipment) Regulations 1992
- HSE Manual Handling Operations Regulations 1992
- HSE HSG 60 – Work related upper limb disorders: a guide to prevention.
- HSE Manual Handling Assessment Charts (MAC)

15.5.4 Identifying and implementing changes/solutions

The Health and Safety Manager reported that on the following scale it is 70% likely that changes will be implemented.



Every year all employees complete a questionnaire which probes issues relating to job satisfaction. This acts as an important facilitator of information and often identifies area for improvement. All results of the questionnaire are presented back to the workforce, with a list of consequential actions to follow based on the results. This questionnaire is used to make decisions at individual company level and also to compare results across all member sites.

15.5.5 Staff turnover

Staff turnover was reported as low.

15.5.6 Injury surveillance

Occupational health nurse conducts yearly medical checks, in which workers raise any issues or concerns that they have.
If workers have any problems they report them to their supervisor who will then contact the occupational nurse if required.
When a worker is off sick they are interviewed to investigate the cause for the time off. If sickness is work related the manager will be informed and the worker may be seen by the occupational nurse.
Occupational nurse provides training on manual handling as part of the induction process.

15.5.7 Cases of MSDs

69 working days lost in the previous year due to work related injuries. To reduce this number the Factory manager has introduced a new training scheme and 'back to work' interviews (in which each person has an interview to investigate cause for time off) this has reduced time off work due to injury from 69 to 11 days over last 12 months.

Seven reported musculoskeletal injuries, four of which were back injuries and three were injuries to the wrist and/or arms.

15.5.8 Health and Safety Support

The Health and Safety Manger was asked to state how supported they felt by; workers, supervisors, managers and engineers/equipment designers in tackling MSD problems within the workplace. The Health and Safety Manager reported feeling the following levels of support:

- 70% level of support from workers,
- 80% level of support from supervisors,
- 90% level of support from managers,
- 80% engineers/designers.

15.5.9 Training

Information not provided

15.5.10 Additional comments from the Health and Safety Manager:

Health and safety in general
Resources and support relating to health and safety are good. Because the company is part of a large group procedures are well structured and are given strong support from company directors. Several awards have been presented to the overarching company in recognition of their safety procedures and initiatives.

It's a dangerous job and the hazards are well recognized and taken seriously.

Manual handling is recognized as an important and high risk issue.

Risk assessment in general
Involvement of all staff in risk assessment process is encouraged.

Risk assessment and checklists for musculoskeletal risk.
The health and safety officer has identified high risk manual handling problems but is not able to identify a solution.

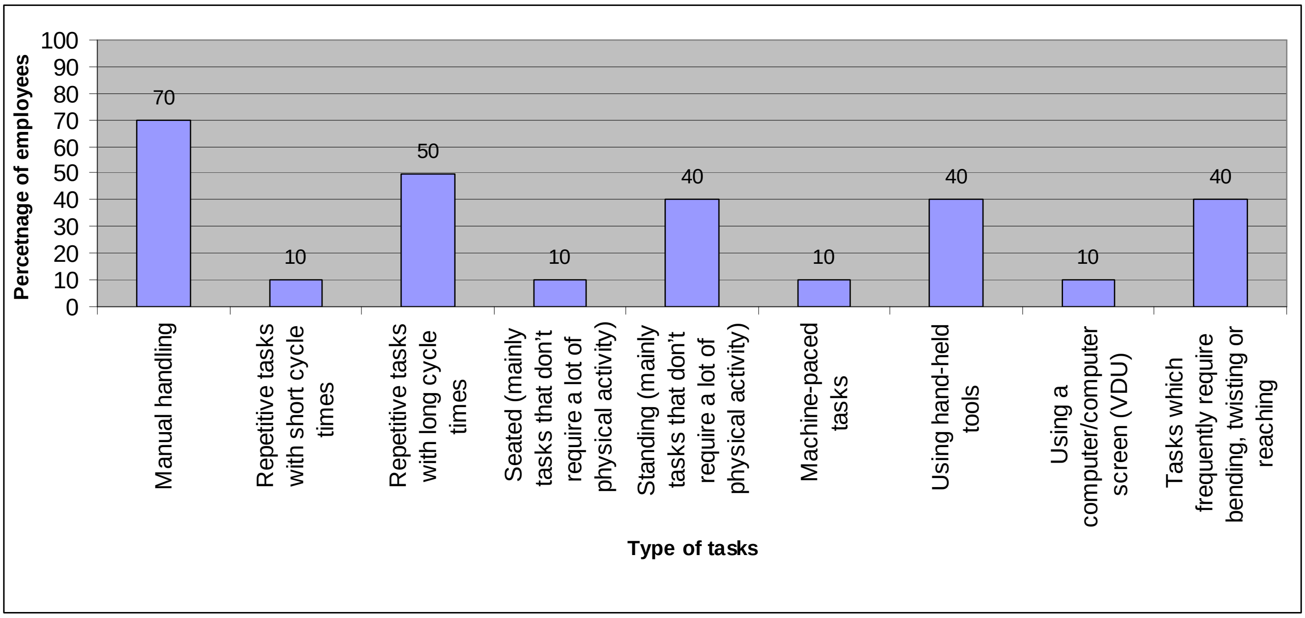
15.6 Case study 6 – Aluminium and alloy manufacturer

15.6.1 The company

The company processes Aluminum, Chrome, Titanium, Nickel Boron and Aluminum Tablets. The company is part of a large group, which has several sites across the U.K. This site employs 220 workers. Employees are paid by salary (not piece rate) and there is an annual productivity-based bonus. Staff turnover was described as very low.

15.6.2 Type of work tasks

The figure below shows the health and safety officer's estimates of the percentage of employees that are engaged in certain types of tasks.



A number of repetitive tasks were observed by the researcher to occur on site that would require a ULD assessment. These were mainly tasks conducted intermittently. For example some tasks would be conducted continuously for a few weeks and then not again until the following month. On the day of the visit only a few tasks were observed these included:

- Stacking aluminum ingots.
- Moving molds.
- Chipping away materials.

15.6.3 Risk Assessment of musculoskeletal risk factors

Number of MSD risk assessments conducted

Manual handling: Yes, all.
ULDs: Yes, all.
All assessments of manual handling and ULD risks are conducted using a checklist based risk assessment.

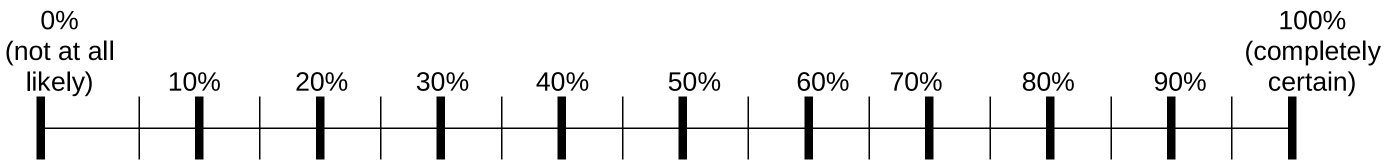
Resources used

- Checklist - developed in house
- Checklist - provided by external consultant / advisor
- HSE HSG 60 – Work related upper limb disorders: a guide to prevention.
- HSE Manual Handling Assessment Charts (MAC)

Procedure
Supervisors carryout the assessments. Safety representatives and shop stewards are also involved in conducting the risk assessments.

15.6.4 Identifying and implementing changes/solutions

The Health and Safety Manager reported that on the following scale it is 50% likely that changes will be implemented.



15.6.5 Staff turnover

Staff turnover was reported as very low.

15.6.6 Injury surveillance

There is no active surveillance. However all employees complete an accident/sickness form following any period of sick leave. Anyone with a musculoskeletal injury is referred to the company physio (external contractors). The physio makes an assessment of the type of injury and fills a report to the health and safety manager.

Where appropriate these are forwarded to the Health and Safety Manager who then conducts any follow up if required, e.g. interview with employee, investigation of work relatedness, work station/task design etc.

15.6.7 Cases of MSDs

30 accidents reported in last 12 months, 30% of which were manual handling related. The company was getting a lot of slip, trips and falls however on further investigation the H and S manager found that these were related to manual handling, consequently the Health and Safety Manager has developed his own category system for recording accidents. The categories used go beyond HSE recording categories. The Health and Safety Manager has developed a further 11 categories for slips trips and falls to get at the actual cause. For example tripping due to reduced visibility whilst carrying objects or slipping whilst carrying an object whilst twisting and in an awkward posture.

15.6.8 Health and Safety Support

The Health and Safety Manger was asked to state how supported they felt by; workers, supervisors, managers and engineers/equipment designers in tackling MSD problems within the workplace. The Health and Safety Manager reported feeling the following levels of support:

- 70% level of support from workers,
- 80% level of support from supervisors,
- 100% level of support from managers,
- 80% level of support from engineers/designers.

The Health and Safety Manager stated that if he says production has to stop to conduct some corrective safety action/intervention then production would stop no questions. The health and safety manager reported that he is strongly supported by the managers and directors.

15.6.9 Training

- **Health and Safety Officer**

  Information not provided

- **Managers/directors**

  Information not provided

- **Supervisors**

  Information not provided

- **Health and Safety representatives**

  Information not provided

- **Shop floor workers**

  Ergonomics and kinetic training. Each department has a training matrix for every employ to record what they have done and what needs to be done. No training or awareness training for repetitive tasks. Only manual handling training.

15.6.10 Additional comments from the Health and Safety Manager:

- **Health and safety in general**
  It's a dangerous job, hazards are well recognized and taken seriously.

  The Health and Safety Manager commented that it is a heavily legislated industry in which health and safety is well established. The safety culture is good and so is the support from a management and workers. Although the 'macho culture' is strong and an issue regarding manual handling.

- **Risk assessment in general**
  No scoring system as disagree with this.
  Don't agree with scoring systems based on past experience when in court.

  Risk assessment is seen as just filling forms. The mind set is wrong at the moment. Currently revisiting all RA and tying them in with accident rates.

  Devised own checklist which uses colour key and italics and shading.

  Constructed a matrix.

- **Risk assessment and checklists for musculoskeletal risk.**
  Developed own injury reporting categories for manual handling and slip trips and falls. To get more at the root cause of the incident rather than just slip trip and fall. Found that most slip, trip and falls are related to other issues such as manual handling.

  MSDs are low priority as low risk perception difficult to get across to workers – Health and Safety Manager working on this.

  Previous risk assessment and prioritising action tend to focus on high risk hazards such as COSHH, chemical burns etc. This is based on perception rather than probability and actual frequency rates. H and S manager currently addressing this by showing that manual handling and MSDs need high priority as although low relative severity the frequency rate is high.

  MAC tool is poor for assessing task which involve pushing and pulling.

15.7 Case study 7 – Salad Processors

15.7.1 The company

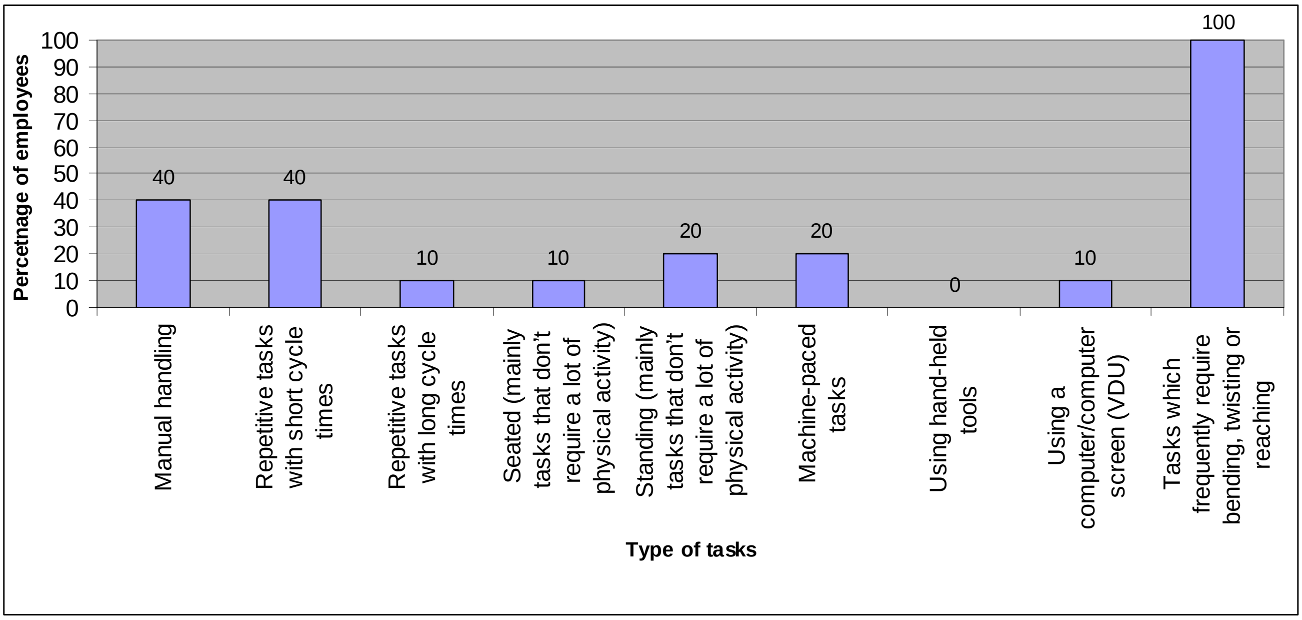
The company prepares and packages salad. They deal with tomatoes and different varieties of lettuces. The company is part of a larger group but each company within this group is independent and acts independently. Therefore there are no common procedures prescribed for all the member sites/companies. The company employs 180 workers which can increase at peak times to 250 workers, with the majority being agency staff. Just over 50% of workers are immigrant staff (predominantly Polish and Hungarian). English language abilities vary and maybe very limited. Currently there is no prerequisite for a certain level of English ability.

Employees are paid by salary (not piece rate). There is an early and a late shift. Each shift is 8 hours long with two 20 minute breaks. Overtime is expected when required. At peak times employees work 12 hour shifts, five or six days a week.

All work tasks are conducted in low temperatures ranging from 2 – 5 °C. The site comprises four work areas; Goods In, Low Risk production, High Risk production and Packing. Researchers did not observe tasks in High Risk.

15.7.2 Type of work tasks

The figure below shows the health and safety officer's estimates of the percentage of employees that are engaged in certain types of tasks. A high number of repetitive tasks were observed by the researcher to occur on site that would require an ULD assessment.



Goods in (3 workers, temperature 2 ^{o}C)
Tasks conducted in this area are mainly manual handling operations. Trays of produce are delivered stacked on pallets. Maximum height of the stacks can range from 1.8 m to 2.2 metres; consequently a lot of lifting occurs at, or above, shoulder height. Workers lift trays off pallets one at a time and take them through to production. Other products such as cabbages are delivered in bins and require workers to stoop and lift produce out on the bins onto trays and take them threw into production.

Low risk Production (temperature 2 ^{o}C)

Line feeders (2 workers)
Pick up trays of produce and tip them to empty the contents onto the conveyor.

Preparation

Line 1. (6 - 10 workers)
Line 2 (3 - 4 workers)
Line 3 (2 - 3 workers)

There are three lines in preparation. The preparation tasks conducted on all the lines are similar and include: picking up individual produce from the conveyor, taking out the core of lettuces using a hand held knife, removing dead leaves. Each item is also visually inspected for foreign bodies. The produce in then placed back onto a different conveyor. Repetition rates are high and machine paced. There is a daily target for each line in terms of tonnage of produce prepared. Each lettuce can weigh between 0.5kg to 1 kg. The machines are typically paced to produce two tonnes an hour.

Inspection (1 to 4 workers)
Workers visually inspect produce as they move by on the conveyor, dead leaves are removed.

Additional products (2 to 3 workers)
This line not in action on the day of the visit. However additional products are prepared in this area which includes carrots, onions, and cabbages.

Washer (1 to 2 workers)
This task requires the loading of baskets of produce into a bath of water; the worker has to lift baskets every one to three minutes throughout the shift. The produce is removed from the washer mechanically on a conveyor into baskets.

Dryers (3 to 4 workers)
Baskets from the washers are lifted into and out of dryers and the tipped into bins.

Packaging
This is mostly an automated process however operators are required to lift and load rolls of bags into the packaging machines and to push bins of raw prepared produce for loading into the packaging machines.

Packing (10 to 15 workers)
Bagged produce is delivered onto a rotating table where a worker picks up the bags, tests that the bags are sealed and then places them into boxes and stacks them onto pallets for distribution.

There is no rotation. However, tasks may vary in preparation depending on the type of product/lines running that day. There are Cell leaders (supervisors) for Goods In, Preparation, Drying and Packing who are responsible for, and organise, staff in that area.

15.7.3 Risk Assessment of musculoskeletal risk factors

Number of MSD risk assessments conducted

Manual handling: Yes, some (MAC tool).
ULDs: None at present (HSG 60).

All assessments of manual handling and ULD risks are (or will be) conducted using a checklist based risk assessment.

Resources used
- HSE's 'Five Steps to risk assessment' Leaflet
- HSE's Health and Safety (Display Screen Equipment) Regulations 1992
- HSE Manual Handling Operations Regulations 1992
- HSE HSG 60 – Work related upper limb disorders: a guide to prevention.
- HSE Manual Handling Assessment Charts (MAC)

Procedure
Currently no risk assessments have been conducted for any ULDs. However the Health and Safety Manager talked us though what he is planning to do. The planned procedure is to use the HSG 60 risk filter, to identify tasks which require a further more detailed assessment. This filter will highlight areas within a task which are of potential concern. Initially the risk filter will be completed by the Health and Safety Manager, with the aim that all line supervisors (cell leaders) will complete the risk filter. The Health Safety Manager felt that the risk filter is within the understanding capabilities of the cell leaders. Where the need for more in-depth assessments is identified by the filter these in-depth assessment will be conducted by the Health and Safety Manager and the cell leader together using HSG 60 full assessment checklist.

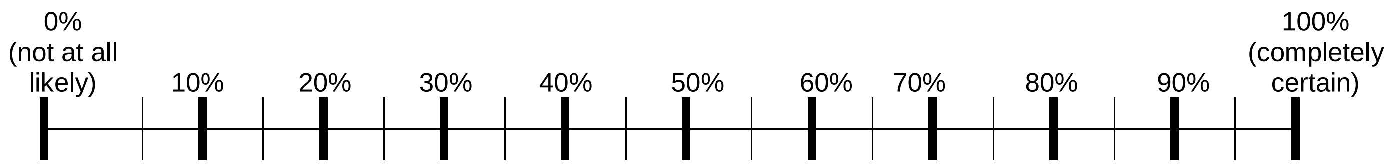
Manual handling – a check list developed in-house by the Health and Safety Manager is currently used. This is used by the Health and Safety Manager to assess all manual handling tasks. The form presents a list of check items which are then checked in terms of low, med, and high level of risk. Next to each item there is an area to write down problems occurring from the task, and then a column to write possible remedial actions.

The Health and Safety Manager is ultimately aiming for a monthly audit using cell leaders.

Supervisors are all consulted when conducting risk assessments however the workers are not involved or consulted.

15.7.4 Identifying and implementing changes/solutions

The Health and Safety Manager reported that on the following scale it is 50% likely that changes will be implemented. The Health and Safety Manager reported that cost and general operational restrictions acted as barriers to implementing changes.



15.7.5 Staff turnover

Staff turnover was reported as high. Most migrant workers work at the company for 12-24 months. Currently none of the production staff have been there longer than 2 years.

15.7.6 Injury surveillance

Information not provided.

15.7.7 Cases of MSDs

No cases of MSDs have been reported. The Health and Safety Manager is surprised by this as he states that a lot of the tasks an highly manually intensive and repetitive. The Health and Safety Manager is concerned that problems are currently being missed due to the short duration people work at the company. A high percentage of the work force is migrant workers who typically leave after two years when their visas have run out. Also currently they do not have any staff that have worked longer than 2 years at the company. The Health and Safety Manager is concerned that problems will start to arise as duration of employment increases. The health and safety officer is interested in alternative means of capturing data on prevalence/discomfort early symptom reporting.

15.7.8 Health and Safety Support

The Health and Safety Manger was asked to state how supported they felt by; workers, supervisors, managers and engineers/equipment designers in tackling MSD problems within the workplace. The Health and Safety Manager reported feeling the following levels of support:

- 20% level of support from workers,
- 20% level of support from supervisors,
- 50% level of support from managers,
- 30% level of support from engineers/designers.

15.7.9 Training

- **Operations director**
  IOSH managing safely.

- **Cell leaders**
  CIEH level 2 foundation training provided by the Health and Safety Manager. This includes training in conducting general risk assessments. They have specific training in manual handling but none for ULDs. The aim is to get all cell leaders to attend the IOSH managing safely course.

- **Shop floor workers**
  Induction provides information on general health and safety and general human resources. No training is given on manual handling or ULD symptoms and risks. Communication is a problem; over 40% of all staff are migrant workers who don’t speak English. The company is currently investigating ways to counteract these communication difficulties through pictorial signage and translation of training and risk documents.

15.7.10 Additional comments from the Health and Safety Manager:

- **Health and safety in general**
  Language is a problem. 14 languages spoken on site. There is a translator in HR but only for a few languages.

  They are currently translating documents into Polish. Trying to produce brief translator cards, with some brief text and a picture for cell leaders to use.

- **Risk assessment in general**
  Ownership is a key drive. Hope to achieve this by getting cell leaders to conduct RA.

- **Risk assessment and checklists for musculoskeletal risk.**

Currently none have been conducted. Process started using HSG 60 filter.
This will eventually be conducted by all cell leaders as the filter is straightforward. The aim is to get all cell leaders to conduct their own risk assessment.

15.8 Case study 8 – Vegetable and salad processors

15.8.1 The company

The company prepares and packages vegetables and salad. They deal with carrots, cabbages, potatoes, lettuces, onions and parsnips etc. The company is part of a larger group. Health and safety managers from different companies meet regularly to discuss health and safety issues and new initiatives; however it is up to the individual companies which ones they install.

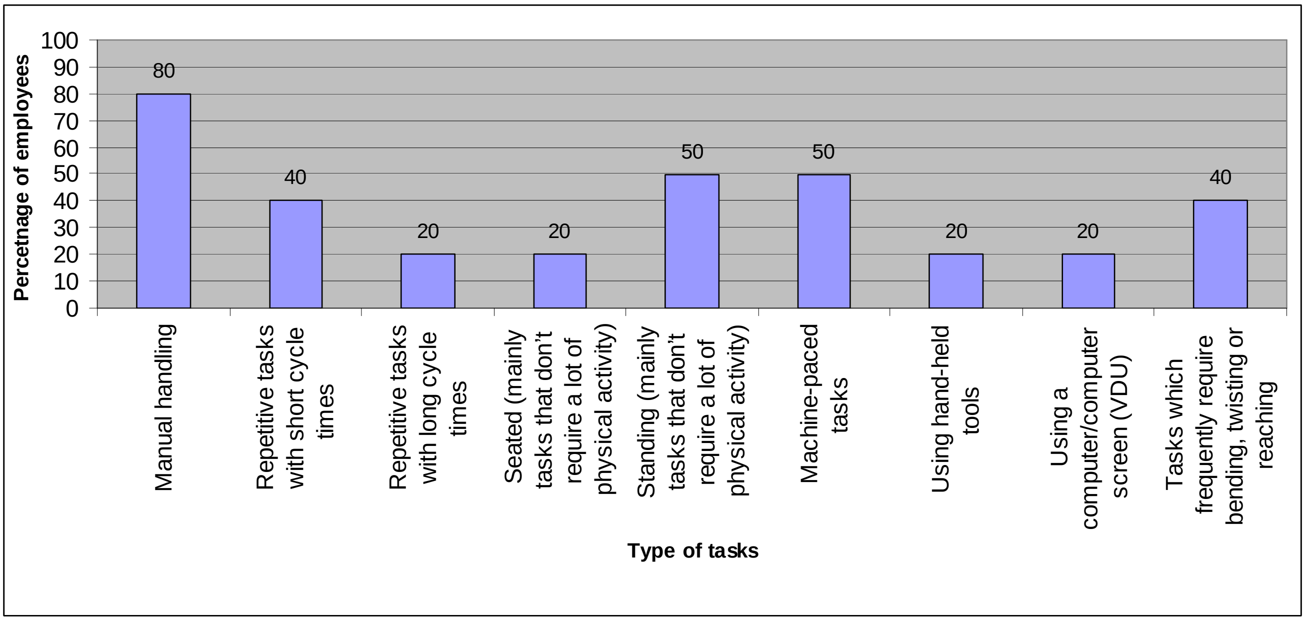
The company employs 950 workers, with the majority being agency staff. Just over 50% of workers are immigrant staff. English language abilities vary and maybe very limited. To be employed by the company there is a prerequisite for candidates to speak a certain level of English.

