The effectiveness of training in promoting a positive OSH culture

Report submitted to the IOSH Research Committee

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Abstract

Although training has long been established as an important safety management practice, there is limited evidence of the long term effectiveness of safety training interventions. The current research collected baseline data on a range of safety measures from a sample of 10 companies (seven small or medium-sized enterprises (SMEs) and three large organisations) based in the north west of England from manufacturing, construction, chemical and service industries. Training interventions were designed and implemented within all the participating companies. The impact of these interventions on employees' motivation, safety knowledge, safety behaviour, safety perceptions and objective reports of minor injuries were measured at two time points: 12 months and 24 months after the implementation of the interventions. Measurements were also taken of managers' safety perceptions and their leadership style. The study showed that accidents were significantly reduced (by 22 per cent on average) and that safety climate became significantly more positive over time. Safety communication, training, safety systems, work environment and work pressure demonstrated a significant improvement after 12 months, which was maintained at 24 months. The greatest impact of the interventions was on the work environment. The main psychological mechanisms were the enhancement of employee motivation and the increase in employees' safety participation. Both managers and employees in SMEs and large organisations across industrial sectors reported that the interventions had a significant impact on company safety culture and productivity. Best practice recommendations, based on the findings of the study, were that training interventions should be tailored specifically to the company's training needs (as assessed through health and safety appraisal processes); interventions should be embedded into the company's processes and procedures; and safety training should form part of the company's overall strategy and be consistent with business objectives. It was concluded that safety interventions can have a significant long term impact on a company's safety culture, when implemented in line with best practice recommendations.

Executive summary

The research examined the long term impact of safety training interventions on safety outcomes in a sample of 10 organisations (seven small or medium-sized enterprises (SMEs) and three large) across the chemical, manufacturing, construction and service sectors. All organisations were based in the north west of England. Training interventions were evaluated for their effectiveness, using both qualitative and quantitative measures. Safety outcomes included minor injuries, safety behaviour (compliance and participation) and safety perceptions of both employees and managers (safety climate). Measures were taken at 12 months and 24 months after the implementation of the interventions.

Main findings

1 The implementation of training interventions had a significant effect on accident rates, leading to a decline (average 22 per cent) in recorded minor injuries over 24 months.
2 Following the implementation of the training interventions, employees' safety motivation increased significantly, although there was no significant change in safety knowledge or involvement over 24 months.
3 Employees' safety climate improved significantly following the implementation of the training interventions. Safety climate (employees' perceptions of company safety) was significantly more positive 12 months following the interventions; this improvement was maintained after a further 12 months.
4 Employee perceptions of the effectiveness of safety communication, training, safety systems, work environment and work pressure all improved significantly over time. The greatest improvements were demonstrated after 12 months, with improvements being maintained (but not further increased) over the next 12 months. The greatest improvement was demonstrated in employees' perceptions of the work environment. However, little change was evident in employees' attitudes towards managers or their perceptions of managers providing a supportive environment.
5 Employee perceptions of a supportive environment from co-workers declined significantly over 24 months following the implementation of the interventions. This may be due to the interventions reducing the need for employees to rely on their co-workers for support as the organisation became more effective at providing such support.
6 Training interventions had a significant impact on employees' safety behaviour over 24 months. The impact of the interventions was to improve both compliance and participation, although the change in safety participation was the most significant effect, with compliance showing a slight increase from an already high level. Behaviour was seen to change over a longer period than perceptions and attitudes, with behavioural change occurring in the second 12 months and perceptual change occurring in the first 12 months.
7 Both managers and employees reported that they perceived the project to be successful and that it had a considerable impact on both company safety culture and productivity. This impact improved significantly over time (with an improved impact at 24 months compared to 12 months). Employees were significantly more positive about the improvements in safety culture and productivity than managers after 12 months, although these differences had disappeared after 24 months. Large organisations also reported greater impact on the safety culture at 12 months compared to SMEs, but again this difference had disappeared at 24 months. The impact was similarly positive across industrial sectors.
8 Training interventions had a positive impact on the safety perceptions of managers, with a significant improvement in the safety climate as rated by managers in SMEs over time (but no significant change for managers in large organisations). Managers' leadership styles became significantly more transformational over time (ie focused on changing employees' safety values to align with those of the organisation). In particular, managers reported that their leadership style involved greater intellectual stimulation (ie challenging employees' assumptions about safety and encouraging more safety suggestions).

Conclusions

Overall, this project has demonstrated that safety training interventions have a significant long term impact in terms of reducing accidents and improving and maintaining a positive safety climate, across different sizes of organisation and industrial sectors.

Best practice recommendations, based on the findings of the study, were that training interventions should be tailored specifically to the company's training needs (as assessed through health and safety appraisal processes); interventions should be embedded into the company's processes and procedures; and safety training should form part of the company's overall strategy and be consistent with business objectives.

1 Introduction

1.1 Background

Training is one of the most commonly implemented interventions for companies seeking to improve safety.[1] Indeed, some of the earliest work examining safety interventions identified effective training as a key factor in their success.[2] Nevertheless, relatively little evaluation work has been conducted to assess the effectiveness of safety training, particularly in relation to longer term outcomes, such as safety culture.

1.1.1 The impact of safety training on safety-related outcomes

Training has been defined as 'the systematic acquisition and development of the knowledge, skills, and attitudes required by employees to adequately perform a task or job or to improve performance in the job environment'.[3] This definition suggests that training comprises activities that have the specific goal of developing new knowledge, skills and attitudes (KSAs), which can be applied in the workplace; although learning also focuses on the development of KSAs, training has the specific goal of improved performance at work-related tasks.[4] Training is not only an opportunity to learn new KSAs, but also prepares employees to meet challenges and engage with changes that take place as part of their jobs.[5] Safety training refers to formal off-the-job training, such as instruction to individuals or groups, but may also include on-the-job coaching. In relation to safety, direct effects of training include the improvement of safety knowledge and skills, improved problem-solving and analytical skills, and enhanced hazard awareness. Indeed, research studies have demonstrated that trained employees follow safety rules and regulations more closely[6,7] than those who have not been trained. Change in employee behaviour, in terms of compliance with safety rules and procedures, has often been viewed as an indicator of training effectiveness.[8,9] Safety training has also been used as a means of risk control in the workplace,[10] as trained employees are less likely to take safety risks.[11] Although training may function to reduce risk-taking behaviour among employees, it should not be used by organisations as a substitute for formal risk assessment, management and control measures.

Training effectiveness, including the influence of training on safety performance, depends on a number of factors, including 'transfer of training', which is defined as the extent to which KSAs developed through training are successfully applied, generalised and maintained over time in the job context. Transfer of training will be influenced by various factors, including the design and delivery of training, trainees' characteristics and motivation, and the work environment.[12] When training has been effectively designed and delivered, KSAs learned will be transferred to the workplace, resulting in improved job performance.[13] Training effectiveness may be judged by the extent to which learning outcomes can be demonstrated. Based on the work of Bloom[14] and Gagne,[15] Kraiger *et al.*[16] proposed three categories of learning outcome: cognitive, skill-based, and affective. Therefore, the degree of learning can be assessed though the evaluation of cognitive outcomes (eg recall of new information and ability to apply knowledge correctly), skill-based outcomes (eg speed of performance and reduced error rates) and affective outcomes (eg motivation, attitude strength and attitude direction).

Empirical studies have found that safety training has a significant effect on a range of safety-related outcomes, including perceived safety knowledge and both self and supervisor ratings of safety performance,[17,18] including the use of personal protective equipment, engaging in work practices to reduce risk, and communicating health and safety information. Vinodkumar & Bhasi[7] identified safety training as the most important safety management practice in eight major accident hazard process industrial units in India. Safety training was found to predict safety knowledge, safety motivation, safety compliance and safety participation. Furthermore, improvements in safety motivation have been found to result in long term effects on employees' safety behaviour and accident involvement.[19] Training not only enhances employees' motivation to engage in safe behaviour, but also increases the belief in their ability to recognise and deal effectively with hazards. Leiter *et al.*[20] found that workers who received adequate training on safety procedures felt more empowered to address the hazards that they encountered. Finally, satisfaction with training tends to increase employees' safety commitment[21] and also, more generally, their organisational commitment.[22] Organisational commitment has been linked to employees' safety behaviour and their subsequent accident involvement.[23]

1.1.2 The influence of safety training on safety attitudes and perceptions

The importance of training in relation to health and safety in organisations is well documented. Substantial evidence supports an association between safety training and safety outcomes, including occupational injuries and accidents. When safety training is effectively implemented (ie adequate

training is provided regularly), this has been associated with lower injury rates in organisations.[21,24,25] In contrast, Reason's[26] model of accident causation includes 'inadequate training' as one of the 'general failure types' at an organisational level that can lead to major accidents.

There are a number of psychological mechanisms linking the effect of safety training to safety behaviour and accident involvement at the individual level. Applying a behavioural perspective, it would be expected that the organisational outcomes of training (such as improved safety culture) would result as a function of the effects of training on individual employees' attitudes, perceptions and behaviour. Therefore, safety training has indirect effects on organisational outcomes (such as accident and injury rates) through its influence on the perceptions and attitudes of employees. There is support in the training literature that psychological variables (at an individual level) mediate the effect of training on organisational outcomes.[27] This model is consistent with Holton's[28] training evaluation model, which includes outcomes at three levels: learning, individual performance and organisational performance.

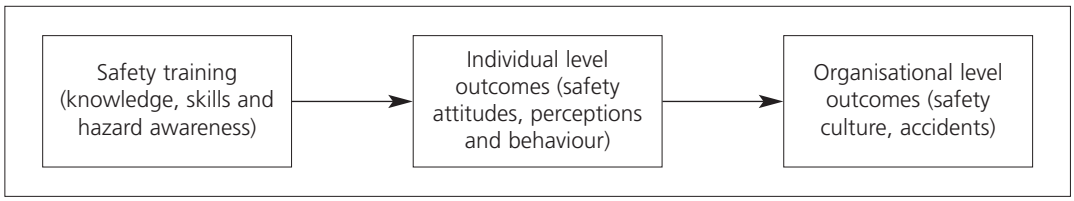


Figure 1
Behavioural model of the impact of safety training on safety culture

1.1.3 Evaluation of the effectiveness of safety training interventions

The Kirkpatrick evaluation model[29,30] is the most widely accepted approach to the measurement of training effectiveness and is used extensively in adult education and learning assessment. The model comprises four levels to determine the effectiveness of a training programme:[30]

- **Level 1 – Reaction.** Evaluation on this level measures how those who participate in the training react to it and the extent to which trainees were satisfied with the training programme.
- **Level 2 – Knowledge/learning.** Learning can be defined as the extent to which trainees change their attitudes, improve their knowledge, and/or increase their skills as a result of participating in the programme.
- **Level 3 – Behaviour.** The extent to which behavioural change has occurred as a result of the training programme (or 'transfer of training').
- **Level 4 – Results.** The final results that occurred due to the training programme, including increased production, improved quality, decreased costs, reduced frequency and/or severity of accidents, increased sales, reduced staff turnover, and higher profits.

A review of training evaluations[31] demonstrated that most measure reaction (level 1) only, with fewer studies conducting an evaluation of the influence of training on learning (32 per cent), behaviour (9 per cent) or results (7 per cent). While the initial reaction to training may be captured by short term evaluation programmes, conducted immediately or shortly after the completion of training, evaluation of levels 2–4 must be conducted over a longer period. Although training is one of the most commonly implemented interventions for companies seeking to improve safety, there is frequently little effort to systematically assess its long term effectiveness, particularly in relation to Kirkpatrick's level 4 evaluation of results. A review of 80 training intervention evaluations found that more than half measured post-training effects less than three months after the training.[1] Such an evaluation may assess employees' reaction to the training and its impact on learning and behavioural outcomes, but can only demonstrate short term effects. In addition, training evaluation studies have tended to focus on a fairly narrow range of outcomes, with little consideration for the broader impact of training interventions on organisational safety culture. For example, post-training evaluations typically measure trainees' safety knowledge and skill, safety behaviour changes, safety attitude changes and safe work practices. Therefore, there is an absence of longitudinal data tracking the effectiveness of training over time, using a range of outcome measures.

Workplace safety climate reflects the underlying safety culture. Thus, tracking changes in the safety climate can help to identify the broader impact of training interventions and their long term effects. There is evidence from the training literature to suggest that training has a significant impact on the work climate, which leads to improved organisational outcomes.[32]

1.2 The present study

The present research evaluated the ongoing effectiveness of training through the development and implementation of an evaluation interview. This was used to identify the enablers and barriers to the successful transfer of safety training in the workplace. The study then developed existing research on transfer of training, with the collection of longitudinal data, and so enhanced existing knowledge about the conditions under which the positive effects of training are maximised. Furthermore, one of the main deliverables was the production of guidelines for best practice in this respect.

The research employed a range of outcome measures:

- safety climate, safety motivation and safety knowledge
- self-reported participation and compliance
- objective reports of minor injuries and accidents.

Such a range of measures allowed the exploration of a number of questions regarding the possible effects of safety training; for example, does training improve performance/change behaviour, enhance motivation, or improve knowledge without affecting attitudes or perceptions of safety? Are the behavioural effects limited to compliance, or are broader aspects of safety performance affected, such as participation? Thus, it was possible to develop a fuller understanding of the effects of training and to identify how it contributes to the development and maintenance of safety culture.

This research has a number of advantages over previous studies. Firstly, it examines the relationship between safety climate and safety outcomes in a range of organisations of different sizes and industries, allowing generalisation of the results. Secondly, the current study tracked the effects of specific interventions, rather than monitoring the safety climate, meaning that the findings yielded more practical guidance in terms of improving safety performance and reducing accidents. Thirdly, there is triangulation of both methods (combining qualitative and quantitative analysis) and data collection (subjective and objective measures), thus increasing the reliability of the findings. Therefore, the current research has added significantly to existing knowledge, in terms of both theory and practice, by implementing a design not previously reported in the safety literature.

1.3 Objectives

The study had the following five main research objectives:

1 to identify factors that influence the effectiveness of safety training
2 to evaluate the impact of safety training on employees' safety attitudes and perceptions, and accident and injury rates
3 to examine the training–performance relationship
4 to investigate the long term effects of training in relation to the maintenance and promotion of a positive safety culture
5 to establish industry guidelines for best practice in the implementation of training interventions to improve safety.

2 Method

2.1 Study design

The study employed a mixed-method longitudinal design. A research design including both qualitative and quantitative measures was considered most suitable to address the overall project aims and objectives and to test the hypotheses empirically, using validated and reliable measures. The longitudinal design allowed for the measurement of safety climate, safety behaviour and minor injuries over a 24-month period. The study consisted of six elements:

- The first part of the study consisted of obtaining managerial perspectives on various pieces of health and safety information, including accident statistics and the provision and implementation of health and safety training in their organisations.
- In order to obtain baseline measures of safety climate (baseline data), quantitative surveys (one for employees and one for management) were developed and issued.
- Following on from the analysis of these results, health and safety training interventions were developed and implemented.
- Following an initial period of 12 months, the impact of the safety training interventions was evaluated using a validated questionnaire measure of safety climate (including scales on safety attitudes and perceptions) and company records of minor accidents and injuries (time 1 data).
- Following the results of the time 1 data, the health and safety interventions were amended and the survey re-administered in order to obtain time 2 data (12 months after time 1 data).
- Additional qualitative data from key stakeholders in the participating organisations were obtained by using an evaluation tool at specified time points.

Figure 2
Project timeline in months

Months	Process
0	Collect managers' perspective
1	Survey distributed
3	Baseline data collected
4	Feedback reports distributed
5	Implement interventions
10	Evaluation tool distributed
11	Survey distributed
13	Time 1 data collected
14	Feedback reports distributed
15	Implement interventions
20	Evaluation tool distributed
21	Survey distributed
23	Time 2 data collected
24	Feedback reports distributed

2.2 Sample

The study aimed to recruit 15 organisations classified as small to medium-sized enterprises (SMEs) and four large organisations. SMEs are classified as those organisations employing fewer than 250 employees, with large organisations employing over 250 employees. The final sample consisted of seven SMEs and three large organisations.* Table 1 presents a brief description of each organisation which participated in the project, including details of their industry sector.

* The final sample was smaller than anticipated because of recruitment problems; the downturn in the economy led to some SMEs withdrawing from the project.

Table 1
Description of the participating companies in terms of size and industry

Company	Size	Description
1	SME	Family-owned chemical company based in the North West with 30 employees
2	Large	Manufacturing company based in the North West with over 250 employees
3	SME	Service company based in the North West with 103 employees
4	SME	Construction company based in the North West with approximately 100 employees
5	SME	Chemical company based in the North West with 205 employees
6	SME	Construction company based in the North West with approximately 30 employees
7	Large	Manufacturing company based in the North West with approximately 400 employees
8	Large	Service company based in the North West with approximately 350 employees
9	SME	Construction company based in the North West with 245 employees
10	SME	Manufacturing company based in the North West with approximately 70 employees

2.3 Recruitment of organisations

The organisations selected were from the construction, transport, chemical, manufacturing and service sectors. According to the UK Health and Safety Executive (HSE),[33] the construction industry represented the largest number of fatal injuries across all the main industry sectors. While reported major injuries in the transport sector have remained stable over the past 10 years, this sector reported the highest rate of over-three-day injuries of any of the main industry sectors.[34] Statistics reveal that in the manufacturing industry over half of the reported injuries involved contact with moving machinery.*[35] The number and diversity of participating organisations allowed findings to be inferred across employment sectors, to provide sufficient power to produce valid conclusions, and to ensure that a wide range of organisations was represented in the final sample.

The initial stage of the recruitment process was to contact organisations who had previously participated in a health and safety project funded by the University of Manchester and the Department for Trade and Industry (DTI). The research team also used specific recruitment strategies in an attempt to establish new contacts and to gain access to a larger spectrum of relevant organisations. These included the following:

- networks: information packs on the project were distributed by email and post to:
  - IOSH contact groups
  - local business link contacts
- university business contacts: the research team contacted personal business contacts to establish whether their organisations would be interested in participating in the research project
- direct organisational contact: various media were used, including *Business Pages* and *Yellow Pages*, to identify organisations based in the North West region which fulfilled the sample criteria. These organisations were then approached by telephone, post and email to ask whether they were willing and able to participate in the research project. Where applicable, project information packs were distributed to those organisations expressing an interest.

* Under the UK Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 (RIDDOR), three categories of serious injuries are reportable by law, namely fatal injuries, 'major' injuries and 'over-three-day' injuries. Major injuries include most fractures, certain dislocations, permanent or temporary loss of sight, certain injuries to the eye, unconsciousness caused by electric shock, and any injury requiring resuscitation or admittance to hospital for more than 24 hours.[36] Over-three-day injuries are those which cause the injured person to be unfit for their normal work duties for more than three days after the day of the accident. Minor injuries are those treatable with first aid and are not reportable under RIDDOR.

The above recruitment processes resulted in a final total of 19 organisations agreeing to participate. Following the distribution of the safety climate measure in order to obtain the baseline data, the sample size was reduced to 10 following the withdrawal of nine organisations. The reasons for the organisations' withdrawal included the following:

- lack of resources due to the economic downturn, including availability of personnel and time required to complete the project
- loss of the key contact due to maternity leave
- 'project fatigue' for those organisations who had participated in the previous project funded by the University of Manchester and the DTI
- for larger organisations, difficulty in gaining union consent to participate in the project.

Following this, the research team continually tried to recruit new organisations, using the above strategies. This resulted in three more organisations being recruited.

The safety training interventions were evaluated at 12 and 24 months.

2.4 Questionnaire development

2.4.1 Development of pilot questionnaire

The questionnaire development initially occurred during the aforementioned university project. The sample for this project comprised 19 organisations across a variety of industry sectors including:

- manufacturing (6)
- construction (5)
- distribution (4)
- chemical (3)
- transport and services (1).

Within that project, a pilot questionnaire was developed firstly from an extensive literature review and secondly from the findings of qualitative semi-structured interviews, which were held with senior health and safety managers in SMEs.

Literature review

The systematic literature review focused on existing safety climate measures and incorporated a thematic analysis. The safety climate measures assessed were obtained from academic journals, using a variety of computerised databases including PsycInfo, ABI-Inform, Emerald, PsycARTICLES, Academic Research Library, Business Source Premier and Science Direct. This was further complemented by a manual search of review articles and the reference sections of all articles identified.

The following keyword search terms were entered into the computerised search engines: safety climate, safety culture *or* safety attitudes, *and* measures, scales *or* questionnaires. The database searches included all entries up to and including 2005. The cut-off of 2005 was used because the search was undertaken at the beginning of the previous university project to contribute to the development of the safety climate measure.

To enable a comprehensive and accurate analysis, a set of criteria was established. This included that the article must contain a measure of safety climate and quantitative data including the sample size, factors extracted and, if stated, the psychometric properties of the analysis. Using these criteria, a sample of 57 studies was obtained; however, studies were included which did not provide all psychometric data of scales used and analysis of data.

In total, 57 measures of safety climate were obtained and were assessed on the following criteria: industry, country, instrument, sample size, dimensions, reliability and validity. The final sample included safety climate questionnaires from 16 countries and 13 industries, with a sample size ranging from 84 to 10,000. Of the studies included, samples were drawn from a number of different industries:

- manufacturing and production (14)
- chemical or nuclear processing (12)
- offshore oil and gas production (10)

- construction (3)
- transport (6)
- public administration and defence (2)
- service (5).

Five further studies drew their sample from various industrial sectors.

A thematic analysis procedure was followed to establish themes within the safety climate scales. This consisted of six phases:

- Phase 1 involved familiarisation with the safety climate scales.
- Phase 2 involved generating initial codes which became apparent from the safety climate scales through extraction of factors from the safety climate measures.
- Phase 3 involved the identification of themes through analysis of the extracted factors (identified in phase two) into related themes.
- Phase 4 involved reviewing the themes.
- The themes were named in phase 5.
- Phase 6 involved identifying links between the themes.

From the 57 safety climate studies, 301 separate dimensions were extracted. Within each study, it is evident that the labelling of factors was not consistent. In an attempt to identify prominent themes, a thematic analysis was performed on the extracted dimensions, in which seven dominant factors emerged. These prominent factors were extracted and are detailed in Table 2, in descending order of occurrence.

Table 2
Factors extracted from a thematic analysis of safety climate scales

Factor	Questionnaires including the factor (%)
Management	81
Safety systems	40
Training	33
Behaviour	28
Communication	26
Work environment	23
Risk	21

Semi-structured interviews
The interview questions were formulated from an extensive literature review, the assessment of existing safety climate measures and advice from two experts in the field of health and safety. This procedure ensured content validity of the interview items. In total, the interview comprised 66 questions aimed at identifying accident and sickness statistics and perceptions of organisational and health and safety culture.

Each interview was taped using a Dictaphone. From the 19 interviews conducted, the material from one interview was unusable due to tape distortion. In total, usable data were gathered from 18 organisations. The interviewees were senior management employees, health and safety managers and managing directors. Initially a letter was sent to prospective interviewees asking for their participation in the research and an initial interview to discuss health and safety issues. Interviews were conducted over a period of eight months. Interviewees' consent was obtained to allow the interview to be taped. The interview followed a semi-structured format, while also investigating any further relevant avenues that arose during the interview. On completion, the interview was transcribed to allow thematic analysis. This thematic analysis identified 38 initial themes. Following refinement of the initial themes, these were further categorised and 16 themes emerged (see Table 3).

