Strategies to promote safe behaviour as part of a health and safety management system

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Strategies to promote safe behaviour as part of a health and safety management system

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Promoting safe behaviour at work is a critical part of the management of health and safety, because behaviour turns systems and procedures into reality. On their own, good systems do not ensure successful health and safety management, as the level of success is determined by how organisations 'live' their systems.

This report provides the reader with an understanding of:

- the theory underpinning strategies to promote safe behaviour;
- the key elements of programmes to promote safe behaviour which are currently in use;
- how to use behavioural strategies to promote a wider range of critical health and safety behaviours;
- how to integrate behavioural strategies into a health and safety management system.

The behavioural programmes currently in use within the UK focus on promoting safe behaviour among frontline staff. These programmes therefore exclude a large proportion of other behaviours that influence health and safety performance. There is potential to extend the behaviour modification principles and strategies currently used, to encourage and promote behaviours which support the health and safety management system (HSMS) and the development of a positive health and safety culture.

Behavioural programmes have become popular in the safety domain, as there is evidence that a proportion of accidents are caused by unsafe behaviour. Whilst a focus on changing unsafe behaviour into safe behaviour is appropriate, this should not deflect attention from also analysing why people behave unsafely. To focus solely on changing individual behaviour without considering necessary changes to how people are organised, managed, motivated, rewarded and their physical work environment, tools and equipment can result in treating the symptom only, without addressing the root causes of unsafe behaviour.

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EXECUTIVE SUMMARY

Promoting safe behaviour at work is a critical part of the management of health and safety, because behaviour turns systems and procedures into reality. Good systems on their own do not ensure successful health and safety management, the level of success is determined by how organisations 'live' their systems[1].

This report aims to provide the reader with an understanding of:

- The theory underpinning strategies to promote safe behaviour
- The key elements of programmes in use to promote safe behaviour
- How to use behavioural strategies to promote critical health and safety behaviours
- How to integrate behavioural strategies into a health and safety management system.

Currently within the UK a range of terms are used to describe strategies to promote safe behaviour, including:

- Safety behaviour modification
- Behaviour-based safety
- Behavioural safety management systems
- Safety observation systems.

Although many different terms are used for these strategies, they are all forms of behaviour modification. There is strong research evidence that behaviour modification techniques can be effective in promoting critical health and safety behaviours, provided they are implemented effectively.

The behaviour modification programmes currently in use within the UK focus on promoting safe behaviour among frontline staff. These programmes therefore exclude a large proportion of the behaviours that influence health and safety performance. There is potential to extend the behaviour modification principles and strategies currently used, to encourage and promote behaviours which support the health and safety management system (HSMS) and the development of a positive health and safety culture.

Strategies to promote health and safety behaviours are both a part of, and support, the HSMS. These strategies are a part of the HSMS as they are a type of risk control strategy and they support the HSMS because they increase the likelihood that rules and procedures are used in practice.

Behaviour modification programmes have become popular in the safety domain, as there is evidence that a proportion of accidents are caused by unsafe behaviour. Whilst a focus on changing unsafe behaviour into safe behaviour is appropriate, this should not deflect attention from analysing <u>why</u> people behave unsafely. To focus solely on changing individual behaviour without considering necessary changes to how people are organised, managed, motivated, rewarded and their physical work environment, tools and equipment can result in treating the symptom only, without addressing the root causes of unsafe behaviour.

1 INTRODUCTION

It is widely accepted that effective risk control depends in part on the behaviour of individuals at all levels within an organisation. In other words good systems, procedures and engineering controls on their own are not enough, it is how well an organisation 'lives' its systems that matters. Behavioural safety techniques improve health and safety risk control by promoting behaviours critical to health and safety.

Over the past few years, there has been a significant increase in the use of behavioural safety programmes in the UK. They are now routinely used in a wide range of industry sectors, from construction to food processing. Behavioural safety techniques are based on a large body of psychological research into the factors that influence behaviour. This research has led to the development of a range of techniques to influence behaviour. Behaviour modification is the psychological term for these techniques. There is strong research evidence that behaviour modification techniques are effective in promoting desired health and safety behaviours[2], provided they are implemented thoroughly, with continued support from management.

Within the health and safety context, behaviour modification techniques tend to be used to promote the safe behaviours which will prevent individual members of frontline staff being injured, rather than critical behaviours required to manage major accident hazards effectively. The impact of behaviours included in current programmes tends to be limited to the individual or their immediate colleagues (e.g. wearing the correct personal protective equipment). Behaviour modification techniques could be used more effectively by expanding their application. They could be used to promote:

- Critical health behaviours (e.g. medical staff washing their hands after an examination)
- Management behaviours (e.g. demonstrating health and safety leadership)
- Risk control behaviours (e.g. following operating procedures).

Behaviour modification techniques can be used to promote positive health and safety behaviours of the entire workforce, not just frontline staff.

This report provides managers and safety specialists with an overview of behaviour modification principles and how to apply them to promote critical health and safety behaviours. The remainder of this document is set out as follows:

Section 2: Outlines the theory underpinning behaviour modification techniques

Section 3: Summarises the key elements of behavioural safety programmes aimed at frontline staff

Section 4: Reviews the evidence of the effectiveness of behaviour modification programmes

Section 5: Describes how behaviour modification techniques can be used to promote critical health and safety risk control behaviours, including management behaviours

Section 6: Provides a framework to integrate behavioural techniques within a health and safety management system

Section 7: Draws general conclusions.

2 BEHAVIOUR MODIFICATION THEORY

The core element of behaviour modification is the ABC model of behaviour, Antecedents (A) Behaviour (B) and Consequences (C)[3]. The ABC model specifies that behaviour is triggered by a set of antecedents (something which precedes a behaviour and is causally linked to the behaviour) and followed by consequences (outcome of the behaviour for the individual) that increase or decrease the likelihood that the behaviour will be repeated. The antecedents are necessary but not sufficient for the behaviour to occur. The consequences explain why people adopt a particular behaviour.

Box 1: ABC model of behaviour

Antecedents *Causal event (trigger) preceding the behaviour*	**Behaviour** *Observable thing that someone does or doesn't do*	**Consequences** *Outcome of the behaviour for the individual that influences the likelihood that the behaviour will be repeated*
A Hear telephone ringing	**B** Lift telephone receiver	**C** Have an interesting conversation with a friend
A Hear telephone ringing	**B** Do not lift receiver, let the answering machine pick up message	**C** Continue working uninterrupted

The example in box 1 illustrates a number of points. Firstly it demonstrates the role of antecedents, because if the individual did not hear the telephone then they would not pick up the telephone receiver. Secondly, it highlights the fact that it is the consequences for the individual that drives their behaviour, because in both instances, the individuals heard the telephone ring but in the second, the person did not lift the receiver because working uninterrupted was, for them, a more positive consequence than conversing with a friend.

ABC analysis facilitates the identification of ways to change behaviour, by ensuring the appropriate antecedents are in place and that the consequences support the desired behaviour.

The ABC model is equally applicable to promote health and safety behaviours. For example, ABC analysis could be conducted to investigate why workers do not currently wear their ear defenders in noisy environments (see table 1), and identify how to promote wearing of ear defenders and thus reduce hearing damage.

Table 1 Example of ABC analysis

Antecedents	Behaviour	Consequences
Ear defenders supplied by company Required by company to wear ear defenders in specific areas Knowledge of potential damage to hearing if ear defenders are not worn Signs highlight areas where defenders are needed Noisy environment …etc.	Wearing ear defenders in noisy environments	Reduces the likelihood of hearing loss in the future Less likely to get into trouble with management for not wearing ear defenders Difficulty hearing their radio Discomfort of wearing ear defenders …etc.
Peers do not wear ear defenders Knowledge that rules on wearing ear defenders are not enforced …etc.	Not wearing ear defenders in noisy environments	Impaired hearing in the future Avoid discomfort of wearing defenders Able to hear better in the noisy environment …etc.

The example in Table 1 shows the complexity of behavioural analysis. In this example, the antecedents are in place for the desired behaviour to occur, as employees are supplied with ear defenders, they are required to wear them, signs highlight where they are needed and they know that noise may damage their hearing. Although the antecedents are in place, many staff do not wear their ear defenders, because they find the consequences of not wearing their ear defenders more attractive (reinforcing) than the consequences of wearing their ear defenders. The following section describes how consequences drive behaviour.

2.1 ANTECEDENTS TRIGGER BEHAVIOUR

Antecedents come before the behaviour, and help to trigger the behaviour. Examples of antecedents include rules and procedures, suitable tools and equipment, information, signs, skills and knowledge, training and knowledge of other people's expectations etc.

Whilst antecedents are necessary to help trigger behaviour, their presence does not guarantee a behaviour will occur. For example, the existence of safety rules and procedures does not ensure safe behaviour will occur. However, in the example in Table 1, providing antecedents such as knowledge about the long-term effects of noise exposure on hearing, and signs indicating where ear defenders should be worn are important in helping to trigger the desired, safe behaviour. Antecedents are necessary for a behaviour to occur, but are not sufficient to ensure the behaviour is maintained over time. To maintain a behaviour over time also requires significant individual consequences.

2.2 HOW CONSEQUENCES DRIVE BEHAVIOUR

Consequences are defined as the outcome of the behaviour for the individual that influences the likelihood that the behaviour will be repeated. Therefore, the frequency of a behaviour can be increased or decreased by altering the consequences following that behaviour.

There are three main types of consequences that influence behaviour. These are:

- **Positive reinforcement,**
- **Negative reinforcement**
- **Punishment**.

Positive and negative reinforcement, increase the likelihood that a behaviour will be repeated, while punishment reduces the likelihood.

Table 2 Types of consequences*

Consequences that increase behaviour

Positive reinforcement	Negative reinforcement
Receive something that you want	Avoid something you do not want

Consequences that decrease behaviour

Punishment	Punishment
Receive something you do not want	Lose something you have or want

***Adapted from Daniels[3]**

The above consequences can be used separately or together to change behaviour. For example, the frequency of managers conducting site tours could be increased by:

- Positive reinforcement: superiors praising manager after they conduct tours
- Negative reinforcement: avoid disapproval from peers for not conducting tours
- Punishment: managers' bonus is reduced if tours are not conducted.

Table 3 Examples of the different types of consequences

Positive reinforcement	Negative reinforcement	Punishment
Positive feedback about achievement	Avoidance of peer disapproval	Removal of benefits
Recognition from manager	Avoidance of pain	Disciplinary action
Praise from colleagues	Avoidance of the loss of financial reward	Physical pain or injury
Prizes	Avoidance of financial penalty/ fine	Feeling guilty

Although both positive and negative reinforcement increase the frequency of a behaviour, they do not produce the same results. Negative reinforcement produces just enough of a behaviour to avoid something unpleasant. Positive reinforcement produces more behaviour than required, in other words it taps into an employee's discretionary effort[3]. Discretionary effort involves doing more than the minimum required, and maximising performance because a person "wants to", rather than "has to".

Reinforcement and punishment are defined by their effect, so if a consequence does not reduce the frequency of a behaviour it is not punishment and similarly if it does not increase the behaviour it is not reinforcing. In fact, the same act could be a reinforcer for one person or in one situation and a punishment in another. It can often be the case that the consequence has the opposite impact than that intended by the person delivering the consequence. This is the case because, the impact of a consequence on a behaviour is not determined by the specific act or the intention of the individual delivering the consequence, but by the person performing the behaviour. For example, a manager wanted to recognise and reward an employee for their involvement in a safety improvement project. They invited the employee to an evening dinner and award ceremony and presented a golf weekend for two as a prize. Despite the manager's intention to provide positive reinforcement, the prize did not have the intended effect as the recipient, a single parent, found difficulty in getting child care to attend the evening dinner, and was preoccupied thinking about his children. He did not use the prize as he had no partner to take, could not leave his children and did not play golf.