Employees are paid by salary (not piece rate). There is an early and a late shift. Each shift is eight hours long with two 20 minutes breaks. Overtime is expected when required. At peak times employees work 12 hour shifts, five or six days a week.

All work tasks are conducted in low temperatures ranging from 2 – 5 °C.

15.8.2 Type of work tasks

The figure below shows the health and safety officer's estimates of the percentages of employees that are engaged in the certain types of tasks. A high number of repetitive tasks were observed by the researcher to occur on site that would require an ULD assessment.



Line feeders (2 workers)
Pick up trays of produce and then tips them to empty the contents onto the conveyor or into bins for preparation.

Preparation (20 + workers)
There are various preparation tasks. The activities involved in each task vary depending on the type of vegetable/salad item. Tasks range from topping and tailing turnips, to preparing lettuce. One area is dedicated to the preparation of onions, with groups of workers conducting very specific tasks, i.e. skinning the onions, spreading the chopped onions. Repetition rates for all tasks are high and often machine paced.

Washer (4 to 5 workers)
This task requires the loading of baskets of produce into a bath of water; the worker has to lift baskets every one to three minutes throughout the shift. The produce is removed from the washer mechanically on a conveyor into baskets.

Dryers (3 to 4 workers)
Baskets from the washers are lifted into, and out of, dryers and then tipped into bins.

Packaging
This is mostly an automated process however operators are required to lift and load rolls of bags into the packaging machines and to push bins of raw prepared produce for loading into the packaging machines.

Packing (15 to 25 workers)
The end product is delivered onto a rotating table where a worker picks up the bags, tests that the bags are sealed and then places them into boxes and stacks them onto pallets for distribution.

There is no rotation. However, tasks may vary in preparation depending on the type of product/lines running that day. There are Cell leaders (supervisors) for Goods In, Preparation, Drying and Packing who are responsible for, and organise, staff in that area.

15.8.3 Risk Assessment of musculoskeletal risk factors

Number of MSD risk assessments conducted

Manual handling: Yes, some (MAC tool).
ULDs: None.

All assessments of manual handling risks are conducted using a checklist based risk assessment (MAC tool).

Resources used

- Checklist - developed in house
- HSE Manual Handling Assessment Charts (MAC)

Procedure
The Health and Safety Manager conducts the risk assessments.
Originally it was the supervisor however this produced unsatisfactory results as there was a tendency for supervisor to interpret the risks as lower than they actually were. The risk assessment used was very subjective. The Health and Safety Manager has since introduced the use of the MAC tool and now all risk assessment for manual handling are conducted by the Health and Safety Manager.

When risk are solutions/interventions are identified the health and safety manager informs the supervisors of changes that are required it then up to the supervisors whether these intervention/changes are made/installed.

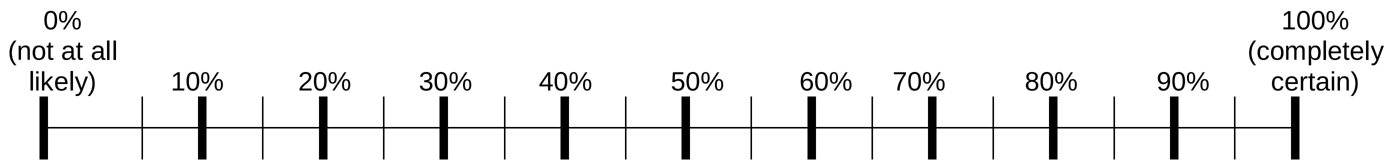
No risk assessments for ULD risks have been conducted.

External help
The company is part of a larger group. Health and safety managers from different companies meet regularly to discuss health and safety issues and new initiatives; however it is up to individual companies as to which ones they install.

15.8.4 Identifying and implementing changes/solutions

The Health and Safety Manager will put together a set of recommendation for changes to reduce risks identified in the risk assessment. These recommendations are presented to the supervisor and it is up to the supervisor to install these changes.

The Health and Safety Manager reported that on the following scale it is 50% likely that changes will be implemented. The health and safety manager reported that worker's acceptance to change was the main obstacle to implementing changes with a common attitude being "we have always done it this way". Cost is also an obstacle.



15.8.5 Staff turnover

Staff turnover was reported as very high.

15.8.6 Injury surveillance

Occupational Health Nurse two days a week. The Nurse deals with long term sick referrals. Occupational Health Nurse conducts DSE assessments.

If someone reports problems to the Occupational Health Nurse then the Nurse will make an assessment of the injury/problem and will put together an outline of restrictions or types of activities the person should avoid.

This is then passed onto the Health and Safety Manager who then translates this into which job tasks the person will be restricted from conducting. This is passed onto the supervisor who is responsible for ensuring that that person does not conducted any of the restricted tasks.

15.8.7 Cases of MSDs

196 accidents reported over last 12 months. 4 of these were manual handling related injuries, 10 sprains and strains related to repetitive work tasks were reported of which five were reported to HSE under RIDDOR.

15.8.8 Health and Safety Support

The Health and Safety Manger was asked to state how supported they felt by; workers, supervisors, managers and engineers/equipment designers in tackling MSD problems within the workplace. The Health and Safety Manager reported feeling the following levels of support:

- 90% level of support from workers,
- 60% level of support from supervisors,
- 60% level of support from managers,
- 50% level of support from engineers/designers.

15.8.9 Training

No information provided

15.8.10 Additional comments from the Health and Safety Manager:

- **Health and safety in general**

Map

New training initiative (funding been made available)
Language a problem although got translator and use pictures. End up having to do visual demonstrations.

Alcohol and drugs a key issue

- **Risk assessment in general**
  No comments

- **Risk assessment and checklists for musculoskeletal risk.**

  Manual handling assessment used to be conducted by supervisor but very subjective and most did not identify a problem even if it was high risk. This is because they are used to the task and not using a fresh pair of eyes. They are unlikely to see a problem where there is one. Also a tendency for supervisors to underestimate the loads involved because they see staff doing the lifts every day and assume the loads to be low.

The MAC tool is preferred and the Health and Safety Manager decided to conduct them all herself to ensure validity and consistency.

MAC used to provide definition of what to look for.

Health and Safety Manager will conduct RA and pass on results to supervisor with recommendations for improvement but it is up to the supervisor to install these changes.

Most controls identified are management ones such as rotation – there are often few physical changes in workstations etc. identified and implemented.

The Occupational Health Nurse will deal with injury or reports of discomfort. They make a report and can provide a restrictions notice as to what actions to avoid. This is passed onto the Health and Safety Manager who then uses to construct a list of tasks that that worker should not conduct. This is passed on the supervisor who then has to make sure that this worker does not conduct any of those restricted tasks.

No risk assessment of ULDs. No checklist used.

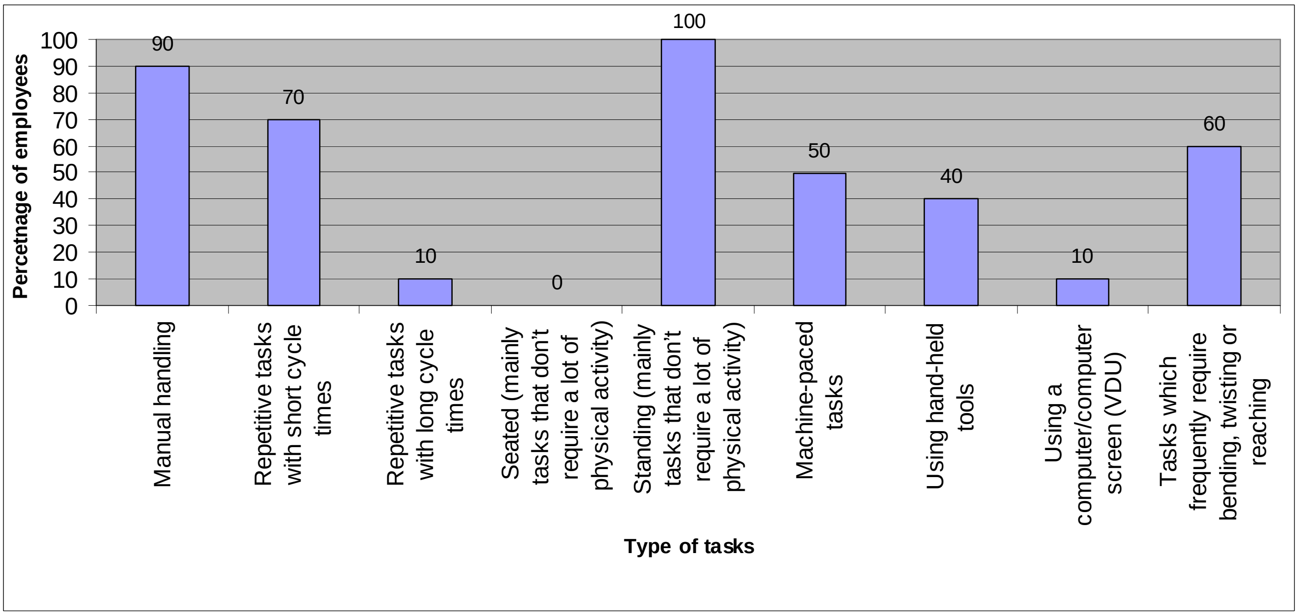
15.9 Case study 9 – Flower bouquets

15.9.1 The company

The company imports flowers from around the world and makes them into bouquets and packs them into boxes to distribute across the U.K. The company is part of a large group, which has a further four sites across the U.K. The Health and Safety Manager for this site is also responsible for the other three sites. This site employs 255 workers. Employees are paid by salary (not piece rate). Employees work seven to eight hour shifts, with two 15 minute breaks and one 10 minute break. At peak times, e.g. Summer, Christmas, Mother's Day and Easter, workers are expected to work overtime which can lead to 12 hours shifts. There are three separate factories on this site, all of which do similar tasks producing slightly different products for different clients. Staff turnover was reported as low. A high percentage of staff are agency workers.

15.9.2 Type of work tasks

The figure below shows the Health and Safety Manager's estimates of the percentages of employees that are engaged in certain types of tasks. A high number of repetitive tasks were observed by the researcher to occur on site that would require an ULD assessment.



There are three separate factories on this site, all of which do similar tasks producing slightly different products for different clients. The following tasks are conducted along each line in each factory. Factory 1 has five lines, Factory 2 has approximately seven lines and Factory 3 three lines.

- Line feeders
- Bunch formers

- Hand tying
- Sleeving the bunches
- Labeling
- Bottom and length check
- Packing - Make box

15.9.3 Risk Assessment of musculoskeletal risk factors

Number of MSD risk assessments conducted
Manual handling: Some
ULDs: None

All assessments of manual handling risks are conducted using a checklist based risk assessment (MAC tool).

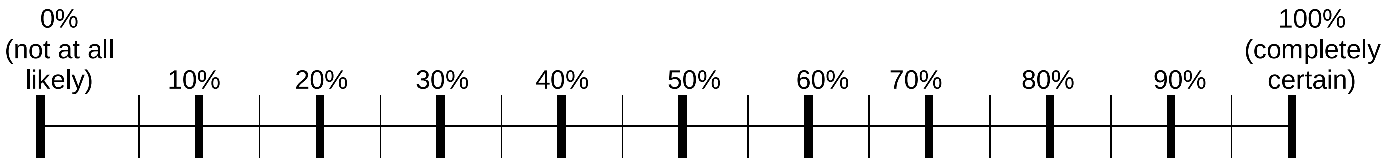
Resources used
- Checklist - developed in house
- HSE's 'Five Steps to risk assessment' Leaflet
- HSE's Health and Safety (Display Screen Equipment) Regulations 1992
- HSE Manual Handling Operations Regulations 1992
- HSE HSG 60 – Work related upper limb disorders: a guide to prevention.
- HSE Manual Handling Assessment Charts (MAC)

Procedure
A general risk assessment is conducted by production managers and/or supervisors. The managers and supervisors have all been trained in conducting on the job general risk assessment by the Health and Safety Manager. From these assessments the need for more specialised risk assessment covering specific risks are identified. These specialised /specific risk assessments are conducted by the Health and Safety manager. Every month an assessment is made on the progress of actions to ascertain whether changes have been made and also to monitor their effectiveness. The MAC tool is used where a manual handling task has been identified. Where a more repetitive type of task, rather than manual lifting, is observed, HSG 60 is referred to. However as yet no assessments of these types of tasks have been conducted, this is because the manager is aware that a number of these tasks will be of high risk but at this stage they cannot see any solutions as to how to reduce the risks. They are therefore not conducting a specific risk assessment of these types of tasks and have opted to wait and get in external help in conducting the risk assessment and also in coming up with actions/solutions. The Health and Safety Manager is concerned that once a specific risk assessment has been conducted they will be 'opening up a can of worms' which at this stage they cannot solve.

15.9.4 Identifying and implementing changes/solutions

The Health and Safety Manager reported that on the following scale it is 40% likely that changes will be implemented. The main obstacles to implementing changes are cost, location, space and the nature of the task.

Communication – attitude questionnaire.



15.9.5 Staff turnover

Staff turnover was reported as low, about 3.6% of staff each year leave. During peak production times about 40% - 60% of the workforce are agency staff.

15.9.6 Injury surveillance

All staff have been trained in accident reporting and consequently the figures have gone up over the last 12 months. Anyone with a problem or discomfort/pain informs their line leader, who will then report to their manager and to the Health and Safety Manager. One day a week an occupational health nurse attends the site. All individuals reporting problems will be referred to the nurse.

Line leaders are trained in the hazards and what to look for regarding MSD risk e.g. poor postures. This training in undocumented. When the line leaders observe someone adopting a poor working poor posture or if they are using inappropriate or poor technique they point out their concern to the worker and discuss how to improve their working technique. If it continues they will inform the Health and Safety Manager who will come and observe the tasks and assess the likely cause.

15.9.7 Cases of MSDs

Six RIDDORS for MSDs in last 12 months. 10 individuals are currently reporting early symptoms to the occupational health nurse.

15.9.8 Health and Safety Support

The Health and Safety Manger was asked to state how supported they felt by; workers, supervisors, managers and engineers/equipment designers in tackling MSD problems within the workplace. The Health and Safety Manager reported feeling the following levels of support:

- 60% level of support from workers,
- 30% level of support from supervisors,
- 50% level of support from managers.

- 30% engineers/equipment designers.

15.9.9 Training

- **Health and Safety Manager**

IOSH tutor and NEBOSH tutor.

- **Managers/directors**

Operation manager IOSH 'Managing Safely' and every three months attend a health and safety conference with the Health and Safety Manager. The conference attended is selected by the Health and Safety Manager. The Operations and Production Managers all receive training in conducting general risk assessment this is a package designed by the Health and Safety Manager.

- **Supervisors**

Receive training in general health and safety from the Health and Safety Manager.
Receive training in conducting general risk assessment this is a package designed by the Health and Safety Manager.
Undocumented training in the hazards and what to look for regarding MSDs and manual handling, e.g. poor postures.

- **Health and Safety representatives**

No comments

- **Shop floor workers**

Receive a 2.5 hour induction training which includes a manual handling video. There is a questionnaire at the end (available in 12 different languages) to assess uptake of information. All employees also receive a handout about ULDs to inform them of the symptoms and increase awareness of the issues. This forms part of the induction package.

15.9.10 Additional comments from the Health and Safety Manager:

Risk assessment and checklists for musculoskeletal risk.
The Health and safety manager is concerned that once a specific risk assessment has been conducted they will be 'opening up a can of worms' which at this stage they cannot solve.

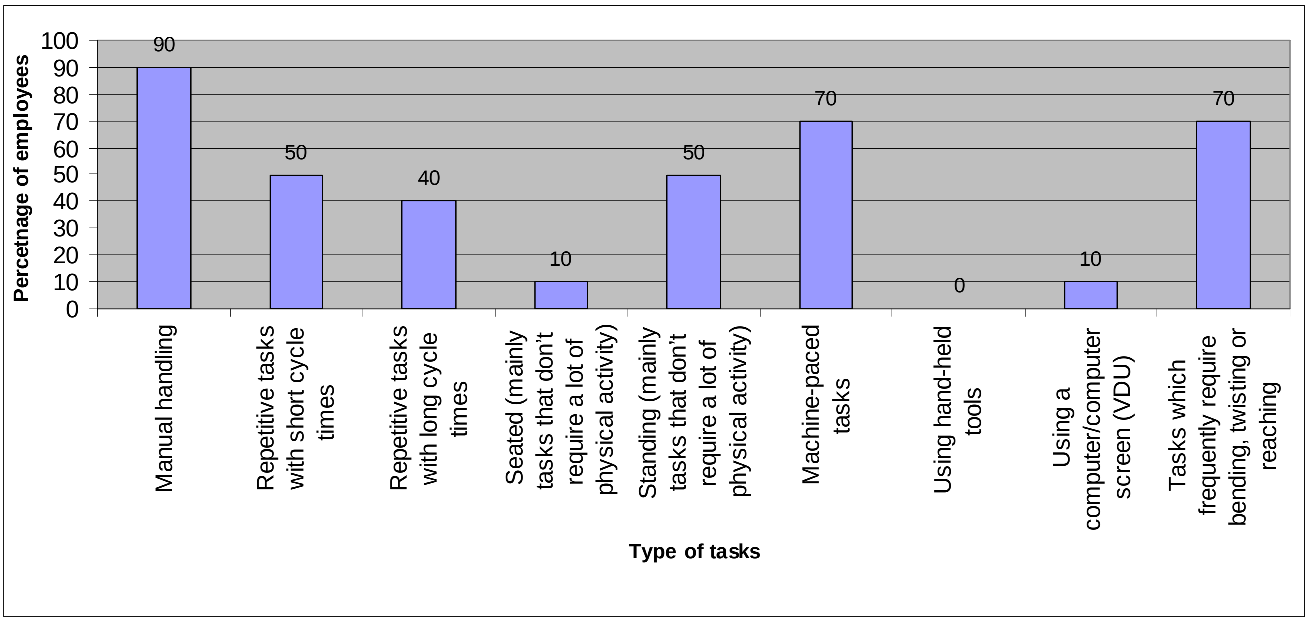
15.10 Case study 10 – Sandwich production

15.10.1 The company

The company makes sandwiches. The company is part of a large group, which has a further 20 sites across the U.K. However the Health and Safety Manager of this site is only responsible for this site. The site employs 1500 core staff and approximately 200 agency staff. 10 -13% of all staff are Polish. Employees are paid by salary (not piece rate) and they work to meet production targets. Employees work seven to eight hour shifts, with two 30 minute breaks and one 15 minute break. Staff turnover was reported as very low.

15.10.2 Type of work tasks

The figure below shows the health and safety officer's estimates of the percentages of employees that are engaged in certain types of tasks. A high number of repetitive tasks were observed by the researcher to occur on site that would require a ULD assessment.



There are approximately six different lines. Each line produces a different product. For each line the production process is very similar and includes the following tasks.

- placing wraps/slices of bread onto the conveyor
- apply preparation solution
- spread mayonnaise
- weigh filling produce and place onto bread/wrap
- distribute contents evenly across surface of bread/wrap
- place lettuce or other filling (not weighed) on to wrap/bread
- place tops on bread or fold wrap.
- cutting

- make boxes
- pick and place boxes onto packing conveyor
- hand label boxes for dispatch.
- pack boxes into large box and place on pallets for dispatch.

All production tasks are conducted in a 5 - 7 °C environment. There is enforced and recorded job rotation along each line. Each worker changes job task every hour. This rotation is schedule in line with results from a risk assessment of each task. Each task has a low, medium and high risk rating for MSDs. Rotation is schedule such that a high risk task is followed by a low or medium risk task. This is to ensure that a worker does not rotate from a high risk to task directly to another high risk task. Each time a worker rotates it is signed off in the rotation book.

15.10.3 Risk Assessment of musculoskeletal risk factors

Number of MSD risk assessments conducted

Manual handling: Some tasks have been assessed by in house staff (MAC tool).
ULDs: Some tasks were assessed about four years ago by an external consultant.

Resources used

- Checklist - developed in house
- HSE's 'Five Steps to Risk Assessment' Leaflet
- HSE's Health and Safety (Display Screen Equipment) Regulations 1992
- HSE Manual Handling Operations Regulations 1992
- HSE HSG 60 – Work related upper limb disorders: a guide to prevention.
- HSE Manual Handling Assessment Charts (MAC)

Procedure
Risk assessment process flow diagrams provided.
Copy of health and environmental risk assessment provided.
There are 9 people who conduct general risk assessment these include Safety representatives from the shop floor (non union and union), engineers and line leaders. Each person receives full day training in conducting general risk assessment, this training is provided internally.

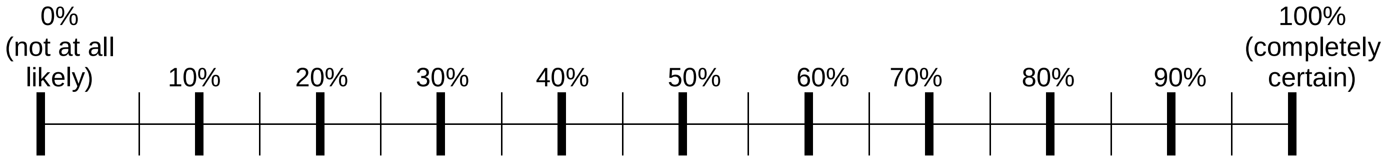
Specialised risk assessments are conducted by the Health and Safety Manager and the Health and Safety Officer who liaise with the person conducting the task and the departmental manger. However they do not conduct risk assessment of ULDs. They only conduct manual handling assessments.

Risk assessments of ULDs were conducted four years ago by an external consultant. Since then new products have been introduced such as wraps and some new machinery has also been introduced. The health and safety committee are consulted when a new piece of machinery is being selected/designed. The old ULD risk assessments are used to predict the risks presented by any consequent new work tasks.

The Health and Safety Officer, and Occupational Nurse are currently developing an ergonomics assessment checklist.

15.10.4 Identifying and implementing changes/solutions

Each year a fixed sum of money is made available to spend on health and safety initiatives. The health and safety manager has to put together a case for where funding should be spent. Results from risk assessment and injury data feed into this process. The Health and Safety Manager reported that on the following scale it is 80% likely that changes will be implemented.



15.10.5 Staff turnover

Staff turnover was reported as very low.

15.10.6 Injury surveillance

At induction all staff are asked to complete a health questionnaire which includes a few questions relating to MSDs.

If someone is off sick, the Occupational Health Nurse contacts them to find out the cause and whether it is work related. If it is suspected as being attributed to work, the Health and Safety Manager is informed who investigates the cause. Workers reporting problems can be referred to the Occupational Nurse, or physio and/or the company doctor. It is a joint effort from all these staff to assign task restrictions.

15.10.7 Cases of MSDs

None reported.

15.10.8 Health and Safety Support

Approximately 90% of the Health and Safety Manager's work time is spent conducting health and safety responsibilities.

The Health and Safety Manger was asked to state how supported they felt by; workers, supervisors, managers and engineers/equipment designers in tackling MSD problems within the workplace. The Health and Safety Manager reported feeling the following levels of support:

- 80% level of support from workers,
- 80% level of support from supervisors,
- 90% level of support from managers.
- 80% level of support from engineers/equipment designers.

15.10.9 Training

- **Health and Safety Officer**
  Masters degree in Health and Safety

- **Managers/directors**
  IOSH Managing Safely course

- **Supervisors**
  None unless on committee

- **Members of Health and Safety committee**
  1 day training in general risk assessment provided by in house training.

- **Shop floor workers**
  Induction covers manual handling and some information of ULDs is provided.

15.10.10 Additional comments from the Health and Safety Manager:

- **Risk assessment in general**
  Currently use a standard process outlined by the over arching company. However this site is currently working to simplify this procedure.

- **Risk assessment and checklists for musculoskeletal risk.**
  Height restriction to control for use of fixed height conveyors.

  They only conduct manual handling assessments. They do not conduct risk assessment of ULDs.

  Risk assessments of ULDs were conducted four years ago by an external consultant. Since then new products have been introduced such as wraps and some new machinery has also been introduced. The health and safety committee are consulted when a new piece of machinery is being selected/designed. The old ULD risk assessments are used to predict the risks presented by any consequent new work tasks.