The literature review and semi-structured interviews allowed for the questionnaire items to be developed. The table of specifications, developed from the review of safety climate measures, was used to ensure the content validity of each item developed – ie that each item was applicable to the

Table 3
Themes identified from the interviews with health and safety managers

1	Awareness
2	Communication
3	Economic change/pressures
4	Encouragement
5	Flexible management practices
6	Excessive health and safety
7	Human error
8	Job security
9	Management
10	Blame/claim culture
11	Procedures
12	Resistance
13	Resources
14	Safety *vs* production
15	Supportive environment
16	Workplace pressures

overall table of specifications. Given the different roles which employees and managers perform, two distinct measures were developed. More items were generated for the employee questionnaire than for the management questionnaire. The predominant reason for this decision originates from the data gathered from the semi-structured interviews, which represented a more tailored approach reflected in management responsibilities and awareness of safety systems rather than encompassing different aspects of safety behaviours and safety knowledge.

2.4.2 Pilot testing of questionnaire

One company was selected from the research project data sample. This company was selected because it needed to be classified as an SME, employing no more than 250 employees, and because the company largely represented the sample to which the final version would be administered.[37] The company was located in the north west of England and represented the manufacturing industry sector. The employee questionnaire was pilot tested with 250 employees. The management questionnaire was pilot tested with 15 management employees. A covering letter and instructions explained the general aims of the long term research project and assured participants of anonymity, confidentiality and the fact that participation was voluntary.

In total, useable responses were received from 75 of the 250 employees, a 30 per cent response rate. Responses were received from 10 of the 15 management employees, a 67 per cent response rate. The pilot test involved identifying the reliability and adequacy of the scales used. Initially, each item was analysed to establish its suitability for inclusion in the final measure. This was achieved by examining the mean, standard deviation, skewness and kurtosis. To examine the distribution of each item in an attempt to achieve a normal distribution, measures of skewness and kurtosis were obtained using the descriptive statistics and frequencies function of the Statistical Package for Social Sciences (SPSS). Following statistical analysis of the pilot questionnaire, the final questionnaire consisted of 39 items for the employee questionnaire and 21 items for the management questionnaire.

2.5 Questionnaire variables

2.5.1 Demographics

Participants were asked information on their age, gender, tenure in the organisation and employment status (ie, full time, part time and so on). Additional information regarding their experience of an accident or injury at work, including its severity and type and whether it caused any lost working time was also sought.

2.5.2 Employee measure

Safety climate
Although there is no common consensus amongst researchers on the underlying dimensions of safety climate, the measure used in the present research covers a broad range of factors, through a number of subscales (each with satisfactory validity and internal consistency). In total the employee questionnaire examined the following variables using 32 items:

- management
- communication
- safety systems
- training
- work environment
- work pressure
- equipment
- supportive environment: co-workers and management
- safety knowledge
- safety involvement.

The safety climate scale was scored so that more positive attitudes from respondents were reflected in higher scores. For each variable, participants were asked to rate each item using a seven-point Likert-type scale, where 1 = 'strongly disagree' and 7 = 'strongly agree'. Internal consistency measures for the overall scale and the subscales are provided in Table 4. For scales that are under development, the value of alpha (Cronbach) should be above 0.60. Examples of the items included for each variable are provided below:

- **Management** was assessed by three items which asked about the extent to which managers were perceived to place value on workplace health and safety. An example item was 'Safety is given a high priority by management'.
- **Communication** was assessed by three items that asked about how safety issues were communicated to employees. An example item was 'There is open communication between management and employees about safety issues'.
- **Safety systems** was assessed by three items that asked about the organisation's safety practices, policies and procedures. An example item was 'Workplace inspections are carried out regularly'.
- **Training** was assessed by three items that asked about the availability of health and safety training in the department. An example item was 'The health and safety training provided is not sufficient'.
- **Work environment** was assessed by three items which asked about employees' perceived safeness of their working environment. An example item was 'My workplace is sometimes a high risk area'.
- **Work pressure** was assessed by three items which asked about attitudes towards the pressures experienced by job demands. An example item was 'Sometimes I work in an unsafe manner because of deadlines'.
- **Equipment** was assessed by three items which asked about attitudes towards the provision and maintenance of equipment required for employees to do their job. An example item was 'Plant and equipment is regularly safety checked'.
- **Supportive environment** (co-workers and management) was assessed by five items which asked about the provision and receipt of support to and from co-workers and managers. An example item was 'I feel comfortable asking my colleagues for help with safety issues'.
- **Knowledge** was assessed by three items which asked about employee awareness and understanding of safety procedures. An example item was 'I know what equipment to use to ensure my work is carried out safely'.
- **Involvement** was assessed by three items which asked about personal involvement in safety issues. An example item was 'I often give ideas and suggestions on safety issues'.

Safety behaviour
The safety behaviour scale included seven items and was split into two subscales: safe behaviour compliance and safe behaviour participation, adapted from Griffin & Neal.[17] All items were assessed on a 1–7 Likert scale (1 = 'strongly disagree' to 7 = 'strongly agree'). The safety behaviour scale was scored so that more positive attitudes from respondents were reflected in higher scores.

- **Safety compliance** was assessed by four items which asked about employees' conformity to organisational safety rules and regulations. An example item was 'I follow all safety rules and procedures when carrying out my job'.

Table 4
Internal consistency measures for the employee safety climate scale and its subscales

Scale	Cronbach's α
Safety climate	0.94
Safety climate subscales	
Management	0.80
Communication	0.77
Safety systems	0.63
Training	0.67
Work environment	0.57
Work pressure	0.72
Equipment	0.56
Supportive environment	0.67
Knowledge	0.53
Involvement	0.70
Safety behaviour and motivation scales	
Compliance	0.70
Participation	0.50
Motivation for safety	0.50

- **Safety participation** was assessed by three items which asked about employees' participation in safety behaviours. An example item was 'I voluntarily carry out tasks to help to improve workplace safety'.

Motivation for safety

Employee motivation to work in a safe manner was adapted from Griffin & Neal.[17] All items were assessed on a 1–7 Likert scale (1 = 'strongly disagree' to 7 = 'strongly agree'). The scale was scored so that more positive attitudes from respondents were reflected in higher scores.

- **Motivation** to perform safety-related activities was assessed by three items. An example item was 'I feel it is important to maintain safety at all times'.

2.5.3 Management measure

The management safety climate questionnaire contained 21 items relating to three elements to help to generate a holistic perspective of safety climate rather than focusing on one specific aspect. These elements were management, safety systems and safety behaviours. All items were assessed on a 1–7 Likert scale (1 = 'strongly disagree' to 7 = 'strongly agree'). The safety climate scale was scored so that more positive attitudes from respondents were reflected in higher scores. Measures of the internal consistency of the scales are given in Table 5.

- **Management** was assessed by three items which asked about the extent to which managers were perceived to place value on workplace health and safety. An example item was 'Accident reports are reviewed regularly by management'.
- **Safety systems** was assessed by 16 items that asked about the organisation's safety practices, policies and procedures. An example item was 'Records of accidents are kept'.
- **Safety behaviours** was assessed by two items that asked about individual safety activities. An example item was 'I ensure that regular workplace inspections are carried out'.

In addition, the management questionnaire included items which measured transformational leadership. Transformational leadership was assessed using 19 items which have been adapted from the Bass & Avolio Multifactor Leadership Questionnaire[38] and asked managers how they supervised and interacted with their staff in the context of workplace safety. The scale was adapted to measure

Scale	Cronbach's α
Safety climate	0.90
Safety climate subscales	
Management	0.54
Safety systems	0.88
Safety behaviours	0.56

Table 5
Internal consistency measures for the management safety climate scale and its subscales

safety-specific transformational leadership rather than general transformational leadership. The transformational leadership measure consisted of four subscales:

- idealised influence
- inspirational motivation
- intellectually stimulating
- individualised consideration.

All items were assessed on a 1–7 Likert scale (1 = 'strongly disagree' to 7 = 'strongly agree'). The transformational leadership scale was scored so that more positive attitudes from respondents were reflected in higher scores. Internal consistency values (Cronbach alpha) are shown in Table 6.

Transformational leadership	Cronbach's α
Idealised influence	0.73
Inspirational motivation	0.80
Intellectual stimulation	0.71
Individualised consideration	0.65

Table 6
Internal consistency measures for the management leadership scales

2.6 Procedure

The study proceeded in a number of stages (as shown in Figure 2). Before the intervention stage, baseline measures were collected. The questionnaire was used to collect data on safety climate and self-reported safety behaviours. Following the collection of baseline data, training interventions were designed and implemented in the companies. Although a package of training interventions was designed, companies were consulted regarding the most suitable interventions for their company. Once the interventions had been implemented, no further training or intervention was administered in the same companies. The questionnaire was redistributed to all participating companies 12 months after the implementation of the training interventions (time 1 data) and again after 24 months (time 2 data), in order to track the effectiveness of the interventions. Feedback reports were presented to each participating company on its individual questionnaire results after each distribution of the questionnaire. Data on minor injuries and accidents were recorded by companies and provided by health and safety managers.

The effectiveness of the training interventions was evaluated using both qualitative and quantitative measures. An evaluation tool, which comprised both open-ended questions and scaled responses, was designed to gauge managers and employees' perceptions of the interventions (see section 2.7 for more details). The questionnaire, which was designed to measure safety climate and self-reported safety behaviours, was used to measure the influence of the training interventions on these outcome variables. Objective accident data was also collected as an outcome measure.

2.6.1 Questionnaire distribution

Two different procedures were used to distribute the questionnaires, namely online and paper administration. The distribution method chosen for each organisation depended on organisational preference and its IT infrastructure.

Online administration

For those organisations that chose the online administration, the key contact in the organisation was emailed an electronic link and survey instructions, including a covering paragraph and instructions

explaining the general aims of the questionnaire and project, assuring participants of anonymity, confidentiality and voluntary participation, which they could then embed in a circulated electronic distribution list.

Paper administration
For those organisations that opted for paper administration, the questionnaires were distributed to key contacts in each organisation. A covering letter and instructions explained the general aims of the questionnaire and project, assured participants of anonymity, confidentiality and voluntary participation. An envelope was provided with each questionnaire to enable participants to complete the questionnaire and return it in confidence to a central location provided by the organisation. All envelopes were then collected for analysis.

2.7 Evaluation tool design

A semi-structured interview schedule was designed, based on previous research and experience, to enable elements of the intervention process and project to be evaluated qualitatively and quantitatively (objective 1). Following on from the implementation of the interventions, this was administered to key managerial contacts and a random employee sample in the organisations. The evaluation tool consisted of six open-ended questions (qualitative data) and five questions which measured on a 1–7 Likert scale the effectiveness of the safety training interventions (quantitative data).

2.8 Safety training intervention design

The safety training interventions were developed from various sources of information:

- the baseline safety climate data
- feedback from the key contacts (usually the health and safety manager)
- a review of existing literature.

A package of interventions was designed to develop both specific safety knowledge and skills, and general safety awareness. Each company was offered the whole package of interventions, but was able to tailor this to its own requirements. For example, the content of training workbooks was modified to focus on specific issues, such as manual handling. The nature of the intervention package was dependent on the existing safety systems in each company. The intervention process included a review of existing processes and procedures in order to identify those areas where development was needed. The safety interventions drew not only on the formal training literature, but also on broader principles of learning and behavioural change. The aim of the interventions was to achieve long term change in safety outcomes, including safety culture. Therefore, it was important that the interventions be integrated into the organisational culture and consistent with organisational strategy. Isolated safety interventions are less likely to be successful in this respect.[1] Therefore, each intervention was designed to become embedded in the organisation, after an initial period of instruction or training on site. Training was delivered through instruction and discussion in groups or through individual training workbooks.

2.8.1 Overview of the safety training categories

Employee knowledge: a health and safety appraisal
Conducting the appraisal every year helps to increase employee awareness of health and safety. At the same time, health and safety is integrated into the broader organisational values. Using the 'Health and Safety Appraisal System' enables employees to identify areas for specific training and improvements and allows them to set safety goals and targets for the forthcoming period. Appendix 1 presents the appraisal template.

Training workbooks
The objectives of the workbooks are to raise the general awareness of health and safety within the organisations and to provide training to improve employee knowledge in specific areas which will promote safe behaviours. Following the workbooks is a review sheet which employees are requested to complete and return to managers. Given the changing nature of the each workplace, training workbooks focused on:

- the work environment: good housekeeping
- workplace transport
- manual handling
- conducting workplace inspections.

Safety systems: review of processes and procedures
To be effective, safety systems need to be incorporated into the overall function of the organisation and cannot exist independently. System safety training was provided on site and included the following:

- Near miss/accident reporting training. A tool was developed to gather information relating to incidents and near misses and which could be used as a learning tool by all employees. It should not only record negative incidents, but should also take account of the 'positive deviations', such as actions taken to recover the situation.
- Job hazard training. Training employees to analyse hazardous aspects of their jobs enables them to be involved in health and safety matters, detect hazards, contribute to individual learning and training plans and helps managers' understanding of their day-to-day duties. Each part of the job or task needs to be broken down into individual tasks or steps, which can be analysed using a worksheet such as the one shown in Figure 3. This enables a full and accurate picture of each employee's job to be developed and can also be useful for new starters as part of the induction process. See Appendix 2 for an example job hazard checklist.

Job description:			
Task description	Existing hazards	Potential hazards	Recommended action
Performed by:			
Date:			

Figure 3
Example individual task worksheet for job hazard analysis

Communication training
The package included training to increase the overall awareness and importance of health and safety in the workplace, including training focus groups in:

- developing and producing safety bulletins
- developing and using safety committees

Safety-specific leadership training
Leadership workshops were developed to provide managers with the appropriate skills and knowledge to enable them to promote safe working practices throughout the organisation. This training programme was delivered through classroom-based lectures. While such techniques have proved useful, in order to maximize the learning situation they were supplemented by discussion groups in order to stimulate the audience, provide information and inspire ideas. Instruction was based on helping managers to develop 'transformational' leadership behaviours, such as taking an interest in employees' safety (individualised consideration), soliciting employees' safety suggestions (intellectual stimulation), demonstrating enthusiasm for safety (inspirational motivation) and leading by example (idealised influence).

2.9 Statistical analysis

The data were analysed using SPSS. For data gathered from the online survey, this was downloaded from the central survey collection data file and exported from the Excel file into SPSS. For data gathered from the paper survey administration, the data was coded and entered directly into SPSS. Descriptive statistics were obtained from the demographic information. This also established the distribution of scores and enabled identification of a normal distribution. A preliminary analysis of the data was performed to ensure the reliability of the scales used.

After the data had been entered into SPSS, it was necessary to make a preliminary inspection of the data to ensure that all data had been entered and coded correctly. To facilitate this, various SPSS functions were used. The 'Explore' function enabled an overview of the data, identifying any missing data. Any questionnaire with more than 5 per cent of missing data was excluded. In SPSS, missing data was coded as '99' and was excluded from computations. The data were inspected to identify any pattern with regards to the missing data as suggested by Tabachnick & Fidell,[39] but none was identified. The 'Frequencies' function provided a clear depiction of all valid cases within each variable. This enabled identification of any data which had been entered or coded incorrectly. Correlations were used in order to establish relationships between variables. The sample sizes in each study were considered appropriate for correlation and regression techniques.[39]

The data were first analysed in order to obtain mean scores for each variable, which provided the baseline data. To identify any differences between mean scores in respect of organisational size and industry sector, *t*-tests and ANOVAs were performed.

The data were then analysed in the context of the main research objectives:

1 to identify the factors that influence the effectiveness of safety training, by measuring perceptions of participants
2 to evaluate the impact of safety training on employees' safety attitudes and perceptions and accident and injury rates
3 to examine the role of potential moderators in the training–performance relationship (including organisational size and industry sector).

To facilitate the examination of objectives 1, 2 and 3, comparisons between baseline, time 1 and time 2 data were performed to establish any significant differences. The statistical tests used included ANOVA, *t*-tests and correlations.

3 Results: sample profile, descriptive statistics and baseline data

3.1 Rationale

This section provides details pertaining to the descriptive statistics of the data gathered from the baseline (BL), time 1 (T1) and time 2 (T2) data samples, followed by an examination of the data to facilitate the establishment of the baseline.

3.2 Data sample composition

The safety climate measurement tool was distributed to the 10 participating organisations (seven SMEs and three large organisations). The breakdown of the sample by industry is displayed in Figure 4.

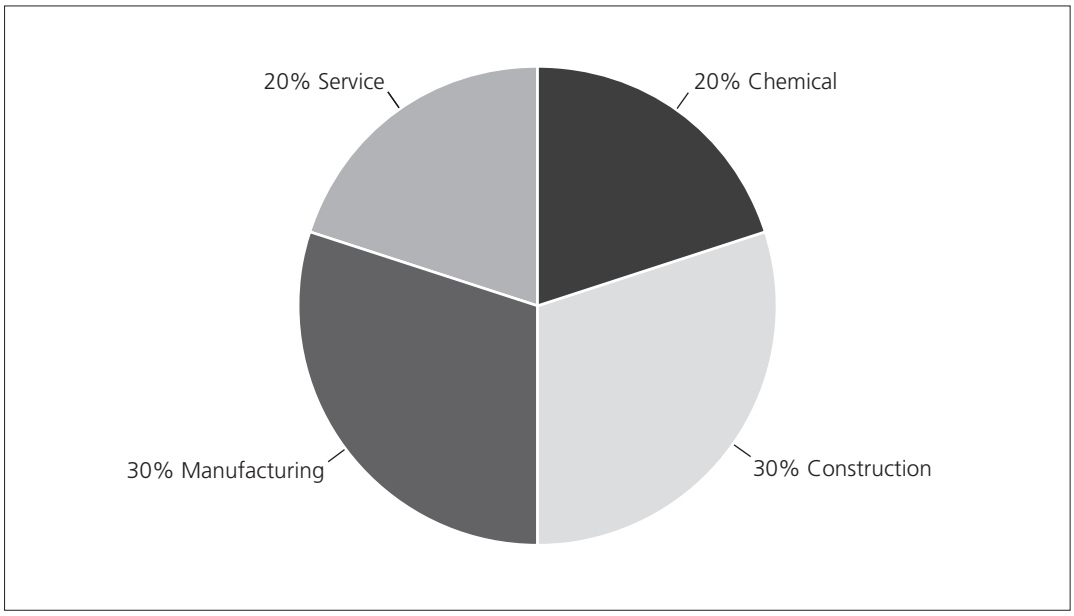


Figure 4
Breakdown of sample by industry

3.3 Sample

Table 7 presents the sample at each of the three time points in respect of the number of questionnaires distributed and received, and a breakdown by employee and management responses. Response rates varied between 33 per cent (for employees at T1) and 57 per cent (for managers at T1 and T2).

Time point	Total distributed	Total received	Questionnaires distributed		Questionnaires received	
			Employee	Management	Employee	Management
Baseline	1795	698 (39%)	1507	288	572 (38%)	126 (44%)
Time 1	1795	670 (37%)	1508	288	505 (33%)	165 (57%)
Time 2	1795	904 (50%)	1508	288	739 (49%)	165 (57%)

Table 7
Breakdown of questionnaire distribution across the three time points

While exact personnel records detailing the gender split for each organisation were not obtained, information presented to each organisational contact regarding the demographic results confirmed that the gender split obtained from the questionnaire responses reflected the organisational gender split. However, this was not statistically analysed.

The data were first examined with regard to the demographic information provided. All questionnaire data were manually checked to identify any systematic responses and those with more than 5 per cent

missing data. At BL, this screening process resulted in 18 employee questionnaires and seven management questionnaires being removed from the data set. At T1, 10 employee questionnaires and eight management questionnaires were removed from the data set. At T2, 13 employee questionnaires and seven management questionnaires were removed from the data set.

3.3.1 Demographic analysis

Following the demographic analysis of the data samples, the following results were established:

- The average age of the sample for each data set was between 21 and 36 years old
- The gender split was as follows:
  - BL: 79 per cent were male and 20 per cent female; 1 per cent did not report their gender
  - T1: 80 per cent were male and 19 per cent female; 1 per cent did not report their gender
  - T2: 81 per cent were male and 17 per cent female; 2 per cent did not report their gender.
- The average tenure for respondents was:
  - BL: 7 years and 6 months
  - T1: 7 years and 1 month
  - T2: 8 years and 5 months.
- The following employment statuses were recorded:
  - BL: 95 per cent full time, 2 per cent part time and 1 per cent temporary; 2 per cent did not report their employment status
  - T1: 94 per cent full time, 3 per cent part time and 1 per cent temporary; 2 per cent did not report their employment status
  - T2: 95 per cent full time, 1 per cent part time and 2 per cent temporary; 2 per cent did not report their employment status.
- The following information was recorded with regard to shift work:
  - BL: 31 per cent worked shifts and 66 did not; 3 per cent did not report this information
  - T1: 32 per cent worked shifts and 66 did not; 2 per cent did not report this information
  - T2: 33 per cent worked shifts and 62 did not; 5 per cent did not report this information.

Additional self-report data were gathered from respondents about their experience of sickness, absence from work and workplace accidents. This is presented as the average time absent from work due to sickness or ill health (Table 8).

Table 8
Self-reported absence from work due to sickness and self-reported accidents

Time point	Absence (days)	Accident (%)
Baseline	5.0	10
Time 1	6.7	8
Time 2	4.3	7

Figures 5–7 demonstrate the type of accidents experienced by employees at the participating companies before the baseline (BL), between the baseline and time 1 (T1) and between time 1 and time 2 (T2).

3.3.2 Managerial perspectives

At BL, the organisations were asked to provide information on:

- accidents, near misses and sickness
- litigation and HSE claims
- training.