As the example illustrates, one of the most problematic aspects of using behaviour modification to change behaviour is selecting consequences that other people will find reinforcing. What we personally find rewarding or reinforcing may not have the same effect on others. It is therefore important to gain insight into what the person or people whose behaviour you are seeking to change are likely to find reinforcing. The greater the understanding or insight about what is important to the group or person whose behaviour is targeted for change, the easier it is to choose appropriate reinforcers.

There are a number of strategies that can be employed to identify effective reinforcers. These include:

- Involving the target individual or group in determining the consequences
- Observing what the individual or group choose to do when they have a choice. The work tasks they actively choose can be used to reinforce less desirable activities.

2.3 IMPACT OF TIMEFRAME, PREDICTABILITY AND SIGNIFICANCE OF CONSEQUENCES

To use ABC analysis with complex behaviours requires a limited number of criteria to assess the impact of a consequence. Three major factors influence the impact that consequences have on the likelihood that a behaviour will be repeated and these are described in the table 4 below.

Table 4: Factors influencing impact of consequences on behaviour

	Timeframe	Predictability	Significance
Large impact on behaviour	Soon	Certain	Important to individual
Limited impact on behaviour	Distant	Uncertain	Unimportant to individual

In table 5a, these factors are applied to the consequences of wearing ear defenders and they are applied to the consequences of not wearing defenders in table 5b.

Table 5a: Some examples of possible consequences of wearing ear defenders

Reinforcing consequences	Timeframe	Predictability	Significance
Avoid hearing loss	Distant	Uncertain	Important to individual
Avoid conflict with manager	Distant	Uncertain	Unimportant to individual
Punishment			
Discomfort	Soon	Certain	Important to individual
Difficult to hear radio	Soon	Certain	Important to individual

In general ABC analysis will reveal that the consequences reinforcing the current behaviour are soon, certain and important and the punishments (if there are any) are distant, uncertain and unimportant. In contrast, if this analysis is conducted on the behaviour which is currently not being practised, it is likely to reveal that the reinforcing consequences (if there are any) are distant uncertain and unimportant while the punishments are soon, certain and important.

Table 5b: Some examples of possible consequences of not wearing ear defenders

Reinforcing consequence	Timeframe	Predictability	Significance
Avoid discomfort of wearing ear defenders	Soon	Certain	Important to individual
Improved sensory information	Soon	Certain	Important to individual
Punishment			
Impaired hearing in the future	Distant	Uncertain	Important to individual

This example demonstrates that, in this particular case, workers do not wear their ear defenders because the positive consequences of not wearing ear defenders are soon, certain and important: while the punishment is distant and uncertain. In addition, the positive consequence of wearing ear defenders (avoiding hearing loss) is distant and uncertain, while the punishments are soon certain and important.

This analysis indicates that wearing ear defenders can be promoted by improving the design of the ear defender to increase comfort and by incorporating a radio into the ear defender. These changes would reduce the punishment for wearing defenders and reduce the benefits of not wearing the defenders.

2.4 IT IS THE CONSEQUENCES FOR THE INDIVIDUAL THAT MATTER

It is the consequences for the individual carrying out the behaviour that drives their behaviour and not the consequences for others. For example, consider the consequences of not conducting laborious quality checks of a hazardous product before it is dispatched to clients, for (a) the employee and (b) the client. The immediate and certain reinforcing consequence for the employee of not conducting the quality checks is to avoid a monotonous task, balanced against the distant and uncertain punishment of losing their job. The consequences

for the client, is a substandard hazardous product that increases the likelihood of a major accident. The behaviour of the individual who is supposed to perform the task is determined by the consequences for them personally, not the consequence to others i.e. the client. Therefore, in this example if there are no monitoring systems in place to check the employee's work there may be no consequence for performing the checks and positive consequences for not performing the checks. If this is the case, some people may not perform the checks.

On the other hand, for an employee with high professional standards, the negative personal consequences of not conducting the quality checks, namely not living up to their own high standards, may outweigh the temptation to avoid the laborious task. In this example, if the employee omitted the quality check, they would feel uncomfortable as their behaviour conflicted with their high professional high standards. The discomfort caused by a discrepancy between one's own attitudes or values and behaviour is known as "cognitive dissonance", and leads to either attitudes/values or behaviour changing to become more congruent. To promote professional behaviour, management would therefore need to provide antecedents to trigger professional conduct (e.g. training, knowledge, membership of professional bodies, expectations) and consequences which reinforce professional behaviour (e.g. recognition, funding, promotion).

2.5 IMPORTANCE OF CONTINUING TO PROVIDE REINFORCING CONSEQUENCES

A common mistake when attempting to influence other people's behaviour is to stop providing reinforcement and encouragement when the behaviour occurs once. For the new behaviour to become a habit, reinforcement must be provided consistently over an extended period. On the other hand, if reinforcement is quickly withdrawn the new behaviour may cease.

2.6 SUMMARY

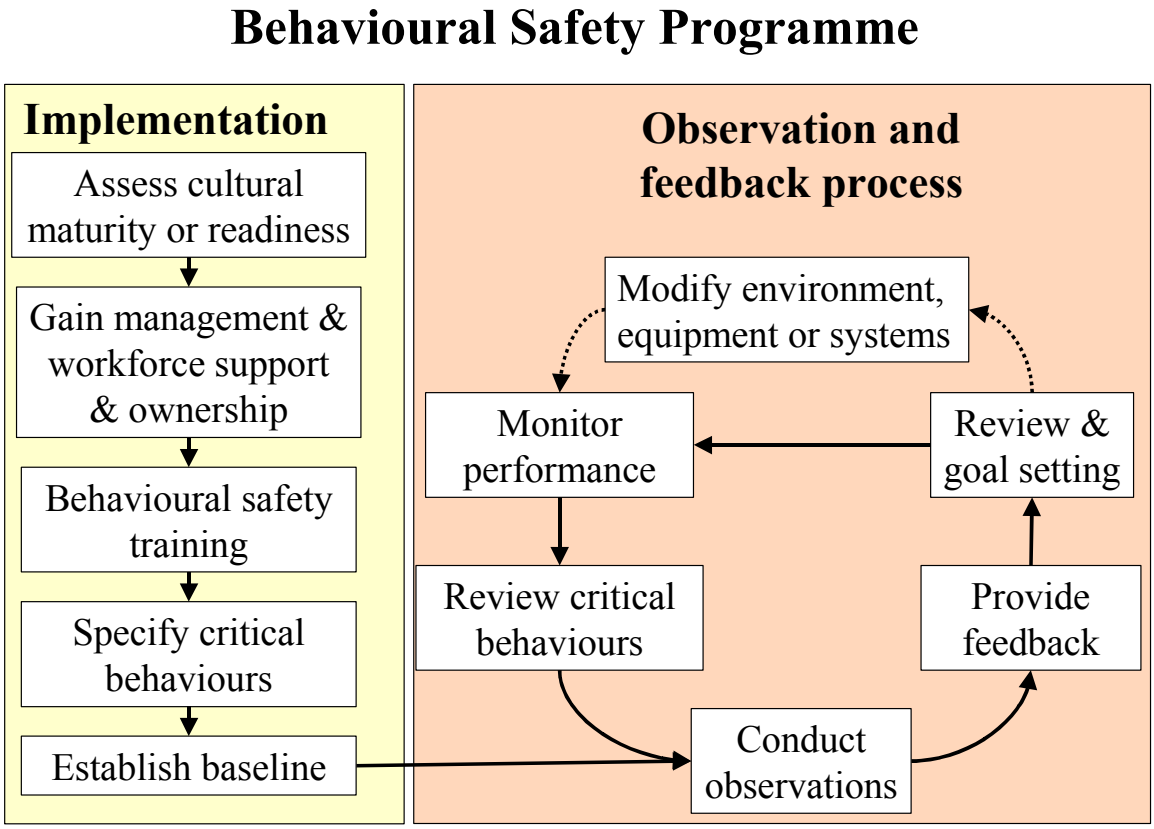
ABC analysis identifies the pattern of antecedents and consequences that are reinforcing the current behaviour and the current consequences of the desired behaviour. This analysis facilitates the identification of interventions to rearrange the antecedents and consequences to increase the frequency of the desired behaviour. It is necessary to have a clear understanding of the behaviour and what is important to the people performing the behaviour to successfully perform an ABC analysis. Therefore, involving individuals with experience of the specific behaviour is critical. The ABC model of behaviour forms the theoretical basis for behaviour modification interventions, but applying the theoretical model in practice is a more complex process. The following section describes how behaviour modification techniques are currently being used to promote critical health and safety behaviours.

3 KEY ELEMENTS OF HEALTH AND SAFETY OBSERVATION AND FEEDBACK PROGRAMMES

Health and safety behaviour observation and feedback programmes promote desired behaviours by introducing positive reinforcement for behaving safely. The positive reinforcement is provided through positive feedback. These programmes are based on the ABC model of behaviour but ABC analysis is seldom used explicitly.

To establish current practices in implementing and maintaining health and safety behaviour observation and feedback programmes a series of telephone interviews were conducted with representatives from eight of UK programme providers (see appendix: A.5: INTERVIEWS WITH BEHAVIOURAL OBSERVATION AND FEEDBACK PROVIDERS). Although the proprietary programmes differed from each other in a number of significant ways (e.g. target group, the way feedback is provided), a number of common components emerged. Figure 1 below provides a generic overview of a behavioural safety programme. The elements listed were not present in all programmes, but they were contained in the majority of programmes. In addition, the overview contains the common elements of programmes described in the research literature.

Figure 1: Overview of a behavioural safety programme



3.1 IMPLEMENTATION

The effectiveness of behavioural safety observation and feedback programmes is dependent upon effective implementation. Figure 1 outlines the main stages in the implementation of a behavioural safety programme.

3.1.1 Assess Cultural Maturity or Readiness

The first stage in the implementation is the assessment of an organisations readiness to implement a behavioural safety programme. The term cultural maturity refers to the important safety culture elements (e.g. management commitment, trust, communication) that determine an organisation's readiness to implement a behavioural safety programme. Recent research[4], suggests that organisations should select behavioural safety programmes which match their level of cultural maturity because a mismatch is one reason why behavioural safety programmes fail. It is therefore important for organisations to establish that they are ready to implement a behavioural safety programme and to identify any potential problems they may encounter. By identifying potential barriers before implementing the programme, an organisation will be able to manage these problems more effectively. For example, if a reorganisation is likely to occur during the implementation of the programme, then the programme could be delayed until after the reorganisation.

There are a number of ways of assessing cultural maturity, for example, conducting a safety climate survey or holding workforce workshops. Details about how to assess the level of cultural maturity are provided in the Changing Minds report[4], and readiness indicators are available in a recently published literature review[2].

3.1.2 Management and Workforce Support

Management and workforce ownership and support for the behavioural safety process is vital for the success of the programme. An effective way of gaining support and ownership is to involve employees in the programme. For individuals to be involved they must feel that their views and opinions are important and that they can make a difference. Therefore, employees must be able to influence the selection of the type programme and how it is going to be implemented. A particularly important group to involve are first line supervisors as they can either facilitate or prevent observations being conducted.

In addition to involving employees in the selection of the programme, they also need to be directly involved in managing the programme. It is not possible for all employees to be involved in running the programme therefore individuals who are going to be involved need to be selected. Providers differed in their approach to the management of the process, with some providers using a single fulltime co-ordination and others opting for a steering group. Steering groups were more common and tended to be created by asking for volunteers. The selection of the steering group is critical, as it needs to contain respected staff members and be representative of the entire workforce (see appendix: A.6.3: CASE STUDY 2: FAILURE OF A BEHAVIOURAL SAFETY PROGRAMME).