  The Health and Safety Officer, and Occupational Nurse are currently developing an ergonomics assessment checklist.

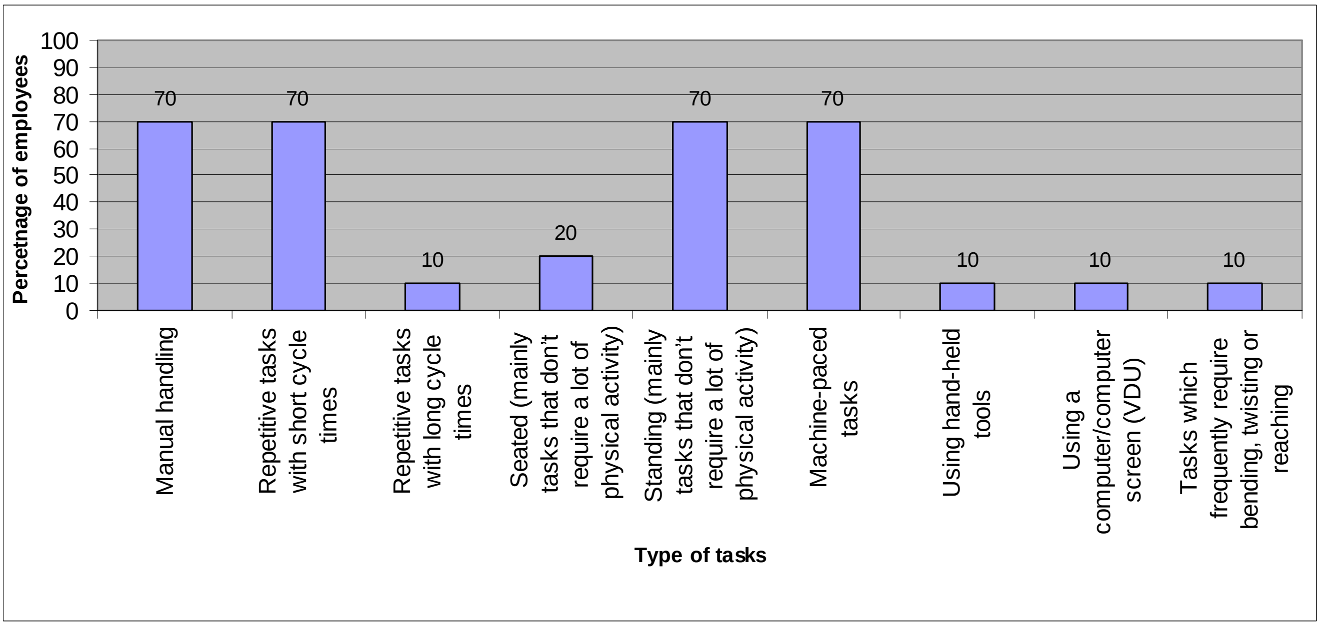
15.11 Case study 11 – Fish processing

15.11.1 The company

The company fillets and processes fish which are then packaged and distributed across the U.K. The company is part of a large group. The Health and Safety Manager for this site is also responsible for another three sites all conducting similar operations. This site employs 550 workers. Employees are paid by salary (not piece rate). Employees work seven to eight hour shifts but the hours are not guaranteed and can vary daily, e.g. one day they may work five hours the following day they may work 11 hours. In an eight hour shift there are three 20 minute breaks plus stoppages due to equipment/line changes. Staff turnover was reported as low. Approximately 50% of staff are migrant and agency workers.

15.11.2 Type of work tasks

The figure below shows the Health and Safety Officer's estimates of the percentage of employees that are engaged in certain types of task. A high number of repetitive tasks were observed by the researcher to occur on site that would require a ULD assessment.



There are approximately seven different lines. Each line produces a different product. For each line the production process is very similar and includes the following tasks;

- hand trimming (using knife)
- manual pin boning (use of pliers to remove bones).
- trimming
- weighing
- picking and filling containers

- packing

15.11.3 Risk Assessment of musculoskeletal risk factors

Number of MSD risk assessments conducted

Manual handling: Yes, all.
ULDs: None.

All assessments of manual handling risks are conducted by an external consultant who uses a checklist based risk assessment .

Resources used
Checklist - provided by external consultant/advisor.
HSE Manual Handling Assessment Charts (MAC).

Procedure
A general risk assessment is conducted by an external consultant. The Health and Safety Manager and line leaders accompany and assist the external consultant during the assessment. The general risk assessment indicates where more specific and detailed risk assessments are required. More specific risk assessments are conducted by the external consultant with consultation from the Health and Safety Manager.

Repetitive tasks are classed as manual handling tasks and are assessed using a checklist designed to cover manual handling (lifting) of objects. The manual handling assessment produces an overall score for each task. A score of 80 or more needs later action. A score of 90 or above requires some action and a score of 105 or above requires immediate action.

The Health and Safety Committee, senior management and the Health and Safety Manager are jointly responsible for ensuring any consequent risk reduction actions identified in the risk assessment are enacted. The same groups of individual are also responsible for checking that these actions have occurred.

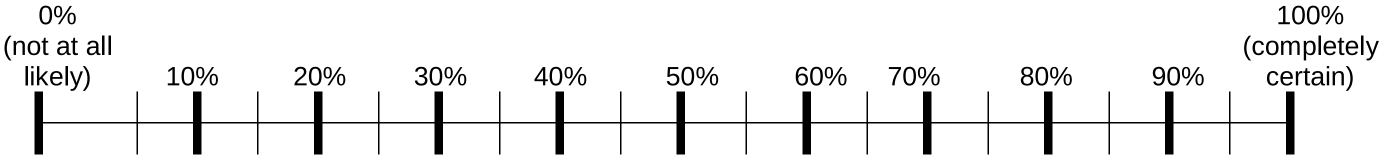
The Health and Safety Committee conducts quarterly safety audits.

The Health Safety Manager is currently looking at having a safety file on each line with links to the correct procedures that must be followed on that line. This will include all significant findings from the risk assessment and will be translated into Polish. Currently all safety files are stored in the Health and Safety Manager’s office.

The Health and Safety Officer is aiming to use the MAC tool for future manual handling assessments.

15.11.4 Identifying and implementing changes/solutions

The Health and Safety Manager reported that on the following scale it is 80% likely that changes will be implemented. The main obstacles to changes being made are the upfront costs.



15.11.5 Staff turnover

Staff turnover was reported as low.

15.11.6 Injury surveillance

There is an accident book and all employees are aware that the accident book exists.

15.11.7 Cases of MSDs

None.

15.11.8 Health and Safety Support

The Health and Safety Manager was asked to state how supported they felt by; workers, supervisors, managers and engineers/equipment designers in tackling MSD problems within the workplace. The Health and Safety Manager reported feeling the following levels of support:

- 80% level of support from workers,
- 80% level of support from supervisors,
- 80% level of support from managers.
- 80% level of support from engineers/equipment designers.

15.11.9 Training

- **Managers/directors**
  IOSH course for senior executives.

- **Shift manager**
  IOSH managing safely course

- **Supervisors**
  Will be receiving training next year.

- **Health and safety representatives/committee members**
  Rely on common sense, no formal training is provided.

- **Shop floor workers**
  Receive leaflets at induction, “How to take care of your back” and Guidance to lifting”. Each leaflet contains images as well as text. The majority of workers receive training in manual handling from an external company.

15.11.10 Additional comments from the Health and Safety Manager:

- **Health and safety in general**
  The Health and Safety Manager always involves the workforce in the development of new equipment or coming up with solutions to problems. However, he finds that even though workers participate in the process and come up with solutions there is still nearly always refusal to use the new equipment. For example, ear defenders and lifting aids.

  Language is a problem – the company is looking to address this by translating all documentation. Currently simple safe systems of work have been translated in to Polish. Chemicals training is also provided using a translator and interpreter.

  The industry is very client driven e.g. such as Tesco, ASDA etc. These customers conduct audits of all their suppliers to ensure suppliers are using good practice. The Health and Safety Manager commented that if these clients included health and safety practice in their audits, funding and resources for health and safety would significantly increase.

- **Training**
  They have had some members of staff trained as trainers to provide manual handling training. This makes it easier to give training to workers as training can be fitted in at short notice to fit around production times.

  Management/directors attitude toward training is poor. They state that all companies that provide training don’t make any money.

  Clients i.e. Tesco assess their suppliers on a number of criteria (training and investment in staff is now becoming one of their criteria).

- **Risk assessment in general**
  Currently the external consultant does not involve workers or supervisors in the assessment process.

- **Risk assessment and checklists for musculoskeletal risk.**
  The Health and Safety Officer is looking to conduct all manual handling assessment himself suing the MAC tool. He reported that the tool is good because:

- it provides scores for tasks which can be used to assist in prioritising action
- it is straightforward to use
- it has nice colours

The Health and Safety Manager commented that they were concerned that they may be an increase in claims as migrant workers become aware of the claims process. The Health and Safety Manager reported that a new pattern in sick leave has been identified among migrant workers which he feels may be indicative of future increase in claims. Recently they have they have made agency staff full time company workers and this has resulted in an increase in sick leave as now they a still receive payment for sick leave.

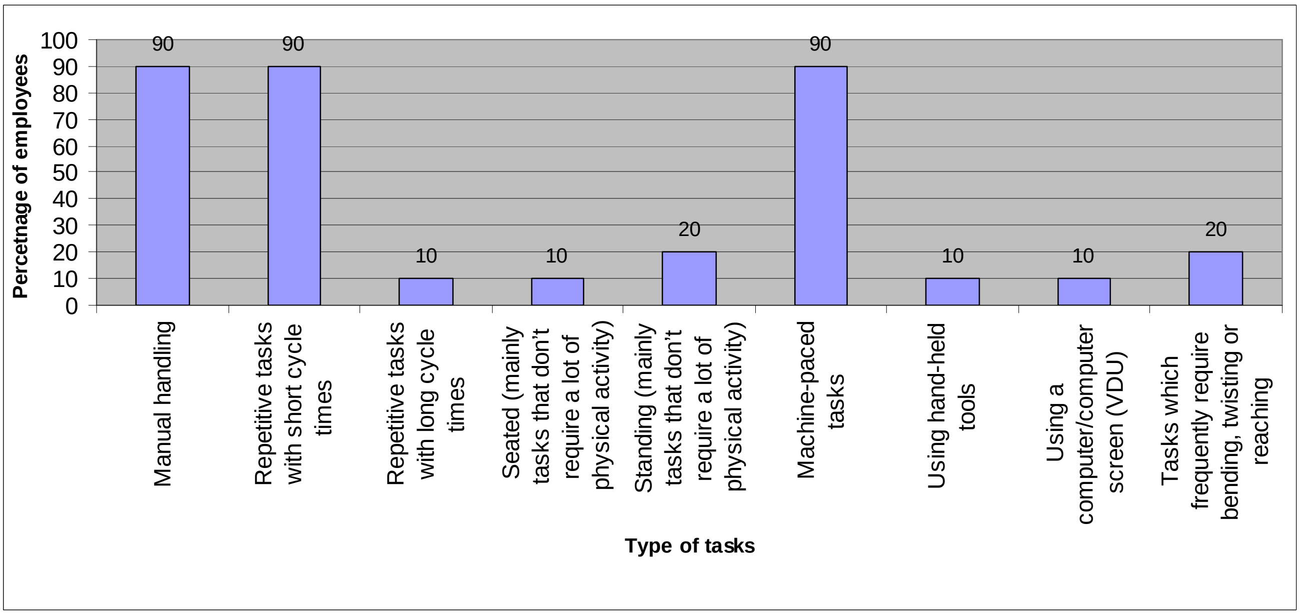
15.12 Case study 12 – Cake manufacturer

15.12.1 The company

The company manufacturers a range of desserts although the predominant product is cake. The company is part of a large group, which has a further 20 food production sites across the U.K. The Health and Safety Manager for this site is only responsible for this site. This site employs 850 core staff and 400 agency workers. Approximately 10% of all employed staff are migrant workers (Russian, Latvian, Iraqi, Kurdish and Lithuanian). Employees are paid by salary (not piece rate). Employees work 8 hour shifts, with a total break of 45 minutes per shift. This consists on one 20 minute paid break and one 30 minute unpaid break for lunch. There are two separate factories on this site. Both factories conduct similar work tasks producing slightly different products. Staff turnover was reported as low.

15.12.2 Type of work tasks

The figure below shows the Health and Safety Officer's estimates for the percentage of employees that are engaged in certain types of task. A high number of repetitive tasks were observed by the researcher to occur on site that would require an ULD assessment.



In Factory 1 there are approximately eight different lines. Each line produces a different type of cake. For each line the production process is very similar and includes the following tasks;

- greasing cake tins
- lifting filled cakes tins and feeding into the oven
- applying filling to one side of the sponge (palette knife or hand)
- placing top sponge onto bottom sponge

- coating cake (icing, chocolate etc.)
- applying sprinkles/decoration
- piping
- inspection
- removing from conveyor
- packaging
- dispatch.

15.12.3 Risk Assessment of musculoskeletal risk factors

Number of MSD risk assessments conducted

Manual handling: Yes, some.
ULDs: None.

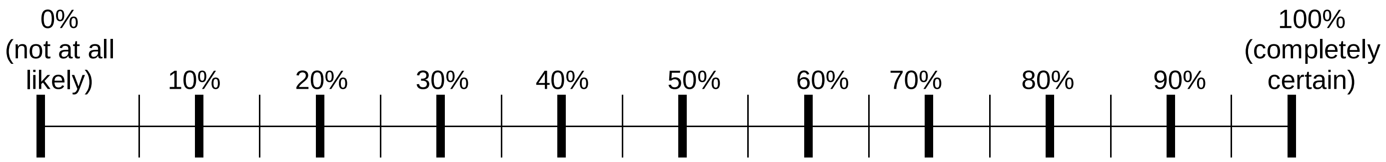
Some of the assessments for manual handling risks are conducted using a checklist based risk assessment.

Resources used

- Checklist - developed in house
- HSE's 'Five Steps to risk assessment' Leaflet
- HSE's Health and Safety (Display Screen Equipment) Regulations 1992
- HSE Manual Handling Operations Regulations 1992

15.12.4 Identifying and implementing changes/solutions

The Health and Safety Manager reported that on the following scale it is 70% likely that changes will be implemented. The main obstacle reported was convincing people that the changes are for their benefit. Often staff believes that risk assessment is only done it to protect company. For example the company has just introduced micro breaks and micro exercises for all 'pipers' to assist workers in relaxing hand muscles. The team leaders have to sign off that these exercises have been conducted before each break. However, workers often fail to perform the exercises.



15.12.5 Staff turnover

Staff turnover was reported as high.

15.12.6 Injury surveillance

Workers experiencing pain, discomfort or problems are to report it to their team leader. The team leader will interview the worker to find out the underlying cause of the problem.

The team leader may also observe how the worker is conducting the task They might take them off the job and/or refer the worker to the Occupational Nurse.

One day a week an Occupational Nurse is on site.

There is a controlled rehabilitation process for getting people back into work following any health issues.

15.12.7 Cases of MSDs

Currently six complaints, each of which has been referred to the Occupational Health Nurse. There have been a number of MSD claims, however, none have been found to be work related.

15.12.8 Health and Safety Support

The Health and Safety Manger was asked to state how supported they felt by; workers, supervisors, managers and engineers/equipment designers in tackling MSD problems within the workplace. The Health and Safety Manager reported feeling the following levels of support:

- 50% level of support from workers,
- 40% level of support from supervisors,
- 70% level of support from managers.
- 50% level of support from engineers/equipment designers.

The Health and Safety Manager reported good support from management and that health and safety is now first on the agenda at management meetings.

15.12.9 Training

- **Health and Safety Officer**
  Information not provided

- **Managers/directors**
  Information not provided

- **Supervisors**
  Receive in house training which is based on the 'Five steps to risk assessment' document. It provides a basic level of understanding of general risk assessment and the terminology used.

- **Shop floor workers**
  Receive training as part of their induction. The training includes basic health and safety, and behavioral health and safety. It is a package that was developed in house but which is delivered at Grimsby College. It is a two hour session of which the main part is a board game called 'Risky'. The game presents a series of home and work based scenarios with different risks and outcomes.

It is designed to get people thinking about the broader implications of taking risks e.g. the effect on them personally and on time etc.

15.12.10 Additional comments from the Health and Safety Manager:

- **Health and safety in general**
  There are disciplinary procedures that team leaders can follow to ensure that workers engage in safe working practices and also where required perform exercises and take rest breaks. However supervisors often fail to implement enforcement of safe working practices. This is primarily due to team leaders not wanting to damage relationships within teams. Team leaders are often members of staff that have been promoted internally and therefore tend to have strong friendships within their teams and are unlikely to conduct disciplinary actions.

  Supervisors only have basic training in general risk assessment and yet they are responsible for deciding when someone should come off the line as well as ensuring that safe working practices are followed and that risk assessments are conducted.

  The company has a new Operations Director who is very keen on health and safety and who is acting as the main driving force for new development in health and safety. The Operations Director is very proactive and wants people on the shop floor to get more involved in the risk assessment process.

  The Operation Director wants responsibility to shift to the supervisors, production managers and to the worker themselves.

  The Health and Safety Manager states that workers don’t seem to understand that he is there to advise and not to solve problems.

  Currently conducting an analysis of accident data and relating it to who has, or has not, had the behavioral safety training to see if has been effective.

  The industry is very strongly driven by the client such as Tesco, ASDA etc who conduct audits of all their suppliers to ensure suppliers are using good practice. This has significantly increased budget given for food safety. There are 25 food safety technical safety staff to ensure good practice and standards. As a comparison there is only one health and safety member of staff. The Health and Safety Manager stated that if clients included health and safety work practice in their audit funding and resources for health and safety would significantly increase.

  Cost for purchasing new equipment or training courses to solely improve health and safety are difficult to justify to management/company directors as there is nothing to illustrate the reduction in costs unless an accident has already occurred.

- **Risk assessment in general**
  The Health and Safety Manager wants workers from all levels to get involved and trained in more specific risk assessments to improve their understanding of the risks.

  People get hung up on completing the checklists correctly rather than implementing the solutions. Sometime the actual completion of a checklist acts as a deterrent in doing anything to reduce the risks. People tend to think that completing a checklist is the end of the process.

- **Risk assessment and checklists for musculoskeletal risk**
  The MAC tool is used however the Health and Safety Manager reported problems with this tool regarding the number of assessments required. The Health Safety Manager pointed out that the MAC tool is seen as specific to the individual rather than the task and because they have a large number of staff it is impractical to complete an assessment for every individual.

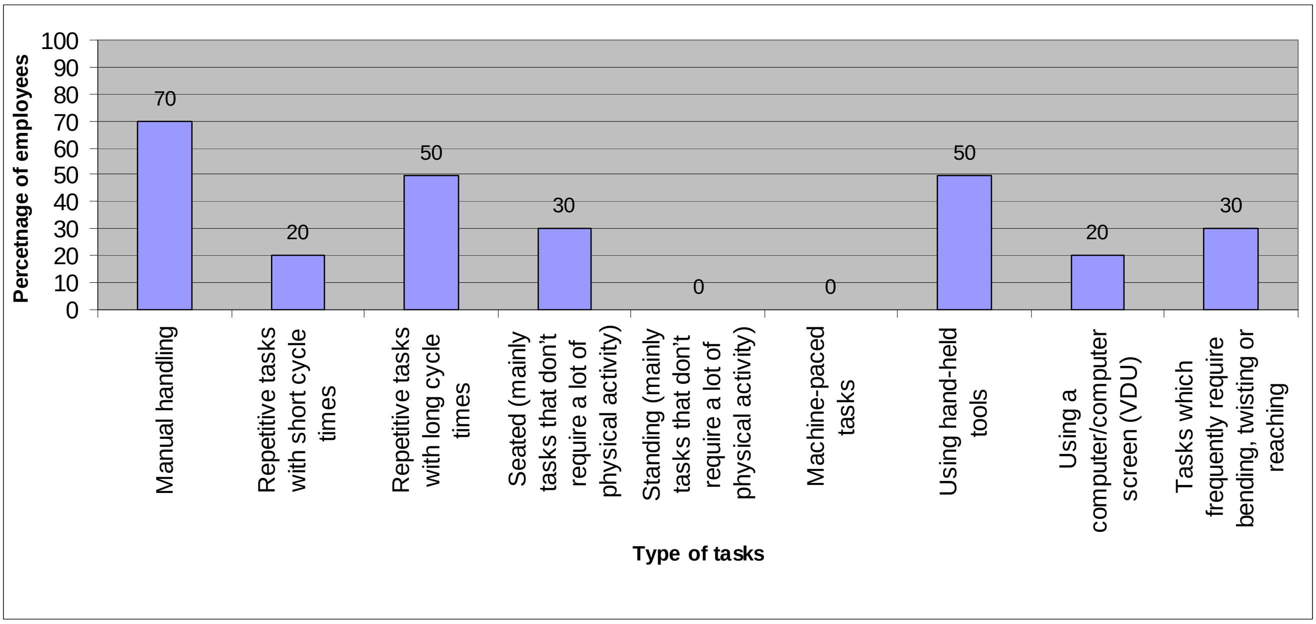
15.13 Case study 13 – Tyre manufacturer

15.13.1 The company

The company makes handmade tyres for motor vehicles, primarily car and motorcycle use. The motorsport industry is their main customer. The health and safety manager for this site is also responsible for the other three sites. This site employs 650 workers. Employees are paid by salary (not piece rate). Employees work seven to eight hour shifts.

15.13.2 Type of work tasks

The figure below shows the Health and Safety Officer's estimates of the percentages of employees that are engaged in certain types of tasks.



The site undertakes specialist production of tyres utilising intensive manual tasks which are assisted by technology. Rubber compounds are created in batches from raw ingredients. Tyre carcasses are constructed by hand from raw materials, involving numerous tasks such as cutting, laying, bias selection, wrapping etc. Rubber compounds are manipulated into working condition be machine assisted activities. Loading and unloading machines offer significant manual handling problems. Carcasses and rubber compounds are combined with other components, such as bead materials, in a skilled process based around a spinning mandrel. Completed tyres are heat treated before storage.

15.13.3 Risk Assessment of musculoskeletal risk factors

Number of MSD risk assessments conducted

Manual handling: All. Manual handling is involved in all activities and al tasks are risk assessed for manual handling
ULDs: Some. Incorporated in to more general risk assessments

Some of the assessments for manual handling risks are conducted using a checklist based risk assessment.

Resources used

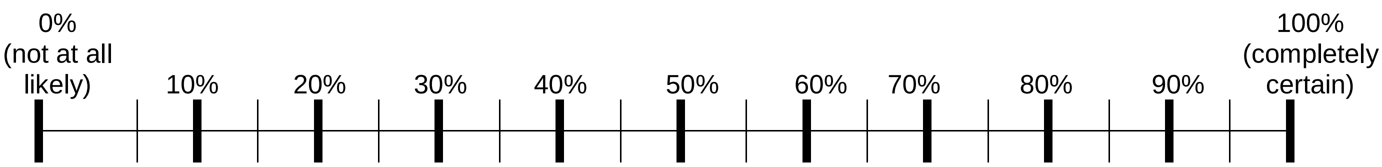
- Checklist - developed in house
- HSE's 'Five Steps to risk assessment' Leaflet
- HSE's Health and Safety (Display Screen Equipment) Regulations 1992
- HSE Manual Handling Operations Regulations 1992

Procedure
Training takes place in house, on the assumption that manual handling is involved in all activities. Specific risks are recorded onto a spreadsheet and dealt with subsequently according to external advice.

External help
External help has been contracted in from consultants who have advised on appropriate health and safety measures. Consultants are based in USA

15.13.4 Identifying and implementing changes/solutions

The Health and Safety Manager reported that on the following scale it is 70% likely that solutions will be identified and 30% likely that changes will be implemented.



15.13.5 Staff turnover

Staff turnover was reported as low.

15.13.6 Injury surveillance

The company utilises an Occupational Health Nurse. The Occupational Nurse undertakes a yearly medical check on all staff. The Occupational Health Nurse also provides training on manual handling in conjunction with the Health and Safety Manager.

15.13.7 Cases of MSDs

69 working days lost last year due to work related injuries. To reduce this number the Factory Manager has introduced a new training scheme and back to work (in which each person has an interview to investigate cause for time off) this has reduced time off work due to injury from 69 to 11 days over last 12 months.