The organisations were asked to reveal their accident statistics for the last year. These data were categorised into minor, serious and fatal accidents. Analysis of the data indicated that all of the 10 organisations had experienced between one and 10 minor injuries in the last year, with one organisation experiencing between 51 and 100 minor accidents. Five organisations revealed experiencing between one and 10 serious injuries. Serious accidents were experienced by four organisations, with three reporting between one and 10 and one between 11 and 50. No fatalities occurred in any of the organisations. Figure 8 displays a breakdown of accidents experienced by the organisations. The data collected are comparable to the HSE reported workplace statistics for 2009 and 2010 in that minor injuries reported were considerably more numerous than those classified as major.[40]

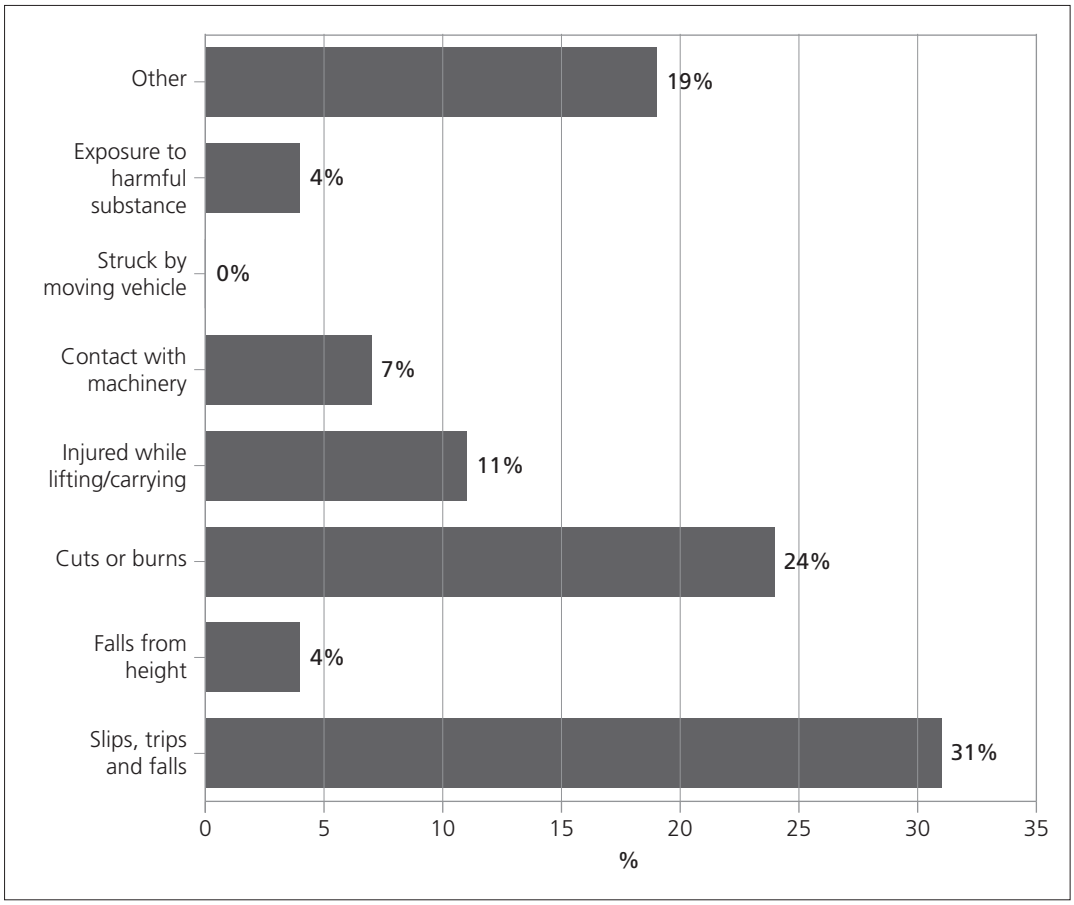


Figure 5
Percentage breakdown of accidents experienced at work (BL)

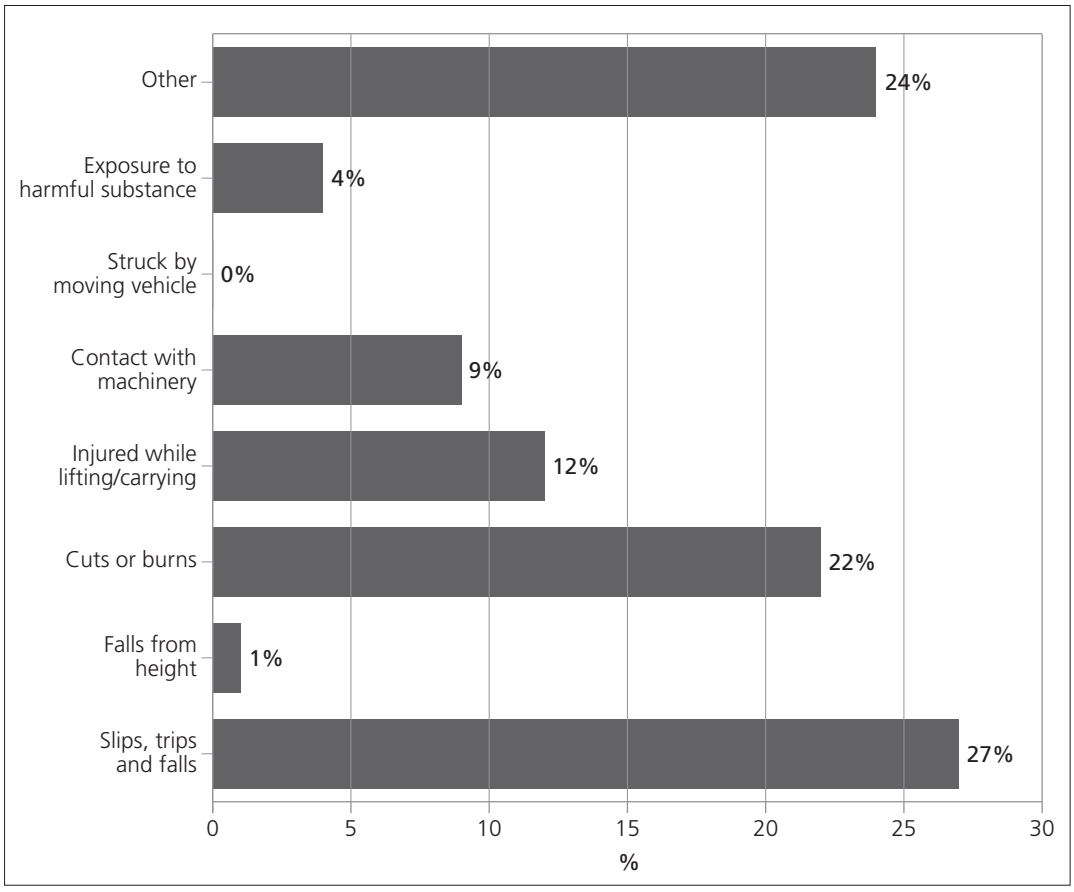


Figure 6
Percentage breakdown of accidents experienced at work (T1)

Figure 7
Percentage breakdown of accidents experienced at work (T2)

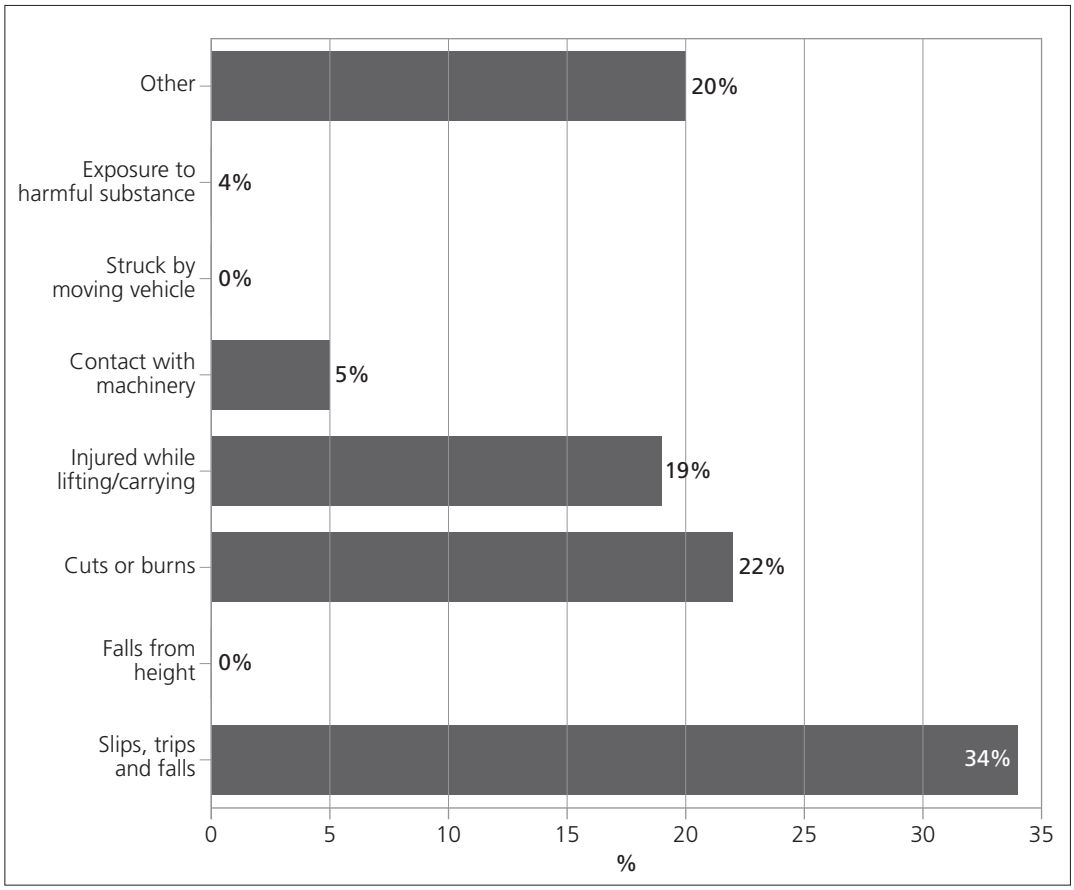
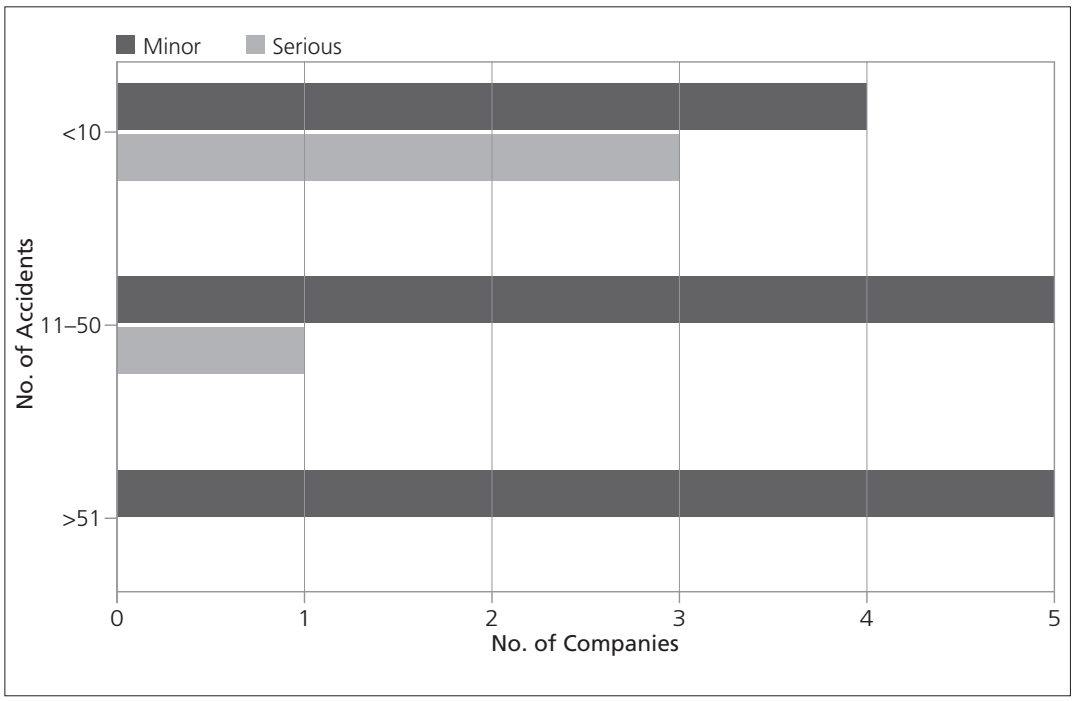


Figure 8
Major and minor accidents from company records at the baseline



In total, all the organisations indicated that they reported 'near misses' and reported keeping records of sickness and absence. However, the results reveal that only six organisations reviewed accident, near misses and sickness reports regularly.

While no organisations reported any notices of prosecutions by the HSE, three organisations reported being in receipt of litigation claims in respect of workplace injuries or illnesses.

All organisations reported conducting health and safety training; 60 per cent of the sample indicated they had a budget for training, 30 per cent did not have a budget for training and 10 per cent were unsure. All organisations reported that training was generally conducted in house and where applicable was outsourced. While induction training was offered to all new employees at each organisation, only 60 per cent of the sample reported providing refresher training.

After the BL data had been collected, the organisations were asked to provide information regarding the occurrence of minor injuries and accidents during the safety training intervention period. This is presented in Table 9, displayed by company and month following the collection of the BL data.

After T1, the organisations were asked to provide information on the occurrence of minor injuries and accidents during the safety training intervention period (see Table 10).

The percentage reduction in accidents as a result of the implementation of the training interventions in the 10 participating companies varied between zero (where the baseline was already very low at two incidents per year) and 43 per cent, with the average being 22 per cent.

Table 9
Accident statistics following collection of baseline data for each company

Company	Total	Number of minor injuries or accidents by month following BL data collection											
		1	2	3	4	5	6	7	8	9	10	11	12
1	7	1	0	1	1	0	0	0	1	2	0	0	1
2	71	5	6	9	1	3	9	11	5	6	6	5	5
3	43	5	4	3	3	5	4	3	3	4	2	4	3
4	22	3	4	2	1	2	0	1	3	1	2	2	1
5	31	3	1	2	3	4	4	3	1	3	2	2	3
6	2	0	0	1	0	0	0	0	1	0	0	0	0
7	56	3	6	6	5	4	3	10	3	3	5	2	6
8	79	6	7	4	10	4	4	10	10	5	8	5	6
9	56	4	6	5	2	3	8	4	6	4	5	5	4
10	24	4	2	2	1	0	3	1	1	2	4	1	3

Table 10
Accident statistics following collection of Time 1 data for each company

Company	Total	Number of minor injuries or accidents by month following T1 data collection											
		1	2	3	4	5	6	7	8	9	10	11	12
1	4	1	0	0	1	0	0	0	1	0	0	0	1
2	48	4	6	5	2	1	4	3	2	5	5	6	5
3	36	4	2	3	2	4	4	2	3	4	1	3	3
4	17	4	4	0	0	2	1	0	2	1	0	2	1
5	18	1	2	0	4	3	2	0	1	0	1	2	2
6	2	0	0	0	1	0	0	0	1	0	0	0	0
7	47	4	4	3	6	2	6	4	1	4	6	4	3
8	65	7	5	6	6	4	5	4	2	6	8	6	6
9	51	2	3	3	4	2	4	6	6	7	6	4	4
10	20	1	0	2	0	1	2	1	0	3	2	5	3

3.3.3 Descriptive statistics

Before the objectives of the project could be tested, the reliability of the scales used in the employee and management questionnaires was established using a measure of internal consistency (Cronbach alpha coefficient). Table 11 presents the internal consistency measures for the employee questionnaire and Table 12 the measures for the management questionnaire.

Table 11 Internal consistency measures for scales on the employee questionnaire

Scale	Cronbach's α (BL)	Cronbach's α (T1)	Cronbach's α (T2)
Safety climate	0.93	0.91	0.94
Safety climate subscales			
Management	0.87	0.65	0.80
Communication	0.84	0.74	0.78
Safety systems	0.55	0.58	0.63
Training	0.69	0.74	0.79
Work environment	0.48	0.60	0.62
Work pressure	0.78	0.64	0.73
Equipment	0.68	0.54	0.66
Supportive environment (co-workers)	0.74	0.68	0.72
Supportive environment (management)	0.77	0.67	0.83
Knowledge	0.66	0.76	0.75
Involvement	0.67	0.57	0.54
Safety behaviour			
Compliance	0.77	0.86	0.79
Participation	0.65	0.51	0.61
Motivation for safety			
Motivation	0.39	0.54	0.63

Table 12 Internal consistency measures for scales on the management questionnaire

Scale	Cronbach's α (BL)	Cronbach's α (T1)	Cronbach's α (T2)
Safety climate	0.89	0.89	0.93
Safety climate subscales			
Management	0.72	0.76	0.83
Safety systems	0.81	0.86	0.90
Safety behaviours	0.73	0.87	0.88
Transformational leadership	0.87	0.92	0.91
Transformational leadership subscales			
Idealised influence	0.62	0.76	0.75
Inspirational motivation	0.80	0.77	0.78
Intellectual stimulation	0.75	0.71	0.69
Individualised consideration	0.66	0.65	0.55

A Cronbach's alpha of 0.70 and above is considered acceptable and reflects the internal reliability of the scale. However, it is also suggested that values below 0.70 may reflect a reliable scale, depending on the diversity of the constructs which are being measured.[41] For scales that are under development, a lower alpha of 0.60 is considered acceptable. The subscale work environment and motivation presented low alpha coefficients at the baseline, but improvements were made at T1 and T2.

At T1, for overall safety climate, improvements were identified in the reliability of the management questionnaire, but there was a slight reduction noted from the employee questionnaire. For the employee questionnaire, improvements were identified in six of the safety climate subscales.

At T2, for overall safety climate, improvements were identified in the reliability of both the employee and management questionnaires. For the employee questionnaire, improvements were identified in five of the safety climate subscales.

Therefore, overall, while various employee subscales revealed alpha coefficients below 0.70, given the diversity of the constructs and the sample size, the alpha coefficients were considered acceptable.

At baseline, all subscales for the management survey at each time point were slightly below or above the accepted level of 0.70 and were considered acceptable.

At T1, for the management questionnaire, each subscale presented reliability improvements. While overall the reliability of the transformational measure improved, only one scale presented an improvement.

At T2, for the management questionnaire, each subscale presented reliability improvements. While overall the reliability of the transformational measure improved, only two scales presented improvements.

Tables 13 and 14 present the means, standard deviations and inter-scale correlations between all of the variables (at each of the time points) for the employee and management data respectively.

At BL, the mean scores obtained are all towards the higher end of the scale, indicating that both employees and management held, on average, positive attitudes of safety climate.

For the employees, the results indicate that safety climate correlates with self-reported safe behaviour (compliance and participation), and also with motivation, involvement and knowledge. The variable presenting the weakest correlation with safety climate is motivation for safety ($r = 0.289$, $p < 0.01$).

The mean overall safety climate score improved from 5.12 to 5.23 at T1, with a further slight improvement to 5.25 at T2. This indicates that employees' perceptions of safety climate in their organisations improved following the implementation of the safety training interventions. Much of this improvement was seen in the first 12 months, with this positive change in the safety climate being maintained after a further 12 months. All safety climate subscale mean scores improved or remained the same, excluding 'supportive environment (co-worker)'. This may indicate that co-workers are less relied on for support with safety issues as the safety training becomes embedded in the organisations. Safety knowledge was 5.90 at BL and remained at 5.90 at T2. Although it was expected that safety knowledge would improve as a result of the interventions, it may be that this was already at a high level and so did not change substantially. Involvement in safety did not show much change over time. However, this was at a lower initial level than knowledge and changed little as a result of the interventions. The variable that showed the greatest change over time was safety motivation, which increased at each time point to a final mean of 6.02. These findings are considered in more detail in Section 5. In terms of safety behaviour, compliance improved slightly from BL to T2, but the greatest change was observed in participation, which increased from 5.38 at BL to 5.63 at T2. For behaviour, the changes were observed at T2 rather than T1. These findings are considered in more detail in Section 6.

All correlations for the employee variables are positive. The results indicate that safety climate correlated with all of the variables; the strongest correlation is with 'supportive environment (management)' ($r = 0.867$, $p < 0.01$). Therefore, this aspect is most representative of the overall safety climate. The variable presenting the weakest correlation with safety climate is 'supportive environment (co-worker)' ($r = 0.377$, $p < 0.01$).

Table 13
Means, standard deviations and correlations for the employee survey variables

Variable	Mean T2 Mean T1 Mean BL	SD T2 SD T1 SD BL	1	2	3	4	5
1 Safety climate (overall)	5.25 5.23 5.12	0.81 0.77 0.79	—				
2 Management	5.47 5.47 5.47	1.14 1.06 1.25	0.821** 0.720** 0.846**	—			
3 Communication	5.38 5.37 5.19	1.13 1.13 1.26	0.821** 0.813** 0.807**	0.732** 0.584** 0.734**	—		
4 Safety systems	5.26 5.26 4.96	1.11 1.06 1.15	0.794** 0.763** 0.724**	0.653** 0.549** 0.659**	0.676** 0.650** 0.579**	—	
5 Training	5.28 5.28 4.99	1.13 1.09 1.14	0.789** 0.737** 0.763**	0.627** 0.457** 0.621**	0.665** 0.623** 0.616**	0.661** 0.662** 0.727**	—
6 Work environment	4.72 4.67 3.67	1.34 1.38 1.39	0.564** 0.490** 0.339**	0.400** 0.245** 0.229**	0.358** 0.426** 0.129**	0.358** 0.336** 0.107*	0.380** 0.361** 0.122**
7 Work pressure	5.05 5.19 4.85	1.46 1.30 1.58	0.696** 0.634** 0.600**	0.496** 0.385** 0.421**	0.447** 0.454** 0.377**	0.504** 0.446** 0.244**	0.431** 0.404** 0.286**
8 Equipment	5.16 5.07 5.15	1.15 1.08 1.22	0.713** 0.706** 0.748**	0.608** 0.607** 0.662**	0.567** 0.487** 0.617**	0.544** 0.476** 0.481**	0.539** 0.500** 0.524**
9 Supportive environment (co-worker)	4.96 5.23 5.48	1.41 1.31 1.10	0.377** 0.490** 0.549**	0.243** 0.254** 0.402**	0.221** 0.332** 0.404**	0.187** 0.266** 0.340**	0.201** 0.252** 0.356**
10 Supportive environment (management)	5.59 5.33 5.55	1.02 1.13 1.02	0.867** 0.737** 0.860**	0.791** 0.622** 0.806**	0.774** 0.578** 0.745**	0.688** 0.516** 0.618**	0.641** 0.394** 0.644**
11 Safe behaviour (compliance)	5.78 5.73 5.73	0.87 0.98 0.89	0.624** 0.728** 0.640**	0.445** 0.494** 0.521**	0.504** 0.576** 0.493**	0.465** 0.436** 0.469**	0.431** 0.450** 0.464**
12 Safe behaviour (participation)	5.63 5.40 5.38	0.87 1.01 1.02	0.647** 0.591** 0.685**	0.506** 0.526** 0.539**	0.570** 0.476** 0.641**	0.499** 0.340** 0.402**	0.547** 0.334** 0.500**
13 Knowledge	5.90 5.72 5.90	0.91 1.08 0.87	0.607** 0.724** 0.618**	0.409** 0.426** 0.428**	0.401** 0.485** 0.395**	0.424** 0.448** 0.316**	0.414** 0.411** 0.383**
14 Involvement	4.45 4.51 4.47	1.42 1.22 1.27	0.460** 0.500** 0.545**	0.269** 0.258** 0.349**	0.320** 0.432** 0.423**	0.312** 0.339** 0.353**	0.334** 0.355** 0.345**
15 Motivation	6.02 5.77 5.61	0.82 0.98 1.02	0.578** 0.591** 0.289**	0.385** 0.440** 0.243**	0.416** 0.400** 0.125**	0.430** 0.370** 0.477**	0.414** 0.297** 0.354**

** Correlation is significant at the 0.01 level

6	7	8	9	10	11	12	13	14	15
—									
0.531** 0.352** 0.336**	—								
0.387** 0.223** 0.185**	0.438** 0.400** 0.364**	—							
0.061 0.145** -0.006	0.165** 0.163** 0.229**	0.149** 0.251** 0.437**	—						
0.427** 0.178** 0.143**	0.563** 0.424** 0.407**	0.629** 0.590** 0.635**	0.217** 0.251** 0.473**	—					
0.258** 0.254** 0.004	0.404** 0.459** 0.349**	0.415** 0.477** 0.443**	0.251** 0.430** 0.474**	0.590** 0.573** 0.616**	—				
0.300** 0.134** 0.052	0.325** 0.372** 0.332**	0.489** 0.484** 0.520**	0.128** 0.172** 0.451**	0.605** 0.611** 0.675**	0.593** 0.566** 0.611**	—			
0.217** 0.200** 0.198**	0.423** 0.404** 0.412**	0.295** 0.496** 0.314**	0.188** 0.338** 0.259**	0.473** 0.605** 0.459**	0.443** 0.675** 0.428**	0.422** 0.525** 0.394**	—		
0.097** 0.122** -0.048	0.160** 0.207** 0.218**	0.278** 0.210** 0.368**	0.098** 0.295** 0.347**	0.319** 0.205** 0.472**	0.371** 0.432** 0.539**	0.462** 0.342** 0.621**	0.203** 0.291** 0.279**	—	
0.227** 0.089* -0.126**	0.410** 0.402** 0.049	0.372** 0.429** 0.167**	0.244** 0.322** 0.187**	0.543** 0.596** 0.248**	0.622** 0.599** 0.376**	0.535** 0.550** 0.172**	0.463** 0.650** 0.254**	0.287** 0.210** 0.209**	—

Table 14
Means, standard deviations and correlations for the management survey variables

Variable	Mean T2 Mean T1 Mean BL	SD T2 SD T1 SD BL	1	2	3	4	5
1 Safety climate	5.46 5.42 5.39	0.73 0.64 0.59	—				
2 Management	5.77 5.78 5.58	0.79 0.70 0.69	0.877** 0.828** 0.875**	—			
3 Safety systems	5.34 5.25 5.15	0.77 0.69 0.64	0.974** 0.967** 0.949**	0.748** 0.659** 0.727**	—		
4 Safety behaviours	6.09 6.03 5.98	0.84 0.86 0.75	0.663** 0.527** 0.690**	0.615** 0.399** 0.592**	0.639** 0.526** 0.493**	—	
5 Transformational leadership	6.11 6.07 5.95	0.56 0.58 0.61	0.490** 0.509** 0.374**	0.444** 0.446** 0.378**	0.470** 0.476** 0.266**	0.407** 0.430** 0.449**	—
6 Idealised influence	6.15 6.06 6.04	0.69 0.75 0.62	0.458** 0.489** 0.375**	0.360** 0.358** 0.336**	0.466** 0.490** 0.298**	0.405** 0.440** 0.418**	0.846** 0.845** 0.821**
7 Inspirational motivation	6.14 6.07 6.05	0.62 0.66 0.66	0.466** 0.485** 0.461**	0.409** 0.433** 0.415**	0.454** 0.449** 0.405**	0.384** 0.383** 0.386**	0.923** 0.956** 0.839**
8 Intellectually stimulating	6.12 6.09 5.76	0.59 0.56 0.98	0.380** 0.419** 0.174	0.380** 0.380** 0.229*	0.347** 0.386** 0.045	0.310** 0.375** 0.383**	0.894** 0.905** 0.816**
9 Individualised consideration	6.04 6.04 5.97	0.66 0.64 0.70	0.416** 0.415** 0.325**	0.411** 0.422** 0.328**	0.383** 0.361** 0.262**	0.333** 0.333** 0.295**	0.844** 0.856** 0.786**

** Correlation is significant at the 0.01 level

All correlations for the management variables are positive, with safety climate correlating positively with a transformational leadership style (which emphasises the transformation of employees' values to align with organisational goals).