The majority of behavioural safety programmes require frontline staff to conduct behavioural safety observations on their colleagues. These individuals are usually referred to as observers. In most instances, employees are asked to volunteer to become observers, but

sometimes the entire workforce is trained or specific groups (safety representatives or supervisors) are selected to participate.

3.1.3 Behavioural Safety Training

Irrespective of the whether a single co-ordinator or a steering group manage the programme, training in behavioural safety techniques will be required. This training is likely to include input on the psychology underpinning behavioural safety, how to identify critical safety behaviours and how to provide feedback, either face-to-face or to a group. The number of individuals trained and the depth of the training will depend on the specific programme. Some programmes train all staff, whereas others train a minority of employees.

In addition to steering group training, observers require training in how to conduct observations and how to record the information. The depth and level of training varies between providers. Some of the providers assess the quality of the observations by comparing their own observation of the situation with the trainee's observation. The majority of providers give the organisation materials and instruction in how to train observers internally.

3.1.4 Specifying Critical Safety Behaviours

The majority of behavioural safety programmes develop a list of critical safety behaviours to be included on a checklist that is completed by observers. A range of techniques can be used to identify critical health and safety behaviours to include on the checklist. All the providers interviewed identified critical behaviours through the analysis of previous accident reports. Having said this, only two providers relied solely on previous accident reports as a source of behaviours. The majority of providers used additional information such as reviewing previous risk assessments (e.g. COSHH), task risk assessment, HSMS audits, input from frontline staff and supervisors and expert judgement. It is therefore recommended that a number of techniques are used to identify critical behaviours. Near-miss or dangerous occurrence reports are an important source of critical safety behaviours, as they may describe behaviours that nearly caused an injury.

Relying solely on accident reports has the limitation that infrequent but critical health and safety behaviours may be excluded. Accident analysis only identifies behaviours that have led to an injury, thus excluding critical health behaviours with consequences that have not yet manifested themselves (e.g. exposure to asbestos) and behaviours that due to chance have not yet caused a recordable injury. In addition, the quality and level of detail provided by accident reports may not facilitate the identification of all the critical behaviours.

3.1.5 Establishing a Baseline

The final element in the implementation phase is establishing a baseline. This involves conducting initial observations to establish the current level of safe behaviours for the critical behaviours identified. Not all programmes establish a baseline. A baseline is useful as it allows feedback on the programme's success in changing behaviour.

3.2 OBSERVATION AND FEEDBACK PROCESS

Once the implementation phase has been completed the observation and feedback loop starts. This is a continuous loop of observation, feedback, goal setting and review.

3.2.1 Observations

The first stage in the process is conducting observations. In general, peers conduct observations, but in some programmes they are conducted by superiors. The proprietary programmes vary in their approach to conducting observations and in how the safe behaviour is measured. In general, the observer is given a checklist with a list of behaviours (e.g. wearing all correct PPE) and the observer has to indicate if the individual is safe, unsafe or the behaviour was not observed. It is critical that the behaviours are clearly described to enable the observer to judge whether someone is behaving safely or unsafely.

In situations where it is difficult for others to observe the behaviour, self-observations can be used. This approach is particularly useful with peripatetic and lone workers or management behaviours. The specific format of the self-observation will depend on the frequency with which the behaviours are performed. For behaviours that are performed frequently e.g. adopting correct posture when using a VDU, the individual can be randomly prompted to conduct an observation, through a pager, email, telephone or a radio. When prompted the individual indicates whether or not the specific behaviours are safe or unsafe. For less frequent behaviours such as conducting safety audits, individuals are prompted to recall the frequency with which critical behaviours were performed. Clearly self-report methods rely on trust.

3.2.2 Feedback

Positive feedback is one of the most important elements in the process, as this is the positive consequence that is introduced to reinforce safe behaviour. There are two main types of feedback, summative and formative[5]. Summative feedback provides the individual with information on their performance, e.g. "*Excellent work Sam*.". Formative feedback provides information on how they can improve their performance, e.g. "*The next time you conduct a risk assessment, try involving your team, as they are likely to have more knowledge of the practicalities of the job*". Formative feedback needs to be delivered by someone who is perceived as credible and knowledgeable by the individual receiving the feedback. Summative feedback can be given in public or in private, but formative should only be given in private or it may be perceived as a punishment.

Three factors influence the impact of feedback, these are:

- **Timing**: Feedback should be timed so that it is useful and meaningful to the person receiving the feedback. Feedback tends to be most effective immediately after the behaviour.
- **Focus**: The feedback should be specific and focus on the desired behaviour
- **Fit**: The feedback should fit with the expectations of the person receiving the feedback.

Behavioural safety programmes vary in the type of feedback given. Some programmes provide feedback to the individual at the time; others provide feedback to the group e.g. presenting results graphically or and some provide both. Table 6 summarises the types of feedback provided.

Table 6: Types of feedback

Mode	Type	
	Summative	**Formative**
Face-to-face	Observer praises the person they observed for behaving safely	The observer highlights ways in which the observee could change their behaviour
Graphical	The percentage of behaviours which were observed as safe are displayed publicly	It is not appropriate to provide formative feedback graphically

Giving feedback, especially formative feedback requires skill and expertise, therefore observers require a significant amount of training and coaching to master these skills.

3.2.3 Goal Setting and Review

Once the observations and feedback process is operating effectively, behavioural improvement goals are participatively set with the target group. Although not all behavioural safety programmes include goal-setting, research evidence[6] indicates that goal setting increases the amount of behavioural change. It is important to set realistic, achievable goals otherwise people will become demotivated.

3.2.4 Modify Environment

The observation and feedback process may identify unsafe conditions or barriers (antecedents) to individuals behaving safely. Improvements to the environment or systems may be required in order to improve employees' behaviour. This information is collected and actions are taken to make improvements. Prompt feedback to staff about status of unsafe conditions highlighted by the system is vital for sustained commitment to the programme.

3.2.5 Monitor Performance

The change in performance is tracked over time, to assess the impact of the programme on the critical safety behaviours. The change in the percentage of observations where a behaviour is safe indicates the effectiveness of the process. If there is no change or limited improvement in a specific behaviour over time, it is important to investigate this behaviour in more detail to identify whether any barriers to behaving safely exist. For example, managers may be reinforcing productivity at the expense of safe behaviour, or poor plant design may make safe behaviour difficult to achieve in practice.

3.2.6 Review List of Critical Behaviours

The list of critical behaviours is revised periodically and new behaviours added and existing behaviours replaced. A critical behaviour can be removed from the list and replaced with a new behaviour, when it has reached 'habit strength', i.e. it is consistently observed as safe. Once the goals are achieved then another round of participative target setting is conducted. In general, participative target setting sessions are held at regular intervals (e.g. quarterly).

3.3 ENABLERS AND BARRIERS TO EFFECTIVE BEHAVIOURAL SAFETY PROGRAMMES

Behavioural safety providers identified a number of factors that influence the success of behavioural safety programmes. The enablers and barriers identified by the providers are summarised in table 7 below.

Management commitment to the process was identified as the single most important factor in determining the success of the programme. The majority of barriers identified by providers were the absence of the enablers identified, for example a lack of management commitment, was the most important barrier.

Table 7: Enablers and barriers to successful behavioural safety programmes

Enablers	Barriers
Management commitment to the programme	A lack of management commitment to the programme especially when it encounters problems
Middle managers understanding of behavioural safety principles	Middle managers not understanding the programme and seeing it as threatening
Middle managers involvement in and support for the programme	Excluding middle managers from the programme who therefore did not release staff to conduct observations
Adequate resources, (e.g. staff time to conduct observations)	Staff unable to conduct the agreed number of observations due to workload commitments (see appendix: A.6.3 CASE STUDY 2: FAILURE OF A BEHAVIOURAL SAFETY PROGRAMME)
A reasonable level of trust between management and frontline staff	A lack of trust can lead staff to perceive that the programme as a 'blame the worker scheme'
The absence of industrial relations issues	It can be more difficult to get a programme off the ground if there are major industrial relations issues
A workforce who are already actively involved in safety through safety committees or other mechanisms	
The experience of the provider and their ability to develop a programme, which meets the organisations needs	
Keeping the programme fresh by introducing something different or new on an annual basis.	

In addition, one provider revealed that they were aware of a programme that failed because the co-ordinator rewrote the behavioural observations to meet their own ends. Although this is an isolated case, it does highlight the potential for a programme to deviate from the intended design over time. Whether this happens deliberately or not, it will limit the impact of the programme. Another provider highlighted the importance of not trying to manage hazards by behaviour modification, where those hazards are more effectively controlled by plant or equipment redesign.

4 EFFECTIVENESS OF BEHAVIOUR MODIFICATION TECHNIQUES

A recent comprehensive review[7] of behaviour modification research studies demonstrated the effectiveness of the technique. The review only included studies with a sound methodology, to ensure that the results presented were based on robust research principles. The author identified 88 studies that met the methodological criteria. These studies covered a wide range of occupational settings and behaviours, including, teacher behaviour, statistical processing, dental care, caregiver - patient interactions and baseball team efficiency. This review clearly demonstrated that behaviour modification can be successfully used to change a range of behaviours. This also indicates that behaviour modification can be used to modify behaviours that enhance health and safety management in general, and not just the behaviour of frontline staff.

4.1 EFFECTIVENESS OF BEHAVIOURAL SAFETY PROGRAMMES

A large number of studies have been conducted to evaluate the effectiveness of behavioural modification programmes in improving workplace safety. These studies have focused on establishing (a) their ability to decrease accidents / injuries, (b) their ability to increase safe behaviour and (c) which components in a behavioural safety programme are most important in changing unsafe behaviour and reducing accidents and injuries (see appendix: A.3 EFFECTIVENESS OF BEHAVIOURAL MODIFICATION PROGRAMMES).

4.1.1 Impact of Behavioural Safety Programmes on Accident Rates

A literature review[8] investigating the effectiveness of behaviour based safety programmes in reducing accident rates identified 33 published studies that reported accident data. Of these studies, 32 reported a reduction in injuries, although the reporting format varied. The level of improvement varied widely, with one study reporting a 2% improvement with another reporting an 85% improvement. In addition, very few of the studies conducted statistical analysis to establish the significance of the change in accident rates. In spite of the limitations of these data presented in published studies, this review concluded that there was sufficient evidence to demonstrate that behavioural safety programmes improve safety when implemented effectively.

4.1.2 Do Behavioural Safety Programmes Change Behaviour?

Strong research evidence exists from a range of industries on three continents that behaviour modification techniques can lead to safer behaviour[2]. The literature review compiled for this report (see appendix: A.3.2 EFFECTS OF PROGRAMME COMPONENTS) concluded that behavioural safety programmes are effective in altering employee behaviour. The review identified twelve methodologically sound research studies, which investigated the effectiveness of behavioural safety programmes in changing behaviour. All twelve studies demonstrated that behavioural safety programmes are effective at changing employee behaviour.

The literature review of general behaviour modification interventions[7] described above, included nine studies where safety was the dependant measure. Seven of the interventions

were judged to be effective and provided support for the effectiveness of behavioural safety interventions. This provides clear evidence that behavioural techniques can be effective at changing employee health and safety behaviour.

4.1.3 Effects of Programme Components

The literature review identified a number of research studies that investigated the relative importance of the component parts of a behavioural safety programme, in order to establish how they can be optimally combined. The studies showed that only changing the antecedents, (e.g. by training staff how to behave safely) achieved mixed results, and where successful only modest improvements were achieved. Significant gains were achieved when the consequences were changed through graphical feedback, goal setting and support from management and peers. Although theoretically and intuitively important, the added impact of immediate face-to-face feedback has not been systematically demonstrated.