15.13.8 Health and Safety Support

Approximately 100% of the Health and Safety Manager work time is spent conducting health and safety responsibilities.

The Health and Safety Manger was asked to state how supported they felt by; workers, supervisors, managers and engineers/equipment designers in tackling MSD problems within the workplace. The Health and Safety Manager reported feeling the following levels of support:

- 30% level of support from workers,
- 30% level of support from supervisors,
- 40% level of support from managers,
- 20% level of support from engineers/equipment designers.

15.13.9 Training

- **Health and Safety Officer**
  Not stated
- **Managers/directors**
  Not stated
- **Supervisors**
  Not stated
- **Shop floor workers**
  New tests were being introduced for shop floor workers which would asses 'before and after' knowledge levels. Training was currently undertaken

15.13.10 Additional comments from the Health and Safety Manager:

- **Health and safety in general**
  The processes involved are naturally hazardous but represent a premium end of the market and provide high value. Training and experience help to offset level of risk presented to workers. Health and safety as a principle is spread between all staff with strong support coming from the team structure.

- **Risk assessment in general**
  The Health and Safety Manager felt that their systems were robust and industry leading and that risk assessment had identified other areas (such as roadside assistance for tyre incidents) were more hazardous.

- **Risk assessment and checklists for musculoskeletal risk.**
  The Health and Safety Manager felt that MSD assessment was adequately covered by the manual handling assessments currently undertaken. The Health and Safety Manager was aware that the tasks associated with hand manufacture of tyres offered the potential for MSDs to be prevalent. However, these items were in demand and there was no alternative means of production. Accordingly these increased risks were accepted and managed as much as possible by education. Undertaking extensive MSD risk assessments was not considered valuable since it would merely highlight risk factors for which interventions could not then be applied due to the nature of the job.

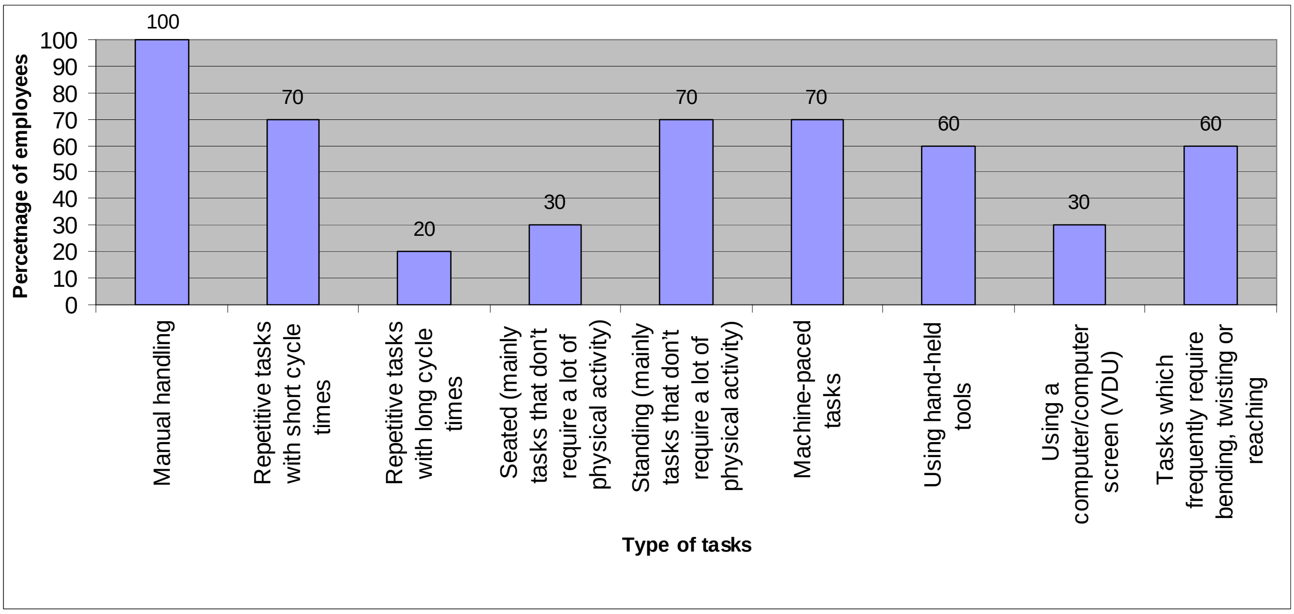
15.14 Case study 14 – Sandwich manufacturer

15.14.1 The company

The company makes sandwiches. The company is part of a large group which has a further 20 sites across the U.K. However, each company works independently from one another and there is no standard health and safety work practice in place across all member companies. Each company has their own health and safety manager. This site employs 500 workers. Employees are paid by salary (not piece rate). Approximately 10 % of staff are agency workers Employees work seven to eight hour shifts, with two 15 minute breaks and one 10 minute break. Staff turnover was reported as very high.

15.14.2 Type of work tasks

The figure below shows the Health and Safety Officer's estimates of the percentages of employees that are engaged in certain types of tasks. A high number of repetitive tasks were observed by the researcher to occur on site that would require an ULD assessment.



15.14.3 Risk Assessment of musculoskeletal risk factors

Number of MSD risk assessments conducted

Manual handling: Yes, some.
ULDs: None.

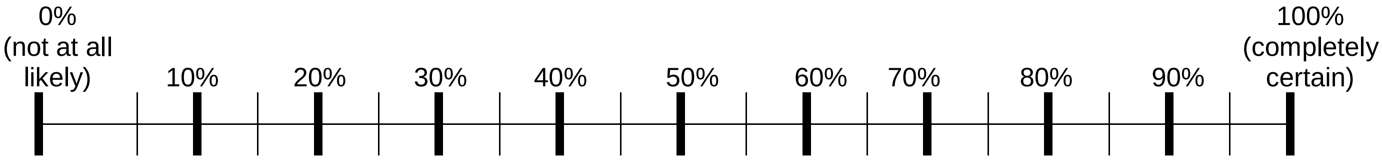
None of the assessments for manual handling use checklists.

Resources used
HSE's 'Five Steps to risk assessment' Leaflet

Procedure
Currently there is no procedure in place. The Health and Safety Manager has only been working there six weeks. The previous Health and Safety Manager had not conducted any risk assessments and no procedures appeared to be in place. The Health Safety Manager commented that they are starting from scratch.

15.14.4 Identifying and implementing changes/solutions

The Health and Safety Manager reported that on the following scale it is 40% likely that changes will be implemented. The main obstacles were reported as are the management of the control measures and supervision.



15.14.5 Staff turnover

Reported as very high

15.14.6 Injury surveillance

Workers report any injuries or problems to their line manager. There is also an accident/incident book which is completed and then passed onto the Health and Safety Manager who may then conduct an investigation.

15.14.7 Cases of MSDs

Four MSDs which have been reported under RIDDOR.

15.14.8 Health and Safety Support

The Health and Safety Manger was asked to state how supported they felt by; workers, supervisors, managers and engineers/equipment designers in tackling MSD problems within the workplace. The Health and Safety Manager reported feeling the following levels of support:

- 50% level of support from workers,
- 50% level of support from supervisors,
- 50% level of support from managers,
- 50% level of support from engineers/equipment designers.

15.14.9 Training

Supervisors and workers receive some training from the Occupational Health Nurse in terms of manual handling risks.

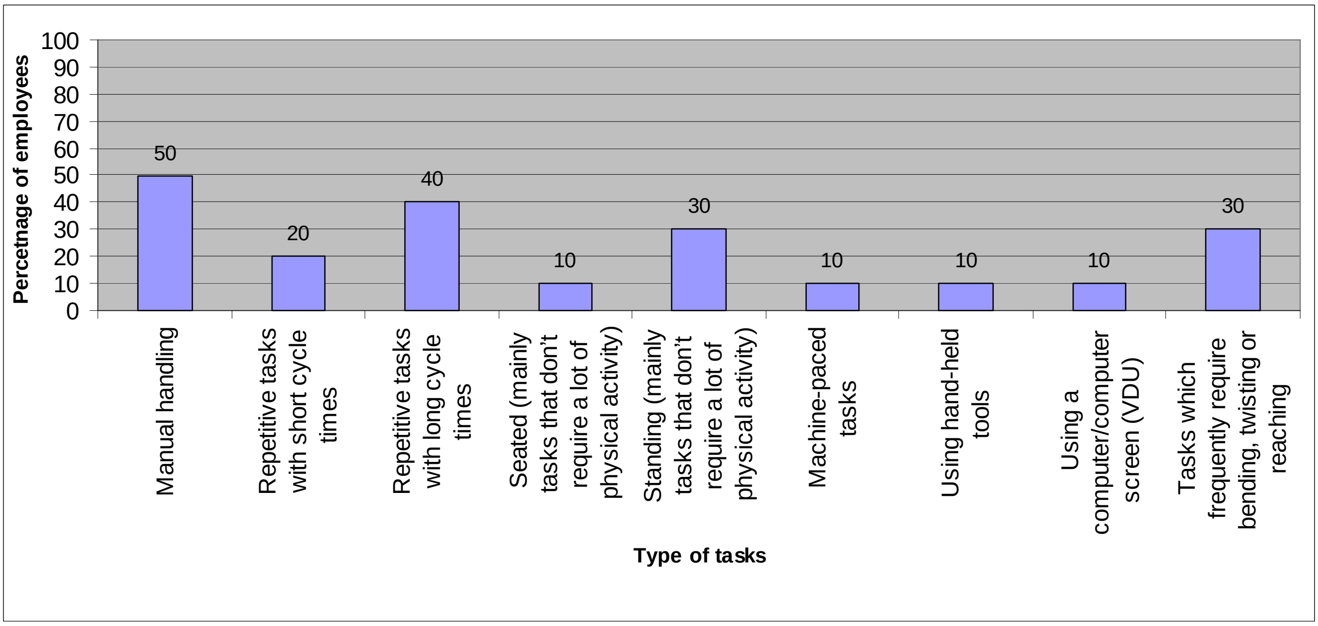
15.15 Case study 15 – Food manufacturer

15.15.1 The company

The company manufactures a range of dairy produce and distributes them across the U.K. The company is part of a large group, which has a further nine sites across the U.K. Each of the nine dairies has a person responsible for health and safety – a 'Work Environment Manager'. The Work Environment Managers, in addition to their health and safety responsibilities, are responsible for a wider range of areas related to the environment. Each sector of the company has different health and safety procedures. The site visited employs 400 workers. Employees are paid by salary (not piece rate). Employees work seven to eight hour shifts. Staff turnover was reported as low.

15.15.2 Type of work tasks

The figure below shows the Health and Safety Officer's estimates of the percentages of employees that are engaged in certain types of tasks.



15.15.3 Risk Assessment of musculoskeletal risk factors

Number of MSD risk assessments conducted

Some tasks have been assessed for manual handling and ULD risks. All of the assessments use a checklist based risk assessment).

Resources used

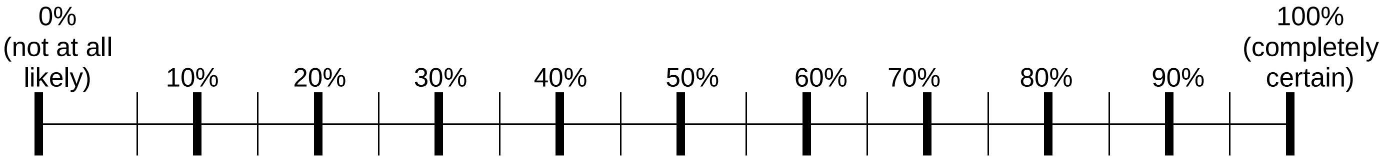
Checklist - developed in house
HSE's 'Five Steps to risk assessment' Leaflet
HSE's Health and Safety (Display Screen Equipment) Regulations 1992

HSE Manual Handling Operations Regulations 1992
HSE Manual Handling Assessment Charts (MAC)

External help
The site currently has an external contractor developing a training package specifically focusing on manual handling and ULD issues. The contractors will train a small number of shop floor workers (i.e. training the trainers). These shop floor workers will then train the remaining workforce and also conduct the assessments.

15.15.4 Identifying and implementing changes/solutions

The Health and Safety Manager reported that on the following scale it is 60% likely that changes will be implemented.



15.15.5 Staff turnover

Staff turnover was reported as low.

15.15.6 Injury surveillance

There is an Occupational Nurse who visits the site once a week. Any member of staff with a problem reports it to the Occupational Health Nurse or the supervisor may refer workers to see the Occupational Health Nurse. The Occupational Health Nurse then repots back to the departmental manager. The departmental manager may then install restrictions or put forward a solution. The Occupational Health Nurse assists with making an assessment and the manager is responsible for ensuring any required changes are made.

15.15.7 Cases of MSDs

On their system most accidents get classed as manual handling injuries. Most of these are entrapments and strained shoulders.

15.15.8 Health and Safety Support

The Health and Safety Manger was asked to state how supported they felt by; workers, supervisors, managers and engineers/equipment designers in tackling MSD problems within the workplace. The Health and Safety Manager reported feeling the following levels of support:

- 80% level of support from workers,
- 80% level of support from supervisors,
- 80% level of support from managers.
- 80% level of support from engineers/equipment designers.

15.15.9 Training

- **Supervisors**
  Received ROSPA manual handling training.

- **Shop floor workers**
  Currently shop floor workers receive a short briefing about manual handling as part of their induction programme. They receive specialised training on the job from supervisors. This is changing, however. The company has funded an external contractor to develop a training package specifically focusing on manual handling and ULD issues. The contractors are conducting risk assessments to identify risk tasks and they are also putting together a package which shows the best way of conducting these tasks e.g. pushing, pulling and lifting methods. The contractors will train a small number of shop floor workers in the 'best' working practices (i.e. training the trainers). These shop floor workers will then train the remaining workforce and also in the future it is hoped that these individuals will also conduct the assessments.

  By training workers to be the trainers rather than just giving this role to the supervisors it is hope that this will;
    a. improve the esteem of the workers
    b. improve worker recognition
    c. assist in combating peer pressure towards adopting bad practice by installing peer pressure to conduct good practice
    d. Improve policing
    e. empower the workforce.

15.15.10 Additional comments from the Health and Safety Manager:

- **Health and safety in general**
  A few years ago the process was heavily automated. This eliminated the need for manually intensive tasks. However, the demands imposed upon the company from the clients who they supply have meant that they have had to return back to manually intensive work methods and reject the automated process.

  Client demands for produce to be delivered on small shelving units has required the operators to manually handle the products to fit the range of display units used within and between different clients.

  Health and safety is not a strong enough argument to get things changed. The Health and Safety Officer reported that making a case based on environmental factors was more readily received and more likely to gain funding and support from managers and from their clients. Therefore to get something changed or a new piece of kit installed they look at selling it from the environmental side rather the health and safety side.

There is a need to get operations on board as any health safety initiatives tends to conflict with operations, e.g. slowing output.

The management is very ‘pro’ safety and encourages rest breaks and when a deadline is tight do not encourage the workforce to work faster, as they appreciate this is when accidents and injuries occur. To account for this all orders are made with sufficient time and back up deliveries to ensure that delays are controlled. However the workforce still makes every effort to get an order out of the door on a normal time regardless of problems, such is their work ethic. Management has a problem enforcing and encouraging workers to work safely at the expense of work time.

Appendix D: Workplace Questionnaire

The Ergonomics and Safety Research Institute (ESRI), which is part of Loughborough University is investigating the effectiveness of risk assessment of musculoskeletal problems in the workplace. As part of this we are visiting a number of companies and observing the types of tasks workers carry out as part of their normal working day. We are also asking people to complete a short questionnaire.

We do not need your name so all the information you provide will be anonymous and will only be viewed by ESRI researchers. The questionnaire takes about 5 minutes to complete.

1. How long have you been working for the company?

Less than 6 months	☐1	4 to 6 years	☐4
6 to 12 months	☐2	7 to 10 years	☐5
1 – 3 years	☐3	Greater than 10 years	☐6

2a. What is your employment type?

Full time ☐1	Part time ☐2	Agency / casual ☐3

b. Which work area do you work in?

____

c. What work tasks do you regularly do?

____

3. Have you heard of 'Musculoskeletal disorders/problems' or 'Repetitive strain injury' (RSI)?

Yes, I have heard of musculoskeletal disorders/problems	☐1	
Yes, I have heard of RSI	☐2	
No, I have not heard of either	☐3	Go to Question 5.

4. Where or how have you heard of musculoskeletal disorders or RSI?
(Please tick more than one if required)

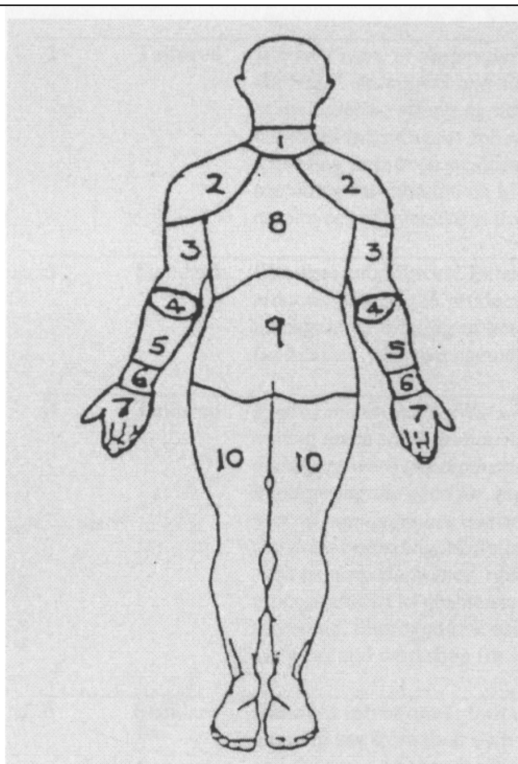
Television	☐$_1$	Work	☐$_6$
Radio	☐$_2$	Training course	☐$_7$
Books	☐$_3$	Doctor	☐$_8$
Magazines	☐$_4$	Physiotherapist	☐$_9$
Websites	☐$_5$	Other, please state: ………………..	☐$_{10}$

5. Musculoskeletal problems and RSI refer to problems affecting the muscles, tendons, ligaments of the neck, shoulders, back, arms, wrist, hands or legs. Symptoms can be feelings of pain, aches, numbness and/or discomfort in any of these body areas.

Have you experienced any pain, aches, or discomfort in any body area
(tick more than one, if required)

No	☐$_1$	**If no,** please go to Question 11.
Yes, in the last 6 months	☐$_1$	
Yes, in the last 7 days	☐$_1$	

6. Please mark a cross on the diagram below where you have felt discomfort in the last 7 days or 6 months.



7. For each of the body part that you have marked with a cross, please circle a number on the scales below to show how much discomfort you have felt.

		Minimal discomfort						Extreme discomfort
1.	Neck	1	2	3	4	5	6	7
2.	Shoulders	1	2	3	4	5	6	7
3.	Upper arms	1	2	3	4	5	6	7
4.	Elbows	1	2	3	4	5	6	7
5.	Forearms	1	2	3	4	5	6	7
6.	Wrists	1	2	3	4	5	6	7
7.	Hand	1	2	3	4	5	6	7
8.	Upper back	1	2	3	4	5	6	7
9.	Lower back	1	2	3	4	5	6	7
10.	Legs	1	2	3	4	5	6	7

8. Have you seen a doctor or other qualified health professional (e.g. nurse, physiotherapist) about these pains, aches or discomfort?

Yes ☐1 No ☐2

9. Have you had to take time off work because these area(s) of pain, ache or discomfort?

Yes ☐1 If yes approximately how long?___________ No ☐2

10. What do you think may have been the cause(s) of your areas of pain, ache or discomfort (consider hobbies, sports, work tasks, etc.)

Hobbies	☐1	Work tasks	☐3
Sport	☐2	House work	☐4
		Other please state	5

11. Can you list up to six risks/causes which may lead to musculoskeletal problems or RSI?

1.__________________________

4.______________________________

2.__________________________

5.______________________________

3.__________________________

6.______________________________

12. Are you concerned about developing musculoskeletal problems from your work?

Yes ☐ 1	No ☐ 2

13. Are there any ways in which the you would like the layout of your workplace changed so that it is easier or more comfortable to do your job?

Yes ☐ 1	No ☐ 2 If No, go to question 16

If YES please describe the changes you would like to be made

14. Do you think changes should be made to reduce the risk of musculoskeletal problems from your work in the next 6 months?

Yes ☐1	No ☐2

15. Do you think changes should be made in the next month or two?

Yes ☐1	No ☐2

16. Do you know if your employer has made any changes to reduce the risk of musculoskeletal problems from your work?

Yes ☐1	No ☐2

17. Are you doing or have you done anything to reduce the risks?

Yes ☐1	No ☐2

If yes, please describe what you have done:

____
____
____
____
____
___

18. Do you feel the communication links for information and suggestions between operations/production and management are mostly…

Good and efficient	☐1
Satisfactory	☐2
Unsatisfactory	☐3
Very poor and inefficient	☐4

19. For each statement please tick a box which best describes your level of agreement						
		Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
A	In my workplace management acts quickly to correct health and safety problems					
B	Health and safety information is always brought to my attention by my line manger/supervisor					
C	In my workplace the chances of developing a work related health problem are quite high					
D	There is good communication here about health and safety issues which affect me					
E	Management here considers health and safety to be equally as important as production					
F	I believe health and safety issues are given a high priority					
G	Some health and safety rules and procedures don’t need to be followed to get the job done safely					
H	Some health and safety rules are not really practical					
I	I am strongly encouraged to report unsafe conditions					
J	I can influence health and safety performance here					
K	I am involved in informing management of important health and safety issues					
L	Health and safety is the number one priority in my mind when completing a job					
M	It is important to me that there is a continuing emphasis on health and safety					
N	I’m sure it’s only a matter of time before I develop a work related health problem					
O	Production targets rarely conflict with health and safety measures					
P	I am always given enough time to get the job done safely.					

THANK YOU for completing this questionnaire.