The mean overall safety climate score improved from 5.39 to 5.46 at T2, indicating that management's perceptions of safety climate in their organisations improved. The mean scores on all safety climate subscales improved over time. The mean score obtained by managers on each dimension of the transformational leadership scale showed positive change over time, with the greatest change demonstrated in 'intellectual stimulation', which improved from 5.76 at baseline to 6.12 at T2. This would suggest that managers perceived that their leadership style had changed over time – engaging in greater use of intellectual stimulation (eg challenging employees to question safety issues and to make their own safety suggestions).

3.4 Baseline safety climate data

Before the project objectives could be tested, baseline data needed to be collected for each participating company. Therefore, the first set of analyses examined employees' perceptions of safety climate, safety behaviours and motivation. With regards to management, the additional measure of safety specific leadership was also examined.

The baseline data for the overall sample is presented in Figure 9. The results are displayed by company, organisational size and sector (see Figures 10, 11 and 12). A positive safety climate score was obtained for both employees and management. This reveals that on average employees have positive perceptions of safety climate in their organisations.

6	7	8	9
—			
0.764** 0.782** 0.764**	—		
0.652** 0.638** 0.496**	0.745** 0.832** 0.451**	—	
0.561** 0.573** 0.573**	0.703** 0.771** 0.662**	0.725** -0.753** 0.476**	—

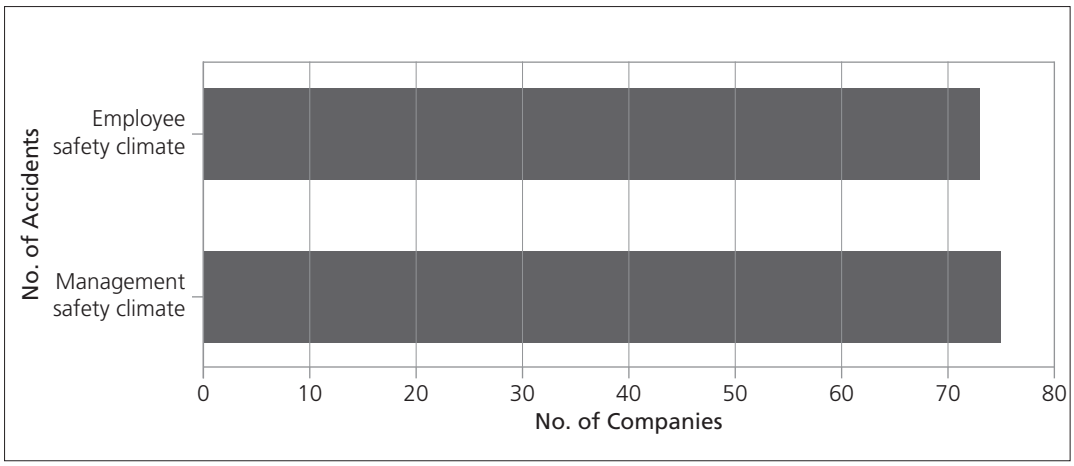


Figure 9
Baseline safety climate scores for the overall sample

Although, on average, managers viewed the safety climate as more positive than employees (see Figure 9), this pattern was not replicated in all the companies under observation. In three companies (1, 4 and 9) employees viewed the safety climate as more positive than the company's managers did.

Employees in SMEs tended to view safety climate as more positive than those in large organisations. This was the opposite for managers, where those who were based in large organisations had the more positive view of safety climate.

Figure 10
Safety climate scores displayed by organisation

To compare the safety climate scores for employees and managers from SMEs and large organisations and each industry sector, and to establish any significant differences, the ANOVA statistical test was performed. The results are presented in Table 15.

The employee results reveal that while both size of organisation and industry sector significantly influenced employees' perceptions of safety climate, industry sector presented the greater influence ($F = 10.59$, $p < 0.001$). From Figure 12, it can be seen that safety climate was perceived as more positive in the chemical and construction industries and less positive in manufacturing. No significant

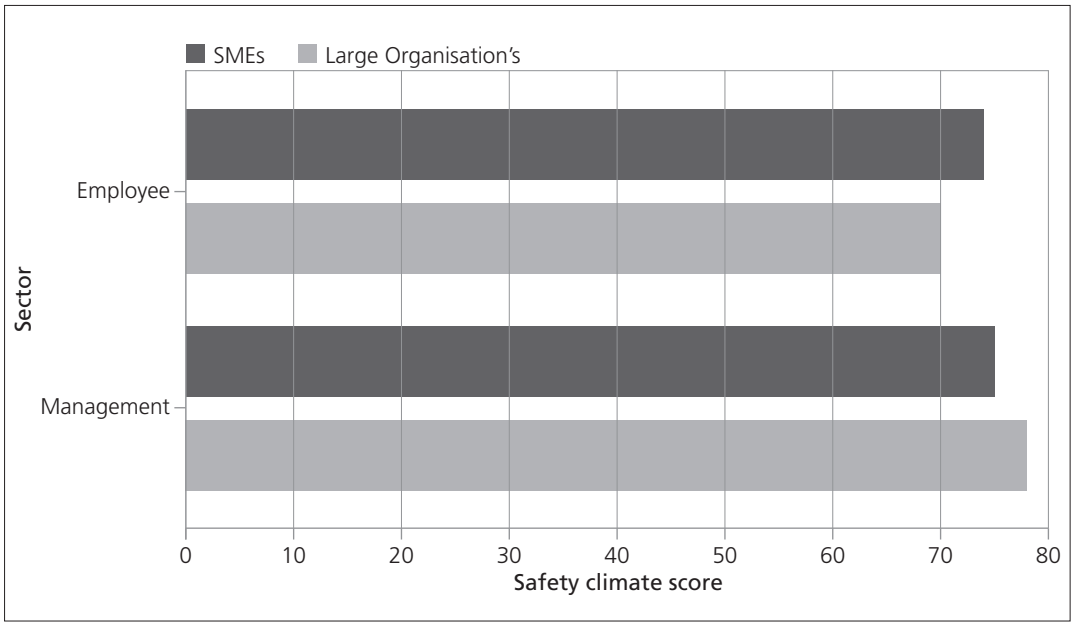


Figure 11
Safety climate scores displayed by organisational size

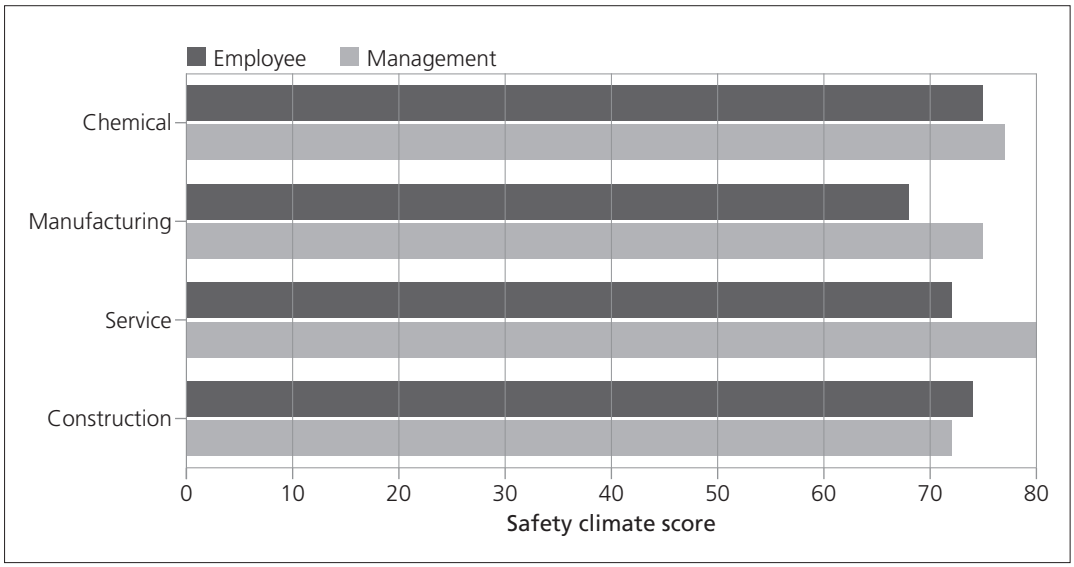


Figure 12
Safety climate scores displayed by industry sector

Employee data	F	Significance
Size	4.60	0.032*
Industry	10.59	0.000**
Size × industry	1.54	0.214
Management data	**F**	**Significance**
Size	1.79	0.183
Industry	2.41	0.070
Size × industry	0.556	0.457

* $p < 0.05$; ** $p < 0.001$

Table 15
ANOVA results for employee and management safety climate scores by organisational size and industry sector

results were found from the management data, indicating that managers' perceptions of the safety climate did not differ significantly depending on either organisation size or industry.

For the employee data, the safety climate data were further analysed into 11 subscales to identify more specific areas to target the health and safety training interventions. The results of these are presented first by overall sample (Figure 13), and then by organisational size and industry sector (Figures 14 and 15).

Figure 13
Safety climate subscales scores for the overall sample

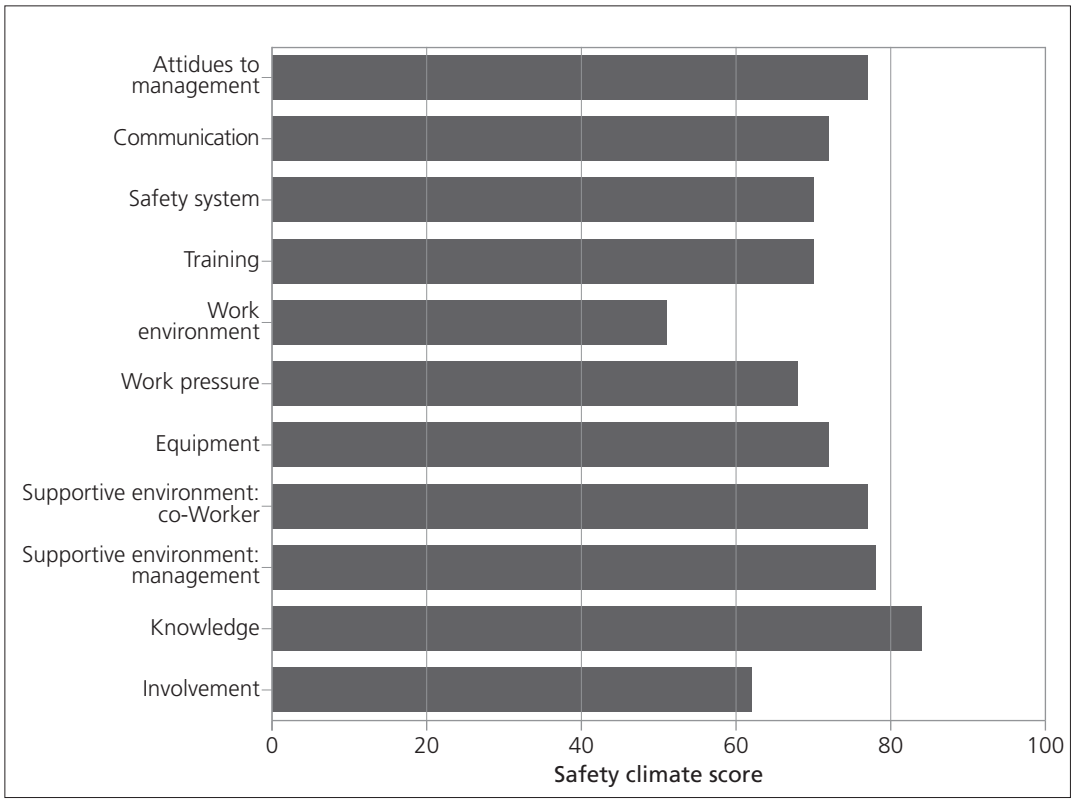


Figure 13 shows that the subscales of work environment and work pressure demonstrated the lowest scores for safety climate. Employees' safety knowledge was rated highest, but employee involvement was scored lower. This pattern is replicated across both SMEs and large organisations (Figure 14). To compare the individual safety climate variable scores for employees from SMEs and large organisations in an attempt to establish any significant differences, the *t*-test statistical test was performed. The results are presented in Table 16.

The results of the *t*-tests reveal significant differences for the following variables:

- attitudes to management
- communication
- work pressure
- equipment
- supportive environment (management)
- knowledge.

On all significant results, employees from SMEs reported significantly higher mean scores than those from larger organisations. This demonstrates that employees working for SMEs had more positive views of their managers' safety priorities and felt that managers provided a more supportive environment. They also perceived safety communication and equipment as significantly better than those working for larger organisations. This is likely to reflect the smaller size of SMEs, where managers are more likely to have closer working relationships with their employees. Less bureaucratic structures may contribute to the perception of better safety communication.

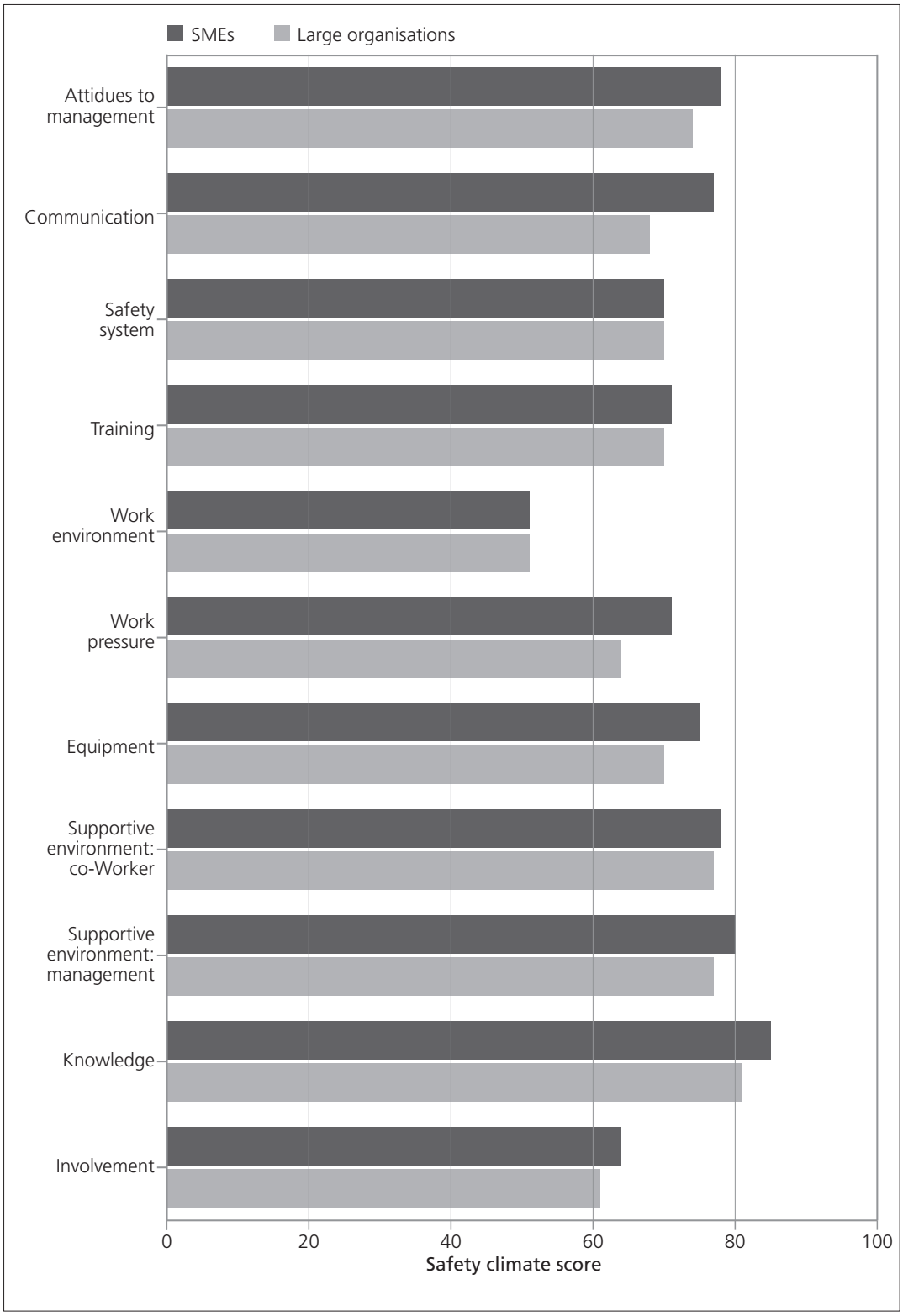


Figure 14
Safety climate subscales scores for each organisational size

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

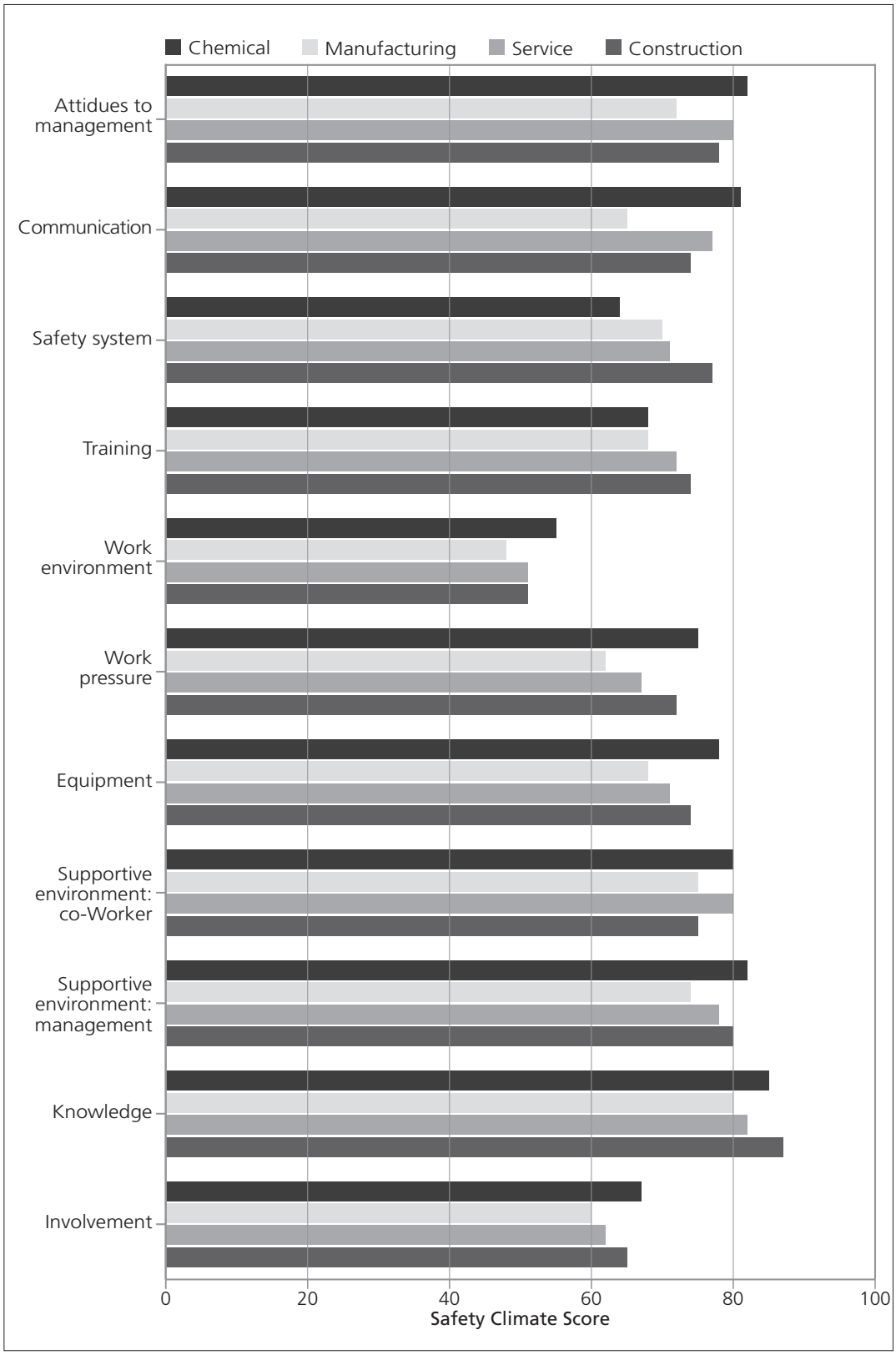


Figure 15
Safety climate subscale scores for each industry sector

Variable	*t*	df	*p*	Mean scores by organisational size	
				SME	Large
Management	2.787	449	0.006**	5.5	5.2
Communication	5.456	566	0.000***	5.4	4.8
Safety systems	0.274	569	0.784	4.9	4.9
Training	1.598	450	0.111	5.0	4.9
Work environment	0.149	568	0.882	3.6	3.6
Work pressure	3.447	568	0.001**	5.0	4.5
Equipment	3.853	568	0.000***	5.3	4.9
Supportive environment (co-worker)	0.873	568	0.383	5.5	5.4
Supportive environment (management)	2.539	568	0.011*	5.6	5.4
Knowledge	4.186	461	0.000***	6.0	5.7
Involvement	1.674	566	0.095	4.5	4.3

Table 16
t-test results for employee safety climate scores by organisational size and industry sector

To examine whether there were any significant differences between mean scores for each safety climate variable in the four industry sectors, a one-way ANOVA statistical test was performed (see Table 17).