5 PROMOTING CRITICAL HEALTH AND SAFETY BEHAVIOURS THAT SUPPORT THE HSMS

Current behavioural safety observation and feedback programmes only target a limited proportion of critical health and safety behaviours[9]. Health and safety can be dramatically improved, if behaviour modification is used to promote even a proportion of the remaining critical health and safety behaviours.

Figure 2 Health and safety behaviours categories

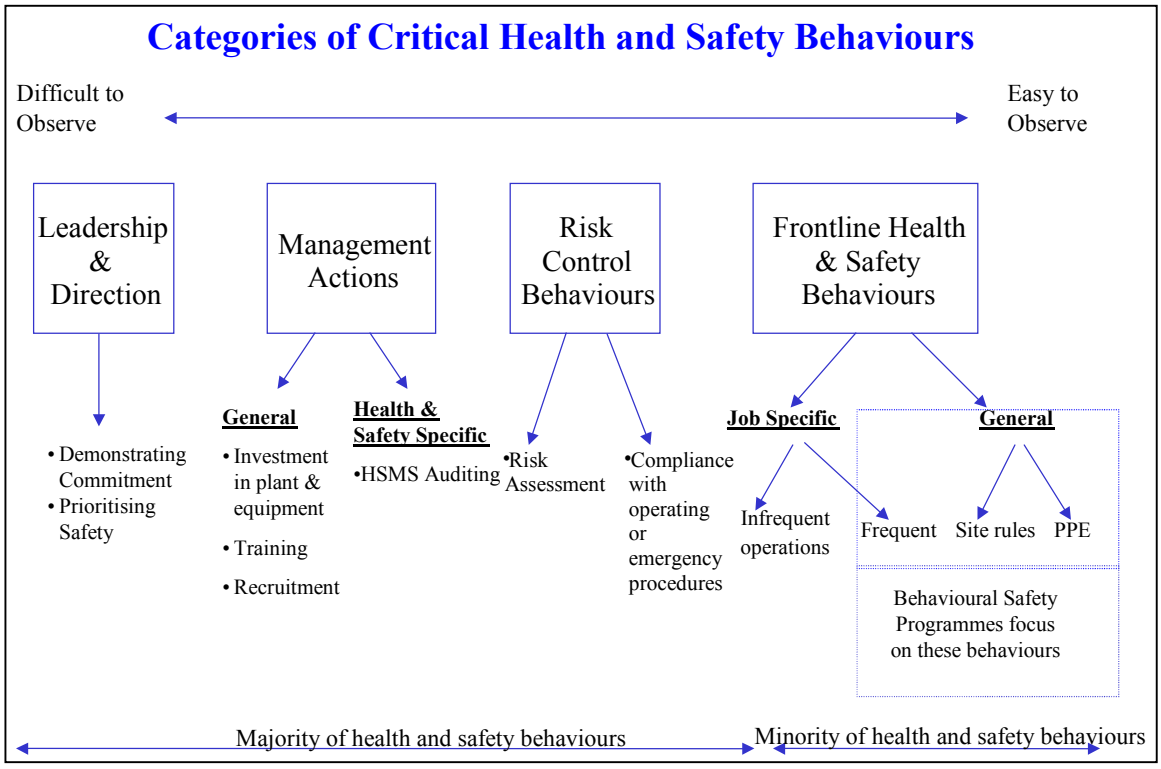


Figure 2 describes four main categories of critical health and safety behaviours, including: frontline health and safety behaviour, risk control behaviour, management actions and leadership and direction. The majority of behavioural safety programmes currently in use within the UK focus on general safety behaviours of frontline personnel including compliance with site rules and procedures (wearing light eye protection, adhering to speed limit) or frequent job specific activities such as correct manual handling behaviours.

Ease of observation is another distinction to be drawn between the four categories of critical health and safety behaviours. Many frontline health and safety behaviours are easier to observe as the nature of the behaviour (e.g. wearing gloves when handling steel strip deliveries) may specify when, where and by whom the behaviour will be displayed. Other important behaviours (e.g. deciding what to invest in equipment) may not specify when or where this will occur, and thus be more difficult to observe.

Since there are no published examples of behaviour modification being used to promote the entire range of critical health and safety behaviours, it is necessary to develop an intervention from first principles.

5.1 DESIGNING A HEALTH AND SAFETY BEHAVIOUR MODIFICATION INTERVENTION

This section describes how to design a behaviour modification intervention to promote critical health and safety behaviour not included in current programmes. Initially the core elements of behaviour modification interventions are described, followed by a six-step guide to behavioural change. Finally, two examples are provided to illustrate how to used the six-step guide to promote critical health and safety behaviours.

Behaviour modification programmes have three main elements[7]:

1. **Pinpointing of relevant behaviours –** carefully specifying the behaviour(s) to be changed, and directly measuring behaviour

2. **Analysing the behaviour and specifically focusing on the antecedents and consequences**, as ***consequences*** (e.g. the type and frequency of feedback we receive) have a powerful impact on determining our behaviour. What takes place before behaviour (the ***antecedents***) can also have a very important impact (e.g. training, goal-setting, communication of company policy).

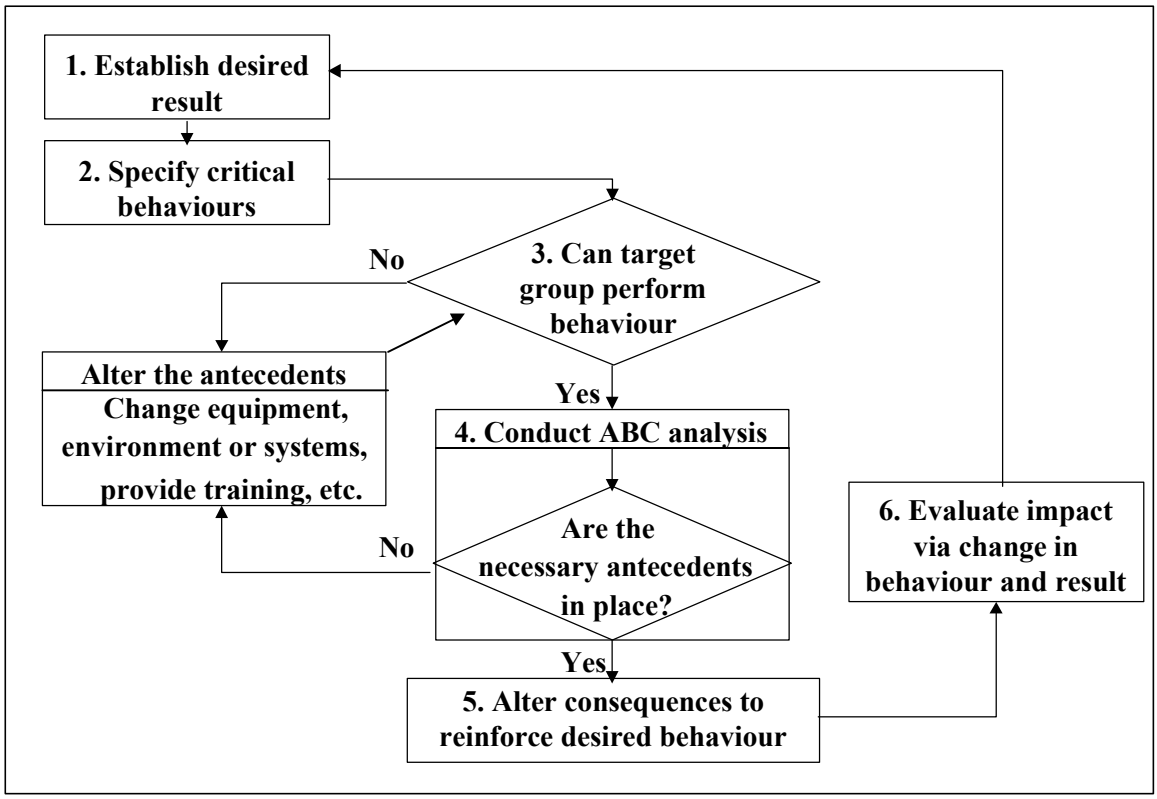
3. **Emphasis on evaluation –** rigorously evaluating whether behaviour has changed as intended, and whether the change was due to the intervention, or other factors.

Behaviour modification interventions vary depending on the organisational setting, the target population and the behaviours to be changed. The three core elements form a six-step intervention process:

1. Establishing the desired result or output of the activity or the individuals under examination
2. Specifying critical behaviours that influence performance of the area to be improved
3. Ensuring that the individual(s) can perform the desired behaviour
4. Conducting ABC analysis on the current and desired behaviour, and where necessary altering antecedents
5. Altering the consequences immediately following the desired behaviour
6. Evaluating the impact of altering the consequence on the behaviour and on the desired result.

These six main steps are represented diagrammatically in figure 3 below.

Figure 3: Behaviour modification programmes



This six-step process can be used to analyse and promote any critical health and safety behaviour.

5.1.1 Step 1: Establish the Desired Result

The first step in any behavioural change process is establishing the desired results or outputs from the group of individuals in question. It is important to be clear about what you are trying to achieve because if you do not know this, it is not possible to judge success. In the context of health and safety, an example of desired result is increased compliance with HSMS procedures and rules, which would be demonstrated through improvements in independent HSMS audit results.

5.1.2 Step 2: Specify Critical Behaviour

Once the desired result is specified, then the behaviours necessary to achieve this result need to be established. When specifying the desired behaviours it is important to remember that behaviours are tangible and observable, they are not beliefs, attitudes or subjective[3]. These behaviours need to be defined precisely. Statements like: 'demonstrates that they are committed to safety' are too general. It is necessary to specify the actual behaviours required to demonstrate commitment to safety. A useful way of identifying critical behaviours is to examine what behaviours differentiate effective employees from those who are less effective

in the area where improvements are sought. Risk assessment can also be used to identify the critical safe and unsafe behaviours associated with hazards.

These behaviours need to be stated as positive actions, as opposed to a lack of action e.g. 'adheres to all rules and procedures' instead of 'does not violate procedures'. Although this may seem like a difference of semantics, it is a critical difference, as it is possible to achieve the latter by doing nothing, which means it is not a behaviour. This pitfall can be avoided by applying the 'dead man test' developed by Dr. Lindsley, which states, "If a dead man can do it, it is not behaviour and you should not waste your time trying to produce it"[3]. Although this may seem like common sense, it is surprising how many common goals violate this rule. For example, a common organisational safety goal is zero accidents, which violates the dead man test, as dead men never have accidents. It is important to specify critical behaviours that positively enhance safety.

In addition to being positive actions, behaviours must be observable, measurable, and reliable. It is sometimes argued that many important behaviours are not observable, but this cannot be the case, as by definition all behaviours are observable, even if the behaviour is only observed by the actor. If it is not something that can be observed then it is not a behaviour.

Once something can be observed then it can be measured, even if a behaviour is not happening it can be measured, "the measure is zero"[3]. It is important that the behaviour can be measured reliably if behaviour change is going to occur. The most effective way of testing reliability is to compare the results of two observers who are observing the same behaviour. If they come up with the same result, then their measurement of the behaviour is reliable. These three criteria (observability, measurability and reliability) can be achieved through detailed description of the specific critical behaviour.

5.1.3 Step 3: Establish that the Target Group can Perform the Behaviour

The target individual or group must have control over the critical behaviour for a behavioural intervention to work. If the behaviour is not within their control, then it will not be possible for them to alter their behaviour. If they are not able to perform the behaviour then changes will be required to the environment, systems, equipment or the individual through training (see HSG48 for further details).

5.1.4 Step 4: Conduct ABC Analysis

ABC analysis is conducted on the desired behaviour and the current behaviour to identify the antecedents and consequences of the behaviour.