Appendix E: Checklist A

Checklist A

Frequency / Repetition

1. Shoulder / arm movements	
The shoulders / arms are moved infrequently (e.g. some intermittent movement)	G / 0
The shoulders / arms are moved frequently (e.g. regular movement with some pauses)	A / 3
The shoulders / arms are moved very frequently (almost continuous movement)	R / 6

2. Repetition	
Similar motion patterns repeated 10 times per minute or less	G / 0
Similar motion patterns repeated more than 11-20 times per minute	A / 3
Similar motion patterns repeated more than 20 times per minute	R / 6

Force

3. Force	
Light force (Less than 1kg) There is no indication of any particular effort	G / 0
Moderate force (1-4kg) or Strong force (More than 4kg) Needs to be exerted a part of the time.	A / 3
Moderate force (1-4kg) Needs to be exerted more than half of the time.	R / 8
Strong force (More than 4kg) Force is obviously high, strong or heavy and needs to be exerted frequently.	R / 10

Posture

4. Awkward head / neck posture	
The neck is held more or less straight (upright) or bent or twisted slightly (less than 15 degrees relative to the upright and forward facing position) most of the time	G 0
The neck is held bent or twisted (more than 15 degrees relative to the upright and forward facing position) a part of the time	A 1
The neck is held bent or twisted (more than 15 degrees relative to the upright and forward facing position) more than half of the time	2

5. Awkward back posture	
The back is upright or is bent, twisted, or sideways less than 15 degrees from the upright forward facing position most of the time	G 0
The back is bent forward, sideways or twisted (more than 20 degrees from upright forward facing position) part of the time	A 1
The back is bent forward, sideways or twisted (more than 20 degrees from the upright forward facing position) more than half of the time	R 2

6. Awkward shoulders/arm posture	
Both of the elbows are close to the body or both arms are supported	G 0
One or both of the elbows are raised away from the body part of the time	A 2
One or both of the elbow are raised away from the body more than half the time	R 4

Posture

7. Static shoulder and elbows	
Both of the shoulders and both elbows regularly change position to adopt relaxed/neutral postures during every hour of work	G / 0
One or both of the shoulders and elbows are in a static position (i.e. infrequently moved) for between 1 and 2 consecutive hours	A / 2
One or both of the shoulders and elbows are in a static position (i.e. infrequently moved) for more than 2 consecutive hours	R / 4

8. Awkward wrist posture	
Both wrists are straight or bent slightly (i.e. less than 15 degrees from the straight position) most of the time	G / 0
One or both of the wrists are bent or deviated more than 15 degrees from the straight position a part of the time	A / 1
One or both of wrists are bent or deviated more than 15 degrees from the straight position for more than half of the time	R / 2

9. Awkward hand / finger grip	
Both hands are not used to grip anything or they are using a ‘Power grip’ (Power grip is where the fingers are wrapped around an object and the thumb placed against it; used, for example, in certain hammering operations)	G / 0
Is one of both hands using a ‘Pinch’ or ‘Wide finger’ grip for a part of the time (‘Pinch’ or ‘Wide finger’ grip is where the fingers are on one side of an object, and the thumb is on the other. Typically, an object lifted in a pinch or wide finger grip do not touch the palm)	A / 1
Is one of both hands using a ‘Pinch’ or ‘Wide finger’ grip for more than half of the time (‘Pinch’ or ‘Wide finger’ grip is where the fingers are on one side of an object, and the thumb is on the other. Typically, an object lifted in a pinch or wide finger grip does not touch the palm)	R / 2

Posture

10. Static fingers, hand and wrist	
Both hands and wrists regularly change position to adopt relaxed/neutral postures during every hour of work	G / 0
One or both hands and wrists are in a static position (i.e. infrequently moved) for between 1 and 2 consecutive hours	A / 1
One or both hands and wrists are in a static position (i.e. infrequently moved) for more than 2 consecutive hours	R / 2

Additional Factors

11. Breaks	
The task is conducted by the worker continuously for less than 1 hour	G / 0
The task is conducted by the worker continuously for 1 to 2 hours	A / 2
The task is conducted by the worker continuously for more than 2 but less than 3 hours	A / 4
The task is conducted by the worker continuously for more than 3 but less than 4 hours	R / 6
The task is conducted by the worker continuously for more than 4 hours	R / 6

12. Work pace	
It is never difficult to keep up with the work	G / 0
It is sometimes difficult to keep up with the work	A / 1
It is often difficult to keep up with the work	R / 2

Additional Factors

13. Other factors	
a. Gloves	☐
b. A tool is used to strike 2 times per minute or more	☐
c. The hand is used a tool and struck 10 times per hour or more	☐
d. The tools, work piece or workstation cause compression of the skin or body part	☐
e. The hand/arm is exposed to vibration	☐
f. The task requires fine precision movements of the hand and fingers	☐
g. A wide finger grip and or hand span is needed to grip, or manipulate items	☐
h. Are there any tools, hand held equipment or work pieces that are too large of small or be gripped easily.	☐
i. Operators are exposed to cold or draughts or grip cold tools	☐
No factors present	G 0
One factor is present	A 1
Two or more factors are present	R 2

Score sheet

Risk factor	Colour Band	Numerical score
1. Shoulder / arm movements		
2. Repetition		
3. Force		
4. Head / neck posture		
5. Back posture		
6. Shoulder / arm posture		
7. Static shoulder and elbows		
8. Wrist posture		
9. Hand and finger grip		
10. Static fingers, hand and wrist		
11. Breaks		
12. Work pace		
13. Other factors		
	Overall task score	

To find out the overall risk level of the task match the overall task score with the proposed level of risk using the table below.

The overall risk level for the whole task is ……… (please circle)

Low risk **Medium risk** **High risk**

Overall task score	Proposed overall risk level	
0-11	Low	Consider individual circumstances
12-25	Medium	Further investigation required
26 or more	High	Further investigation required immediately

Please make suggestions as to what changes could be made to reduce the risks?

Appendix F: Checklist B

Frequency and repetition		
	No	Yes
Shoulder / arm movements		
1. Does the task involve frequent or very frequent shoulder and arm movements (e.g. regular movement with some pauses or almost continuous movement)	☐	☐
Repetition		
2. Does the task involve similar motion patterns being repeated frequently	☐	☐

If you have ticked any yes boxes, please complete the table below.

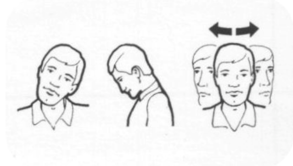
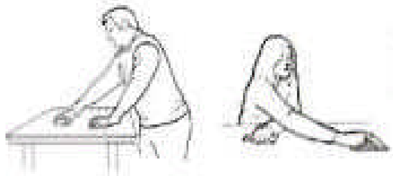
Describe any problems and probable causes……	**Tick potential improvements which may be useful for this task and which should be investigated further**	
	Reduce repetition	
	•Mechanise or automate repetitive functions	☐
	•Use power/ratchet tools	☐
	•Remove machine or other pacing	☐
	•Restructure task (job design)	☐
	•Remove or monitor piecework schemes	☐
	Reduce duration	
	•Implement job enlargement	☐
	•Ensure adequate breaks	☐
	•Implement job rotation	☐
	•Limit / control overtime	☐

Force		
	No	Yes
3. Does the task require moderate or strong force to be exerted more than 15% of the time ***For example:*** • Pinching or gripping objects with some effort • Moving levers or pushing buttons with some effort • Manipulating lids or components with some effort • Pushing or forcing items together with some effort • Pushing or forcing items together with some effort • Using tools with some effort	☐	☐

If you have ticked any yes boxes, please complete the table below.

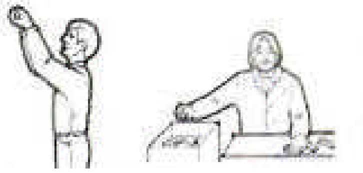
Describe any problems and probable causes…….	**Tick potential improvements which may be useful for this task and which should be investigated further**	
	Reduce force	
	•Reduce forces necessary	☐
	•Use power tools	☐
	•Can the function be achieved differently?	☐
	•Use jigs to hold items	☐
	•Reduce weight of items	☐
	•Present items differently	☐
	•Increase mechanical advantage	☐
	•Alter task to use stronger muscles	☐
	•Use foot pedals	☐
	•If gloves used check that they are appropriate	☐
	•Maintain tools	☐
	•Ensure tools are suitable for task	☐
	•Improve handles	☐
	•Use light weight tools	☐
	•Use tool counterbalances	☐
	•Ensure tool handles fit workers comfortably	☐

Posture

		No	Yes
Awkward head/neck posture			
4. Does the task involve holding the neck bent or twisted more than 15% of the time		☐	☐
Awkward back posture			
5. Does the task involve the body being bent forward, sideways or twisted more than 15% of the time		☐	☐

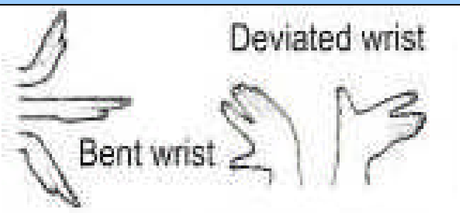
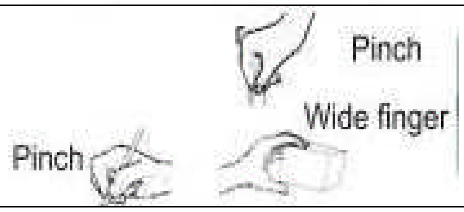
If you have ticked any yes boxes, please complete the table below.

Describe any problems and probable causes…	Tick potential improvements which may be useful for this task and which should be investigated further	
	Optimise visual viewing	
	•Ensure visual requirements are not too demanding	☐
	•Provide visual aids	☐
	•Ensure lighting is suitable	☐
	•Reposition items that workers are required to look at	☐
	Optimise working posture	
	•Automate or mechanise	☐
	•Modify operations or production method	☐
	•Relocate equipment or items	☐
	•Present work items differently	☐
	•Reduce amount of manipulation required	☐
	Ensure workplaces and equipment account for differences in worker size, shape and strength	☐
	•Ensure working heights are appropriate	☐
	•Ensure items are within reach distances	☐
	•Provide suitable and adjustable seating	☐
	•Use fixtures/jigs	☐
	•Ensure tools are suitable for task	☐
	•Ensure tools do not require awkward posture	☐
	•Provide arm support for precision work	☐
	•Introduce micro pauses or rest breaks which encourage adopting relaxing and significantly different postures to those adopted whilst working	☐ ☐

		No	Yes
Awkward shoulders/arms posture			
6. Is one or both of the elbows raised away from the body more than 15% of the time		☐	☐
7. Is one or both of the shoulders and elbows in a static position (i.e. infrequently moved) for more than 1 hour		☐	☐

If you have ticked any yes boxes, please complete the table below.

Describe any problems and probable causes.	**Tick potential improvements which may be useful for this task and which should be investigated further**	
	Optimise visual viewing	
	• Ensure visual requirements are not too demanding	☐
	• Provide visual aids	☐
	• Ensure lighting is suitable	☐
	• Reposition items that workers are required to look at	☐
	Optimise working posture	
	• Automate or mechanise	☐
	• Modify operations or production method	☐
	• Relocate equipment or items	☐
	• Present work items differently	☐
	• Reduce amount of manipulation required	☐
	• Ensure workplaces and equipment account for differences in worker size, shape and strength	☐
	• Ensure working heights are appropriate	☐
	• Ensure items are within reach distances	☐
	• Provide suitable and adjustable seating	☐
	• Use fixtures/jigs	☐
	• Ensure tools are suitable for task	☐
	• Ensure tools do not require awkward posture	☐
	• Provide arm support for precision work	☐
	Introduce micro pauses or rest breaks which encourage adopting relaxing and significantly different postures to those adopted whilst working	☐

Awkward and / or static posture			
		No	Yes
Awkward wrist posture			
8. Is one or both of the wrists bent or deviated more than 15% of the time		☐	☐
9. Is a pinch or wide finger grip being used for more than 15% of the time		☐	☐
10. Is one or both hands and wrists held in a static position (i.e. infrequently moved) for more than 1 hour		☐	☐

If you have ticked any yes boxes, please complete the table below.

Describe any problems and probable causes.	**Tick potential improvements which may be useful for this task and which should be investigated further**	
	Optimise working posture	
	•Automate or mechanise	☐
	•Modify operations or production method	☐
	•Reduce amount of manipulation required	☐
	•Ensure workplaces and equipment account	☐
	for differences in worker size, shape and strength	
	•Use fixtures/jigs	☐
	•Ensure tools are suitable for task	☐
	•Ensure tools do not require awkward posture	☐
	•Provide arm support for precision work	☐
	Reduce repetition	
	Introduce more rest breaks that encourage adopting relaxing and different postures to those adopted whilst working	☐

Additional Factors		
	No	Yes
Breaks		
11. The task is conducted by the worker continuously for more than 1 hour	☐	☐
Work pace		
12. It is sometimes or often difficult to keep up with the work	☐	☐

If you have ticked any yes boxes, please complete the table below.

Describe any problems and probable causes………	Tick potential improvements which may be useful for this task and which should be investigated further	
	Reduce duration	
	•Use alternative process(es)	☐
	•Introduce breaks	☐
	Rotate workers to significantly different tasks which require different movements/actions	☐
	•Provide information and training	☐
	•Conduct health surveillance	☐

Additional factors		
	No	Yes
13. Other factors		
a. Gloves	☐	☐
b. A tool is used to strike two times per minute or more	☐	☐
c. The hand is used as a tool and struck 10 times per hour or more	☐	☐
d. The tools, work piece or workstation cause compression of the skin or body part	☐	☐
e. The hand/arm is exposed to vibration	☐	☐
f. Task requires fine precision movements of the hand and fingers	☐	☐
g. A wide finger grip and or hand span is needed to grip, or manipulate items	☐	☐
h. Are there any tools, hand held equipment or work pieces that are too large of small or be gripped easily.	☐	☐
i. Operators are exposed to cold or draughts or grip cold tools	☐	☐

If you have ticked any yes boxes, please complete the table below.

Describe any problems and probable causes……..	Tick potential improvements which may be useful for this task and which should be investigated further	
	Improve working environment	
	• Use alternative process(es)	☐
	• Select alternative lower vibration equipment	☐
	• Use balance / tensioners	☐
	• Maintain equipment	☐
	• Reduce exposure time to vibration	☐
	• Provide information and training	☐
	• Conduct health surveillance	☐
	• Avoid working in cold	☐
	• Avoid handling or insulate cold items or tools	☐
	• Redirect blowing air	☐
	• Use warm clothing	☐
	Ensure workplaces and equipment account for differences in worker size, shape and strength	☐

TOTAL number of ‘Yes’ ticks______________________

In the table below please rate the level of action required for each risk factor for this task.

Risk factor - Worksheet reference number	Priority for action High, medium, low priority
1. Shoulder / arm movements	
2. Repetition	
3. Force	
4. Head / neck posture	
5. Back posture	
6. Shoulder / arm posture	
7. Static shoulder and elbows	
8. Wrist posture	
9. Hand and finger grip	
10. Static fingers, hand and wrist	
11. Breaks	
12. Work pace	
13. Other factors	

The overall risk level for the whole task is ……… (please circle)

Low **Medium** **High**

Please make suggestions as to what changes could be made to reduce the risks?

Appendix G: Presentation & verbal protocol for Trial 1

Presentation and verbal protocol for Trial 1.

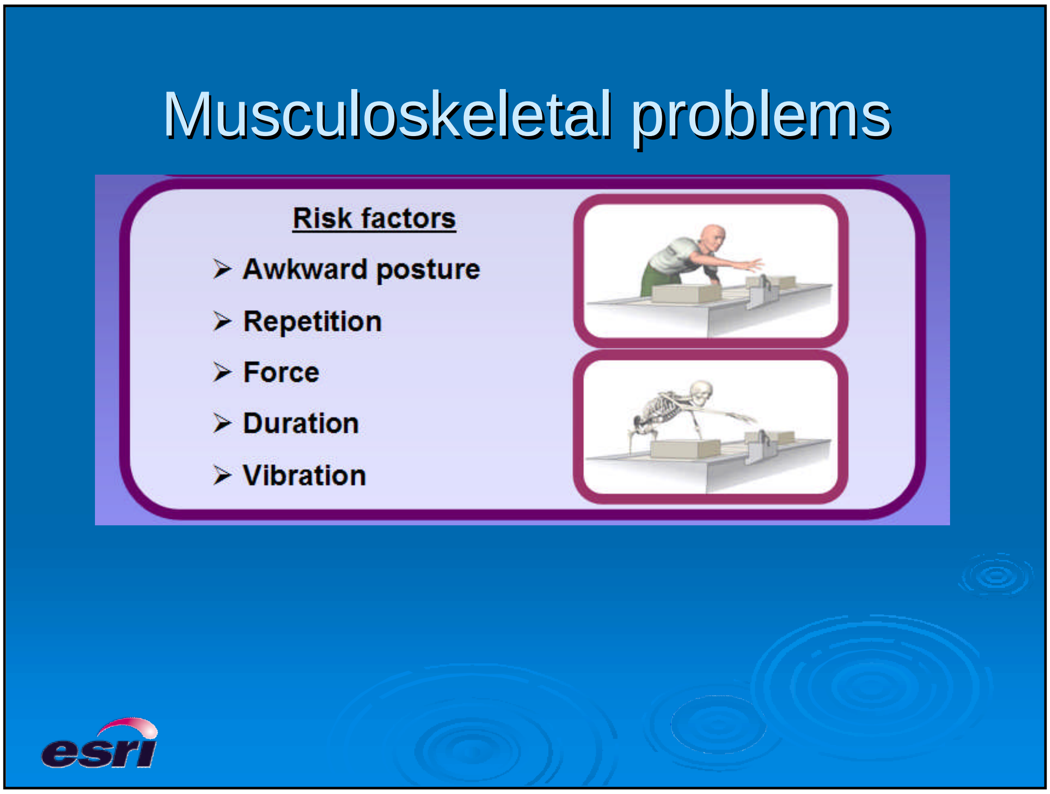
Hello, First of all I would like to thank you all for coming. I am not sure what you have been told about today so I will start off with a quick introduction and explain what we will be doing today.

My name is _____________I work the Ergonomics safety research institute, ESRI for short, ESRI is part of Loughborough University, and conducts research into health and safety in 2 main areas – Vehicle safety and health and safety in the workplace.

We are currently conducting a study looking at how effective two different risk assessment tools are in assessing risks in the workplace. To do this we are going round to lots of different companies talking to people like yourselves, and get their feedback on how effective and how easy it is to use the assessment tools.

Today we will be having a go at using two different assessment tools for assessing musculoskeletal problems.

Has anybody heard of Musculoskeletal Problems?



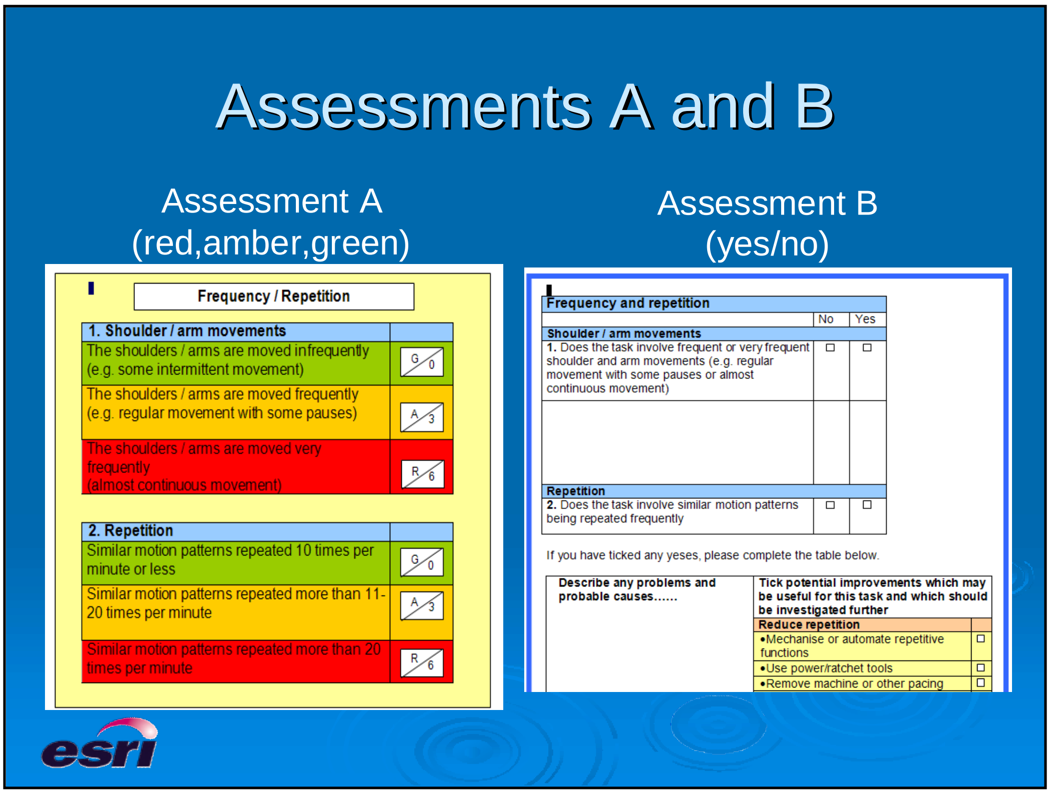
The word musculoskeletal refers to your bodies muscles – muscular-

And skeleton – skeletal system
And the bits which connect the two, these being the tendons and ligaments. These connect your muscles to your bones.

Musculoskeletal problems refer to injury to the muscles, ligaments and tendons which occur from overuse. For example – you may have heard musculoskeletal problems being referred to as RSI (repetitive strain injury).

There are known risk factor (causes which act in combination) that can increase the likelihood of getting a musculoskeletal problem and these are; **Repetition, force, awkward postures and duration**. –You can enter these risk factors at home, playing sport or doing gardening or at work. The level of risk of all these risk factors depends on **how long and how often** they are conducted and **how awkward the postures are** and how much force is applied.

To assess the risks of musculoskeletal problems people have devised lots of different assessment tools and we are going to have ago at using two of these tools today.



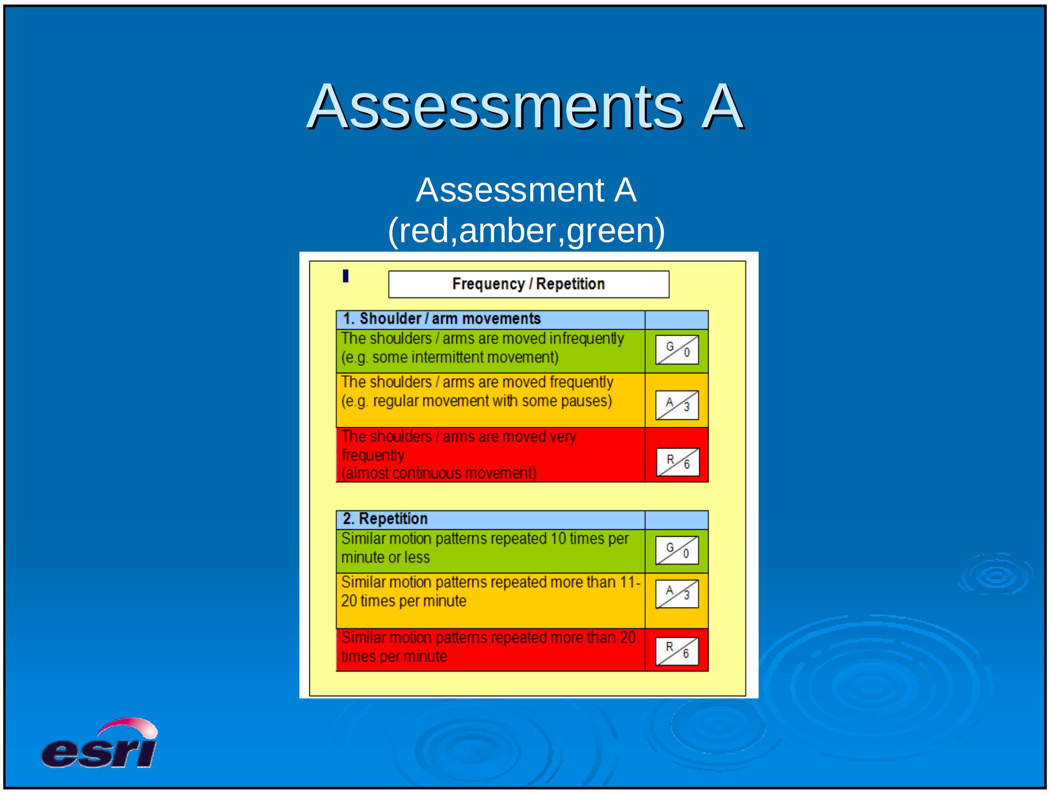
Assessment A is a traffic light system – it has green, amber and red levels of risk and Assessment B is a yes/no response.

This is going to be a pretty quiet session – you won't hear too much from me, because we want to see how effective these two tools are at assessing risk when they are used as a standalone tool, i.e. just using the written instructions that come with them.

So I am not going to tell you how to use the tool, instead we want to see how effective they are when you only have the written instructions which come with them.

When you have read the instructions we are then going to have a look at some video tasks and use the assessment to assess the level of risks and write down what could be done to reduce any risk that you identify.

We are not testing you- we are testing the assessment tools to see how easy they are for you to use and how effective they are.



Ok, now here is checklist A and the instructions you have 5 -10 minutes to read through and familiarise yourself with the instructions and the assessment booklet.

ACTION-

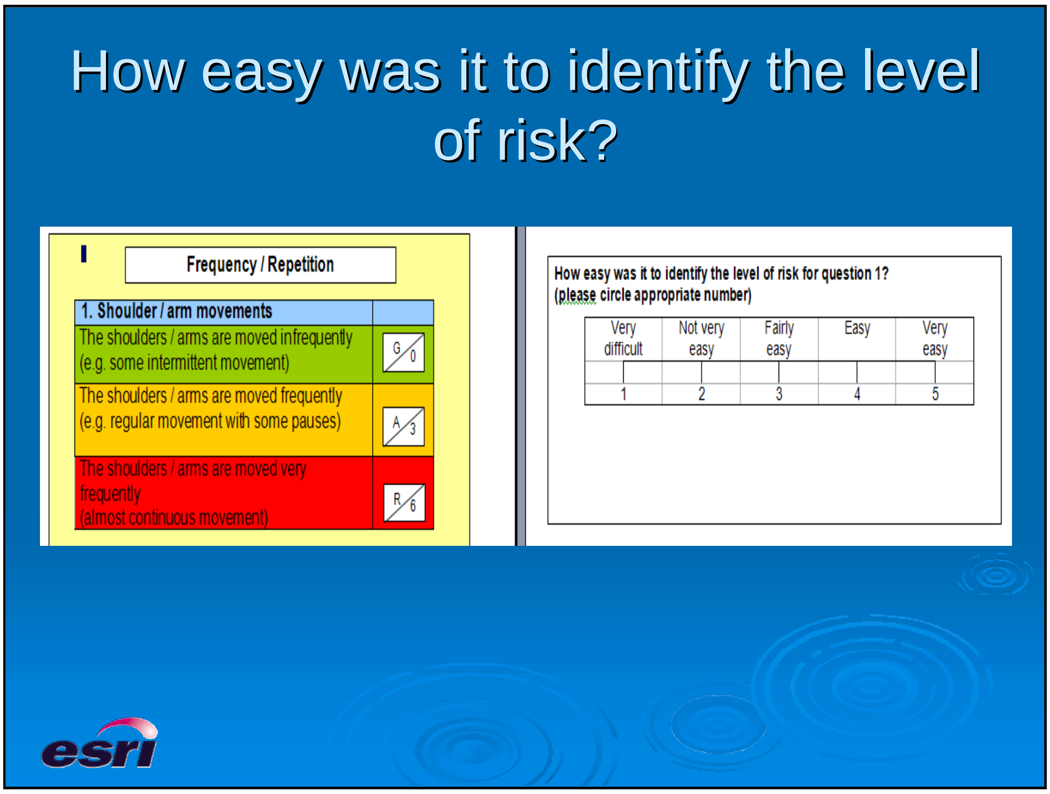
After 5-10 minutes instruction time- Hold up the assessment booklet and point out what going to complete and explain briefly.