Employee data	F	*p*	Mean scores for each industry			
			Chemical	Manu-facturing	Service	Construc-tion
Management	9.750	0.000***	5.8	5.1	5.6	5.5
Communication	27.821	0.000***	5.7	4.6	5.4	5.2
Safety systems	14.880	0.000***	4.5	4.9	5.0	5.4
Training	5.717	0.001**	4.8	4.8	5.1	5.2
Work environment	3.552	0.014*	3.9	3.4	3.6	3.6
Work pressure	10.820	0.000***	5.3	4.4	4.7	5.1
Equipment	9.478	0.000***	5.5	4.8	5.0	5.2
Supportive environment (co-worker)	2.096	0.100	5.6	5.3	5.6	5.3
Supportive environment (management)	10.345	0.000***	5.8	5.2	5.5	5.6
Knowledge	14.195	0.000***	6.0	5.6	5.8	6.1
Involvement	3.711	0.012*	4.7	4.2	4.4	4.6

Table 17
ANOVA results for employee safety climate sub-scale scores by industry sector

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

The results reveal significant differences between the industry sectors for each safety climate subscale excluding 'supportive environment (co-worker)'. Further analysis of the *post hoc* tests reveals the following significant differences in mean scores:

- **Management.** The chemical industry reported significantly higher scores than the manufacturing industry. Manufacturing industry attitudes towards management were significantly lower than those of all other industries.
- **Communication.** The chemical industry reported significantly higher scores for positive health and safety communication than the manufacturing and construction industries. The manufacturing industry reported significantly lower scores for positive health and safety communication than all other industries.
- **Safety systems.** The chemical industry reported significantly lower scores relating to the existence of safety systems than all other industries. The construction industry reported significantly higher scores than those from the manufacturing industry.
- **Training.** The service and construction industry both reported significantly higher scores for the provision of health and safety training than the manufacturing industry. Furthermore, the construction industry reported significantly higher scores than those obtained from the chemical industry.
- **Work environment.** Only the chemical industry presented any significant results and reported a safer working environment than the manufacturing industry.
- **Work pressure.** The chemical industry reported experiencing work pressure to a significantly lesser extent to those respondents working in the manufacturing and service industries.
- **Equipment.** The results reveal that employees in the chemical industry reported having significantly more sufficient and safe equipment to enable them to perform their duties than those working in the manufacturing and service industries.
- **Supportive environment (management).** Employees from the chemical and construction industry reported a significantly more supportive management environment than those working in the manufacturing industry.
- **Knowledge.** Employees working in the construction industry reported significantly greater health and safety knowledge than those working in the service and manufacturing industries. Employees from the chemical industry reported significantly greater health and safety knowledge than those in the manufacturing industry.
- **Involvement.** Employees in the chemical industry reported getting involved in health and safety matters to a significantly greater extent than those in the manufacturing industry.

For the management data, the safety climate data were further analysed into two subscales to identify more specific areas to target the health and safety training interventions. The results of these are presented firstly by overall sample (Figure 16), and then by organisational size and industry sector (Figures 17 and 18).

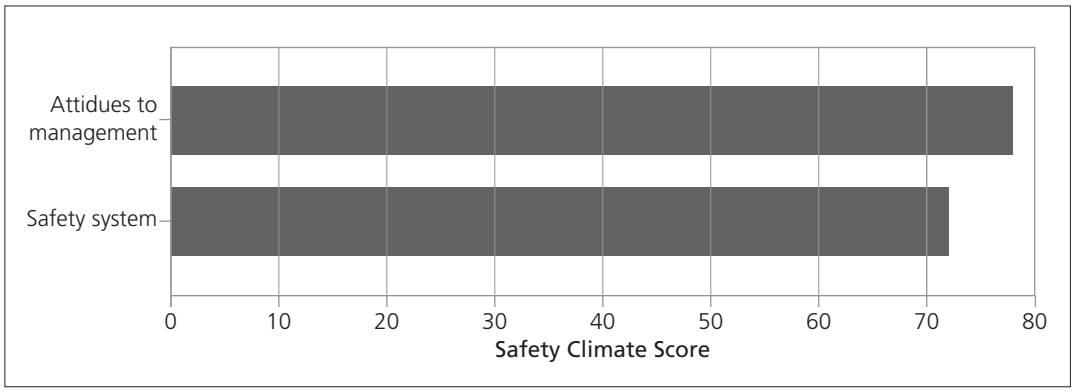


Figure 16
Safety climate subscale scores for the overall management sample

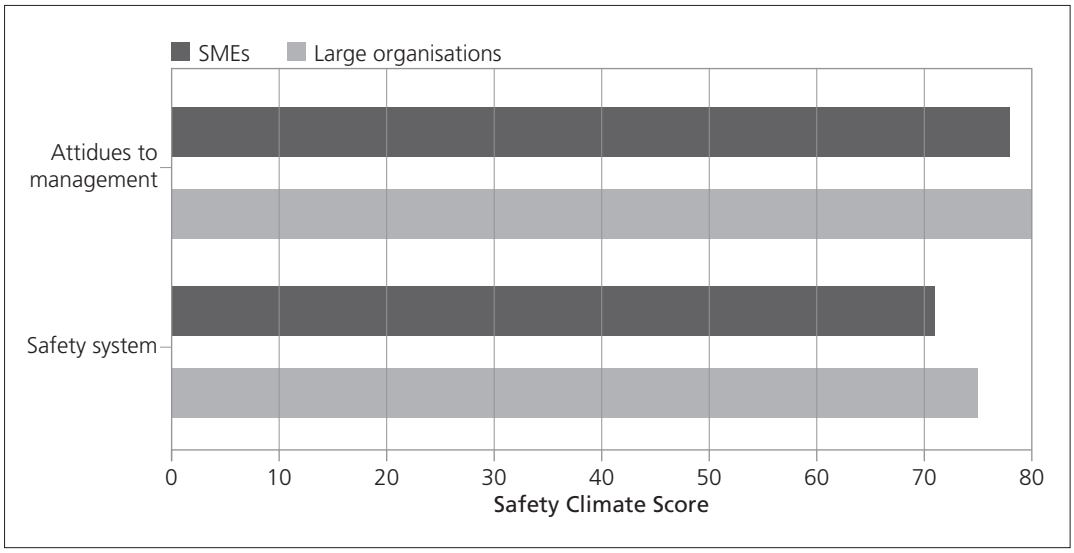


Figure 17
Management safety climate subscale scores for each organisational size

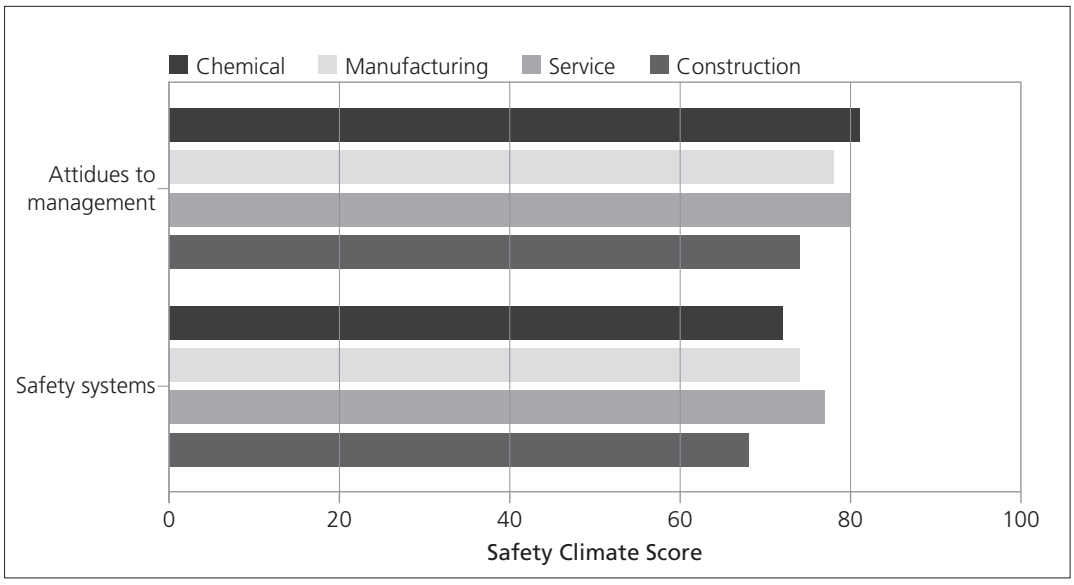


Figure 18
Management safety climate subscale scores for each industry sector

To compare the safety climate subscale scores for managers from SMEs and large organisations, in an attempt to establish any significant differences, the *t*-test statistical test was performed. The results are presented in Table 18.

Variable	*t*	df	*p*	Mean scores by organisational size	
				SME	Large
Attitude towards management	–0.301	124	0.764	5.5	5.6
Safety systems	–2.368	64	0.021*	5.0	5.3

Table 18
t-test results for management safety climate scores by organisational size and industry sector

* $p < 0.05$

The results reveal a significant difference for the safety systems variable. This reveals that managers from large organisations reported significantly higher mean scores than those from SMEs with regards to the existence of effective safety systems in their organisations.

To examine whether there were any significant differences between mean scores for each safety climate variable in the four industry sectors, an ANOVA statistical test was performed. Table 19 presents the results.

Table 19
ANOVA results for management safety climate subscale scores by industry sector

Employee data	F	*p*	Mean scores for each industry			
			Chemical	Manu-facturing	Service	Construc-tion
Attitude towards management	2.760	0.045*	5.7	5.5	5.6	5.2
Safety systems	3.660	0.014*	5.1	5.2	5.4	4.8

* $p < 0.05$

The results reveal significant differences between the industry sectors for each safety climate subscale. Further analysis of the *post hoc* tests reveals the following significant differences in mean scores:

- **Attitudes towards management.** The chemical industry reported significantly higher scores than the construction industry.
- **Safety systems.** The service industry reported significantly higher scores relating to the existence of effective safety systems than the construction industry.

Therefore, following the above analysis of the baseline data, the results revealed that the lower scoring safety climate subscales were safety systems, training, the work environment and involvement. These safety issues were specifically addressed by a number of the interventions that were implemented in the participating companies:

- the work environment: good housekeeping
- safety systems: review of processes and procedures
- near miss reporting procedure
- health and safety appraisal
- involvement: job design hazard awareness
- communication: increasing overall existence and importance of health and safety in the workplace
- management training: improving safety-specific leadership skills.

4. Results: objective 1 – identification of factors that influence the effectiveness of safety training

4.1 Rationale

This section focuses on the identification of factors that influence the effectiveness of safety training by measuring the perceptions of participants (employees and managers) using the semi-structured evaluation tool.

4.2 Qualitative analysis

The qualitative data gathered from the evaluation tool was first examined in an attempt to identify predominant themes which would help to identify the factors that influenced the effectiveness of the safety training interventions. A thematic analysis was performed on each of the questions to establish any predominant themes. This involved reading through the transcripts to develop categories or themes which became apparent in relation to the respondents' perceptions of the effectiveness of the safety training interventions. The key themes are presented in Table 20.

Table 20
Key themes raised in the qualitative data

Question	Management themes	Employee themes
1 How have the interventions changed the attitudes of the workforce?	• Less resistant to health and safety procedures • More willing to get involved in workplace initiatives not just health and safety initiatives	• Improved attitude towards management – looking after the workforce • Improved morale • Excessive health and safety – more procedures to follow
2 How have the interventions changed the behaviours of the participating employees?	• Improved compliance with procedures	• Provided the opportunity to be involved in decision-making
3 Have the interventions increased employee knowledge and awareness of health and safety matters?	• Raised general awareness not only of health and safety matters but also the work that the health and safety department get involved in. • Integrated health and safety into the organisation as a core part of the business	• Raised general awareness • Awareness of own boundary of existing knowledge of health and safety
4 Have you experienced any difficulties or problems implementing any of the interventions? If so, please give details.	• Roll-out procedure needs to be management driven • Employee willingness is dependent on age and experience	• Pressure still exists to get the job done and take part
5 Have any external or internal factors affected the implementation of the interventions? If so, please give details.	• Staff shortages • Economic climate • Economic pressures • Competing priorities • Resources • Willingness to get involved • Timescale	• Work pressure • Timescales involved • Job security
6 How could the interventions or the intervention process be improved?	• Commitment from senior management • More time • Develop groups from other companies to compare and discuss findings and whole process	• Time allocated within working day to get involved with training interventions

Barriers to the implementation of safety interventions were identified as:

- the importance of having the interventions rolled out across the company and that this process was management driven
- differences in employee willingness to become involved (often based on age and experience).

Employees identified the primary barrier as managing the ongoing pressure to get the job done and wanting to take part in the interventions. There were a large number of external pressures that acted as barriers, including:

- staff shortages
- economic pressures
- competing priorities
- lack of resources
- willingness of staff to get involved.

Enablers were identified as:

- commitment from senior management
- time allocated to employees during the work day to get involved with interventions.

4.3 Quantitative analysis

The quantitative data gathered from the evaluation tool were then examined in an attempt to identify various factors relating to the effectiveness of the safety training interventions. These are:

- the effect of the training interventions on productivity
- perceptions of feedback from employees following the training interventions
- perceptions of feedback from management following the training interventions
- the effect of the training interventions on the overall safety culture
- perceptions of the overall project.

The evaluation tool was distributed to 51 managers and 201 employees at T1 and T2. Responses were received from all managers and employees at both times. The overall mean scores at T1 and T2 are presented in Table 21.

Table 21
Mean scores for the evaluation tool factors (obtained at T1 and T2)

Factors	Mean T1	Mean T2
1 Productivity	4.84	5.35
2 Employee feedback	4.28	5.07
3 Management feedback	4.42	5.48
4 Overall effect on safety culture	4.63	5.42
5 Overall perception of project	4.73	5.46

The results reveal that overall the respondents' perceptions of the impact of the safety training interventions had a positive effect on productivity. Perceptions of employee and management feedback following implementation of the safety training intervention period improved from T1 to T2. The results reveal that respondents' perceptions of management feedback following the training interventions were more positive than employees at both T1 and T2 (mean = 4.42 and 5.48 respectively). The effect of the training interventions on the overall organisational safety culture improved from T1 to T2. Furthermore, in general, respondents reported a favourable perception in respect of the overall project.

A series of *t*-tests were run to identify any significant differences in scores obtained at T1 and those obtained at T2. The results reveal that at T2, there was a significant improvement in all five of the factors examined in the evaluation tool. Perceptions of the impact of the safety training interventions on productivity significantly improved ($t(502) = 5.771$, $p < 0.000$; mean = 4.84 and 5.35 respectively). Perceptions of employee feedback regarding the effectiveness of the interventions significantly improved ($t(502) = 9.501$, $p < 0.000$; mean = 4.28 and 5.07 respectively). Perceptions of feedback from

management significantly improved ($t(502) = 15.523$, $p < 0.000$; mean = 4.42 and 5.48 respectively). In general, the perceptions of the impact of the training interventions on the overall safety culture of the organisations significantly improved from T1 to T2 ($t(502) = 11.036$, $p < 0.000$; mean = 4.63 and 5.42 respectively). The impact of the perceptions of the overall project significantly improved following distribution of the evaluation tool at T1 to T2 ($t(502) = 11.007$, $p < 0.000$; mean = 4.73 and 5.46 respectively).

The data were then further examined to identify any differences regarding the identification of factors that influence the effectiveness of safety training between employees and managers, organisational size and industry sector. The results are presented in Figures 19 and 20.

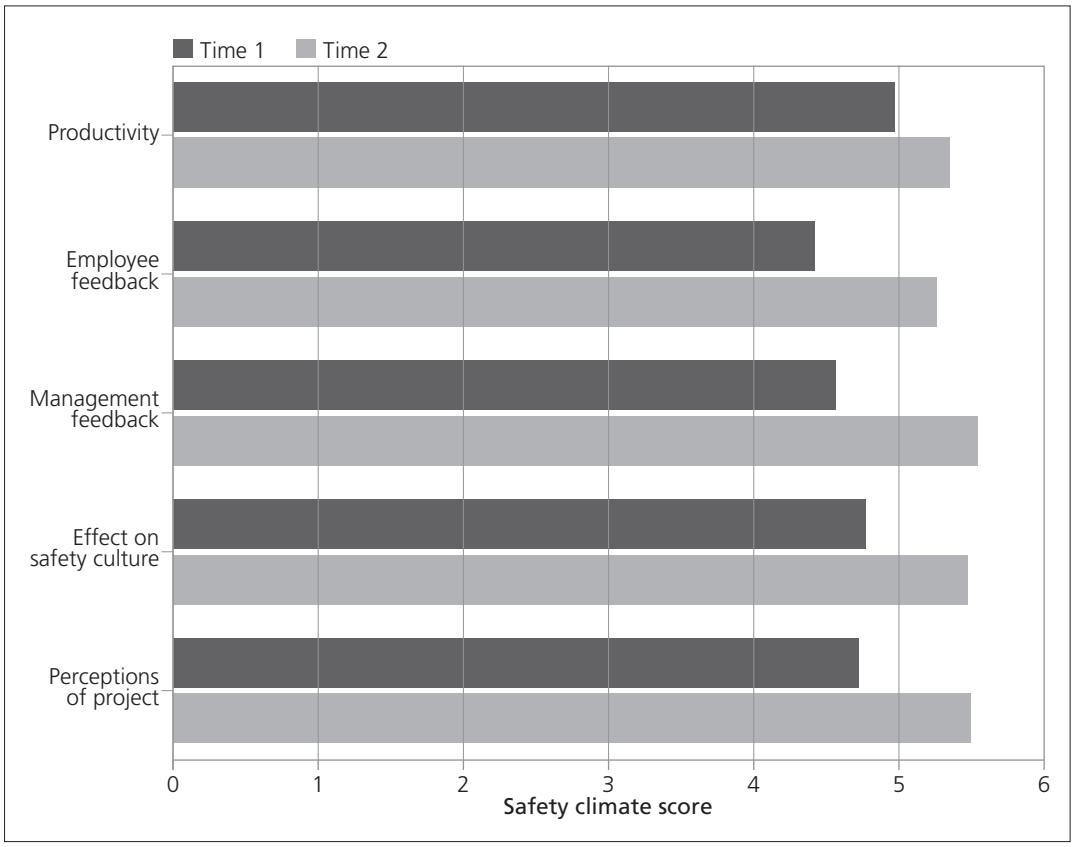


Figure 19
Factors that influence employees' perceptions of the effectiveness of safety training

A series of *t*-tests was performed to identify any significant differences in mean scores obtained from employees and managers at T1 and T2 (see Tables 22 and 23).

The results reveal that at T1 significant differences were identified in each variable excluding variable 5, the overall perceptions of the project. Employees reported significantly higher scores than managers relating to more positive perceptions of the impact of the safety training interventions on productivity, employee feedback, management feedback and the overall effect on safety culture.

However, at T2 the only significant differences identified related to employee and management feedback. Again, employees reported significantly higher scores relating to the perceptions of employee and managers feedback following implementation of the safety training interventions.

A series of *t*-tests was then performed to identify any significant differences in mean scores obtained from respondents from SMEs and large organisations at T1 and T2 (Tables 24 and 25).

The results reveal that at T1 only one significant difference in mean score was obtained. Employees from large organisations reported that the safety training interventions had a positive overall effect on safety culture to a significantly greater extent than those from SMEs (mean = 4.83 and 4.44 respectively).

As at T1, the results for T2 present only one significant difference in employees' perceptions of the effectiveness of the safety training interventions. Again, employees in large organisations reported that

Figure 20
Factors that influence managers' perceptions of the effectiveness of safety training

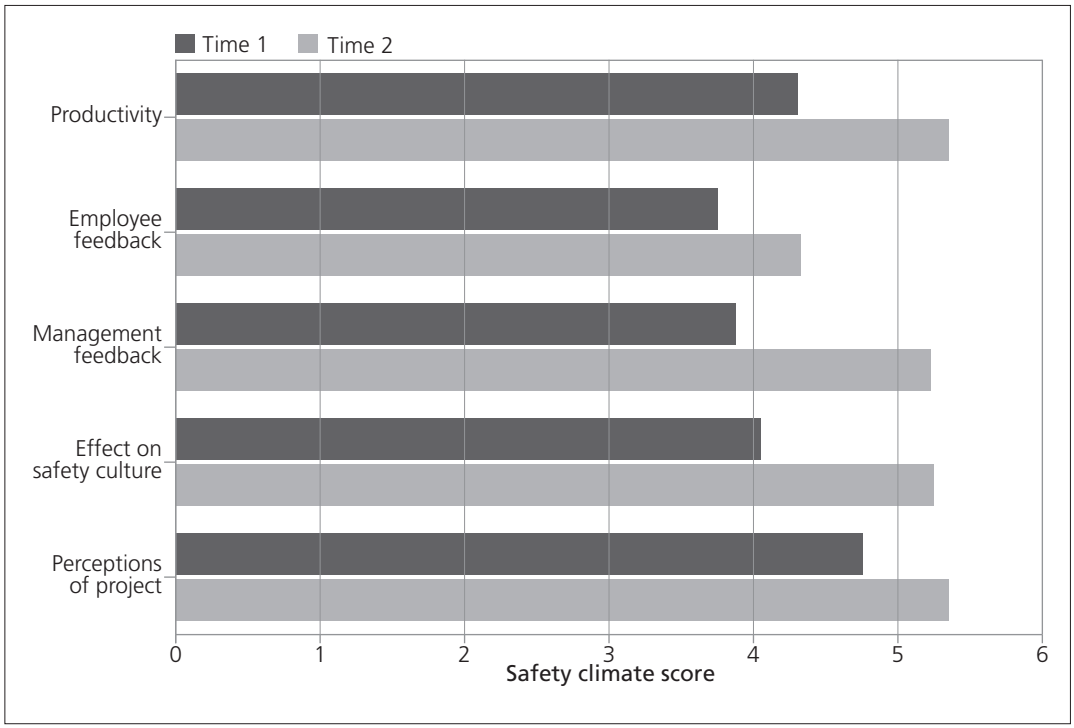


Table 22
Differences in the perceptions of employees and managers regarding the effectiveness of the safety interventions at T1

Variable	*t*	df	*p*	Mean scores	
				Employees	Managers
1 Productivity	4.016	250	0.000***	4.97	4.31
2. Employee feedback	5.202	250	0.000***	4.42	3.72
3. Management feedback	5.953	250	0.000***	4.56	3.88
4. Overall effect on safety culture	5.520	250	0.000***	4.77	4.05
5. Overall perception of project	–0.357	250	0.722	4.72	4.76

*** $p < 0.001$

Table 23
Differences in the perceptions of employees and managers regarding the effectiveness of the safety interventions at T2

Variable	*t*	df	*p*	Mean scores	
				Employees	Managers
1 Productivity	0.034	250	0.973	5.35	5.35
2. Employee feedback	6.695	250	0.000***	5.26	4.33
3. Management feedback	2.837	250	0.005**	5.54	5.25
4. Overall effect on safety culture	1.884	250	0.061	5.47	5.25
5. Overall perception of project	1.321	250	0.188	5.49	5.35

** $p < 0.01$; *** $p < 0.001$

Variable	*t*	df	*p*	Mean scores by organisational size	
				SME	Large
1 Productivity	–1.408	250	0.160	4.75	4.94
2. Employee feedback	–1.655	247	0.099	4.19	4.38
3. Management feedback	–1.559	248	0.120	4.34	4.50
4. Overall effect on safety culture	–3.560	240	0.000***	4.44	4.83
5. Overall perception of project	1.150	231	0.251	4.67	4.79

*** $p < 0.001$

Table 24
Differences in the perceptions regarding the effectiveness of the safety interventions by organisational size at T1

Variable	*t*	df	*p*	Mean scores by organisational size	
				SME	Large
1 Productivity	1.354	246	0.177	5.43	5.27
2. Employee feedback	–1.194	239	0.234	5.00	5.15
3. Management feedback	–1.515	250	0.131	5.41	5.55
4. Overall effect on safety culture	–1.997	248	0.047*	5.34	5.52
5. Overall perception of project	–0.687	247	0.493	5.43	5.50

* $p < 0.05$

Table 25
Differences in the perceptions regarding the effectiveness of the safety interventions by organisational size at T2

the safety training interventions had had a greater impact on the overall safety culture than those employees from SMEs (mean = 5.52 and 5.34 respectively). The difference at T2 is smaller than the difference at T1.