Alter the Antecedents

If this analysis reveals that the antecedents for the desired behaviour are not in place then this will need to be addressed. Antecedents are important and necessary to enable the individual to perform the behaviour; therefore, all individuals that may be required to perform this behaviour will require these antecedents. For example, following a fatality an organisation mandated that all employees working above six feet had to wear a safety harness. In effect, this meant that all process operators would need to wear a safety harness on occasion, but they had not received training in how to use a safety harness. A subsequent incident revealed that process operators were not using the harness correctly and it was providing limited protection.

Analyse Consequences

The ABC analysis involves rating the consequences of the desired and undesired behaviour in terms of their timeframe, predictability and significance (as described in section 2.3). An effective way of ensuring that the consequences for the individual are identified is to involve individuals who perform the behaviour in the analysis. The process of identifying consequences needs to be conducted in an open environment where participants can highlight negative consequences (punishments) for performing the desired behaviour.

5.1.5 Step 5: Alter Consequences to Reinforce Desired Behaviour

The ABC analysis identifies the consequences that are driving the current behaviour, which highlights the areas requiring change. The intervention will involve providing more soon, certain and positive consequences for the desired behaviours or removing these consequences from the undesired behaviour. In reality, a mixture of both will be required. For further information on providing consequences, refer to section 2.2 of this report.

5.1.6 Step 6: Evaluate Impact of Intervention

Assessing the effectiveness of the programme requires establishing the level of behavioural change and change in the desired result following the intervention. In practice, this involves comparing the output and the behaviour of the target group following the intervention with the baseline measure to establish the degree of change.

5.2 USING BEHAVIOUR MODIFICATION TO PROMOTE MANAGEMENT BEHAVIOURS: AN EXAMPLE

The above outlined the six stages of a behaviour modification intervention. The following section illustrates how this six-step process can be used to promote any critical health and safety behaviour through an example of promoting management behaviours. Management behaviour can heavily influence the success or failure of a behavioural safety programme, and safety leadership behaviour has been directly linked to team accident rates (see section A4.1 for further details).

5.2.1 Step One: Define the Desired Result of the Management Activity

In this example, the desired result of effective safety leadership is a positive safety climate. For the purposes of this example, this is indicated by at least 70% of employees perceiving that senior managers are committed to safety.

5.2.2 Step Two: Specify the Critical Behaviours

In this example, the first activity in specifying the critical behaviours required for effective safety leadership involved reviewing the existing literature on safety leadership. The literature review identified two behaviours that were consistently associated with effective safety leadership and therefore these were selected for the current example. The two critical behaviours are:

- Meeting with employees frequently to discuss safety issues.
- Responding quickly to safety suggestions and concerns raised by employees.

The identification of company-specific leadership behaviours could be established by holding discussion groups with employees and interviews with managers who are perceived to be committed to safety.

5.2.3 Step Three: Establish that the Managers can Perform the Behaviours

Managers have control over their time and meet frequently with subordinates and therefore are able to meet with employees frequently to discuss safety issues. Pressures from other commitments sometimes make it difficult for managers to meet with staff frequently. Although managers are not able to implement all safety suggestions or resolve all the concerns raised, they are able to respond to employees about what action they have taken and what future steps are planned.

5.2.4 Step Four: Conduct ABC Analysis on the Two Desired Behaviours

The two critical behaviours were analysed using the ABC process described in section 2 of this report. Initially ABC analysis is conducted for the current behaviour in order to understand why people are displaying this behaviour. Then an ABC analysis is conducted on the desired behaviour. This analysis identified changes required to the antecedents and consequences required to promote the desired behaviour.

The first critical management behaviour concerned meeting with employees to discuss safety issues. The current behaviour is not meeting with employees to discuss safety issues. The ABC analysis of this behaviour is presented in table 8a below.

Table 8a: ABC analysis of not meeting with employees frequently to discuss safety

Antecedents	Behaviour	Consequences	R/P	T	P	S
Other managers do not meet with staff to discuss safety Uncertain about how to hold safety conversations with staff Do not perceive that senior managers consider it important to have safety conversations with staff No time to have safety conversations …etc.	Not meeting with employees frequently to discuss safety issues	Continue working uninterrupted	R	S	C	I
		Avoid negative interactions with subordinates	R	S	C	I
		Praised by managers for having time available to devote to production	R	S	C	I
		Perceived by staff as not committed to safety …etc.	P	D	U	I
Other managers do not meet with staff to discuss safety Uncertain about how to hold safety conversations with staff Do not perceive that senior managers consider it important to have safety conversations with staff No time to have safety conversations …etc.	Meeting with employees frequently to discuss safety issues	Perceived by subordinates as committed to safety	R	D	U	U
		Increased workload	P	S	C	I
		Receive a list of problems to resolve …etc.	P	S	C	I

R/P =Reinforcement/ Punishment. T= Timeframe (Soon / Distant). P= Predictability (Certain/ Uncertain). S= Significance (Important/ Unimportant).

The ABC analysis in table 8a reveals that managers do not meet with employees frequently to discuss safety issues because they do not have the skills, it is not seen as important, other managers do not do it and they do not believe they have the time. In addition managers are positively reinforced for not having safety conversations with staff. In addition the reinforcing consequences for not meeting with employees are soon, certain and unimportant, while the punishment is distant and uncertain. It is therefore not surprising that managers do not meet with staff frequently to discuss safety.

The analysis of consequences indicates that the reinforcing consequences for meeting with staff to discuss safety issues are distant, uncertain and unimportant, while the punishments are soon, certain and important.

An ABC analysis was then conducted to identify the antecedents and consequences that will promote the desired behaviour.

Table 8b: ABC analysis of meeting with employees frequently to discuss safety

Antecedents	Consequences	R/P	T	P	S
Awareness of the benefits of discussing safety with subordinates Holding safety discussions is a part of job Prioritised by senior management by raising the issue at management meetings etc Comprehensive training provided Awareness that a proportion of annual bonus is linked to safety discussions Specific time allocated for holding conversations Frequency of discussions discussed at annual appraisal Knowledge that staff will be asked about the frequency and quality of safety discussions Effective system in place to deal with problems raised …etc.	Receive positive feedback	R	S	C	I
	Recognition by management	R	S	C	I
	Avoid loss of bonus	R	S	C	I
	Achieve goals	R	S	C	I
	Receive positive appraisal	R	S	C	I
	Perceived by subordinates as committed to safety …etc.	R	D	U	U

R/P =Reinforcement/ Punishment. T= Timeframe (Soon / Distant). P= Predictability (Certain/ Uncertain). S= Significance (Important/ Unimportant).

Alter the Antecedents

The ABC analysis in table 8a revealed that the antecedents required for the desired behaviour are not currently in place, therefore these need to be addressed first. In this example the antecedents were addressed by requiring all managers to receive training in how to have safety conversations with staff members. These meetings were opened and attended by at least one senior manager. This manager clearly explained the expectation that managers would have frequent constructive conversations about safety with staff. The training consisted of information about behaviour modification, motivation and role-play to provide skills practice. The training concluded with each participant pledging to conduct a specified number of conversations per month. Within one month of the initial training an internal coach met with each participant and accompanied him or her when they were having safety conversations with staff. In addition, a new system was put in place to assist managers dealing with safety issues raised by staff during safety conversations. This system involved the manager writing down a brief description of the issue raised by the employee at the time of the conversation on a specially-designed uniquely numbered form. The employee received a copy. The form was submitted to the appropriate department e.g. maintenance, purchasing or senior management and recorded on a central database. Employees and management could track the progress of any action and raise a query if the issue was not dealt within 3 months. These queries were brought to the attention of senior managers.

By altering the antecedents the desired behaviour is now more likely to occur. The frequency of the desired behaviour will also be increased by providing more reinforcing consequences that are soon, certain and important and removing the punishments for the desired behaviour. These are described in the consequences column of table 8b, and in section 5.2.5 below.

The second critical management behaviour concerned responding quickly to safety suggestions and concerns raised by employees. Initially ABC analysis is conducted for the current behaviour in order to understand why people are not displaying this behaviour. The

ABC analysis for responding quickly and not responding to safety suggestions and concerns raised by employees is presented in table 9a below.

Table 9a: ABC analysis for not responding to safety issues raised by staff

Antecedents	Behaviour	Consequences	R/P	T	P	S
No system in place to deal with safety suggestions Employee raising safety issues or making safety suggestion Unclear if it is part of job Lack of resources for health and safety Perception that health and safety is not a senior management priority …etc.	Responding quickly to safety suggestion and concerns raised by employees	Perceived by subordinates as committed to safety	R	D	U	U
		Increased workload	P	S	C	I
		Conflict with peers in order to get issue raised resolved …etc.	P	S	C	I
No system in place to deal with safety suggestions Employee raising safety issues or making safety suggestion Unclear if it is part of job Lack of resources for health and safety Perception that health and safety is not a senior management priority …etc.	Not responding to safety suggestion and concerns raised by employees	Avoid dealing with issue raised	R	S	C	I
		Avoid negative interactions with peers to progress issue	R	S	C	I
		Perceived as not committed to safety …etc.	P	D	U	I

R/P =Reinforcement/ Punishment. T= Timeframe (Soon / Distant). P= Predictability (Certain/ Uncertain). S= Significance (Important/ Unimportant).

An ABC analysis was also conducted to identify the antecedents and consequences that will promote the desired behaviour. This is displayed in table 9b below.

Table 9b: ABC analysis for responding quickly to safety issues raised by staff

Antecedents	Consequences	R/P	T	P	S
Employee raising safety issues or making safety suggestion Responding to safety suggestions is clearly part of job Prioritised by senior management by raising the issue at management meetings etc. Specific meetings held to discuss safety suggestions Awareness that responding quickly is important Effective system in place to deal with issues and safety suggestions Response time to suggestions tracked and discussed at appraisal …etc.	Receive positive feedback	R	S	C	I
	Recognition by management	R	S	C	I
	Achieve goals	R	S	C	I
	Receive positive appraisal	R	S	C	I
	Perceived by subordinates as committed to safety …etc.	R	D	U	U

R/P =Reinforcement/ Punishment. T= Timeframe (Soon / Distant). P= Predictability (Certain/ Uncertain). S= Significance (Important/ Unimportant).

Alter the Antecedents

The analysis reveals that the antecedents required for the desired behaviour are not currently in place; therefore these need to be addressed first. In this example the antecedents were addressed by introducing a system to track safety suggestions and by highlighting the importance senior managers place on responding to safety suggestions and issues raised by staff. In addition, dedicated resources were made available to implement safety suggestions.

The analysis of consequences indicates that the reinforcing consequences for responding quickly to safety suggestions and concerns raised by employees are distant, uncertain and unimportant, while the punishments are soon, certain and important. In addition, the reinforcing consequences for not responding are soon, certain and unimportant, while the punishment is distant and uncertain. The frequency of the desired behaviour will be increased by introducing consequences that reinforce the behaviour and are soon certain and important and by removing the punishments for the desired behaviour. These are described in the consequences column of table 9b, and in section 5.2.5 below.

5.2.5 Step Five: Alter the consequences

The ABC analysis for both of the critical behaviours revealed that, in addition to altering the antecedents, these behaviours could also be promoted by introducing additional consequences to reinforce the desired behaviour. An effective way of doing this is to introduce an observation and feedback programme to promote these behaviours.

Designing an observation and feedback programme targeted at managers, professional and technical staff presents a number of difficulties. For example, the relatively low number of managers within an organisation means that there is less opportunity to observe managers

displaying these behaviours. Therefore, even if managers are meeting with subordinates frequently to discuss safety issues they may not be observed. It can also be difficult to observe managers' behaviour as they can be conducted behind closed doors. It is unlikely that a random observation programme would be able to collect meaningful data on this behaviour and therefore it is unlikely to work. This suggests that a self-observation of the critical behaviours would be more effective.