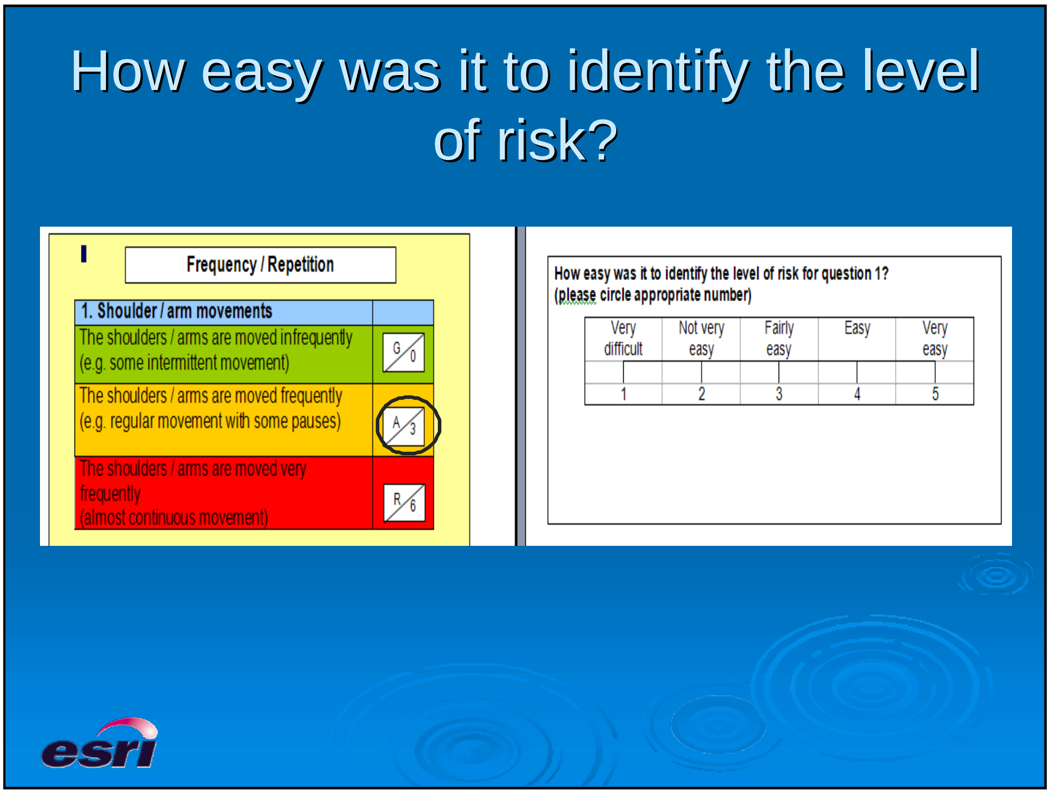
- Put your name on the front and write down the task number (tell them what this is).
- There are 13 questions
- Need to point out that they have to circle either Green, amber or red box for each question and then rate how easy they found to complete that question. Tell them 'If you don`t know what to put or which category to tick then tick the one you think is the best and then rate it as difficult to complete of the rating scale'.

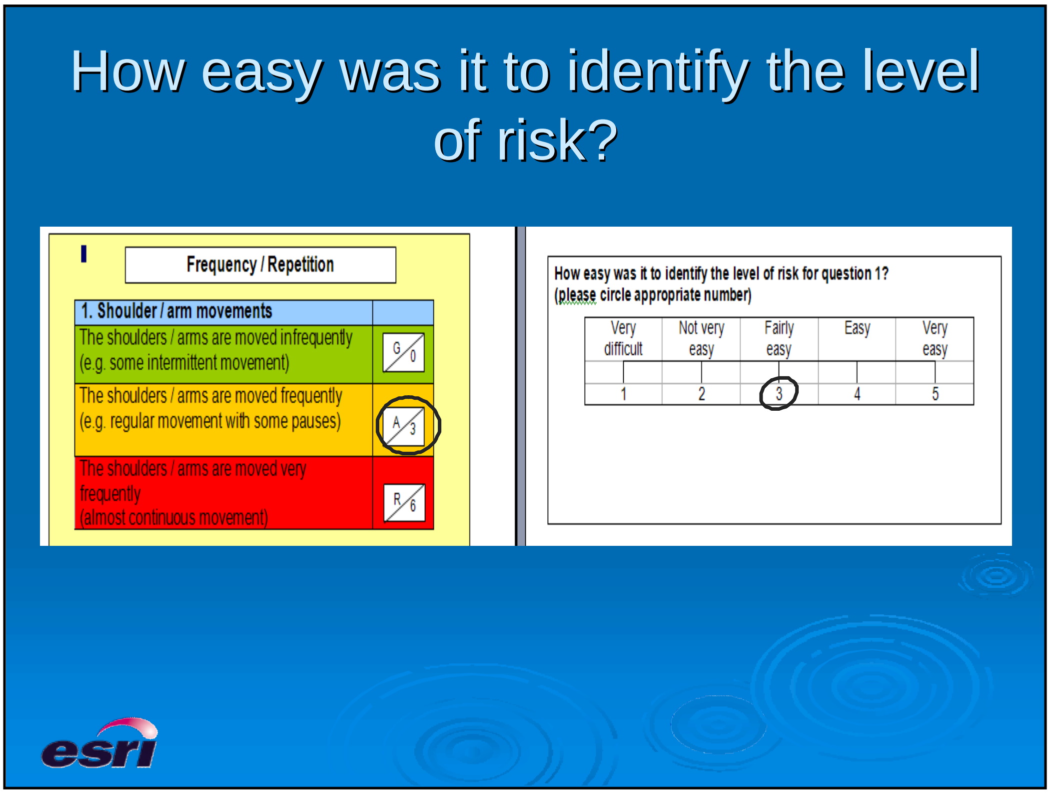
- Make sure you show the last page and show where totals need to be added up and where to write any suggestions they may have for making improvements to reduce the risks of the task.

Are there any questions?

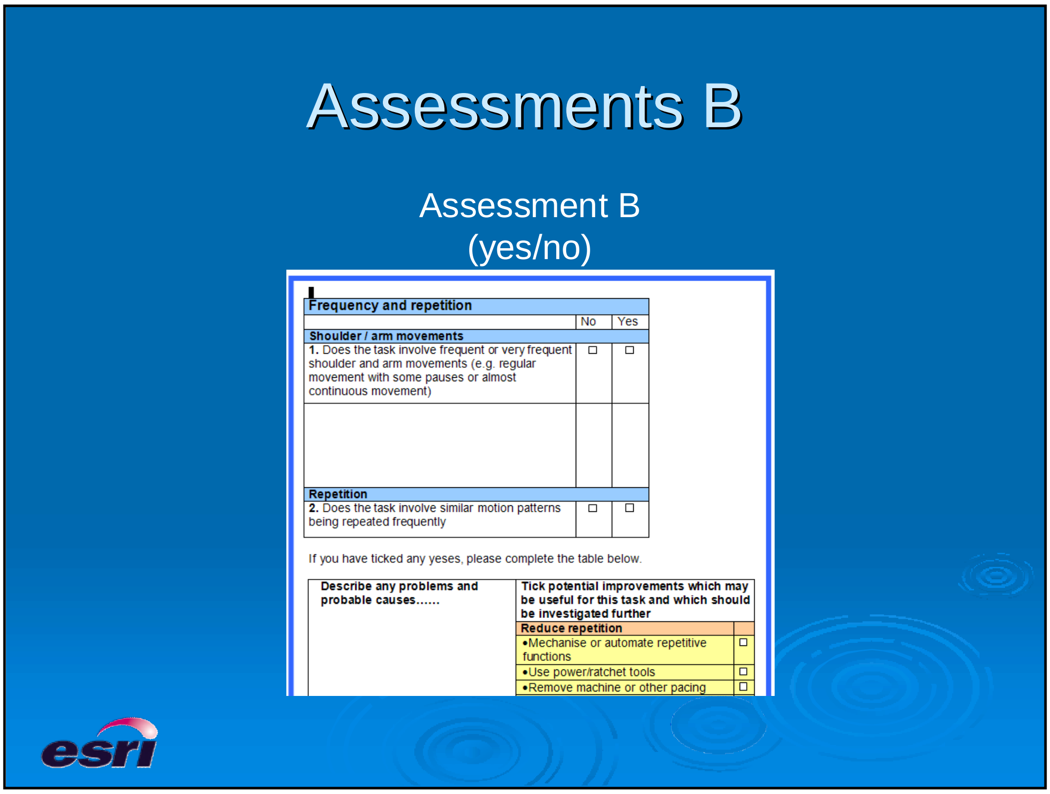
You will be given 20 minutes to complete each assessment, so if you cannot finish in that time don't worry. If we finish before this time then that's fine too. I will give you a warning when you only have 5 minutes remaining and that you should try and finish your assessment.







Present tasks for assessment with Checklist A.



Present tasks for assessment with Checklist A.

Appendix H: Written instructions for Checklist A

Written instructions for Checklist A

Introduction
This assessment tool is designed to help assess the risk of musculoskeletal problems from repetitive work tasks that involve the upper limbs (neck, shoulders, arms, wrists and hands).

A repetitive task is made up of a sequence of actions of fairly short duration, which are repeated over and over again and almost always use the same or very similar actions (e.g. stitching a piece of cloth, manufacturing one part, packaging items).

This assessment tool assesses whether some of the common risk factors that contribute to the development of musculoskeletal problems are present in a particular work task. These risk factors include:

- Force
- Awkward postures
- Repetitive movements
- Duration
- Working environment

The tool also helps you to decide whether action is required to reduce any of the identified risks.

This assessment tool asks a series of questions for each risk factor. For each risk factor there are at least three different choices of answer, and each possible response is categorised as either Green, Amber or Red and has a corresponding numerical score. You have to circle the most appropriate box, for example;

Here the assessor has circled the Amber box (A) which gets a score of 3.

1. Shoulder / arm movements	
Infrequent (e.g. some intermittent movement)	G 0
Frequent (e.g. regular movement with some pauses)	A 3
Very frequent (almost continuous movement)	R 6

The tool can be used to highlight areas (i.e. individual risk factors) of concern and it can also be used to gain a single overall risk score for the whole task by adding the numerical scores for each risk factor together at the very end of the assessment.

Before completing the assessment
Spend some time observing the work task being conducted to ensure that what you are seeing is representative of normal work practices.

Making the assessment

Assess each risk factor
Follow the assessment guide to determine the level of risk for each risk factor.
For each risk factor there is a table with green, amber and red rows please circle one square (containing a letter and a number) for the statement that best describes the action involved in the task.

At the end you need to transfer each score onto to the score sheet on the last page and rate each risk factor in terms of Low ,Medium and High priority for action.

Risk rating for the whole task
On the last page add up all the scores to give an overall task score.

The overall score will give an indication of the risk level of the task as a whole.

Overall task score	Proposed overall risk level	
0-11	**Low**	**Consider individual circumstances**
12-25	**Medium**	**Further investigation required**
26 or more	**High**	**Further investigation required immediately**

Ideas/suggestions on how to improve the task

At the very end please write (in the box provided) any ideas you have as to what changes could be made to reduce the risks of musculoskeletal disorders from this task.

Appendix I: Written instructions for Checklist B

Written instructions for Checklist B

Introduction
This assessment tool is designed to help assess the risk of musculoskeletal problems from repetitive work tasks that involve the upper limbs (neck, shoulders, arms, wrists and hands).

A repetitive task is made up of a sequence of actions of fairly short duration, which are repeated over and over again and almost always use the same or very similar actions (e.g. stitching a piece of cloth, manufacturing one part, packaging similar items).

This assessment tool assesses whether some of the common risk factors that contribute to the development of musculoskeletal problems are present in a particular work task. These risk factors include:

- Force
- Awkward postures
- Repetitive movements
- Duration
- Working environment

The tool can be used to highlight areas (i.e. individual risk factors) of concern and it can be used to gain a single overall risk score for the whole task by counting up the total number of YES ticks.

Before completing the assessment
Spend some time observing the work task being conducted to ensure that what you are seeing is representative of normal work practices.

Making the assessment
The assessment asks a series of questions for each risk factor. For each risk factor you tick either - no (it is not present) or - Yes (it is present).

Frequency and repetition		
	No	Yes
Shoulder / arm movements		
1. Does the task involve frequent or very frequent shoulder and arm movements (e.g. regular movement with some pauses or almost continuous movement)	☑	☐
Repetition		
2. Does the task involve similar motion patterns being repeated frequently	☐	☑

For each Yes tick
You should;

1. Write a few words describing the cause of that particular risk or what you think the problem is in the column entitled 'Describe any problems or **probable causes'**.

2. Look across to the end column ('**Tick potential improvements which may be useful for this task and which should be investigated further**') and tick improvements you think might be useful in reducing that particular risk factor in this task.

For example;

Describe any problems and probable causes……	Tick potential improvements which may be useful for this task and which should be investigated further.	
Operating the switch is may problem regarding repetition. The workers has to pick up each approaching item from a conveyor and place it into a jig. To open and close the jig they have flick a switch. This occurs very fast and requires repetitive actions of the hands and fingers to operate the switch.	**Reduce repetition**	
	•Mechanise or automate repetitive functions	☑
	•Use power/ratchet tools	☐
	•Remove machine or other pacing	☐
	•Restructure task (job design)	☐
	•Remove or monitor piecework schemes	☐
	Reduce duration	
	•Implement job enlargement	☐
	•Ensure adequate breaks	☑
	•Implement job rotation	☐
	•Limit / control overtime	☐

At the end of the assessment count up the total number of YES ticks to gain a single overall risk score for the whole task and write the score in the box provided at the end of the assessment. At the end of the assessment you should rate each risk factor in terms of Low, Medium and High priority for action.

Ideas/suggestions on how to improve the task

At the very end please write (in the box provided) any ideas you have as to what changes could be made to reduce the risks of musculoskeletal disorders from this task.

To do this you might want to flick back through your assessment of the task and see which boxes you have ticked in ''**Tick potential improvements which may be useful for this task and which should be investigated further**" this might give you more ideas on what sort of changes could be made.

Appendix J: Comparison Questionnaire

Comparison Questionnaire

Name (please print your name): ___________________________________

1. Overall which of these two assessment tools was the easiest to use? (please tick)

Assessment A (red, amber, green) ☐ Assessment B ☐

2. Which of these assessment tools would you prefer to use on your workplace? (please tick)

Assessment A (red, amber, green) ☐ Assessment B ☐

3. Which of these assessments do you think would be the best to help your company reduce the risks of musculoskeletal problems in your workplace? (please tick)

Assessment A (red, amber, green) ☐ Assessment B ☐

4. How effective was each assessment tool in identifying whether the whole task was either high, medium or low risk
(please circle your rating score for A and B)

	Not at all effective ←				→ Very effective
Assessment A (red,amber,green)	1	2	3	4	5
Assessment B	1	2	3	4	5

5. How effective was each assessment tool in identifying particular areas (risk factors) within a task as high, medium or low risk
(please circle your rating score for A and B)

	Not at all effective ←				→ Very effective
Assessment A (red,amber,green)	1	2	3	4	5
Assessment B	1	2	3	4	5

6. How effective was each assessment tool in identifying what the causes to the problems were
(please circle your rating score for A and B)

	Not at all effective ⟷				Very effective
Assessment A (red,amber,green)	1	2	3	4	5
Assessment B	1	2	3	4	5

7. How effective was each assessment tool in identifying what changes should/could be made to reduce the risks
(please circle your rating score for A and B)

	Not at all effective ⟷				Very effective
Assessment A (red,amber,green)	1	2	3	4	5
Assessment B	1	2	3	4	5

8. How easy was it for you to understand the instructions on how to use the assessment tool (please circle your rating scores).

	Very difficult	Not very easy	Fairly easy	easy	Very easy
Assessment A (red,amber,green)	1	2	3	4	5
Assessment B	1	2	3	4	5

9. How confident did you feel in using the assessment tool?

	Not at all confident ⟷				Very confident
Assessment A (red,amber,green)	1	2	3	4	5
Assessment B	1	2	3	4	5

10. How confident were you that you had assessed the tasks correctly?

	Not at all confident ⟷				Very confident
Assessment A (red,amber,green)	1	2	3	4	5
Assessment B	1	2	3	4	5

11. For each of the following statements please circle the response that best describes your level of agreement to that statement.

a. I would have liked more background information about the risk factors (please circle)

Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree

b. I would have liked more information about how to complete the risk assessments.

Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree

c. I would have liked more information about possible control actions/changes to make to reduce the risks.

Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree

d. I think face to face training in the use of the assessments would be more useful than following written instructions.

Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree

e. I think following written instruction would be more useful than attending a face to face training session.

Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree

f. I thought that the written instructions were sufficient to conduct the assessments.

Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree

g. I would have liked to have gone through some example assessments with a trainer.

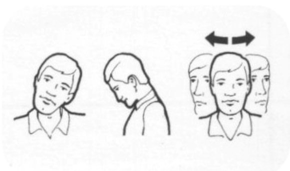
Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree

12. Which of these terms (1 or 2) do you find most helpful in describing a risk.
(please tick the statement you most prefer (1 or 2)).

1 ☐	2 ☐
Does the task involve similar motion patterns being repeated frequently	Similar motion patterns are repeated more than 11-20 times per minute

1 ☐	2 ☐
Moderate force (1-4kg) or Strong force (More than 4kg) is exerted	Moderate or strong force is exerted

1 ☐	2 ☐
Does the task involve holding the neck bent or twisted more than 15% of the time	Does the task involve holding the neck bent or twisted a part of the time

1 ☐	2 ☐
Does the task involve holding the neck bent or twisted 	Does the task involve holding the neck bent or twisted (more than 15 degrees relative to the upright and forward facing position)

1 ☐	2 ☐
The back is bent forward, sideways or twisted (more than 20 degrees from upright forward facing position)	The back is bent forward, sideways or twisted 

13. What were the top two things you liked most about ………..
a. Assessment A (red, amber, green) 1____________________ ____________________ 2____________________ ____________________
b. Assessment B 1____________________ ____________________ 2____________________ ____________________

14. What were the two things you most disliked about ……………
a. Assessment A (red, amber, green) 1____________________ ____________________ 2____________________ ____________________
b. Assessment B 1____________________ ____________________ 2____________________ ____________________

Appendix K: IOSH accredited trainer's presentation and lesson plans

IOSH accredited trainer's presentation and lesson plans

Trainer	**Jonathan Backhouse** DipNEBOSH BA(Hons) CertEd GradIOSH MIfL		Revision	2.1	Venue	-
Course/topic	Focusing on musculoskeletal problems		Session Time	**2 ½ hrs**	Date	**-**
Aims	Understand the effects and identify control measures for musculoskeletal problems in the work place					

Timing	Objectives/learning outcomes **The learner will:**	**Resources**	**Teacher Activities**	**Learner Activities**	**Assessment**
10	Course structure	-	Health, Safety and Welfare Course Timings / Breaks etc. Aims / Objectives / Assessment	Compete paperwork	Observation
5	Explain what are musculoskeletal problems; their symptoms; and why they are a concern.	-	Open session by asking group their definition (ice breaker) Lecture from slide 4	Discussion	Observation
10	1. State the risks factors effecting musculoskeletal problems in the workplace	PPT	Lecture from slide 5, defining each heading on slide	Q&A	Q&A
20	2. Identify activities requiring a risk assessment	PPT and Video Clips	Discussion based upon One Video clip	Discussion	Observation
10	3. Identify risk factors giving rise to musculoskeletal problems	Handout / PPT	Lecture from slide 7	Q&A	Q&A
-	Break				
10	4. Explain the principles and practice of risk assessment	-	Explanation of Terms: Hazard; Risk; Control	Small group: Worked example from groups suggestions	Feedback of worked example
20-30	5. Complete an assessment	Handouts	Work through assessment with group Play video related to industry	Complete assessment handouts	Assessment completed
5	6. Identify preventative and precautionary measures	Handout / PPT	Lecture from slide 10	Q&A	Q&A
5	7. List ways of reducing the risk of musculoskeletal problems	PPT	Discussion based upon slide 11 (HSG 60 upper limb disorders in the workplace) headings	Gives example from heading	Discussion
10	Complete course evaluation	-	Give evaluation paperwork out	Compete paperwork	Observation
-	Handover to Clare	-	-	-	-

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Focusing on Musculoskeletal Problems

Slide 1

Before we start …

- Health, Safety and Welfare Arrangements
  - Emergencies: Fire and First Aid
  - House keeping: Toilets, Smoking, Mobiles

Course Timings
  - Start and Finnish
  - Breaks

- Tutor
  - Jonathan Backhouse
    DipNEBOSH BA(Hons) CertEd GradIOSH MIfL
    Occupational Safety and Health Practitioner

Slide 2

Aims, objectives and assessment

- Aims
  - Understand the effects and identify control measures for musculoskeletal problems in the work place

- Objectives (by the end of the session the student will be able to)
  1. State the risks factors effecting musculoskeletal problems in the workplace
  2. Identify activities requiring a risk assessment
  3. Identify risk factors giving rise to musculoskeletal problems
  4. Explain the principles and practice of risk assessment
  5. Complete an assessment
  6. Identify preventative and precautionary measures
  7. List ways of reducing the risk of musculoskeletal problems

- Assessment
  - Complete assessment A/B

Slide 3

- Musculoskeletal problems

- What are the symptoms?

- Why are they a concern?

Slide 4

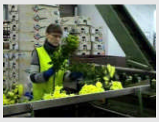
1. Risks factors

- Force
- Awkward postures
- Repetitive movements
- Duration
- Working environment
- Other factors

Slide 5

2. Activities requiring risk assessments

Lab Work **Cake Making** **Flowers Packing**



Plus other activities …

- Production line worker
- Checkout operative
- Driving

- Computer operator - DSE Assessment
- Cleaners - COSHH Assessment
- Using power tools - Vibration & Noise Assessments

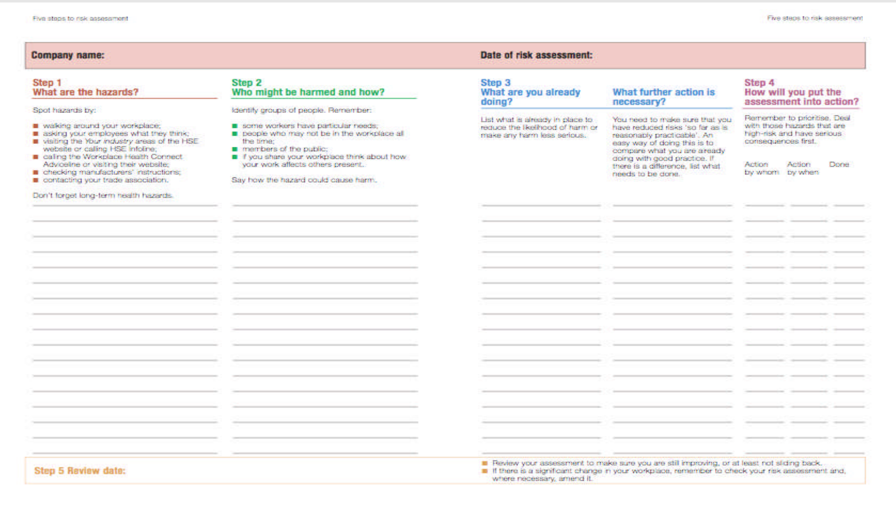
Slide 6

3. Risk factors giving rise musculoskeletal problems

- Repetitive tasks
- Poor working environment
- Extremes of temperature and humidity
- Poor lighting or lighting too bright
- Length of time at work
- Uncomfortable positions or posture
- Design of equipment
- The need to wear personal protective equipment for long periods
- Poor posture
- Vibration

Slide 7

4. Principles and practice of risk assessment



Five steps to risk assessment

Five steps to risk assessment

Company name:

Date of risk assessment:

Step 1
What are the hazards?