To identify any differences in scores obtained at T1 and T2 for each industry sector, the statistical test ANOVA was used (see Table 26).

Employee data	*F*	*p*	Mean scores for each industry			
			Chemical	Manu-facturing	Service	Construc-tion
1 Productivity	0.405	0.750	4.64	4.89	4.86	4.81
2 Employee feedback	0.786	0.503	4.32	4.33	4.30	4.12
3 Management feedback	1.736	0.160	4.25	4.33	4.57	4.45
4 Overall effect on safety culture	7.315	0.000***	4.64	4.56	4.96	4.27
5 Overall perception of project	1.074	0.361	4.57	4.78	4.80	4.73

*** $p < 0.001$

Table 26
Differences in the perceptions regarding the effectiveness of the safety interventions by industrial sector at T1

The results reveal that the only significant difference in mean scores was obtained at T1 and relates to the impact that the safety training interventions have had on the overall safety culture ($p < 0.01$). Post hoc analysis shows that the respondents from the service industry reported that the impact of the safety training interventions on overall safety culture was significantly greater than those from the manufacturing and construction industry ($p < 0.05$ and $p < 0.01$, mean = 4.96, 4.56 and 4.27 respectively; see Table 27).

The differences reported at T1 were not replicated at T2, where there were no significant differences between any of the industrial sectors.

Table 27
Differences in the perceptions regarding the effectiveness of the safety interventions by industrial sector at T2

Employee data	*F*	*p*	Mean scores for each industry			
			Chemical	Manu-facturing	Service	Construc-tion
1 Productivity	1.792	0.149	5.50	5.23	5.30	5.56
2 Employee feedback	0.705	0.550	5.00	5.15	4.96	5.14
3 Management feedback	2.229	0.085	5.67	5.54	5.44	5.39
4 Overall effect on safety culture	0.178	0.911	5.35	5.44	5.40	5.47
5 Overall perception of project	1.041	0.093	5.60	5.40	5.59	5.32

4.4 Section summary

The perceptions of the employees reveal that the safety training interventions had a positive impact on the overall organisational culture. Positive themes were identified from management and employees from the qualitative analysis. However, the notion of top–down management commitment to the project, employee willingness to participate and existing job pressures were highlighted as problems when implementing the safety training interventions. In addition, various internal and external factors were identified as factors which may negatively influence the implementation of the safety training interventions. From this list of identified themes, the current economic climate and the consequences of such for both managers and employees featured predominantly.

The qualitative analysis reveals that perceptions of the effectiveness of the safety training interventions over the intervention period improved from T1 to T2. In addition, perceptions of the impact of the safety training interventions on each factor (productivity, employee feedback, management feedback, overall safety culture and the project in general) increased at T2. Interestingly, employees reported higher mean scores than managers at T1 and T2, indicating that employees' perceptions of the effectiveness of the safety training interventions were greater than those of the managers.

At T1 the mean scores of respondents from large organisations were greater than those from respondents in SMEs on each factor. However, at T2 perceptions of the respondents from SMEs revealed that the safety training interventions had had a greater impact on productivity in those organisations than they had in large organisations.

Comparing the results by industry sector, while the mean scores improved for each industry from T1 to T2, the only significant result was established at T1. This indicated that respondents from the service industry reported that the impact of the safety training interventions on overall safety culture was significantly greater than respondents from the manufacturing and construction industries.

5 Results: objective 2 – evaluation of the impact of safety training on employees' safety attitudes and perceptions, and accident and injury rates

5.1 Rationale

This section focuses on the second set of analyses, which examined the evaluation of the impact of the safety training interventions on employees' safety attitudes and perceptions using data taken from the re-administration of the surveys. The effectiveness of the safety training interventions was also analysed using accident and injury rates.

5.2 Safety climate data

The data obtained at BL, T1 and T2 for the overall sample are presented in Figure 21. A slightly higher positive safety climate score was obtained for both employees and management at T1 and T2. This reveals that following safety training interventions, attitudes and perceptions of safety climate improved. The results are displayed by organisation, organisational size and sector in Figures 22–25.

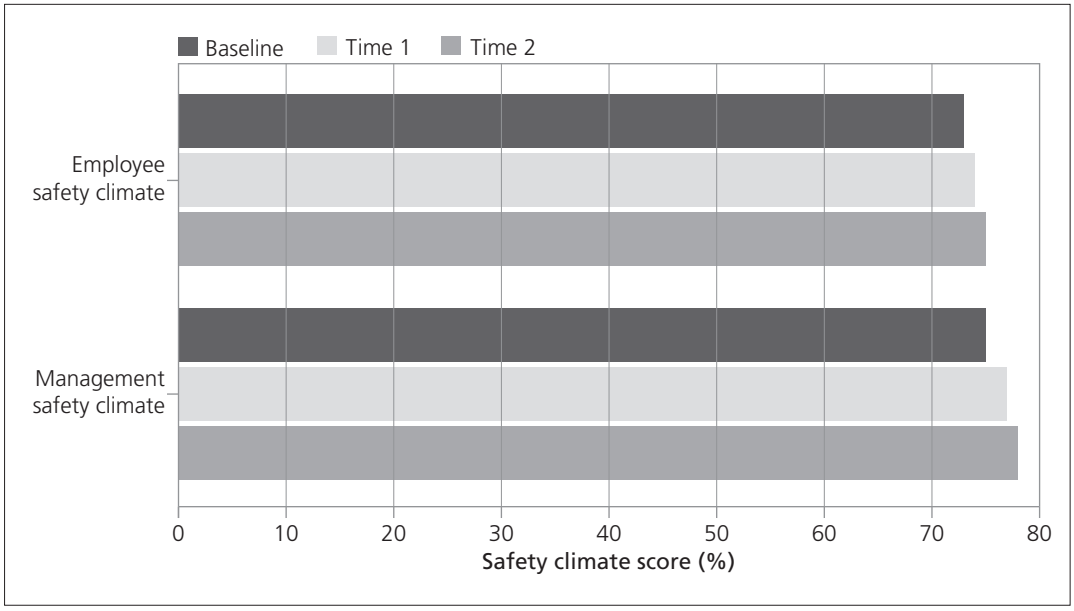


Figure 21
Overall safety climate scores for employees and managers across the three time points

Figure 22
Overall safety climate scores for employees over time displayed by organisation

Figure 23
Overall safety climate scores for managers over time displayed by organisation

Figure 24
Overall safety climate scores for SMEs over time (employees and managers)

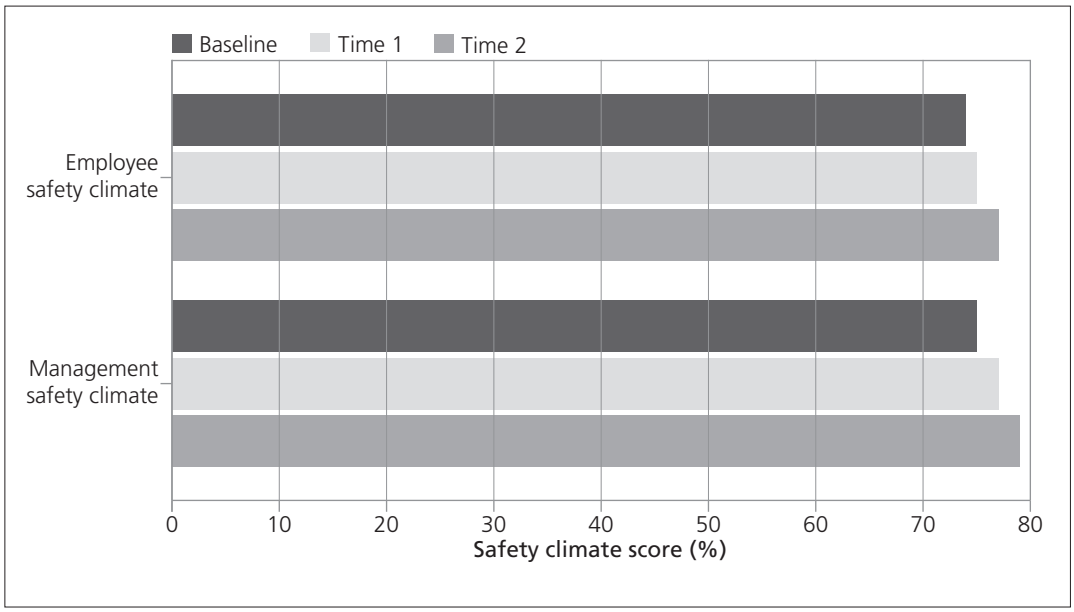


Figure 25
Overall safety climate scores for large organisations over time (employees and managers)

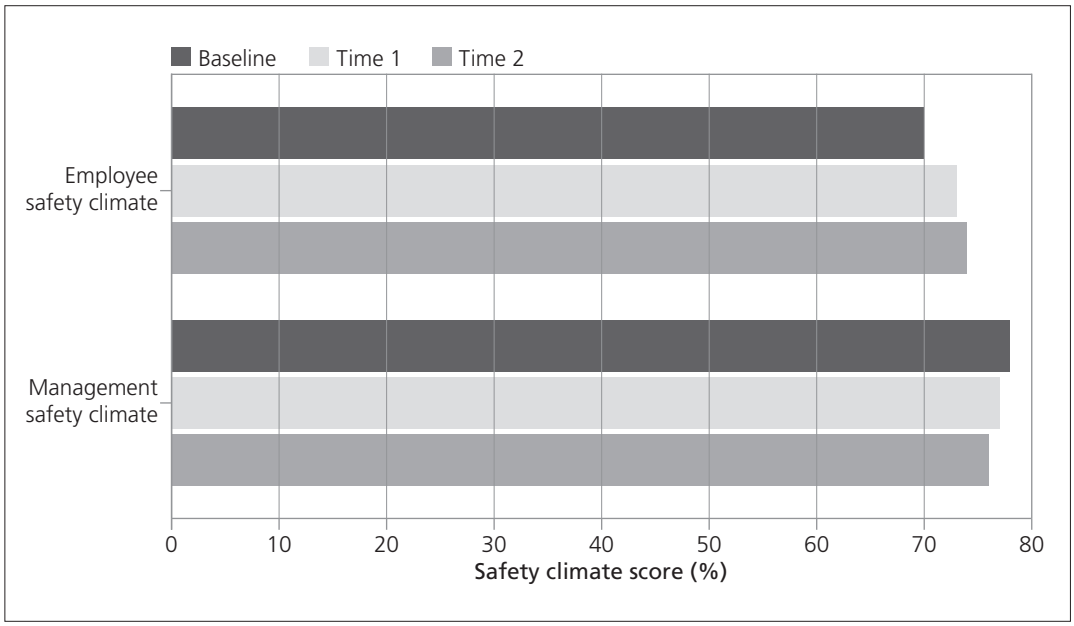


Figure 22 shows that the pattern of safety climate scores across the three time points varied for the participating organisation. Safety climate scores increased as a result of the interventions in all organisations except organisations 4 (where safety climate decreased) and 7 (where there was no change in safety climate). Figure 23 shows that safety climate scores increased for managers in eight of the 10 organisations. For organisations 2 and 7, managers' perceptions of the safety climate decreased over time.

Safety climate scores for employees and management from SMEs improved at T1 and T2. However, for large organisations, while employee safety climate scores improved, management attitudes towards safety climate decreased slightly at T1 and T2.

To compare the safety climate scores for employees and managers from SMEs and large organisations to establish any significant differences, ANOVA tests were performed.

For the employee data, the results reveal significant differences in safety climate scores obtained at the three time points for employees from SMEs ($F = 4.49$, $p < 0.01$). The test results reveal that employees' attitudes towards safety climate improved during the training intervention period (BL mean = 5.22, T1

mean = 5.30 and T2 mean = 5.42). Similar results were found for employees from large organisations ($F = 5.65$, $p < 0.01$). Employees' attitudes towards the safety climate in their organisation improved during the training intervention period (BL mean = 4.97, T1 mean = 5.17 and T2 mean = 5.18).

Trend analyses were performed across the three time points to establish any linear trend. Using the ANOVA statistical test with the polynominal option, the comparison tests were examined in order to determine whether the safety climate mean scores increased across time points in a linear way. The results revealed that a significant linear trend was established for SMEs and large organisations ($F = 8.19$, $p < 0.01$ and $F = 13.14$, $p < 0.01$ respectively).

For the management data, the results reveal significant differences in safety climate scores obtained at the three time points for managers from SMEs ($F = 8.45$, $p < 0.01$). The test results reveal that managers' attitudes towards safety climate improved over the training intervention period (BL mean = 5.32, T1 mean = 5.41 and T2 mean = 5.69). However, for managers from large organisations, no significant differences were found ($F = 0.155$, $p > 0.05$). The mean scores reveal that managers' attitudes towards safety climate in large organisations decreased slightly over the training intervention period (BL mean = 5.52, T1 = 5.44 and T2 = 5.46), but this decrease was not significant (Figure 26).

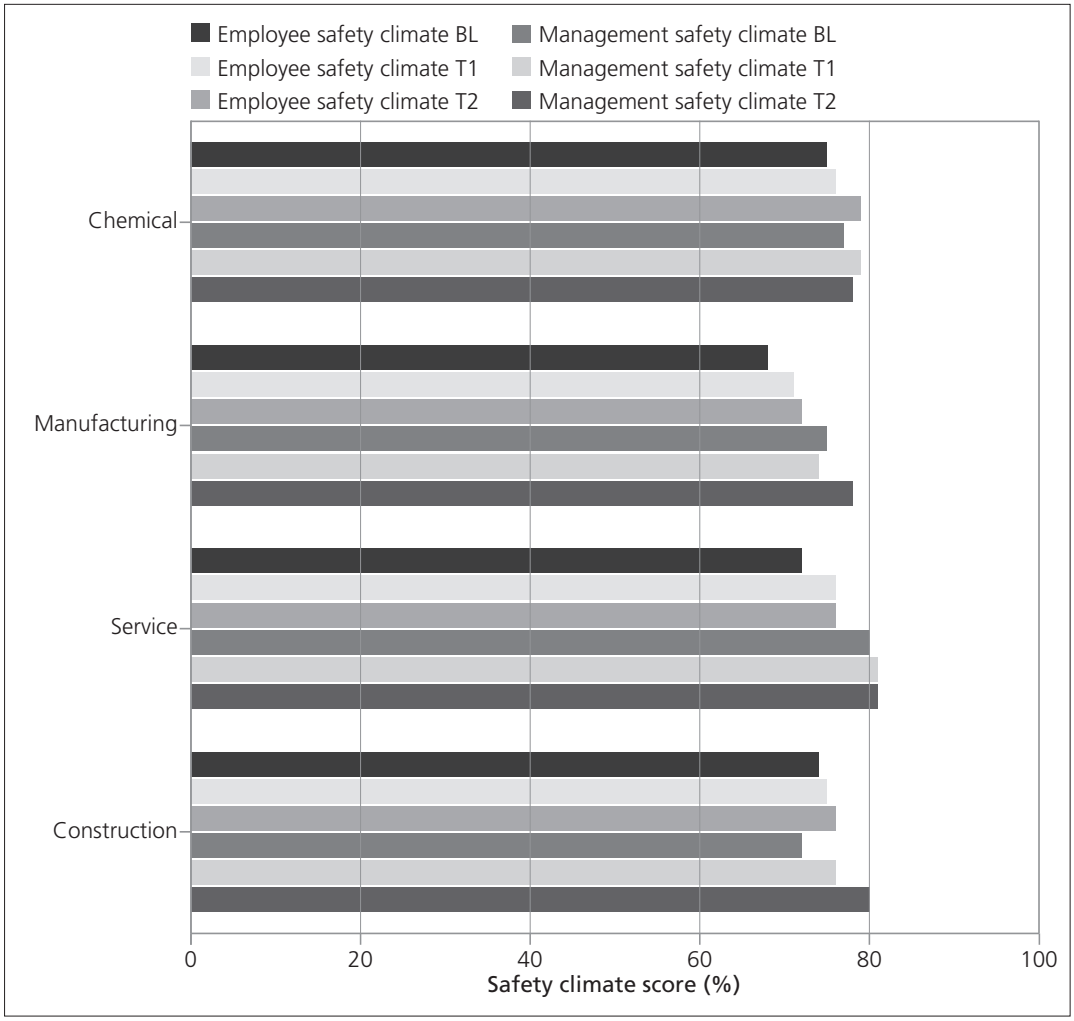


Figure 26
Overall safety climate scores over time for employees and managers displayed by industry sector

Safety climate scores improved or remained the same at T1 and T2 for employees from each industry sector. However, for managers from the chemical industry, safety climate scores increased from BL to T1 but decreased from T1 to T2. For those managers working in the manufacturing industry, while safety climate scores decreased from BL to T1, at T2 the scores increased, revealing the highest of all scores obtained at any of the three time points.

Further examination of the data was performed using the ANOVA statistical test to identify any significant differences between industry sectors (see Table 28).

Table 28
ANOVA results for employee safety climate scores over time by industry sector

Safety climate	*F*	*p*	Mean scores for each industry			
			Chemical	Manu-facturing	Service	Construc-tion
Baseline	10.112	0.000***	5.33	5.01	5.20	5.10
Time 1	15.129	0.000***	5.38	5.09	5.36	5.30
Time 2	13.469	0.000***	5.59	5.06	5.34	5.35

*** $p < 0.001$

The results reveal significant differences between the scores obtained at BL, T1 and T2 between industry sector. Further examination of the *post hoc* analysis revealed that at BL, T1 and T2, attitudes towards the existence of a positive safety climate in the chemical industry were significantly higher than for the manufacturing industry (mean = 5.33, 5.38 and 5.59 (chemical industry) 5.01, 5.09 and 5.06 (manufacturing industry)). At BL, T1 and T2, employees from the manufacturing industry reported significantly lower attitudes towards the existence of a positive safety climate than those from the service industry: mean = 5.01, 5.09 and 5.06 (manufacturing industry); 5.20, 5.36 and 5.34 (service industry).

For the employee data, the safety climate data was further analysed into 11 subscales. The results of these are presented firstly by overall sample (Figure 27), and followed by organisational size (Figures 28 and 29).

ANOVA statistical tests were performed to establish any significant differences between BL, T1 and T2 data (see Table 29). The subscale that revealed the greatest change was in relation to significant improvements in employees' perceptions of the work environment.

Table 29
ANOVA results for employee safety climate subscale scores at BL, T1 and T2

Employee data	*F*	*p*	Mean scores		
			BL	T1	T2
Management	0.003	0.997	5.47	5.47	5.47
Communication	5.011	0.007**	5.19	5.37	5.38
Safety systems	14.453	0.000***	4.96	5.26	5.26
Training	12.996	0.000***	4.99	5.28	5.28
Work environment	110.457	0.000***	3.67	4.67	4.72
Work pressure	7.347	0.001**	4.85	5.19	5.05
Equipment	1.006	0.336	5.15	5.07	5.16
Supportive environment (co-worker)	26.083	0.000***	5.48	5.23	4.96
Supportive environment (management)	9.995	0.000***	5.55	5.33	5.59
Knowledge	6.705	0.001**	5.90	5.72	5.90
Involvement	0.301	0.740	4.47	4.51	4.45