Consultation with the target group of managers is required before introducing a self-observation and feedback programme. The consultation needs to explain the rationale behind observation and feedback, the theory underpinning behaviour modification and how the information collected will be used. Managers will also require training in how to conduct the observations and record their data.

Observation and feedback programmes require a list of clearly defined behavioural measures. The list of behavioural measures is drawn up in consultation with the target group of managers. The following is the list of behavioural measures to promote the two critical behaviours.

- The number of interactions per week with frontline staff where safety is the main topic of conversation and the member of staff rates as positive. (Employee to complete card evaluating quality of interaction and submit it anonymously)
- The number of safety concerns raised by employees per week that are responded to, actions agreed and a completion date mutually agreed within 12 working hours.
- The percentage of actions completed within the mutually agreed completion date per week
- The number of safety suggestions raised by employees per week that are responded to, next steps identified and a completion date mutually agreed within 12 working hours.
- The percentage of safety suggestions progressed each week within the mutually agreed timescale.

Once the behavioural measure is agreed, a set of initial observations provides a baseline measure of current performance. The management team set a group target for each behavioural measure using the baseline results. Individual managers conduct self-observations, with confirmatory information drawn from frontline staff through their evaluation of discussions, safety concerns raised and safety suggestions made. Managers use an individual behavioural matrix to record their performance. The results are shared with the manager's team and the results for the management group are presented graphically to the entire workforce.

The managers also identify the consequences of the desired behaviour to ensure that they find them reinforcing. The consequences for performing the desired behaviours for the managers include praise from colleagues and superiors, positive feedback and success at reaching target.

5.2.6 Step Six: Evaluate the impact of the intervention

The effectiveness of the programme in changing behaviour is evaluated by comparing results with the baseline measure to establish the degree of behavioural change. The effectiveness of the programme in improving the safety climate is measured by repeating the safety climate survey to identify the degree of change in employee perceptions.

5.3 USING BEHAVIOUR MODIFICATION TO PROMOTE RISK CONTROL BEHAVIOURS: AN EXAMPLE

Behaviour modification can also be used to promote critical risk control behaviours. This example focuses on thorough completion of the necessary paperwork for a permit-to-work (PTW) system.

5.3.1 Step One: Define the Desired Result of the Risk Control Behaviour

The desired result is a completed PTW which correctly identifies all relevant hazards and control measures.

5.3.2 Step Two: Specify the Critical Behaviour

The critical behaviour is:

- Thorough completion of PTW paperwork, with all hazards and control measures identified.

5.3.3 Step Three: Establish that Target Group can Perform the Behaviours

It is possible for the target group of authorised PTW issuers to perform the behaviour, as some do this to the required standard now.

5.3.4 Step Four: Conduct ABC Analysis on the Desired Behaviours

The critical behaviours were analysed using the ABC process described in section 2 of this report. The ABC analysis for both thorough and incomplete completion of PTW paperwork is presented in table 10a below.

Table 10a: ABC analysis investigating the completion of PTW paperwork

Antecedents	Behaviour	Consequences	R/P	T	P	S
PTW form does not provide prompts of possible hazards or control measures Form is lengthy and not well laid out Training in how to complete PTW paperwork was inadequate Supervisors have not clearly stated their expectations about the quality of PTWs required Rules and procedures do not clarify mandatory information to be included in PTW form …etc.	Thorough completion of PTW paperwork, with all hazards and control measures identified	Takes a lot of time to do properly	P	T	C	I
		No-one examines PTWs to check if they have been completed properly	R	D	U	U
		Colleagues ridicule efforts to do a thorough PTW	P	S	C	I
		An accident may be avoided due to thorough completion of PTW …etc.	R	D	U	I
PTW form does not provide prompts of possible hazards or control measures Form is lengthy and not well laid out Training in how to complete PTW paperwork was inadequate Supervisors have not clearly stated their expectations about the quality of PTWs required Rules and procedures do not clarify mandatory information to be included in PTW form …etc.	Incomplete and sloppy completion of PTW paperwork, where all hazards and control measures are not identified	Saves time	R	S	C	I
		Avoids a lot of writing	R	S	C	I
		An accident may occur due to hazards and control measures being omitted from PTW …etc.	P	D	U	I

R/P =Reinforcement/ Punishment. T= Timeframe (Soon/ Distant). P= Predictability (Certain/ Uncertain). S= Significance (Important/ Unimportant).

The ABC analysis in table 10a highlights that several antecedents are currently missing, which need to be present to maximise chances of the desired behaviour occurring. The ABC analysis also indicates that soon, certain and immediate consequences are currently reinforcing the incomplete completion of PTW paperwork. Although incomplete completion of PTW paperwork could result in an accident, this consequence is perceived as being distant and uncertain, therefore does not strongly drive behaviour in this example. The ABC analysis

also reveals that punishment or weak reinforcement results from thorough completion of PTW paperwork. It is therefore not surprising that some people do not complete PTW paperwork thoroughly.

The frequency of the desired behaviour will be increased by altering the antecedents and providing more reinforcing consequences that are soon, certain and important, and removing the punishment for the desired behaviour. The results of an ABC analysis for the desired behaviour are presented in table 10b below.

Table 10b: ABC analysis of thorough completion of PTW

Antecedents	Consequences	R/P	T	P	S
PTW form redesigned to provide prompts of possible hazards and control measures PTW implemented on a computer system to aid consistency Good quality training provided in how to use PTW system Clarification provided on rules and procedures specifying when a PTW should be raised, and mandatory information to be included Supervisors emphasised their expectations about required quality and completeness of PTW paperwork Purpose of PTW re-emphasised, namely to control work and avoid harm to people …etc.	Computer-based PTW now quick and easy to complete	R	S	C	I
	Supervisors regularly check completed PTWs, and provide encouragement and guidance	R	S	C	I
	Colleagues support each other in raising the standard of completed PTWs	R	S	C	I
	Thorough completion of PTW reduces the likelihood of accidents occurring …etc.	R	S	C	I

R/P =Reinforcement/ Punishment. T= Timeframe (Soon/ Distant). P= Predictability (Certain/ Uncertain). S= Significance (Important/ Unimportant).

Alter the Antecedents

In this example, the antecedents were altered to promote thorough completion of PTW paperwork. The PTW form was redesigned to include prompts of likely hazards and control measures, and implemented on a computer system to encourage consistency. Training was provided, which covered the relevant rules and procedures specifying when a PTW should be raised, and the mandatory information to be included. Supervisors also provided team briefings on their expectations about the quality and completeness of PTW paperwork.

5.3.5 Step Five: Alter the Consequences

The ABC analysis for the critical behaviour revealed that the behaviours could be promoted by introducing additional consequences to reinforce the desired behaviour and by removing some of the punishing consequences.

In this example, consequences were altered by implementing the redesigned PTW system on a computer, which was quicker and easier to complete. Supervisors began to regularly check completed PTWs, and provide encouragement to those who did this well. As the standard of PTWs was raised colleagues stopped ridiculing thorough completion.

5.3.6 Step Six: Evaluate the Impact of the Intervention

The number and appropriateness of hazards and control measures identified on PTWs before and after the intervention were compared, and a significant improvement was noted.

6 INTEGRATING BEHAVIOUR MODIFICATION WITH THE HSMS

Currently behavioural safety interventions are often separate from other aspects of the health and safety management system. This lack of integration is likely to limit the effectiveness of the intervention. In order to address this issue a literature search was conducted to find existing integrated behavioural safety frameworks. Unfortunately, this search did not produce any literature on how behavioural safety interventions have been integrated into HSMS. Three case studies were therefore conducted with UK organisations that had implemented three different types of behavioural safety programme. These are described in Appendix A.6. Case Study 3 was most integrated to the HSMS, Case Study 1 had a degree of integration and Case Study 2 was not integrated. It is interesting to note that Case Study 2 was the only one that failed.

In light of the absence of published literature on this specific topic, generic HSMS literature was reviewed and a framework was developed from first principles, and the results of the case studies. The process of constructing a framework revealed that although a behavioural safety intervention is **a part of the HSMS**, it also **supports the HSMS**. One of the main outputs of an HSMS is employees adopting critical safe behaviours and not behaving in a unsafe manner e.g. PTW systems are designed to ensure employees do not perform operations that conflict with other operations. Fundamentally the effectiveness of any HSMS relies on the behaviours of all members of the organisation (including subcontractors, customers and visitors). It is therefore clear that promoting critical health and safety behaviours is a core objective of the HSMS.

The framework was constructed to meet the following requirements:

1. Specify how a behaviour modification intervention can be integrated into the HSMS.
2. Describe the interdependency between behaviour modification and the other elements of the HSMS through the flow of information.
3. Explain how behaviour modification can support the HSMS and other aspects of safety (e.g. safety culture).

6.1 BEHAVIOUR MODIFICATION AS A PART OF THE HSMS

A behavioural safety intervention can be considered as a Risk Control System (RCS) and as such, is similar to other RCSs such as a permit to work system. The purpose of any RCS "is to make sure that appropriate workplace precautions are implemented and kept in place" (HSG65 p48). Behaviour modification interventions do this by increasing the frequency of critical behaviours required to minimise risk and by reducing the frequency of behaviours that increase risk. The critical behaviours may apply to all employees (including contractors) e.g. wearing appropriate PPE, or they may only apply to specific groups e.g. maintenance staff.

The critical behaviours may be a) those required to control risk (completing a PTW, wearing PPE), b) behaviours that are in themselves at risk activities (climbing a ladder, lifting materials) or c) they may be behaviours that support the HSMS e.g. the visible behaviour of managers that demonstrates the importance they place on safety. Similar to other RCSs the elements of a HSMS described in HSG65 (policy, organising, implementing, measuring, reviewing and auditing) can be used to provide a framework for behavioural safety

interventions. An example is provided below to illustrate how a behavioural intervention can be integrated within the HSMS.

6.1.1 Policy

The objective of the behavioural safety intervention is to increase the frequency of critical safety behaviours of all individuals working within this organisation.

6.1.2 Organising

- Control
  The behavioural safety steering group are responsible for the day-to-day operation of the system. They are also responsible for measuring performance (behavioural change). The safety department will work with the steering group to review performance of the system annually. The validity and frequency of behavioural observations will be included in the HSMS audit process.

- Cooperation
  The behavioural safety steering group consists of a representative sample of employees from across the organisation. Major occupational group are represented. Each steering group member is responsible for involving staff in their area of the organisation. Steering group members collect feedback from employees in their area before steering group meetings. The behavioural safety intervention is an agenda item at every safety meeting.

- Communication
  The intervention is promoted through a number of channels, including a newsletter, results are posted on staff notice boards, induction for new staff, inclusion in the company newsletter and safety meetings.

6.1.3 Implementing

Critical behaviours are specified for each group of employees, depending upon their risk exposure, the impact they can have on the HSMS and the risk exposure of others. For example, critical behaviours of managers are different from the critical behaviours of maintenance staff. The critical behaviours are established for each group by reviewing the following sources of information: safety management system, risk assessments, accidents and incident reports, HSMS audit results and workforce perceptions (see section 6.3). More detail on how to identify critical behaviours can be found in section A3.3 of this report. The analysis of this information produces a list of critical behaviours, which must be described clearly enough to enable an individual observing this behaviour to judge if it is being performed in a safe or unsafe manner.

It may be the case that once a critical behaviour is identified, it becomes apparent that the best way to reduce risk is to change the work environment to render the behaviour unnecessary, or alter any antecedents or consequences that are not promoting the desired behaviour.

The behaviour of members of each specific group is observed on a regular basis to establish the percentage of their behaviour that is judged as safe or unsafe. The individual conducting the observation gives the person observed immediate face-to-face feedback at the time of the observation. The results of the observations for each group are displayed on notice boards and

other public areas. The frequency that observations are conducted varies between groups, as some groups display critical behaviours more frequently than others do.