Spot hazards by:

- walking around your workplace;
- asking your employees what they think;
- visiting the Your industry areas of the HSE website or calling HSE Infoline;
- calling the Workplace Health Connect Adviceline or visiting their website;
- checking manufacturers' instructions;
- contacting your trade association.

Don't forget long-term health hazards.

Step 2
Who might be harmed and how?

Identify groups of people. Remember:

- some workers have particular needs;
- people who may not be in the workplace all the time;
- members of the public;
- if you share your workplace think about how your work affects others present.

Say how the hazard could cause harm.

Step 3
What are you already doing?

List what is already in place to reduce the likelihood of harm or make any harm less serious.

What further action is necessary?

You need to make sure that you have reduced risks 'so far as is reasonably practicable'. An easy way of doing this is to compare what you are already doing with good practice. If there is a difference, list what needs to be done.

Step 4
How will you put the assessment into action?

Remember to prioritise. Deal with those hazards that are high-risk and have serious consequences first.

Action by whom	Action by when	Done

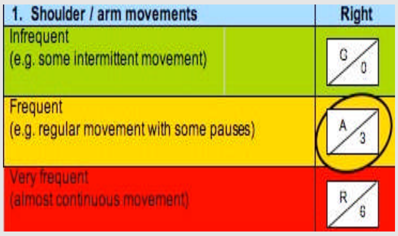
Step 5 Review date:

- Review your assessment to make sure you are still improving, or at least not sliding back.
- If there is a significant change in your workplace, remember to check your risk assessment and, where necessary, amend it.

Slide 8

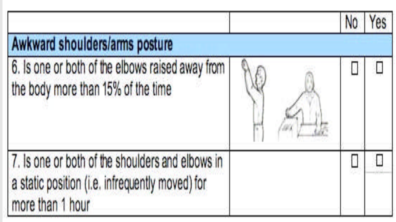
5. Assessments …

Assessment A



1. Shoulder / arm movements	Right
Infrequent (e.g. some intermittent movement)	G / 0
Frequent (e.g. regular movement with some pauses)	A / 3
Very frequent (almost continuous movement)	R / 6

Assessment B

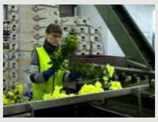


		No	Yes
Awkward shoulders/arms posture			
6. Is one or both of the elbows raised away from the body more than 15% of the time		☐	☐
7. Is one or both of the shoulders and elbows in a static position (i.e. infrequently moved) for more than 1 hour		☐	☐

"Assessments are used as a filter - a fist level of assessment to see if there is a risk and whether more detailed assessment by an expert is required."

Lab Work **Cake Making** **Flowers Packing**





Slide 9

6. Preventative and precautionary measures

Preventative

- Improved design or working areas
- Provision of special tools

Precautionary

- Better training and supervision
- Adjustment of workloads and rest periods
- Health surveillance aimed at early detection

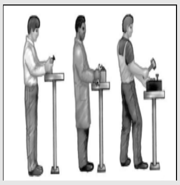
Information and training

- Risks to health
- How to recognise problems
- Precautions in place (the need for regular breaks)
- How to report problems

Slide 10

7. Reducing the risk

- Optimising work posture
- Reducing force
- Reducing duration
- Psychosocial
- Tools



Slide 11

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

Thank you, any questions?

Slide 12

Appendix L: ESRI amended training presentation

ESRI amended training presentation

Introduction

- Loughborough University Research Study
- Laurence (Loughborough University)
- Jonathan (IOSH trainer)

Slide 1

Before we start …

- Health, Safety and Welfare Arrangements
  - Emergencies: Fire and First Aid
  - House keeping: Toilets, Smoking, Mobiles

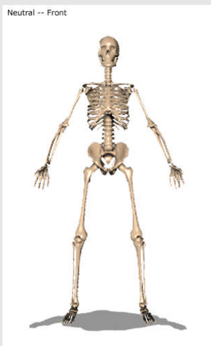
Course Timings
  - Start and Finish
  - Breaks

- Trainer
  - Jonathan Backhouse
    DipNEBOSH BA(Hons) CertEd GradIOSH MIfL
    Occupational Safety and Health Practitioner

Slide 2

Musculoskeletal Problems

Slide 3

What does the word Musculoskeletal mean? Loughborough University Slide 4	
What does the word Musculoskeletal mean? **It refers to the:** **Muscles**  Loughborough University Slide 5	The word musculoskeletal refers to your bodies muscles – muscular-
What does the word Musculoskeletal mean? **It refers to the:** **Muscles**  **Skeleton**  Loughborough University Slide 6	And skeleton – skeletal

What does the word Musculoskeletal mean?

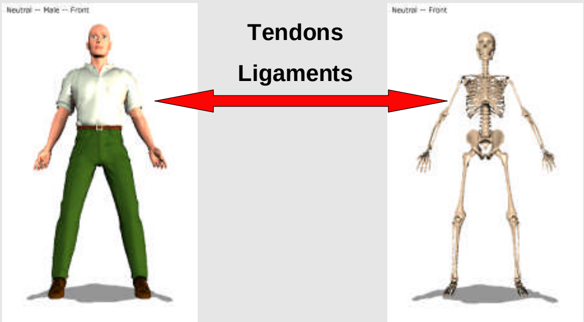
It refers to the:

Muscles

Skeleton

Tendons

Ligaments



Slide 7

And the bits which connect the two, these being the tendons and ligaments. These connect your muscles to your bones.

What we aim to do today!

- Aims

  To understand;

  – What musculoskeletal problems are
  – The effects musculoskeletal problems have on people and their work
  – What we can do to reduce the likelihood of getting a musculoskeletal problem
  – How we can assess the level of risk of musculoskeletal problems in different work tasks
  – The effects and identify control measures for reducing the risk

Slide 8

What are Musculoskeletal problems?

- Repetitive strain injury (RSI)
- Over-use injuries
- Musculoskeletal disorders result from repeated and intensive use of the muscles, tendons and ligaments etc. which result in their gradual wear and tear.
- They can happen when the job you are doing wants your body to do more than it can.

Slide 9

Musculoskeletal problems refer to injury to the muscles, ligaments and tendons which occur from overuse. For example – you may have heard musculoskeletal problems being referred to as RSI (repetitive strain injury).

Musculoskeletal problems result from repeated and intensive use of the muscles, tendons and ligaments etc. which result in their gradual wear and tear.

Work related musculoskeletal disorders occur when there is a mismatch between the physical requirements of the work and the physical capacities of the human body.

What are the symptoms?

The symptoms include:

- Tingling
- Pain
- Ache
- Discomfort
- Numbness
- Loss of feeling
- Loss of grip strength

Slide 10

What are the main risks/causes?

- Repetition – How often?
- Applying force – How hard?
- Awkward or fixed postures – How uncomfortable?
- Duration – How long?
- Environment - Temperature, lighting, stress

Slide 11

Examples?

Slide 12

Examples?

- **Sports?**
  - Repetition
  - Applying force
  - Awkward or fixed postures
  - Duration
  - Environment (temperature, lighting, stress)

Slide 13

Examples?

- **Sports**

  - Repetition
  - Applying force
  - Awkward or fixed postures
  - Duration
  - Environment (temperature, lighting, stress)

Slide 14

Racing drivers
Neck problems – from repeatedly holding their neck upright against the forces when turning corners (applying force).
Wrist problems from holding the steering wheel for long time (fixed posture) and having to apply force to turn the wheel (Force).

Examples?

- **Sports**

  - Repetition
  - Applying force
  - Awkward or fixed postures
  - Duration
  - Environment (temperature, lighting, stress)

Slide 15

Tennis

Back injuries from repeatedly serving-
awkward posture to reach the ball when tossed for the served.
Applying force to swing the racket and hit the ball while in an awkward posture.

Examples?

- **Sports**

- Repetition
- Applying force
- Awkward or fixed postures
- Duration
- Environment (temperature, lighting, stress)

Slide 16

Golf

Repeatedly swinging – awkward posture and force, different temperatures

Cold can make your stiff and tense and make it harder to move.

Examples?

- **At home?**

- Repetition
- Applying force
- Awkward or fixed postures
- Duration
- Environment (temperature, lighting, stress)

Slide 17

Can you think of any home activities where people may experience a musculoskeletal problem?

Where they experience
Repetition,
Use force,
Adopt awkward posture
Duration – do it for a long time

Examples?

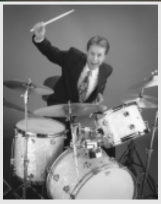
- **At home?**

- Repetition
- Applying force
- Awkward or fixed postures
- Duration
- Environment (temperature, lighting, stress)

Slide 18

Gardening

Examples? • **At home?**   • Repetition • Applying force • Awkward or fixed postures • Duration • Environment (temperature, lighting, stress) Copyright Loughborough University 2008 Loughborough University Slide 19	Cleaning
Examples? • **Musicians?** • Repetition • Applying force • Awkward or fixed postures • Duration • Environment (temperature, lighting, stress) Copyright Loughborough University 2008 Loughborough University Slide 20	Musicians Can you think of any musicians who may experience a musculoskeletal problem? Where they experience Repetition, Use force, Adopt awkward posture Duration – do it for a long time
Examples? • **Musicians?**  • Repetition • Applying force • Awkward or fixed postures • Duration • Environment (temperature, lighting, stress) Copyright Loughborough University 2008 Loughborough University Slide 21	Violin player – neck problems from holding their neck in an awkward posture for long time.

Examples? • **Musicians?**   • Repetition • Applying force • Awkward or fixed postures • Duration • Environment (temperature, lighting, stress) Loughborough University Slide 22	Drummer
Examples? • **At work?** **In your workplace** • Repetition • Applying force • Awkward or fixed postures • Duration • Environment (temperature, lighting, stress) Loughborough University Slide 23	What about in your workplace? Can you think of any task that you or other people do that are Repetitive, Use force, Awkward posture Duration – do it for a long time Get people talking about their work tasks and if they have to adopt any particular awkward postures, apply force, etc… and WHY? Do they use work areas that are too high too low? -are things difficult to reach? - are tools not designed well? Etc…

Work is different to leisure activities…..

You have less control.

- Your work needs to get done in a short time
- Your job controls how fast your need to work
- Your work controls when you can have a break
- There is one way to do the work
- Your job needs certain tools to be used
- You need to get the work done to get paid
- The area you work in is used by a lot of different people (different sizes)

Slide 24

Why are musculoskeletal problems a concern in the workplace?

Work activities | **Affects on the worker** | **Affects for the company**

Slide 25

Risk assessment

- What is a hazard?
- What is risk?
- Risk assessments are carried out for all sort of activities in the workplace to help improve and control the health and safety of people in the workplace;

For example:

- Fire
- Chemical
- Using equipment

Slide 26

Principles and practice of risk assessment

- What are the hazards?
- Who might be harmed and how?
- What are you already doing?
- What further action is needed?
- How will you put the assessment into action?

Slide 27

Work activities requiring musculoskeletal risk assessments

- Computer operator - DSE Assessment

- Manual handling

- Repetitive tasks

Slide 28

There are specialised risk assessment designed just to look and assess the risks of

Using a computer as part of your job.

Manual handling – lifting things

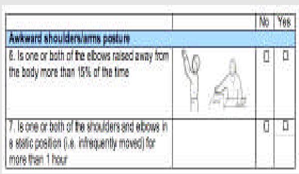
And repetitive tasks

Hand over between presenters

Assessments of repetitive tasks involving the upper body.

Assessment A

Assessment B



"Assessments are used as a filter - a fist level of assessment to see if there is a risk and whether more detailed assessment by an expert is required."

Slide 29

Here are two risk assessment designed to look at repetitive tasks. You have had a go at using both. Today we are going to just look at assessment ____.

Risk factors giving rise to musculoskeletal problems

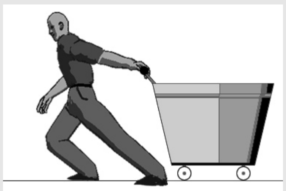
- Repetition
- Applying force
- Awkward or fixed postures
- Duration
- Environment (temperature, lighting, stress)

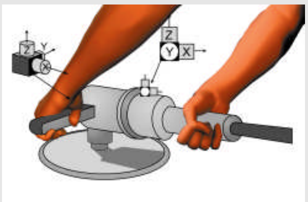
Slide 30

Repetition

Slide 31

Force

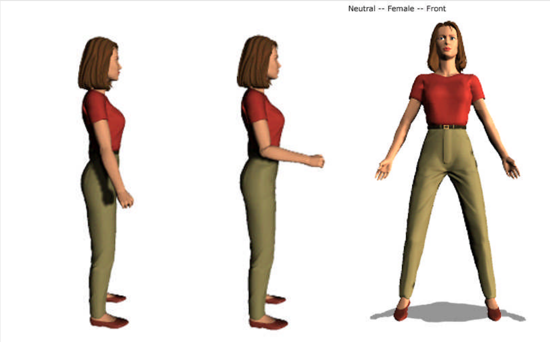




Slide 32

Awkward or static postures

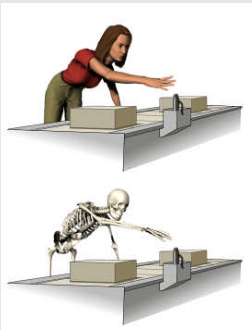
- What are neutral postures?



Slide 33

Awkward postures

- What are awkward postures?



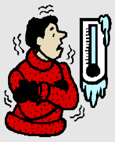
Slide 34

Duration

Slide 35

Working environment

- Temperature



- Draughts

- Stress

Slide 36

Additional factors

- Gloves
- A tool used to strike something
- Lighting levels are not good enough for the job
- Tools , work surface or tools cause compression of the skin (surfaces or equipment that dig in)

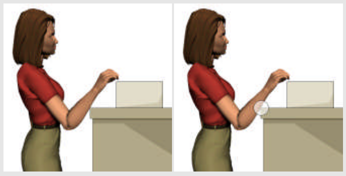
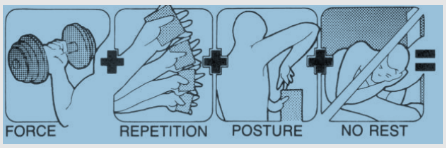


Image taken from Vern Putz-Anderson 1988

Slide 37

All risk factors can act in combination….



- Or singly….
  - Which gets tired first?

Image taken from Vern Putz-Anderson 1988

Slide 38

So….

Lets have a go at assessing a risk !

Slide 39

Loughborough University

Lets have a go at assessing the risk !

Conducts this task continuously for two hours then goes and does a completely different task

It is never difficult to keep up with the work.

The flowers he handles are wet and the room is draughty.

Slide 40

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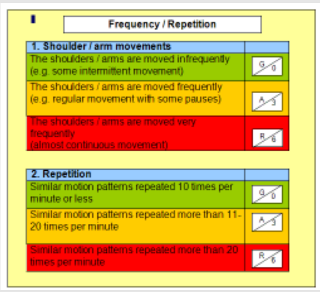
Frequency / Repetition



Frequency / Repetition

1. Shoulder / arm movements	
The shoulders / arms are moved infrequently (e.g. some intermittent movement)	G / 0
The shoulders / arms are moved frequently (e.g. regular movement with some pauses)	A / 3
The shoulders / arms are moved very frequently (almost continuous movement)	R / 6

2. Repetition	
Similar motion patterns repeated 10 times per minute or less	G / 0
Similar motion patterns repeated more than 11-20 times per minute	A / 3
Similar motion patterns repeated more than 20 times per minute	R / 6

Stopwatch

Slide 41

Loughborough University

Awkward Posture – Head and Neck

4. Awkward head / neck posture	
The neck is held more or less straight (upright) or bent or twisted slightly (less than 15 degrees relative to the upright and forward facing position) most of the time	G 0
The neck is held bent or twisted (more than 15 degrees relative to the upright and forward facing position) a part of the time	A 1
The neck is held bent or twisted (more than 15 degrees relative to the upright and forward facing position) more than half of the time	R 2

Slide 43

Work way through remaining slides each depicting definitions of each check item using appropriate

Reducing the risks

Prevention – Stop it happening in the first place –removing the risk.

- Improved design or working areas
- Provision of special tools

Precaution – **In case you can not stop it – can not remove all risks**

- Better training and supervision
- Adjustment of workloads and rest periods
- Health surveillance aimed at early detection

Information and training

- How the job might hurt you
- How to recognise problems
- Precautions in place (the need for regular breaks)
- How to report problems

Slide 62

Reducing the risk

Reducing repetition

- Mechanise or automate repetitive functions
- Job rotation
- Make the job bigger to include other different tasks– make it less repetitive
- Remove machine or other pacing

Slide 63

Reducing the risk

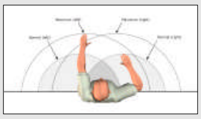
Reducing force

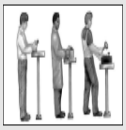
- Use weaker springs in triggers or other power sources rather than muscle power.
- Reduce frequency with which force needs to be applied.
- Reduce time spent applying force.
- Can foot pedal be used to provide force?
- Distribute force requirements over several fingers rather than one.
- Allow workers to use alternate hands to operate controls.

Slide 64

Reducing the risk

Improving work posture and comfort





- Workstation design
  - Work heights
  - Reach distances
  - Account for differences in size and shape of workers.
- Tool design
  - Angles of handles
  - Different sized tools
- Presentation of work
  - Different angles
- Seating
  - Adjustable chairs
  - Leg space

Image taken from Vern Putz-Anderson 1988

Slide 65

Reducing the risk

Reducing duration

- Introduce rest breaks
- Introduce micro pauses
- Job rotation
- Make the job bigger to include other different tasks– make it less repetitive
- Remove machine or other pacing

Slide 66

Reducing the risk

Tools

- Use light weight tools or provide supports, jigs or counterbalance devices.
- Hand tools should not require excessive force or have handles that are too large or small.
- They should not exert pressure or dig into the hand.
- Make sure well maintained.
- Ensure tool handles fit workers comfortably.

Slide 67

So what could we do to reduce the risks for the flower labeller?

Slide 68

Please make suggestions as to what changes could be made to reduce the risks?

- Investigate workstation height (looks a little low for this worker).
- Automate labelling or reposition the labeller to a slightly lower height.
- Rotate workers to significantly different tasks which require different movements/actions.

Slide 69

Summary

The risks	Reducing the risks
• Repetition • Applying force • Awkward or fixed postures • Duration • Environment (temperature, lighting, stress)	• Improve working posture • Reducing force • Reducing duration • Tools

Slide 70

Thank you, any questions?

Marked image taken from Vern Putz-Anderson 1988

Cumulative Trauma Disorders- A manual for musculoskeletal diseases of the upper limbs.

Slide 71

Appendix M: Training evaluation questionnaire

Training evaluation questionnaire

Name: ____

1. Can you please list up to six risks/causes which may lead to musculoskeletal problems or RSI?

1.____________________________ 4.________________________________

2.____________________________ 5.________________________________

3.____________________________ 6.________________________________

2. How confident were you that you had assessed the last two tasks correctly?

	Not at all confident ←			→	Very confident
Task 1	1	2	3	4	5
Task 2	1	2	3	4	5

3.How confident did you feel in using the assessment tool before and after receiving training?

	Not at all confident ←			→	Very confident
Before training	1	2	3	4	5
After training	1	2	3	4	5

5. For each of the following statements please circle the response that best describes your level of agreement to that statement.

h. I would have liked more background information about the risk factors (please circle)

Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree

i. I would have liked more information about how to complete the risk assessments.

Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree

j. I would have liked more information about possible control actions/changes to make to reduce the risks.

Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree

k. I think face to face training in the use of the assessments was more useful than following just the written instructions.

Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree

l. I think following written instruction was more useful than attending a face to face training session.

Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree

m. It was good to go through an example assessment with the trainer.

Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree

About the training course

Student Assessment		**Please add comments:**
Have you enjoyed the course?	☐ yes ☐ no	
Has this course increased your knowledge about the risks for Musculoskeletal problems?	☐ yes ☐ no	
Has this course been of practical benefit to you? i.e. will you use the knowledge you have gained back in the workplace?	☐ yes ☐ no	
How would you improve this course?		

Is there anything you feel the tutor did to hinder your learning? Please comment:	☐ yes ☐ no
Is there anything you feel the tutor did to help your learning? Please comment:	☐ yes ☐ no

Using the following ratings please tick the score in the boxes below:
(5 = Excellent) (4 = Very Good) (3 = Good) (2 = Satisfactory) (1 = Poor)

Content of the course:	☐ 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1 Please comment:
Course Material:	☐ 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1 Please comment:
The pace of the course:	☐ 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1 Please comment:
Overall Standard:	☐ 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1 Please comment:

Appendix N: Ease of use and ease of completion data

Ease of use and ease of completion data

Table 1. Ratings of ease of completion for each check item of Checklist A and B

	Ratings for ease of completing each check item										
	Checklist A Combined results from companies 1,2, 3 and 4 for all tasks					Checklist B Combined results from companies 1,2, 3 and 4 for all tasks					Check items where there is a significant difference between A and B
	Mean	Mode	Std. dev	Min	Max	Mean	Mode	Std. dev	Min	Max	
1	3.8	3, 4, 5	0.9	1.0	5.0	3.8	3.0	1.0	1.0	5.0	
2	3.5	3.0	0.9	2.0	5.0	3.7	3, 5	1.1	1.0	5.0	
3	3.8	4.0	0.9	1.0	5.0	3.7	3.0	1.0	1.0	5.0	
4	3.3	3.0	0.9	1.0	5.0	3.7	4.0	0.9	2.0	5.0	B significantly easier than A
5	3.4	4.0	0.9	1.0	5.0	3.7	4.0	1.0	1.0	5.0	B significantly easier than A
6	3.6	3.0	0.9	2.0	5.0	3.6	3, 4	0.9	1.0	5.0	
7	3.3	3.0	0.9	2.0	5.0	3.5	3.0	0.9	1.0	5.0	
8	3.3	3.0	0.9	1.0	5.0	3.4	3.0	1.0	1.0	5.0	
9	3.3	3.0	1.0	1.0	5.0	3.6	3.0	0.9	2.0	5.0	
10	3.3	3.0	1.1	1.0	5.0	3.5	3.0	0.9	2.0	5.0	
11	3.9	5.0	1.0	1.0	5.0	4.0	5.0	1.0	1.0	5.0	
12	4.0	5.0	1.2	1.0	5.0	4.0	5.0	1.0	1.0	5.0	
13	3.3	3.0	1.1	1.0	5.0	3.4	3.0	0.9	2.0	5.0	

Table 2. Ratings of ease of completion for each check item of Checklist A when split by job position.

	Ratings for ease of completing each check item of Checklist A										
	Team leaders, Line leaders and Line managers Combined results from companies 1,2, 3 and 4 for all tasks					Line workers Combined results from companies 1,2, 3 and 4 for all tasks					Check items where there is a significant difference between Team leaders group and Line workers
	Mean	Mode	Std. dev	Min	Max	Mean	Mode	Std. dev	Min	Max	
1	3.71	3	1.04	1	5	3.78	4	0.91	1	5	
2	3.38	3	0.82	2	5	3.56	3	0.86	2	5	
3	3.63	3	1.01	2	5	3.95	4	0.85	1	5	
4	3.04	3	0.81	1	5	3.41	3	0.91	1	5	Line workers reported completion was significantly easier than Team Leaders group.
5	3.25	3	0.99	2	5	3.48	4	0.84	1	5	

6	3.21	3	0.98	2	5	3.70	3	0.84	2	5	Line workers reported completion was significantly easier than Team Leaders group.
7	3.04	2	1.04	2	5	3.44	3	0.89	2	5	
8	3.21	3, 4	1.02	1	5	3.40	3	0.91	1	5	
9	3.13	4	1.12	1	5	3.38	3	0.99	1	5	
10	3	2	1.22	1	5	3.37	3	1.03	1	5	
11	3.79	5	1.14	2	5	4.02	5	0.99	1	5	
12	3.58	5	1.35	1	5	4.16	5	1.01	1	5	
13	3.21	3	0.93	2	5	3.37	3	1.10	1	5	

Table 3. Ratings of ease of completion for each check item of Checklist B when split by job position.