** $p < 0.01$; *** $p < 0.001$

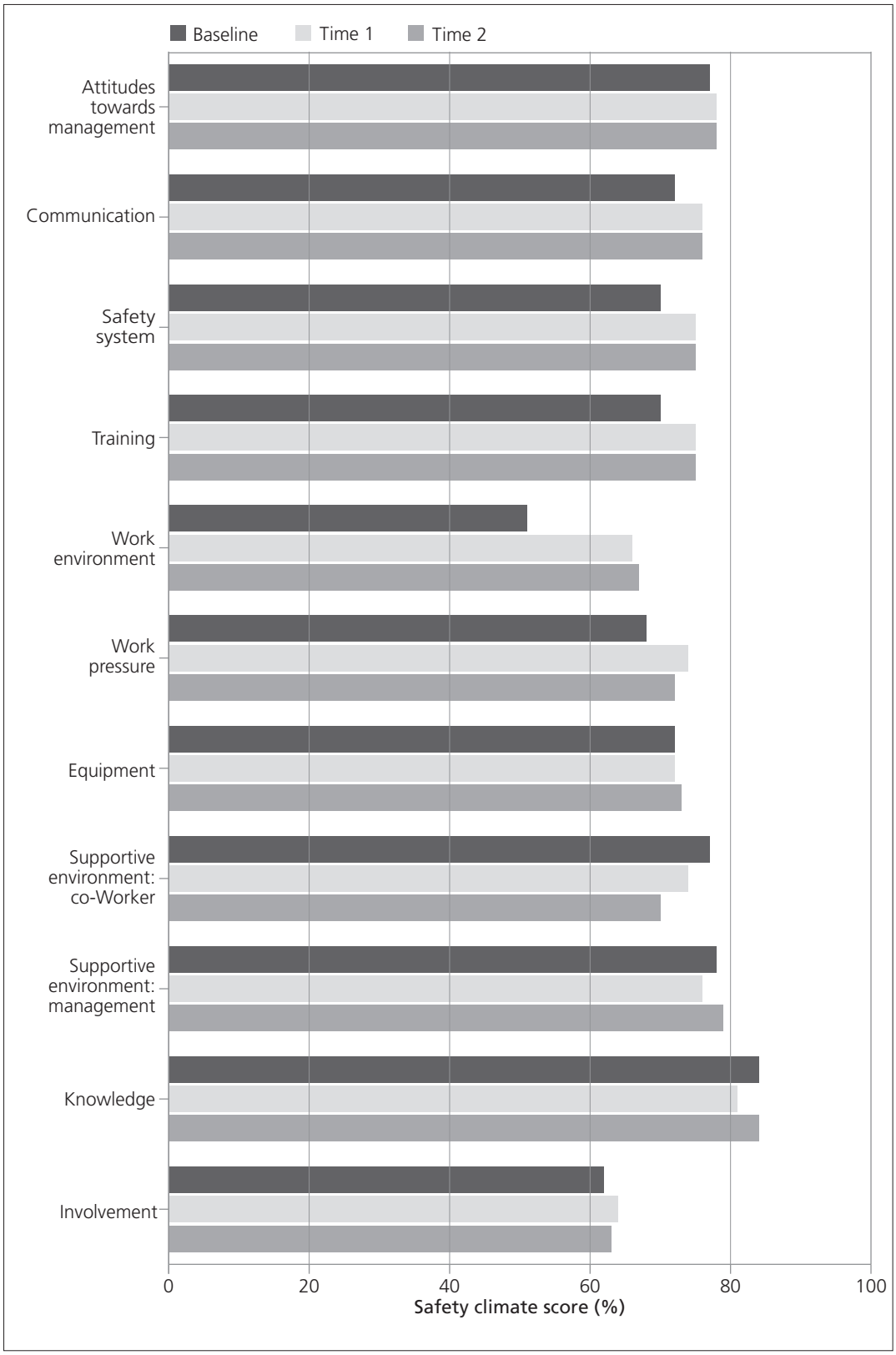


Figure 27
Safety climate subscales scores over time for the overall sample

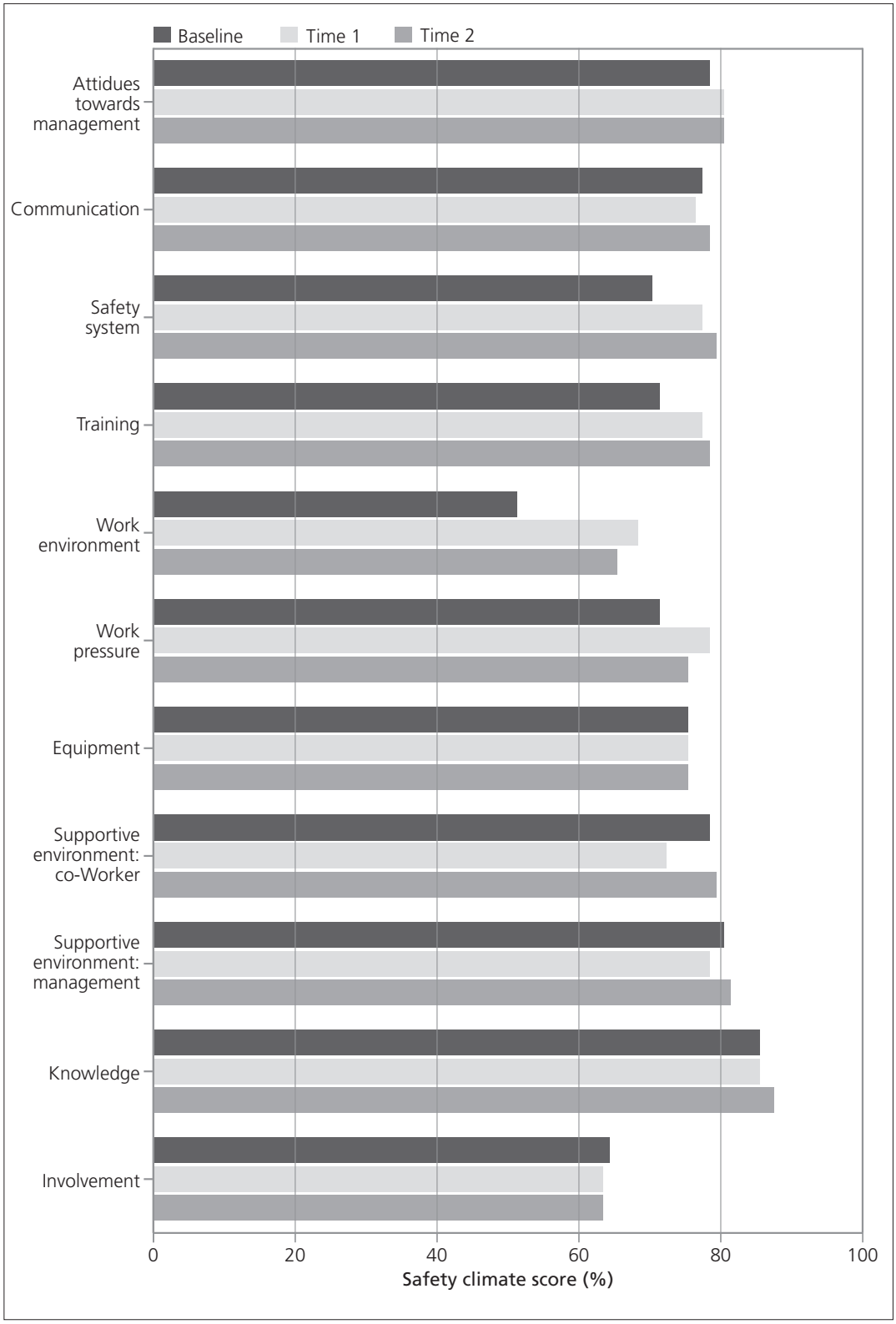


Figure 28
Safety climate subscale scores over time for SMEs

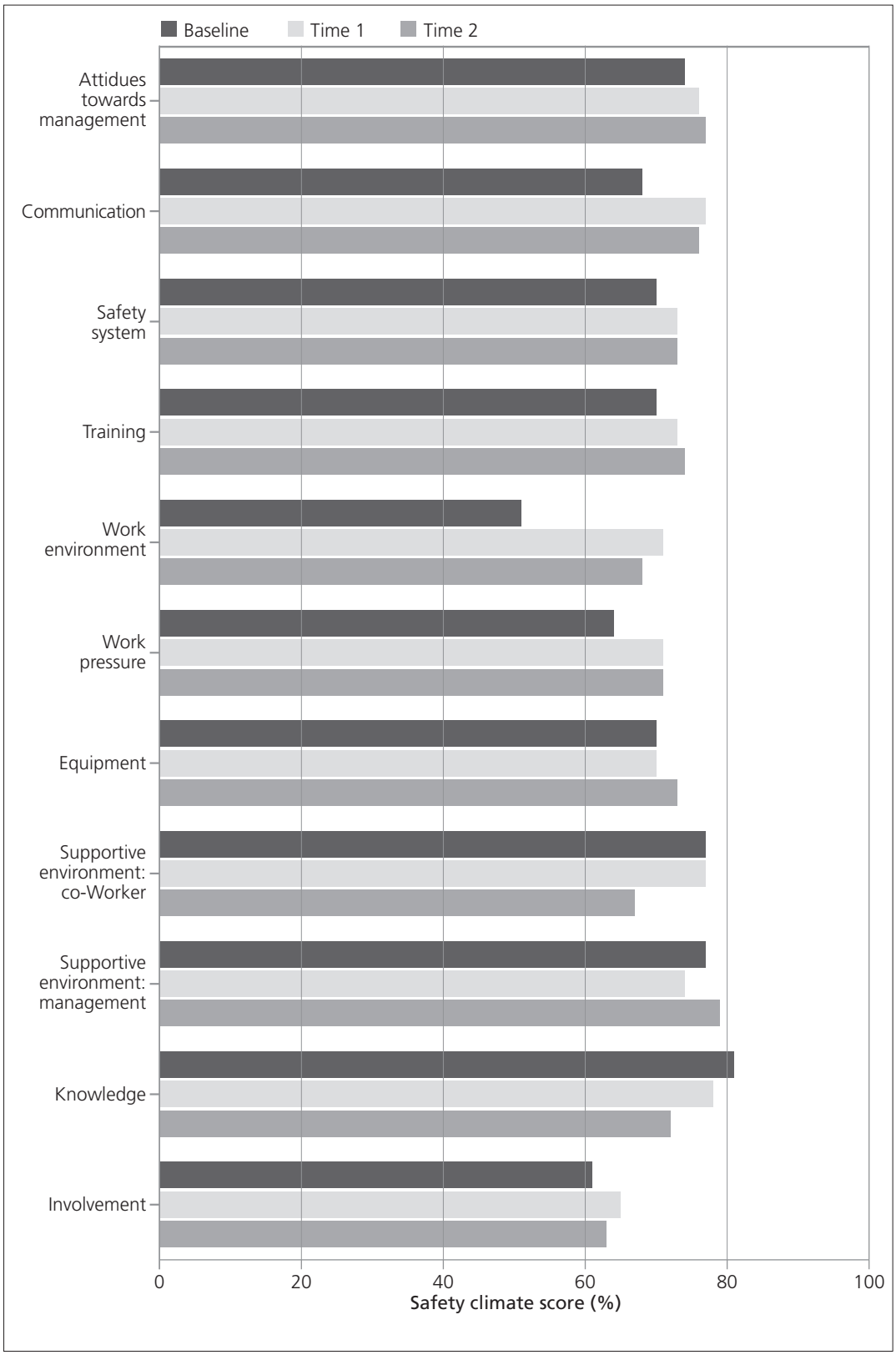


Figure 29
Safety climate subscale scores over time for large organisations

The results reveal significant differences for the following variables from BL to T1. While these improvements were then maintained at T2, no further significant improvements were identified.

- **Communication.** Significant improvements in scores from BL to T1 and BL to T2 (mean = 5.19, 5.37 and 5.38). This reveals that following the safety training interventions, employees' attitudes towards the effectiveness of health and safety communication improved from the BL data.
- **Safety systems.** Significant improvements in scores from BL to T1 and BL to T2 (mean = 4.96, 5.26 and 5.26). This reveals that following the safety training interventions, employees' attitudes towards the effectiveness of health and safety systems improved from the BL data.
- **Training.** Significant improvements in scores from BL to T1 and BL to T2 (mean = 4.99, 5.28 and 5.28). This reveals that following the safety training interventions, employees' attitudes towards the effectiveness of health and safety training improved from the BL data.
- **Work environment.** Significant improvements in scores from BL to T1 and BL to T2 (mean = 3.67, 4.67 and 4.72). This reveals that following the safety training interventions, employees' attitudes towards the safeness of the working environment improved from the baseline data.
- **Work pressure.** Significant improvements in scores from BL to T1 and BL to T2 (mean = 4.85, 5.19 and 5.05). This reveals that following the safety training interventions, employees' attitudes towards the extent of work pressure decline following the safety training interventions from the baseline data.
- **Supportive environment (co-worker).** Significant decrease in scores from BL to T1 and from T1 to T2 (mean = 5.48, 5.23 and 4.96). This reveals that following the safety training interventions, employees' attitudes towards the existence of a supportive environment from co-workers following the safety training interventions decreased from the baseline data.
- **Supportive environment (management).** Significant decrease in scores from BL to T1 and significant improvement from T1 to T2 (mean = 5.55, 5.33 and 5.59). This reveals that following the safety training interventions, employees' attitudes towards the existence of a supportive environment from management decreased form BL to T1 but then improved from T1 to T2.
- **Knowledge.** Significant decrease in scores from BL to T1 and significant improvement from T1 to T2 (mean = 5.90, 5.72 and 5.90). This reveals that following the safety training interventions, employees' attitudes towards their knowledge of health and safety decreased from the baseline data to T1 but increased from T1 to T2.

Figure 28 reveals that for SMEs, there were improvements in employees' perceptions of safety systems and training. Improvements were also evident in relation to the work environment and work pressure at T1. The pattern of findings is similar for large organisations, with improvements observed over time for safety systems, training, work environment and work pressure (see Figure 29).

5.3 Accident and injury rates

To examine the overall effectiveness of the safety training interventions using the accident and injury data provided by the management key contact in the organisation, a one-sample *t*-test was performed. The data gathered over the first and second 12 months after the safety training interventions were used for the analysis. Mean scores for the first 12 months (T1) were compared with mean scores for the second 12 months (T2). The results reveal a significant difference in the scores obtained at T1 and T2 ($t = 4.72$, $p < 0.01$). The mean scores reveal that accident rates significantly decreased at T2 from T1 following the completion of the safety training interventions.

At T1, correlation analyses revealed a small negative relationship between accident rates and employees' overall attitudes to safety climate, but this was not significant ($r = -0.083$, $p > 0.05$). Further analysis of the training subscale of safety climate revealed a negative relationship between accident rate and perceptions of the provision of training ($r = -0.111$, $p < 0.05$). This reveals that as perceptions of provision of health and safety training become more positive, accident rates decreased.

At T2, no significant correlation was established between accident rates and employee overall attitudes towards safety climate ($r = -0.065$, $p > 0.05$). Further analysis of the training subscales of safety climate did not reveal any significant relationships ($r = -0.032$, $p > 0.05$).

6 Results: objective 3 – examination of the training–performance relationship

6.1 Rationale

In order to assess objective 3, potential moderators (industry sector and size of organisation) were tested for their effect on the relationship between training and performance (see Figure 30).

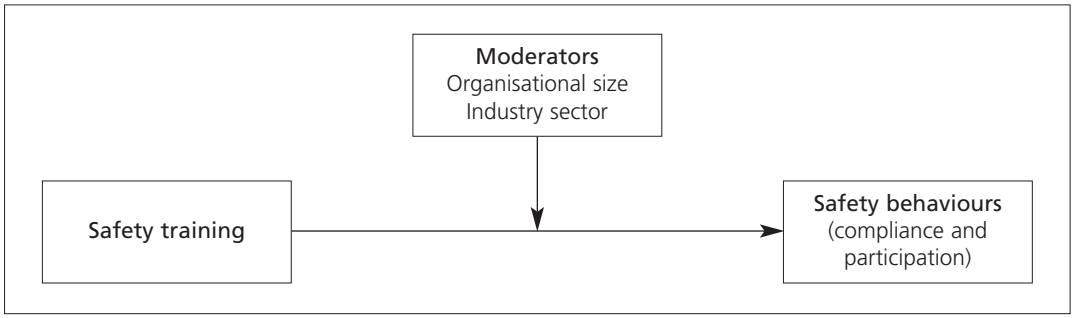


Figure 30
Moderators potentially affecting the relationship between safety training and safety performance (compliance and participation)

6.2 Performance data at BL, T1 and T2

Safety performance was measured using two indicators of safe behaviour: compliance and participation. Compliance refers to the extent to which employees follow safety rules, regulations and procedures. It reflects 'in-role' behaviour (that is, employees engage in the type of behaviour that is expected and forms part of their job role). Participation refers to the extent to which employees are willing to engage in safety-related behaviour, such as helping work colleagues, attending safety training, making suggestions for safety improvements and so on. These behaviours are often 'extra-role', as they have a voluntary element and are not strictly required within the individual's job role. There is evidence that both types of behaviour are associated with a positive safety climate[42] and lower accident rates.[23] It would be expected that safety training would result in improved levels of both compliance and participation over time.

To establish any significant differences in compliance and participation scores for employees from SMEs and large organisations and each industry sector, the ANOVA statistical test was performed. The results are presented in Table 30. The results reveal that compliance with safety rules differed significantly across industrial sectors ($F = 2.49$, $p < 0.01$). Further, post hoc tests revealed that the chemical industry had significantly higher safety compliance scores than the manufacturing and service industries (mean = 6.02, 5.79 and 5.72 respectively). There was no significant effect for organisational size or the interaction between size and industry (although the latter approached significance at $p = 0.055$).

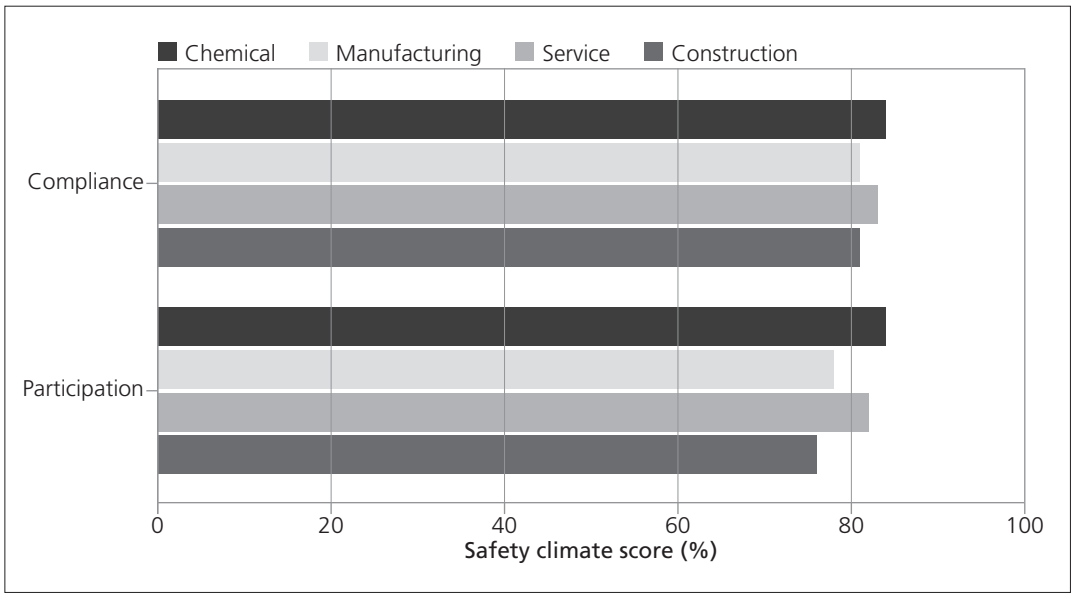
	F	Significance
Compliance scores		
Size	0.271	0.846
Industry	2.494	0.008**
Size × Industry	2.695	0.055
Participation scores		
Size	0.006	0.937
Industry	3.015	0.001**
Size × Industry	0.441	0.724

** $p < 0.01$

Table 30
ANOVA results for compliance and participation scores by organisational size and industry sector

For participation in safety activities, the results reveal significant differences were established within industry sector ($F = 3.02$, $p < 0.01$). Further *post hoc* tests revealed that organisations from the chemical industry presented significantly higher participation than employees from the manufacturing and construction sectors (mean = 5.88, 5.49 and 5.35 respectively). Furthermore, employees from the service sector reported significantly higher participation than those from the manufacturing sector (mean = 5.74 and 5.49 respectively). Significant differences in scores for industrial sector are shown in Figure 31.

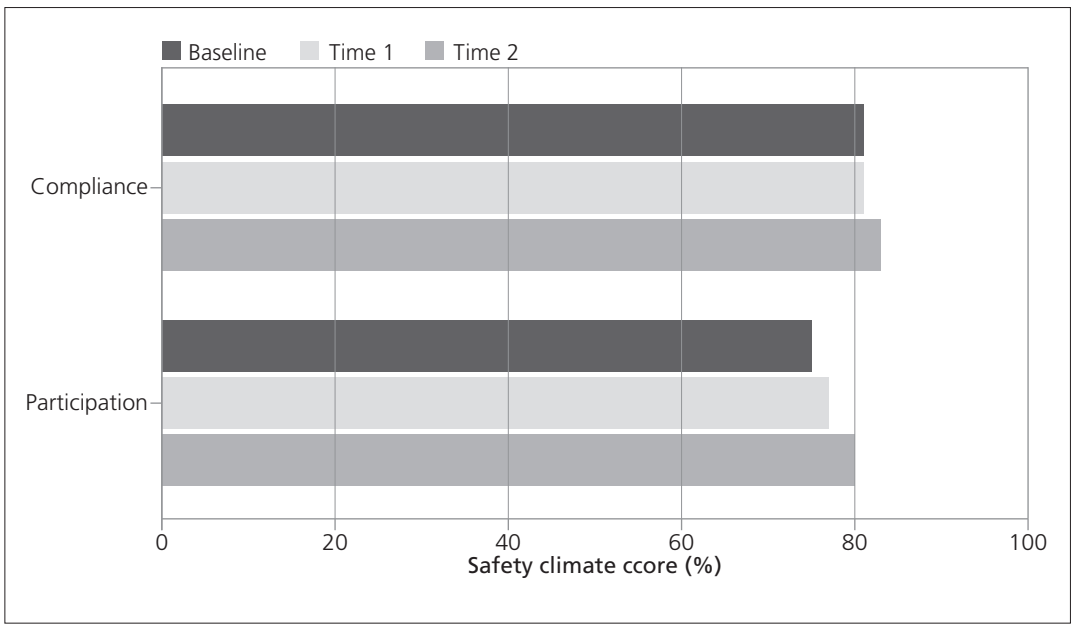
Figure 31
Compliance and participation scores for each industry sector



Overall, the chemical industry reported the highest scores for compliance and participation. For compliance, the manufacturing and construction industry reported the lowest scores. For participation, the construction industry reported the lowest scores.

The compliance and participation data obtained at the three time points for the overall sample is presented in Figure 32.

Figure 32
Change in compliance and participation scores over time



The results reveal that both compliance and participation either remained the same or improved at T1. While improvements were established in both scores from T1 to T2, a series of t-tests confirmed no significant improvements in compliance scores obtained between T1 and T2. However, for participation, a significant improvement was established between BL and T1 ($t(1539) = 2.423$, $p < 0.05$). No significant improvement was established at T2 for participation.

This trend was the same for both SMEs and large organisations (see Figures 33 and 34).

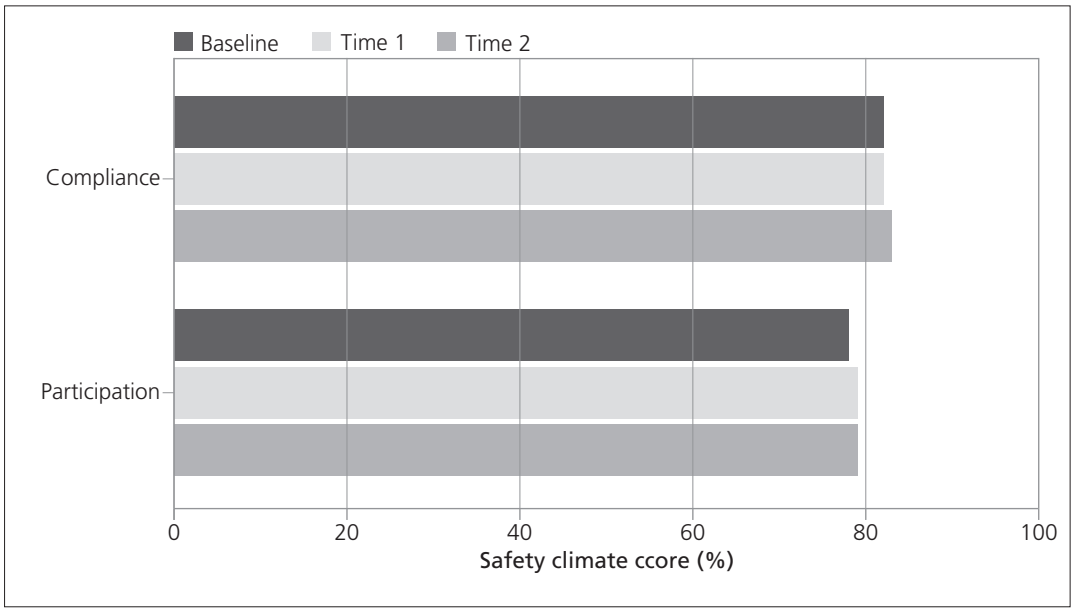


Figure 33
Change in SME compliance and participation scores over time

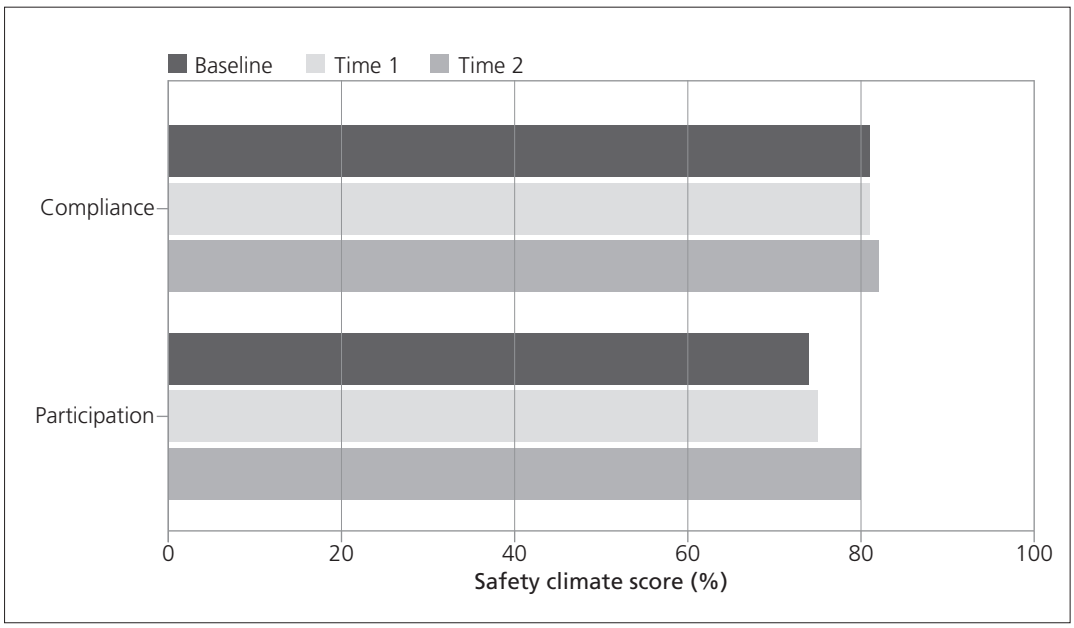


Figure 34
Change in large organisations' compliance and participation scores over time

The changes in both types of safety behaviour are displayed by organisation in Figures 35 and 36 and by industry in Figures 37 and 38. In seven of the 10 organisations, safety compliance increased as a result of the interventions (at either T1 or T2 or both). For safety participation, increases were observed in eight of the 10 organisations (at either T1 or T2 or both).