6.1.4 Measuring Performance

Performance is measured in terms of the percentage of safe behaviours displayed. Performance is tracked over time with the change in the percentage safe behaviour recorded. Each group agrees the goals for the percentage safe for each of the critical behaviours relevant for their group. These goals are revised at regular intervals. The critical behaviours are revised if new critical behaviours are identified or if a specific behaviour is consistently being observed as safe.

The reliability of the observation is checked at regular intervals, by getting two observers to independently conduct an observation of one individual at the same time. The two sets of results are compared and a reliability score is calculated.

6.1.5 Reviewing Performance

In this example, on an annual basis, the steering committee and the safety department work together to review the performance of the behavioural safety intervention. They review the level of behavioural change observed, the number of observations and the reliability of observations. Lagging safety indicators are also reviewed. The results are used to improve the process and they are shared with those involved.

6.1.6 Auditing

In this example, safety department auditors audit the behavioural safety system, by reviewing observation sheets, reliability data and interviewing a sample of employees in each department. Independent audits are conducted by external staff on a bi-annual basis.

6.2 USING BEHAVIOUR MODIFICATION TO SUPPORT THE HSMS

The above provides a HSMS framework for behavioural modification interventions. Behavioural modification interventions can be also used to support other elements of the HSMS. In addition, a behavioural safety intervention can use information produced by other elements of the HSMS. The interdependency between behavioural safety interventions and other elements of the HSMS is best described through the flow of information. The outputs of other elements of the HSMS can be used as an input for a behavioural safety intervention. For example, high hazard operations identified by risk assessments can be examined to identify the critical behaviours required to prevent the hazard from being realised. These behaviours can then be analysed to identify the antecedents and consequences, in order to identify intervention strategies. The output from a behavioural safety intervention can input in other HSMS elements e.g. performance measurement. For example, the change in the percentage safe behaviours can be used as one measure of the change in safety performance over time (see A.6.4 Using Behavioural Safety Observation Data to Measure HSMS Performance).

An overview of the flow of information between elements of the HSMS and behavioural safety intervention is provided in figure 4.

Figure 4: Information flow between behavioural safety and the HSMS

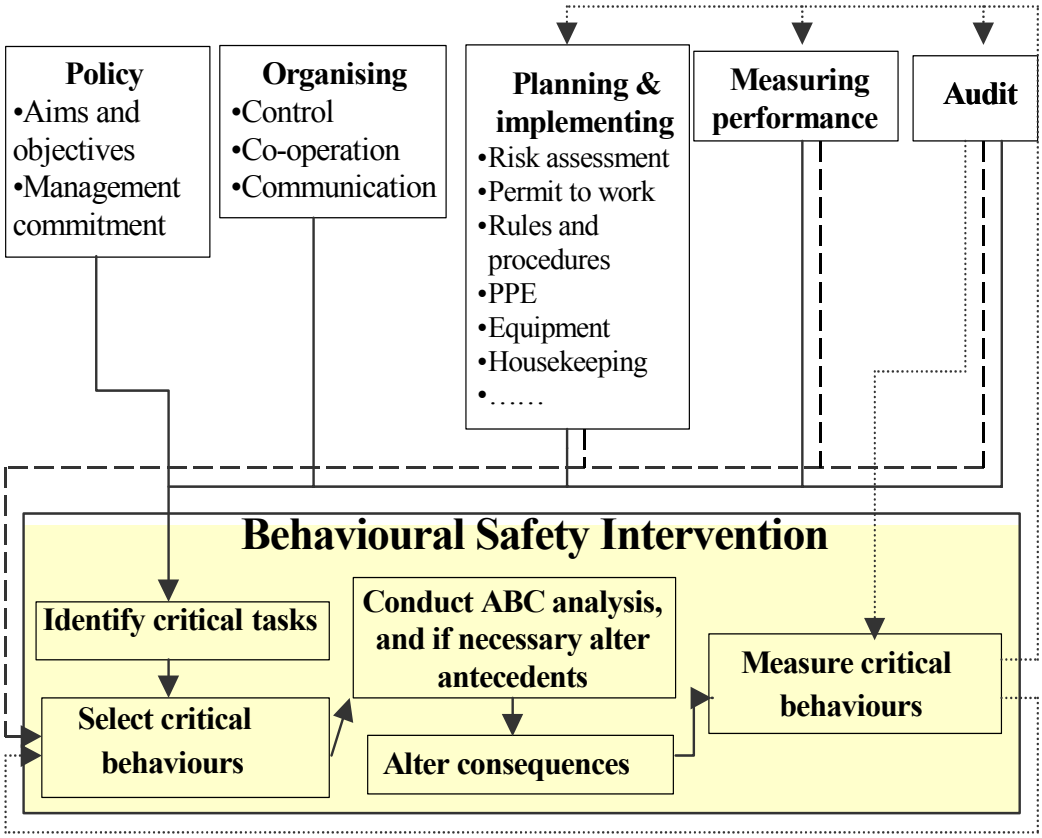


Figure 4 indicates that information from the five main elements of a HSMS can be used to identify critical tasks. This relationship is represented by solid black lines. For example, the organising element of the HSMS may specify that lessons learnt from incident investigations be disseminated to all employees. A number of critical behaviours are required to execute this task (e.g. supervisors meeting with team members to discuss the outcome of an incident investigation). This indicates that critical tasks require further analysis to identify the critical behaviours that can be included in a behavioural safety intervention.

Three of the elements (Planning and implementing, Measuring performance and Audit) are likely to specify critical behaviours. This relationship is represented by dashed black lines. For example, the planning and implementing element may specify that PPE detailed in the PTW must be worn, or the person authorising a PTW must visit the worksite before signing the permit. These behaviours could be included in a behavioural safety intervention.

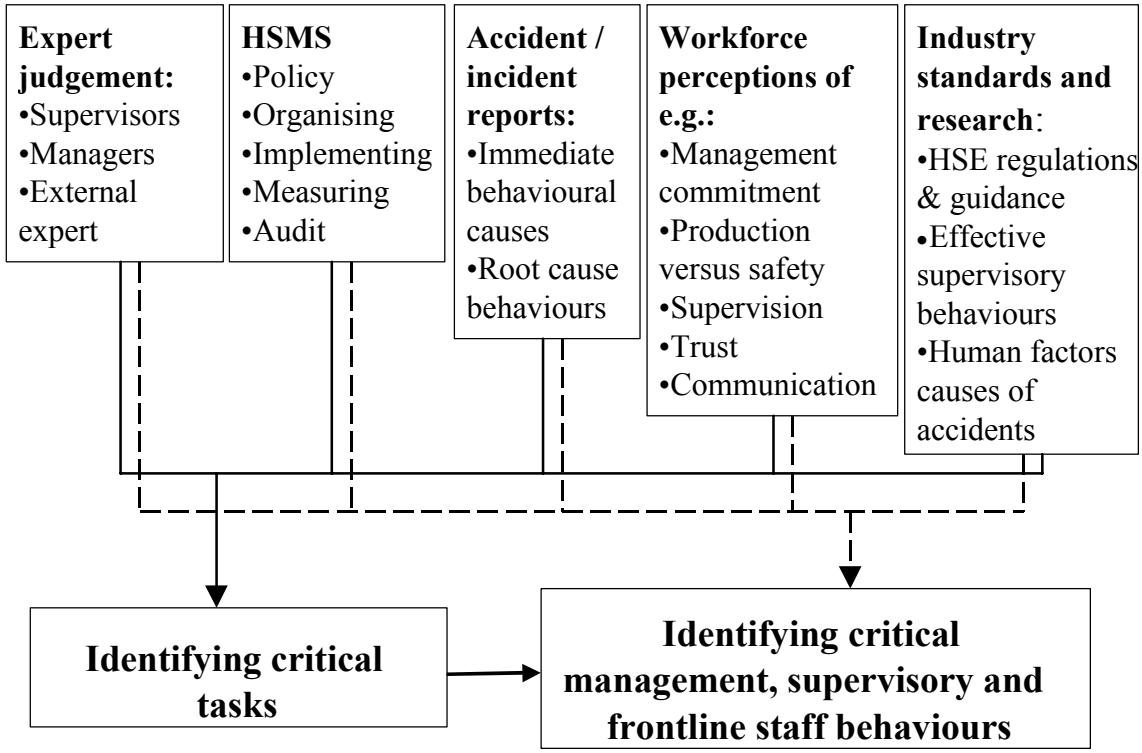
The output from a behavioural safety intervention can input into other elements of the HSMS. This relationship is represented by dotted black lines. Figure 4 indicates that the results of a behavioural safety intervention can provide information for Audit, Measuring performance and Planning and implementing. The results of a behavioural safety intervention can be used as a part of the audit process to indicate the general level of compliance with the systems and procedures associated with the list of critical behaviours. The risk assessment process can use the results of the behavioural intervention to highlight tasks where additional controls are required. In addition, the Audit process could be used to check the frequency and quality of observations conducted.

The above highlights the two-way relationship between the elements of the HSMS including other RCSs and a behavioural safety intervention. Although the nature and extent of the information flow between a behavioural safety intervention and other elements of the HSMS will vary, integration is likely to increase the effectiveness of all interventions.

6.3 INTEGRATED APPROACH TO IDENTIFYING CRITICAL SAFETY BEHAVIOURS

Section 3.1.4 outlined a range of techniques described by providers to identify critical health and safety behaviours. In order to produce an integrated behavioural safety framework, all information available needs to be considered when identifying critical behaviours. Figure 5 below presents a number of sources of information that could be used to identify tasks and critical behaviours. The main sources include expert judgement, the HSMS, incident investigations, workforce perceptions and industry standards. Solid black lines represent useful sources of information about critical tasks; dashed black lines represent sources more relevant to critical behaviours.

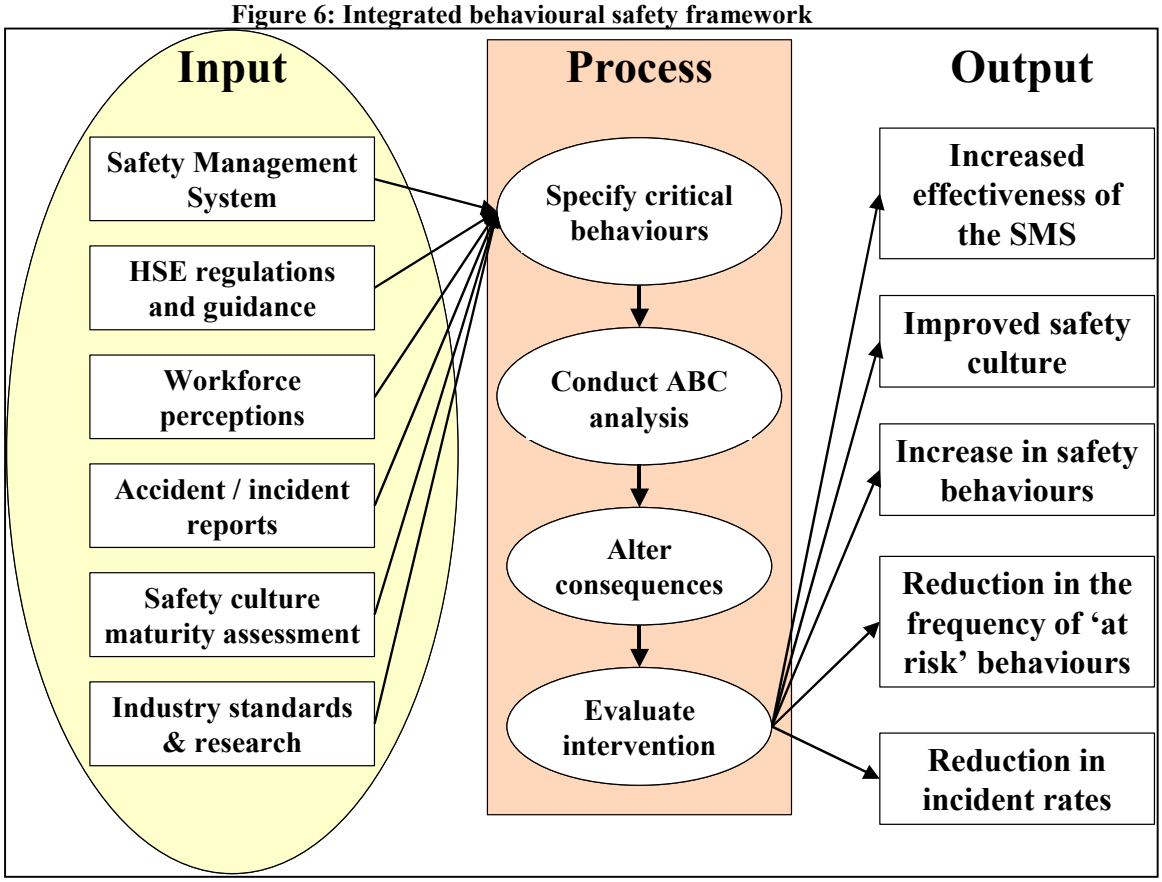
Figure 5: Identifying critical tasks and behaviours



6.4 SUMMARY FRAMEWORK

The above has outlined the relationship between behavioural safety and the HSMS, the sources of information available to identify critical behaviours and the two-way relationship with safety culture. This information has been put together to produce the overall behavioural safety framework presented in figure 6 below. This framework describes the inputs into the behavioural safety process and the potential outputs from the process. This framework can act as a guide to effective implementation and to evaluating the extent to which an existing intervention is integrated into existing management systems.