	Ratings for ease of completing each check item of Checklist B										
	Team leaders, Line leaders and Line managers Combined results from companies 1,2, 3 and 4 for all tasks					**Line workers** Combined results from companies 1,2, 3 and 4 for all tasks					**Check items where there is a significant difference between Team leaders group and Line workers**
	Mean	**Mode**	**Std. dev**	**Min**	**Max**	**Mean**	**Mode**	**Std. dev**	**Min**	**Max**	
1	3.68	3	1.06	2	5	3.81	3	1	5	1.05	
2	3.63	3	1.04	2	5	3.77	5	1	5	1.07	
3	3.62	3,4	0.85	2	5	3.66	3	1	5	1.07	
4	3.41	3	0.89	2	5	3.76	4	2	5	0.94	
5	3.46	3,4	1.03	1	5	3.75	4	1	5	0.99	
6	3.38	3	1.10	1	5	3.70	4	2	5	0.87	
7	3.48	3	0.92	1	5	3.55	3	2	5	0.94	
8	3.25	3	0.93	2	5	3.40	3	1	5	1.01	
9	3.46	3	0.84	2	5	3.65	4	2	5	0.97	
10	3.48	3	0.85	2	5	3.44	3	2	5	0.98	
11	3.81	5	1.14	2	5	4.04	5	1	5	0.98	
12	3.78	3	1.12	1	5	4.13	5	2	5	0.97	
13	3.00	3	0.71	2	4	3.80	3,4	3	5	0.84	

Appendix O: Level 2 analysis checklist, task & check item comparison

Level 2 analysis

		Checklist A				Checklist B				Tasks where there is a significant difference between A and B ease of completion ratings
		Task 1	Task 2	Task 3	Task 4	Task 1	Task 2	Task 3	Task 4	
1	Mean	3.59	3.83	3.87	3.85	3.75	4.18	3.76	3.53	
	Mode	3	3	5	4	5	5	3,4,5	3	
	Std. Dev	.82	.786	1.22	.899	1.26	1.08	.890	1.01	
	Min-max	2 – 5	3 - 5	1 - 5	2 - 5	1 - 5	2 - 5	2 - 5	2 - 5	
2	Mean	3.44	3.33	3.52	3.77	3.79	4.18	3.69	3.41	Task 2- B significantly easier than A
	Mode	3	3	3	4	5	5	3,4,5	3	
	Std. Dev	.93	.840	.846	.725	1.06	.982	.998	1.18	
	Min-max	2 - 5	2 - 5	2 - 5	3 - 5	2 - 5	2 - 5	2 - 5	1 - 5	
3	Mean	3.79	3.72	3.82	4.08	3.96	4.36	3.22	3.53	Task 2 – B significantly easier than A
	Mode	4 & 5	4	4	4	4	5	3	3	
	Std. Dev	1.149	.669	.958	.669	.806	.809	.906	1.19	Task 3 – A significantly easier than B
	Min-max	1 - 5	3 - 5	2 - 5	3 - 5	3 - 5	3 - 5	2 - 5	1 - 5	
4	Mean	3.18	3.33	3.35	3.54	3.96	3.82	3.47	3.44	Task 1 – B significantly easier than A
	Mode	3	3	3	3	4	3	4	4	
	Std. Dev	.758	1.03	.982	.877	.859	.982	.929	.964	
	Min-max	1 - 4	1 - 5	1 - 5	2 - 5	2 - 5	3 - 5	2 - 5	2 - 5	
5	Mean	3.38	3.06	3.52	3.69	3.74	4.09	3.55	3.50	Task 2 – B significantly easier than A
	Mode	4	3	3	3	4	4	3	3,4,5	
	Std. Dev	.985	.802	.730	.947	1.25	.944	.869	.894	
	Min-max	1 - 5	2 - 4	2 - 5	2 - 5	1 - 5	2 - 5	2 - 5	2 - 5	
6	Mean	3.47	3.39	3.74	3.69	3.61	3.73	3.53	3.67	
	Mode	3	3	3	3	4	3	3	4	
	Std. Dev	.992	.778	.915	.751	1.23	.905	.861	.724	
	Min-max	2 - 5	2 - 5	2 - 5	3 - 5	1 - 5	3 - 5	2 - 5	2 - 5	
7	Mean	3.15	3.28	3.57	3.46	3.59	4.00	3.36	3.43	
	Mode	3	4	3	3	4	3	3	4	
	Std. Dev	1.019	.826	.896	.967	1.14	.894	.742	.938	
	Min-max	2 - 5	2 - 4	2 - 5	2 - 5	1 - 5	3 - 5	2 - 5	2 - 5	

8	Mean	3.06	3.33	3.57	3.62	3.50	2.73	3.52	3.24	
	Mode	3	3	3	3,4,5	3	2	4	3	
	Std. Dev	.952	.686	1.08	.870	1.06	1.42	.712	.903	
	Min-max	1 - 5	2 - 4	1 - 5	2 - 5	2 - 5	1 - 5	2 - 5	2 - 5	
9	Mean	3.21	3.28	3.22	3.77	3.73	4.09	3.45	3.35	Task 2 - B significantly easier than A
	Mode	3	4	3	4	3	4	3,4,5	3	
	Std. Dev	.978	1.02	1.13	.927	.935	.944	.833	.996	
	Min-max	1 - 5	1 - 5	1 - 5	2 - 5	2 - 5	2 - 5	2 – 5	2 - 5	
10	Mean	3.35	3.29	3.00	3.46	3.65	3.55	3.33	3.35	
	Mode	3	4	3	4	3	4	3	3	
	Std. Dev	1.041	.985	1.21	1.13	.832	1.04	.816	1.22	
	Min-max	2 - 5	1 - 5	1 - 5	1 - 5	2 - 5	2 - 5	2 - 5	2 - 5	
11	Mean	3.88	3.78	3.87	4.33	4.36	4.50	3.71	3.82	
	Mode	5	4 & 5	4	4	4	5	3,4,5	5	
	Std. Dev	1.175	1.17	.920	.651	.658	.707	1.09	1.07	
	Min-max	2 - 5	2 - 5	1 - 5	3 - 5	3 - 5	3 - 5	2 - 5	2 - 5	
12	Mean	3.85	3.78	3.96	4.58	4.19	4.50	3.91	3.69	Task 4 – A significantly easier than B
	Mode	5	5	4,5	5	5	5	5	3	
	Std. Dev	1.306	1.26	1.02	.793	1.03	.707	1.06	1.08	
	Min-max	1 - 5	1 - 5	1 - 5	3 - 5	1 - 5	3 - 5	2 - 5	2 - 5	
13	Mean	3.18	3.39	3.43	3.31	3.35	3.40	3.26	3.35	
	Mode	3	3	3	3	3	3	3	3	
	Std. Dev	1.167	.916	.992	1.11	1.07	.843	.828	1.06	
	Min-max	1 - 5	2 - 5	2 - 5	1 - 5	1 - 5	2 - 5	2 - 5	2 - 5	

Appendix P: Level 2 Analysis Trial 1 - Level of agreement tables

Level 2 Analysis: Trial 1 - Level of agreement tables,

Table 1. Percentage agreements of participants and expert responses for each check item for checklist A and B for each task (1 – 4).

		Percentage agreement of participant responses and model response	
		Checklist A	Checklist B
1	T1	91% (32/35)	75% (18/24)
	T2	100% (18/18)	100% (11/11)
	T3	100% (24/24)	88% (30/34)
	T4	92% (12/13)	82% (14/17)
2	T1	37% (13/35)	8% (2/24)
	T2	89% (16/18)	100% (11/11)
	T3	83% (20/24)	79% (27/34)
	T4	54% (7/13)	12% (2/17)
3	T1	77% (24/35)	67% (16/24)
	T2	72% (13/18)	91% (10/11)
	T3	71% (17/24)	62% (21/34)
	T4	85% (11/13)	59% (10/17)
4	T1	69% (24/35)	88% (21/24)
	T2	67% (12/18)	73% (8/11)
	T3	58% (14/24)	62% (21/34)
	T4	46% (6/13)	47% (8/17)
5	T1	43% (15/35)	50% (12/24)
	T2	78% (14/18)	82% (9/11)
	T3	25% (6/24)	15% (5/34)
	T4	77% (10/13)	41% (7/17)
6	T1	91% (32/35)	79% (19/24)
	T2	94% (17/18)	64% (7/11)
	T3	54% (13/24)	56% (19/34)
	T4	39% (5/13)	59% (10/17)
7	T1	74% (26/35)	88% (21/24)
	T2	67% (12/18)	46% (5/11)
	T3	54% (13/24)	18% (6/34)
	T4	69% (9/13)	88% (15/17)
8	T1	71% (25/35)	46% (11/24)
	T2	33% (6/18)	64% (7/11)
	T3	25% (6/24)	41% (14/34)
	T4	39% (5/13)	65% (11/17)
9	T1	86% (30/35)	79% (19/24)
	T2	78% (14/18)	36% (4/11)
	T3	71% (17/24)	27% (9/34)
	T4	92% (12/13)	59% (10/17)

10	T1	60% (21/35)	79% (19/24)
	T2	61% (11/18)	46% (5/11)
	T3	38% (9/24)	82% (28/34)
	T4	77% (10/13)	88% (15/17)
11	T1	71% (25/35)	79% (19/24)
	T2	94% (17/18)	91% (10/11)
	T3	96% (23/24)	85% (29/34)
	T4	92% (12/13)	82% (14/17)
12	T1	71% (25/35)	92% (22/24)
	T2	94% (17/18)	82% (9/11)
	T3	96% (23/24)	91% (31/34)
	T4	85% (11/13)	88% (15/17)
13	T1	97% (34/35)	88% (21/24)
	T2	100 (18/18)	100% (11/11)
	T3	100% (24/24)	97% (33/34)
	T4	100% (13/13)	100% (17/17)

Table 2. Percentage agreements of participants and expert responses for each check item for checklist A and B for each task (1 – 4) split by respondents job position.

		Percentage agreement of participant responses and model response			
		Checklist A		**Checklist B**	
		Team Leader, Line Leader or Line Manager	**Line Worker or Operative**	**Team Leader, Line Leader or Line Manager**	**Line Worker or Operative**
1	T1	90% (9/10)	92% (22/24)	88% (7/8)	69% (11/16)
	T2	100% (5/5)	100% (13/13)	100% (5/5)	100% (6/6)
	T3	100% (7/7)	100% (17/17)	90% (9/10)	88% (21/24)
	T4	100% (2/2)	91% (10/11)	80% (4/5)	83% (10/12)
2	T1	50% (5/10)	29% (7/24)	0% (0/8)	13% (2/16)
	T2	80% (4/5)	92% (12/13)	100% (5/5)	100% (6/6)
	T3	86% (6/7)	82% (14/17)	80% (8/10)	79% (19/24)
	T4	50% (1/2)	55% (6/11)	0% (0/5)	17% (2/12)
3	T1	70% (7/10)	83% (20/24)	63% (5/8)	69% (11/16)
	T2	60% (3/5)	77% (10/13)	100% (5/5)	83% (5/6)
	T3	86% (6/7)	65% (11/17)	80% (8/10)	54% (13/24)
	T4	100% (2/2)	82% (9/11)	100% (5/5)	46% (5/11)
4	T1	60 (6/10)	75% (18/24)	88% (7/8)	88% (14/16)
	T2	60% (3/5)	69% (9/13)	80% (4/5)	67% (4/6)
	T3	57% (4/7)	59% (10/17)	50% (5/10)	67% (16/24)
	T4	50% (1/2)	46% (5/11)	20% (1/5)	58% (7/12)
5	T1	40% (4/10)	46% (11/24)	38% (3/8)	56% (9/16)
	T2	100% (5/5)	69% (9/13)	100% (5/5)	67% (4/6)
	T3	29% (2/7)	24% (4/17)	30% (3/10)	8% (2/24)
	T4	100% (2/2)	73% (8/11)	40% (2/5)	42% (5/12)

6	T1	90% (9/10)	92% (22/24)	88% (7/8)	75% (12/16)
	T2	100% (5/5)	92% (12/13)	100% (5/5)	33% (2/6)
	T3	57% (4/7)	53% (9/17)	80% (8/10)	46% (11/24)
	T4	0% (0/2)	46% (5/11)	60% (3/5)	58% (7/12)
7	T1	60% (6/10)	79% (19/24)	100% (8/8)	81% (13/16)
	T2	80% (4/5)	62% (8/13)	60% (3/5)	33% (2/6)
	T3	29% (2/7)	65% (11/17)	20% (2/10)	17% (4/24)
	T4	50% (1/2)	73% (8/11)	80% (4/5)	92% (11/12)
8	T1	70% (7/10)	71% (17/24)	50% (4/8)	44% (7/16)
	T2	40% (2/5)	31% (4/13)	80% (4/5)	50% (3/6)
	T3	14% (1/7)	29% (5/17)	60% (6/10)	33% (8/24)
	T4	0% (0/2)	46% (5/11)	40% (2/5)	75% (9/12)
9	T1	70% (7/10)	92% (22/24)	88% (7/8)	75% (12/16)
	T2	40% (2/5)	15% (2/13)	80% (4/5)	50% (3/6)
	T3	29% (2/7)	88% (15/17)	40% (5/10)	21% (5/24)
	T4	50% (1/2)	100% (11/11)	80% (4/5)	50% (6/12)
10	T1	60% (6/10)	58% (14/24)	88% (7/8)	75% (12/16)
	T2	100% (5/5)	46% (6/13)	60% (3/5)	33% (2/6)
	T3	43% (3/7)	35% (6/17)	100% (10/10)	75% (18/24)
	T4	100% (2/2)	73% (8/11)	80% (4/5)	92% (11/12)
11	T1	70% (7/10)	75% (18/24)	63% (5/8)	88% (14/16)
	T2	100% (5/5)	92% (12/13)	100% (5/5)	83% (5/6)
	T3	100% (7/7)	94% (16/17)	90% (9/10/)	83% (20/24)
	T4	100% (2/2)	91% (10/11)	80% (4/5)	83% (10/12)
12	T1	60% (6/10)	79% (19/24)	88% (7/8)	94% (15/16)
	T2	80% (4/5)	100% (13/13)	80% (4/5)	83% (5/6)
	T3	100% (7/7)	94% (16/17)	80% (8/10)	96% (23/24)
	T4	50% (1/2)	91% (10/11)	100% (5/5)	83% (10/12)
13	T1	100% (10/10)	96% (23/24)	75% (6/8)	94% (15/16)
	T2	100% (5/5)	100% (13/13)	100% (5/5)	100% (6/6)
	T3	100% (7/7)	100% (17/17)	90% (9/10)	100% (24/24)
	T4	100% (2/2)	100% (11/11)	100% (5/5)	100% (12/12)

Table 3. Percentage agreement for each check item of checklist A and B split by task.

	Mean percentage agreement of participant responses and model response for tasks 1 to 4							
	Checklist A				Checklist B			
Check item	Task 1	Task 2	Task 3	Task 4	Task 1	Task 2	Task 3	Task 4
1	91%	100%	100%	92%	75%	100%	88%	82%
2	37%	89%	83%	54%	8%	100%	79%	12%
3	77%	72%	71%	85%	67%	91%	62%	59%
4	69%	67%	58%	46%	88%	73%	62%	47%
5	43%	78%	25%	77%	50%	82%	15%	41%
6	91%	94%	54%	39%	79%	64%	56%	59%
7	74%	67%	54%	69%	88%	46%	18%	88%
8	71%	33%	25%	39%	46%	64%	41%	65%
9	86%	78%	71%	92%	79%	36%	27%	59%
10	60%	61%	38%	77%	79%	46%	82%	88%
11	71%	94%	96%	92%	79%	91%	85%	82%
12	71%	94%	96%	85%	92%	82%	91%	88%
13	97%	100%	100%	100%	88%	100%	97%	100%

Percentage agreements of participants and expert responses for each check item for checklist A and B for each task (1 – 4) split by company

		Percentage agreement of participant responses and model response for tasks 1 to 4							
		Checklist A				Checklist B			
Check item	Task	**Company 1**	**Company 2**	**Company 3**	**Company 4**	**Company 1**	**Company 2**	**Company 3**	**Company 4**
1	1	88% (14/16)	95% (18/19)					73% (11/15)	78% (7/9)
	2	100% (9/9)	100% (9/9)					100% (8/8)	100% (3/3)
	3			100% (15/15)	100% (9/9)	75% (12/16)	100% (18/18)		
	4			100% (7/7)	83% (5/6)	57% (4/7)	100% (10/10)		
2	1	38% (6/16)	37% (7/19)					7% (1/15)	11% (1/9)
	2	78% (7/9)	100% (9/9)					100% (8/8)	100% (3/3)
	3			87% (13/15)	78% (7/9)	63% (10/16)	94% (17/18)		
	4			71% (5/7)	33% (2/6)	29% (2/7)	0% (0/10)		
3	1	56% (9/16)	96% (18/19)					60% (9/15)	78% (7/9)
	2	56% (5/9)	89% (8/9)					88% (7/8)	100% (3/3)
	3			67% (10/15)	78% (7/9)	56% (9/16)	67% (12/18)		
	4			86% (6/7)	83% (5/6)	71% (5/7)	50% (5/10)		
4	1	50% (8/16)	84% (16/19)					93% (14/15)	78% (7/9)
	2	89% (8/9)	44% (4/9)					75% (6/8)	68% (2/3)
	3			33.3% (5/15)	100% (9/9)	44% (7/16)	78% (14/18)		
	4			29% (2/7)	67% (4/6)	0% (0/7)	80% (8/10)		
5	1	44% (7/16)	42% (8/19)					53% (8/15)	44% (4/9)
	2	89% (8/9)	67% (6/9)					75% (6/8)	100% (3/3)
	3			33.3% (5/15)	11% (1/9)	25% (4/16)	6% (1/18)		
	4			86% (6/7)	67% (4/6)	57% (4/7)	30% (3/10)		

6	1	88% (14/16)	95% (18/19)					80% (12/15)	78% (7/9)
	2	100% (9/9)	89% (8/9)					63% (5/8)	68% (2/3)
	3			53% (8/15)	56% (5/9)	44% (7/16)	67% (12/18)		
	4			43% (3/7)	33% (2/6)	86% (6/7)	40% (4/10)		
7	1	56% (9/16)	90% (17/19)					87% (13/15)	89% (8/9)
	2	89% (8/9)	44% (4/9)					50% (4/8)	33% (1/3)
	3			67% (10/15)	33% (3/9)	31% (5/16)	6% (1/18)		
	4			71% (5/7)	67% (4/6)	71% (5/7)	100% (10/10)		
8	1	75% (12/16)	68% (13/19)					47% (7/15)	44% (4/9)
	2	11% (1/9)	56% (5/9)					63% (5/8)	68% (2/3)
	3			27% (4/15)	22% (2/9)	56% (9/16)	28% (5/18)		
	4			43% (3/7)	33% (2/6)	71% (5/7)	60% (6/10)		
9	1	69% (11/16)	100% (19/19)					93% (14/15)	56% (5/9)
	2	78% (7/9)	78% (7/9)					50% (4/8)	0% (0/3)
	3			80% (12/15)	56% (5/9)	19% (3/16)	33% (6/18)		
	4			100% (7/7)	83% (5/6)	29% (2/7)	80% (8/10)		
10	1	38% (6/16)	79% (19/19)					80% (12/15)	79% (7/9)
	2	79% (7/9)	44% (4/9)					50% (8/8)	33% (1/3)
	3			20% (3/15)	67% (6/9)	75% (12/16)	89% (16/18)		
	4			57% (4/7)	100% (6/6)	71% (5/7)	100% (10/10)		
11	1	38% (6/16)	100% (19/19)					73% (11/15)	89% (8/9)
	2	100% (9/9)	89% (8/9)					88% (7/8)	100% (3/3)
	3			93% (14/15)	100% (9/9)	75% (12/16)	94% (17/18)		
	4			100% (7/7)	83% (5/6)	57% (4/7)	100% (10/10)		

12	1	44% (7/16)	95% (18/19)					87% (13/15)	100% (9/9)
	2	89% (8/9)	100% (9/9)					88% (7/8)	68% (2/3)
	3			93% (14/15)	100% (9/9)	81% (13/16)	100% (18/18)		
	4			86% (6/7)	83% (5/6)	100% (7/7)	80% (8/10)		
13	1	94% (15/16)	100% (19/19)					100% (15/15)	67% (6/9)
	2	100% (9/9)	100% (9/9)					100% (8/8)	100% (3/3)
	3			100% (15/15)	100% (9/9)	94% (15/16)	100% (18/18)		
	4			100% (7/7)	100% (6/6)	100% (7/7)	100% (10/10)		

Appendix Q: Trial 1 – Total number of risk factors

Trial 1 - Total number of risk factors

Prior to level 1 to justify taking mean values across tasks.

Kruskal Wallis- to check if TASK had a significant effect on Discrepancy values. All tasks combined.

All tasks before training – Absolute Discrepancy Values

Task	Number	Mean rank
1	35	45.66
2	18	50.17
3	24	36.69
4	13	54.88
Total	90	

Test statistics (a,b)

	All tasks before training – Absolute Discrepancy Values
Chi-Square	5.272
Df	3
Asymp. Sig.	0.153

a – Kruskal Wallis test, b – Grouping variable: task

Appendix R: Level 2 Analysis - Each task separately

Level 2 Analysis - Each task separately

Between subjects (Mann Whitney)

	Participant total number of risk factors present – Model total number of risk factors present								
	Checklist A				Checklist B				Tasks where there is a significant difference between A and B
Tasks	**Mean**	**Std. dev**	**Min**	**Max**	**Mean**	**Std. dev**	**Min**	**Max**	
1	1.89	1.89	0	7	1.61	1.27	0	4	0.948
2	1.83	1.25	0	4	2.45	1.86	1	7	0.550
3	1.17	1.17	0	4	1.56	1.62	0	8	0.382
4	2.3	1.6	0	5	2.65	1.27	1	5	0.563

Checklist A

	Participant total number of risk factors present – Model total number of risk factors present								
	Job position								Tasks where there is a significant difference in checklist B results from the two job positions
	Team Leader, Line Leader or Line Manager N= 10				Line Worker or Operative N=24				
Tasks	**Mean**	**Std. dev**	**Min**	**Max**	**Mean**	**Std. dev**	**Min**	**Max**	
1	2.2	2.3	0	6	1.75	1.78	0	7	0.809
2	1.2	0.83	0	2	2.07	1.32	0	4	0.208
3	1.25	1.49	0	4	1.13	1.02	0	3	0.976
4	3	1.7	1	4	2.1	1.6	0	5	0.469

Checklist B

	Participant total number of risk factors present – Model total number of risk factors present								
	Job position								Tasks where there is a significant difference in checklist B results from the two job positions
	Team Leader, Line Leader or Line Manager N= 8				Line Worker or Operative N=15				
Tasks	**Mean**	**Std. dev**	**Min**	**Max**	**Mean**	**Std. dev**	**Min**	**Max**	
1	1.75	1.17	0	3	1.53	1.36	0	4	0.591
2	2	1.41	1	4	2.83	2.23	1	7	0.662
3	2.3	2.11	1	8	1.25	1.29	0	6	0.055
4	2.6	1.14	1	4	2.67	1.37	1	5	0.959

Appendix S: Level 2 Analysis Trial 1 – Overall risk ratings

Level 2 Analysis: Trial 1 - Overall risk ratings.

Comparison of Checklist A and Checklist B assessment results for overall risk rating. The following results are from data collected from 89 completed assessments using Checklist A and 86 completed assessment using checklist B.

		Percentage of respondents that agree with model response	
		Assessment A	Assessment B
Task 1	Not stated	2.9	20.8
	Low	5.7	33.3
	Medium	88.6	41.7
	High	2.9	4.2
Task 2	Not stated	0	18.2
	Low	0	0
	Medium	50.0	45.5
	High	50.0	36.4
Task 3	Not stated	0	20.6
	Low	0	5.9
	Medium	75.0	44.1
	High	25.0	29.4
Task 4	Not stated	0	0
	Low	46.2	17.6
	Medium	53.8	64.7
	High	0	17.6

Highlighted figures in yellow are the percentages of participants that agreed with the 'Model' response.