Figure 35
Change in compliance scores over time displayed by organisation

Figure 36
Change in participation scores over time displayed by organisation

Figure 37
Change in compliance scores over time displayed by industry

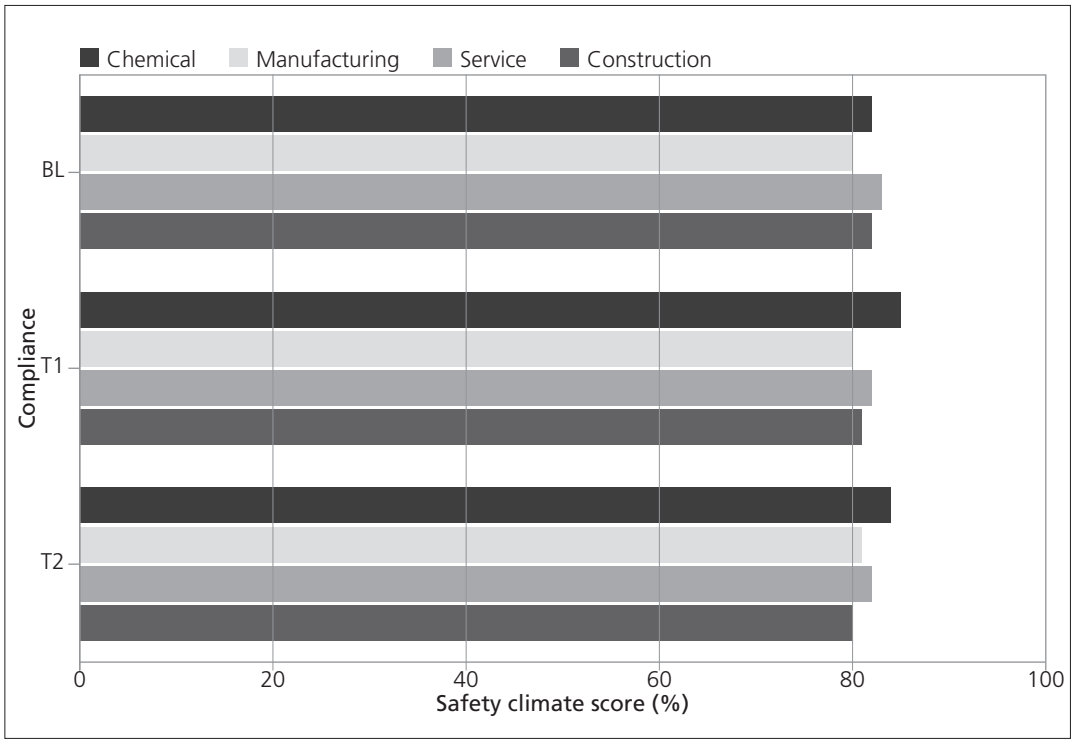
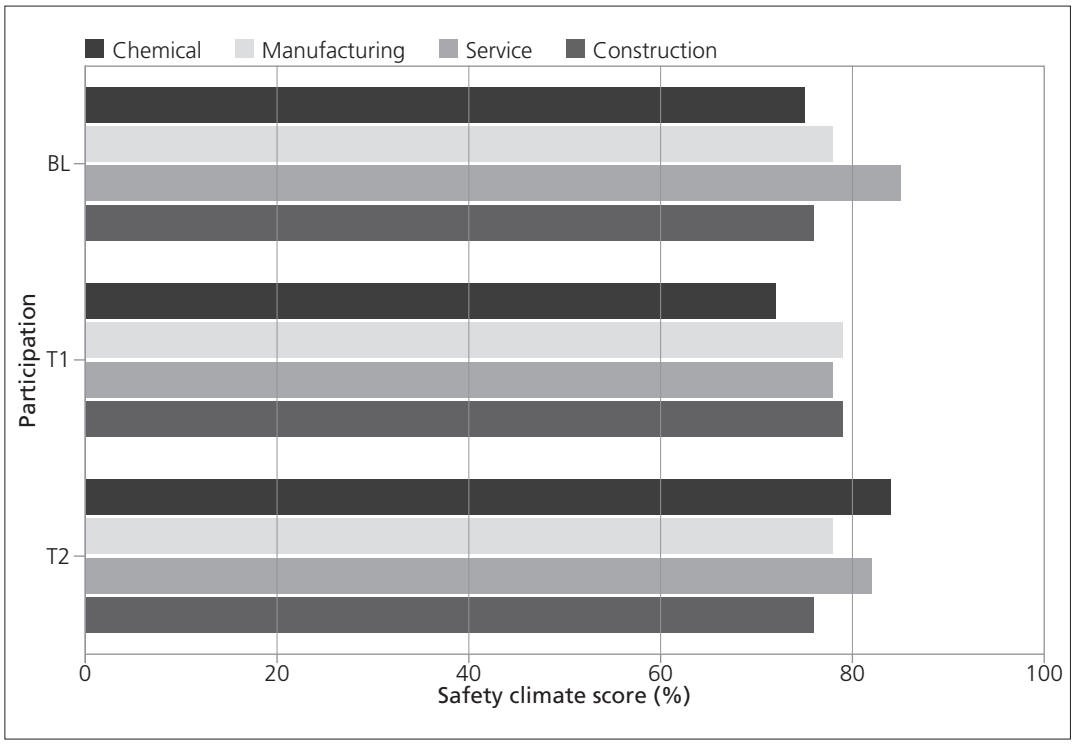


Figure 38
Change in participation scores over time displayed by industry



Further analysis reveals that for compliance, employees from the chemical industry reported significantly higher mean scores at T1 than those from the manufacturing or service sectors (mean = 6.00, 5.60 and 5.79 respectively). For participation, signficant differences in scores were only reported at T2. The results reveal that the chemical industry reported significantly higher participation scores than the manufacturing and construction sectors (mean = 5.8, 5.4 and 5.3 respectively). The manufacturing sector reported significantly higher scores than the service sector (mean = 5.7 and 5.4 respectively) and the service sector reported significantly higher scores than the construction sector (mean = 5.7 and 5.3 respectively).

6.3 Section summary

It is evident from this section that the impact of the interventions on safety-related behaviour was not as substantial as the effect on safety climate. Participation was affected to a greater extent than compliance, which was already at a comparatively high level. There was little difference in the results for SMEs compared to large organisations, suggesting that organisational size does not act as a moderator in terms of the impact of training interventions. There was significant variation in the norms for participation across different industries, and the impact of the interventions varied across industries, although there was a general trend for participation to improve over time. It is likely that industrial sector does have a significant moderating effect on the impact of the interventions, but this requires further investigation.

7 Discussion: objective 4 – to investigate the long term effects of training in relation to the maintenance and promotion of a positive safety culture

7.1 Rationale

In order to assess objective 4, data gathered and analysed in relation to objectives 1–3 was used for the longitudinal investigation of the impact of safety training interventions on safety culture in the participating companies.

7.2 Evidence of the promotion and maintenance of safety culture

Cooper[43] describes safety culture as 'the product of multiple goal-directed interactions between people (psychological), jobs (behavioural) and the organization (situational)' (p. 118). Safety culture represents the dynamic interplay between these three elements. This is consistent with models of organisational culture that emphasise the different layers that reflect a company's safety culture. For example, Guldenmund[44] conceptualised safety culture as comprising three layers: the outer layer (visible artefacts); the middle layer (espoused values and attitudes); and the core (basic assumptions). The basic assumptions regarding the value of safety must be deduced from espoused values and artefacts, as these are more explicit and directly measurable. Therefore, evidence that the training interventions in the current research had a significant impact on the organisations' underlying safety culture should be demonstrated across psychological, behavioural and situational aspects. Evidence that these more explicit elements have changed would suggest that the underlying values of the organisation (the core of safety culture) have also shifted.

7.2.1 Findings relating to psychological elements

One of the primary elements of safety culture relates to people (psychological factors). The present research focused on a number of psychological measures to gauge the impact of the interventions on safety culture, including safety attitudes, perceptions of safety climate, employee safety motivation, knowledge and involvement. Perceptions of safety climate were measured at three time points: at baseline, 12 months (T1) and 24 months (T2) following the interventions. The study found that safety climate improved from BL to T1 and from T1 to T2 (a significant linear trend). The greatest improvement for most safety climate subscales was evident from baseline to T1 (with the increase maintained at T2), including safety communication, training, safety systems and work pressure. Perceptions of the work environment improved most substantially, with improvements being made at both T1 and T2. This indicates that even though awareness of health and safety hazards increased, the work environment was still perceived to become less hazardous over time. Changes in safety perceptions were observed for both employees and managers.

Employee motivation was the major psychological variable to change as a result of the interventions over time. Although it was expected that safety knowledge would improve, no significant change was observed. This might have been due to the high level of safety knowledge already reported at BL. However, it was motivation, rather than involvement, which demonstrated most change over time.

7.2.2 Findings relating to behavioural elements

Safety culture is expressed not only in attitudes and perceptions, but also in behaviour. Safety-related behaviour is an important aspect of safety culture, as it has been linked directly with involvement in occupational accidents.[42] The current research used self-reported measures of safety compliance (following rules and regulations) and safety participation (engagement in safety-related activities), as well as objective reports (from the organisations) of minor injuries following the implementation of the interventions.*

A small but significant improvement was found for safety compliance, with this measure improving from T1 to T2. This confirmed the perceptions of managers (based on the qualitative findings from the evaluation tool) that employee compliance with health and safety procedures had improved as a result of the interventions. Nevertheless, the behaviour that demonstrated the most significant change

* It was originally intended to include behavioural observations as an objective measure of employee behaviour. However, in consultation with the participating organisations, these observational data were not collected, because of the difficulty of identifying suitable behaviours for observation that satisfactorily reflected the range of behaviour affected by the interventions.

over time was safety participation. This demonstrates that employees were more willing to engage in safety-related activities. This also confirms the perceptions of managers that employees were more willing to get involved in initiatives (including health and safety initiatives, but other workplace initiatives as well). The objective measure of occupational injuries demonstrated that significantly fewer minor injuries were recorded following the interventions. Overall this measure showed a 22 per cent reduction, with all organisations except one recording a significant decline in minor accidents. One organisation recorded the same number of accidents over the two 12-month periods, but this was very low in both periods.

7.2.3 Findings relating to situational elements

Situational elements rarely change as a result of training interventions, which are usually targeted at individual employees (in terms of changing knowledge, skills, attitudes and behaviour). However, in the present research, situational changes were observed in terms of organisations' safety systems, procedures and communications. The training interventions were designed to embed learning at both an individual and an organisational level. Thus, the interventions involved:

- reviewing processes and procedures
- introducing near-miss reporting procedures
- health and safety appraisals
- improvements to communication channels, such as the use of safety bulletins.

Employees reported that they felt they had greater opportunity to contribute to the decision-making process and that their general awareness of health and safety issues had increased. Situational changes were reflected in the specific safety climate subscales that demonstrated improvements – safety systems, communication and training. The greatest effect was in terms of the work environment, indicating that changes were perceived by employees in their day-to-day working environment.

7.3 Understanding the findings in relation to the study limitations

No applied research is without its limitations. Consequently, there were several limitations affecting the study design and data analysis, which should be taken into account alongside the study's findings.

7.3.1 Study design

The use of control groups (no intervention) would have strengthened the design of the study. Unfortunately, this was not possible, largely because of the nature of the organisations included in the sample. Many were SMEs, where companies wanted to introduce the interventions across their small company or to specific departments (where there was no equivalent department to use as a control). It is difficult to persuade companies of the benefits of participating in a design that involves control groups. Therefore, there are potential threats to the internal validity of the study introduced by the nature of the study design. For example, it is not possible to rule out the possibility that any improvements observed in the outcome measures were due to the 'Hawthorne effect' (ie due to the attention of the research team) rather than the interventions themselves. However, given the findings of the evaluation tool, which indicated that both managers and employees viewed the interventions as having a favourable effect on a number of outcome measures, this is unlikely.

7.3.2 Questionnaire

Some of the questionnaire subscales had lower levels of internal consistency than desired. The subscales remained unchanged due to the need for comparability over the three time points, so no incremental improvement to the scales was possible during the project. Further development of the questionnaire is recommended in the future.

7.3.3 Potential moderating factors

The project considered organisational size and industry as possible moderators. However, there are likely to be additional moderators that were not investigated, including training delivery and the relative influence of the different interventions. Given that the interventions were delivered in a consistent manner across companies, it is unlikely that delivery had much of an effect in the current project. It is the case that interventions differed somewhat between companies. However, it would have been difficult to tease out these moderating effects in the current study. For example, interventions to improve safety systems were more extensive in SMEs than larger organisations, and would be confounded with organisational size. However, it is recommended that future research examine the effect of a wider range of potential moderators. A further factor that would influence the relative effectiveness of training interventions would be the appropriateness of the interventions for the company. Therefore it is recommended that training needs analysis be conducted at the baseline in

order to identify the most appropriate interventions, and also that training validation be conducted after interventions, as well as the evaluations at subsequent time points. This would be critical in ensuring the appropriate interventions are applied.

7.4 Conclusions

Significant changes were demonstrated across psychological, behavioural and situational elements of the safety culture. This would suggest that each of these elements supports a change in the underlying safety culture of participating companies. These changes were observed over a 24-month period, suggesting that these are long term changes that can be sustained over time. These findings support the evaluation data from both managers and employees that they believed that their company safety culture had improved as a result of the interventions. Importantly, this change in safety culture was not viewed in opposition to productivity, as this was also perceived to have improved significantly.

8 Practical implications: objective 5 – to establish industry guidelines for best practice in implementing training interventions to improve safety

8.1 Rationale

An assessment of all the information gathered from objectives 1–4 provided the data needed to develop the main deliverable of the project, the industry guidelines on best practice.

8.2 Recommendations for best practice based on the research findings

1 The interventions were designed to specifically target health and safety issues identified as problems for the participating organisations, rather than being a generic 'off-the-shelf' training programme.
2 The first step in the intervention programme was the implementation of health and safety appraisal to identify training needs. This process was embedded into organisations as an annual occurrence so that it would become an established organisational process. The interventions included training in the effective use of appraisals and the identification of training needs.
3 The interventions were designed so that they could be integrated into the organisations' existing systems and were aligned with their business objectives. Therefore, the interventions were not viewed by managers or employees as isolated or separate from the organisations' general operations.
4 The interventions were embedded into the companies' processes and procedures. This meant that the positive benefits of the interventions were developed over 12 months and then maintained for a further 12 months. However, in order to see further improvements, additional interventions would be necessary. The ongoing use of the health and safety appraisal system would provide the opportunity to identify and implement additional interventions over time.
5 Training is often viewed simply as a means of improving safety knowledge in a specific area, leading to better compliance with safety procedures. However, when integrated into a broader safety intervention programme, training can have a wide range of benefits, particularly in terms of enhancing employee safety motivation and participation. In the current study, training was used not only to increase safety knowledge, but to enhance awareness of hazards. This was noted in the evaluation of the interventions as being a positive benefit.
6 The changes in the safety climate reflected aspects that had been targeted by the interventions, including communication, safety systems, work environment and work pressure, as well as perceptions of training. This demonstrates the importance of locating training within a broader context of safety interventions in order to achieve long term positive effects on the safety climate.
7 Training is often viewed as a safety measure aimed at employees. However, the intervention programme included training workshops for managers. This training resulted in significant enhancements to managers' leadership style over time.
8 Training needs to be viewed as an investment, rather than an expense. The training interventions resulted in a significant reduction in accidents and lasting improvements in the safety climate (over two years). This is an important finding, as it highlights the long term benefits of training interventions for organisations. Such benefits should be weighed against some of the barriers identified by managers – such as economic pressures, competing priorities and lack of resources.
9 Gaining senior management commitment to the interventions and specifically allocating employees' work time to becoming involved in the project were the main enablers and contributed to the success of the project.
10 The baseline data demonstrated some significant differences by organisational size and industry in the initial safety climate that existed in the organisations. However, as the interventions were specifically tailored for the companies involved, significant safety outcomes were demonstrated across the organisations, regardless of their size or industrial sector. Therefore, the findings could be generalised across organisations and are likely to be widely applicable.

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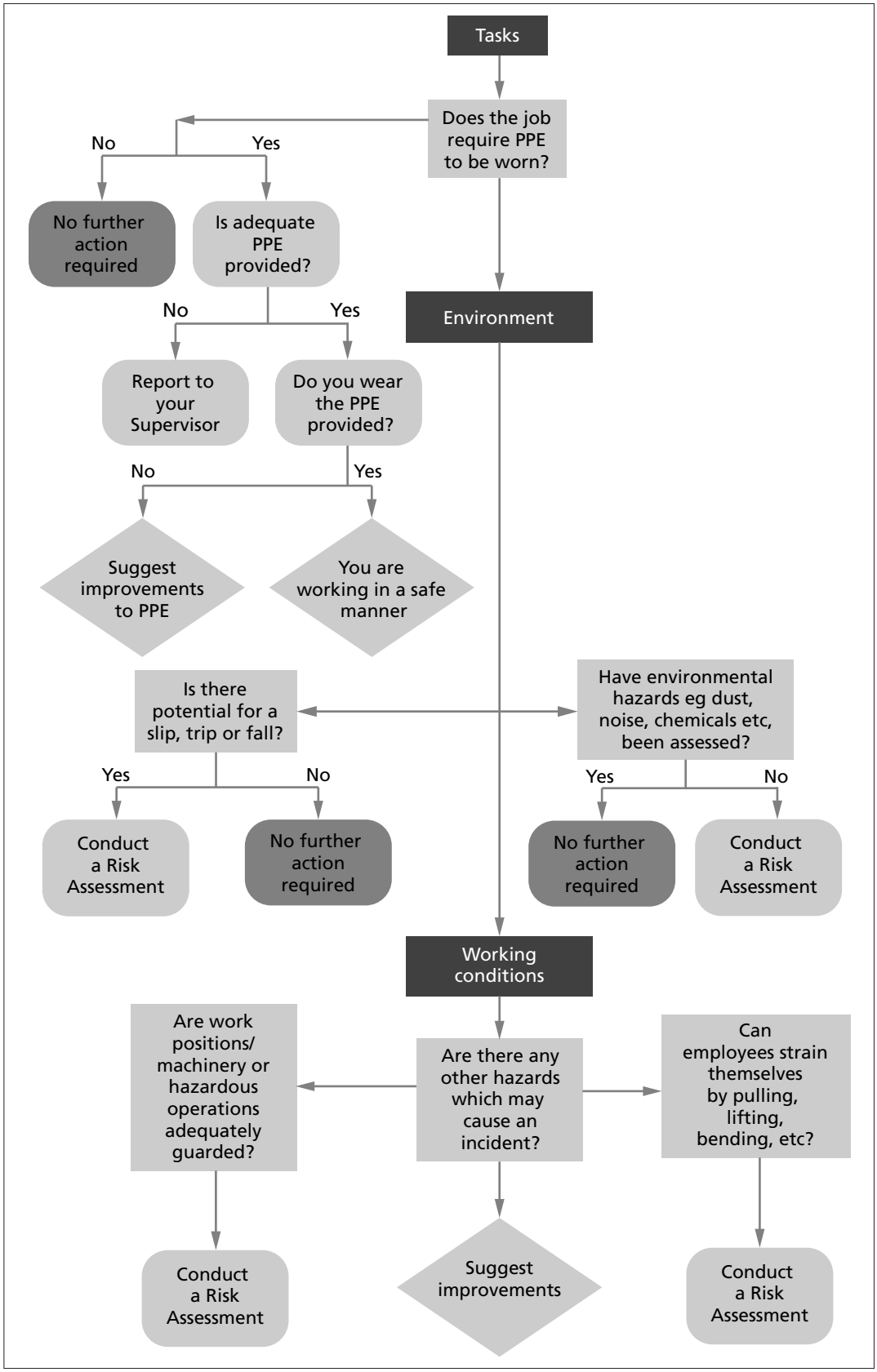
Appendix 1: Health and safety appraisal

Part A: to be completed by appraisee	
Name:	Department:
Position:	Time in present position:
Date:	Appraiser:
Part B: To complete before the interview and return to the appraiser by (date)	
B1: Please state your understanding of how you conduct your main duties and responsibilities in a safe working manner.	
B2: What elements of your job do you find most difficult? Are there any aspects of health and safety which could improve these elements?	
B3: What health and safety action could be taken to improve your performance in your current position?	
B4: What sort of health and safety training / experiences would benefit you in the next year?	
B5: Score your own capability or knowledge in the following areas in terms of your current role requirements (1–3 = poor, 4–6 = satisfactory, 7–9 = good and 10 = excellent). • Wearing the correct Personal Protective Equipment (PPE) __ • What to do during a fire drill __ • Identifying hazards in your workspace __ • Understanding the meaning of safety signs __ • Understanding the Company Health and Safety policy __ • Keeping your workspace clean and tidy __ • Your health and safety responsibilities __	
Part C: to be completed during the appraisal by the appraiser	
C1: Describe the purpose of the appraisee's job. Discuss and compare with entry in B1–B4. Clarify any points as appropriate.	
C2: Discuss the appraisee's capability or knowledge in the following areas in terms of their current role requirements. Compare scores with B5 and discuss. • Wearing the correct Personal Protective Equipment (PPE) __ • What to do during a fire drill __ • Identifying hazards in your workspace __ • Understanding the meaning of safety signs __ • Understanding the Company Health and Safety policy __ • Keeping your workspace clean and tidy __ • Your health and safety responsibilities __	
C3: Discuss and agree areas of health and safety development and training for the next year. Compare with B5. Set health and safety goals / targets against SMART objectives. • Specific • Measurable • Agreed • Realistic • Timebound	

Part D: when Part C has been completed, both parties to sign and date	
Appraisee name:	Appraiser name:
Signed:	Signed:
Date:	Date:

Appendix 2: Example job hazard checklist



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