Figure 6: Integrated behavioural safety framework



7 CONCLUSIONS

Behaviour is a critical aspect of all activities conducted within every organisation. Therefore, the behaviour of all staff has a dramatic impact on health and safety. Behaviour modification techniques can be used to promote the effective use of risk control strategies and to analyse the at risk behaviours to ensure that the risk is minimised.

There is strong research evidence that behaviour modification is effective in changing a range behaviours within organisational settings. Within a safety context, the research shows that behavioural safety programmes can alter frontline employees' behaviour, reduce accident rates and improve the safety climate. Surprisingly, no publications were identified which demonstrated the effectiveness of a behavioural modification intervention in promoting critical risk control behaviours or safety leadership behaviours.

In the absence of a published description of interventions designed to promote critical risk control behaviours, first principles were used to describe how behaviour modification could be used to promote these behaviours. The approaches described could be used to promote many critical behaviours, such as managers ensuring that manpower levels are adequate for the workload or frontline staff monitoring the status of machinery to ensure it is functioning effectively.

It is widely accepted that human behaviour is a contributory factor in approximately 80% of accidents. This statistic has lead to confusion about how to improve health and safety at work, as many people have concluded that further improvements in safety will occur by changing the employees in some way to make them ‘safer’ or to make them adhere to safety rules and procedures. Perceiving the problem as "within the employee" limits the identification of effective solutions. Behavioural change is not brought about by changing the person, but by changing their environment. This document describes strategies to promote critical health and safety behaviours. Implementing these strategies involves introducing new systems and or changing existing systems and engineering controls. The strategies described in this document will not change the employees, only their behaviour.

APPENDIX: DETAILED RESEARCH FINDINGS

A.1 INTRODUCTION

A range of psychological techniques, known as behaviour modification, have been developed to change people's behaviour. Behaviour modification has been used in a wide range of contexts from education to health care. Behaviour modification techniques could be used to improve health and safety risk control by identifying and promoting critical health and safety behaviours. Critics also argue that too much focus on behavioural safety can divert attention from higher-level, more effective controls[9]. Furthermore, some believe that when behavioural safety is integrated into the overall safety management system, real improvements only occur when the non-behavioural components of the system are themselves fully effective[10]. It is therefore important to understand whether and how these programmes can be effectively integrated into the HSMS.

HSE therefore commissioned The Keil Centre to:

1. Review behavioural safety literature to obtain information on how it increases target behaviours (ABC model), the effectiveness of behavioural approaches to safety, its impact on safety culture and Safety Management Systems (HSMS), techniques available to identify critical behaviours of managers and front line staff and examples of how it has been integrated with the HSMS
2. Identify how behavioural safety techniques (including the ABC model) can be used to promote these critical behaviours
3. Use the information obtained from the above review to develop a framework to illustrate how critical behaviours support the safety management system and its development. In addition, the framework will indicate how information obtained from other elements of the HSMS (e.g. risk assessment) and safety climate assessments can be used to identify critical safety behaviours
4. Interview providers of proprietary systems to obtain information on prerequisites for implementation and the key steps involved in running an effective behavioural safety programme
5. Undertake case studies to identify the requirements of the main industrial sectors, including Extraction and Utilities, Service and Manufacturing

This appendix covers points 1-5 above. Initially a summary of the research literature on the application of behaviour modification techniques to health and safety risk management is presented. This is followed by a summary of the safety leadership literature to identify critical management behaviours. The results of the interviews with providers of behavioural safety programmes are described in section 5 and the results of three independent behaviour modification case studies are described in section 6.

A.2 THEORY OF BEHAVIOUR MODIFICATION

Behaviour modification techniques are derived from the ideas of behavioural psychologists[12]. Behaviourist ideas have a long history and their influence can be seen in many areas of applied psychology[13]. Behaviourists argue that it is only important to focus on external observable behaviour as opposed to internal psychological processes, states, emotions or feelings. Many psychologists would disagree with this limited view, but this does not detract from the fact that many behavioural techniques have been successfully applied in organisational settings.

There are two main types of behaviour modification, classical conditioning (automatic/ innate responses triggered by external stimulus) and operant conditioning (behaviour that operates on the environment). An example of classical conditioning is one's mouth involuntarily watering at the smell of food. Operant behaviour refers to any behaviour that is not a simple automatic response, in fact, most human behaviour is operant, e.g. driving a car, cooking food or playing football. The general theory and principles of operant conditioning have been developed in order to apply it within occupational contexts. Collectively, these techniques are referred to as Behaviour modification. Behaviour modification has three features[7]:

1. **Pinpointing of relevant behaviours –** carefully specifying the behaviour(s) to be changed, and directly observing behaviour

2. **A focus on the antecedents and consequences of behaviour**, as ***consequences*** (e.g. the type and frequency of feedback we receive) have a powerful impact on determining our behaviour. What takes place before behaviour (the ***antecedents***) also can have an important impact (e.g. training, goal-setting, communication of company policy).

3. **Emphasis on evaluation –** rigorously evaluating whether behaviour has changed as intended, and whether the change was due to the intervention, or other factors.

A.3 EFFECTIVENESS OF BEHAVIOURAL MODIFICATION PROGRAMMES

Strong research evidence exists from a range of industries on three continents that behaviour modification techniques can lead to safer behaviour, and reductions in accident / injury rates. A recent comprehensive review[7] of behaviour modification research studies demonstrated the effectiveness of the process. This review clearly shows that behaviour modification can be used successfully to change a range of behaviours. This indicates that behaviour modification has the potential to be used to modify behaviours that enhance health and safety management in general and not just the at risk behaviour of frontline staff. The review included nine studies where safety was the dependant measure. Seven of the interventions were judged to be effective and provided support for the effectiveness of behavioural interventions.

A separate literature review[8] investigating the effectiveness of behaviour based safety provided further evidence that behaviour modification techniques can reduce accident rates. The authors of the review identified 33 published studies that reported accident data. Of these studies, 32 reported a reduction in injuries, although the reporting format varied. The level of improvement varied widely with one study reporting a 2% improvement with another reporting an 85% improvement. Only three of the studies used significant testing and only one showed a significant difference.

A number of research studies have been conducted to investigate the relative importance of the component parts (see Figure A.1) of a behavioural safety programme, in order to establish how they can be optimally combined. Use of a training-only component achieved mixed results, and where successful only modest improvements. The addition of graphical feedback, goal-setting and support from management and peers produced significant additional gains. Although theoretically and intuitively important, the added impact of immediate face-to-face feedback has not been systematically demonstrated. Management's commitment to supporting programme implementation was also identified as a critical success factor. These studies are described in detail in section A.3.2 below.

Since 1978 a large number of studies have been conducted to evaluate the effectiveness of behavioural modification programmes in improving workplace safety. These studies have focused on establishing (a) their ability to increase safe behaviour, (b) their ability to decrease accidents / injuries and (c) which components in a behaviour modification programme are most important in changing unsafe behaviour and reducing accidents and injuries.

A.3.1 EFFECTS ON SAFE BEHAVIOUR AND INJURIES

A.3.1.1 US Wholesale Bakery

One of the earliest examples of the successful application of behaviour modification to improve safety took place in a US wholesale bakery[14]. Following concerns over increasing plant injury rates, the departmental shift with the highest injury rate was selected for a behaviour modification project. Prior to the project, little or no reinforcement was provided by management or colleagues when people took time to act in a safe manner, and no opportunities were provided for employees to learn how to avoid unsafe practices.

Behavioural analysis of previous accidents led to a clearly-defined behavioural observation checklist describing safe and unsafe behaviours or, where possible, the outcome of the behaviour. Independent, trained observers measured baseline levels of safe behaviour. Following baseline measurement, groups of employees took part in a thirty-minute training session, where they were shown slides demonstrating safe/unsafe behaviour, focusing on behaviours with the lowest baseline level. Baseline performance was graphically displayed, and employees agreed to strive towards a 90% safe behaviour goal.

Over subsequent weeks, behavioural safety performance improved, consistently exceeding goals in one area. Supervisors also deliberately made favourable comments to employees who were behaving safely on key tasks.

Employee reactions to the project were favourable, however management and supervisory support was patchy. Employees subsequently took responsibility for observing and providing feedback. Over the first year of implementation, the injury frequency rate dropped from 53.8 to 10 per million man-hours worked.

A.3.1.2 US Sugar-Cane Machinery Manufacturing Plant

This study was conducted in those parts of the plant that accounted for 95% of all recorded injuries. An observational checklist of safe/unsafe behaviours was developed, based on accident analyses, supervisor's comments and published industry data. Observations of employee behaviour were conducted by independent external observers and a company safety supervisor. Following collection of baseline data, training was provided in which the

checklist, observation method and safe/unsafe behaviours were explained, Over subsequent weeks, a 90% safe behaviour goal was introduced and reinforced by supervisors, however no feedback about actual performance was given. Finally, regular feedback on safety performance was displayed, which included current performance against the 90% goal.

Average behavioural safety performance improved from 62 to 95%, with a corresponding decrease in accident rates. The estimated cost-benefit ratio for this safety programme was at least 1:8.

A.3.1.3 US Metal Fabrication Site

At a US metal fabrication facility, a six-phase programme was implemented to improve safety[15]. In phase one, a behavioural measure of safe/unsafe behaviour was developed, and baseline observations made by independent, trained observers. Phase two consisted of a period of employee training, during which safe and unsafe behaviours were explained and demonstrated. A 95% safe behaviour goal was set by management. The third phase involved weekly feedback of safe behaviour performance against goals at a group safety meeting. In phase four, once the 95% goal had been achieved, the frequency of feedback was reduced to once per fortnight. No drop in safety performance occurred when the frequency of feedback was reduced. In phase five, training, feedback and goal-setting were discontinued, and behavioural safety performance dropped. Finally, phase six involved the reintroduction of fortnightly feedback, which led to a recovery of behavioural safety performance. This six-phase programme confirmed the essential role of feedback in improving safety performance. Effects on accident / injury rates were not reported.

A.3.1.4 US Review of 24 Behaviour Modification Studies

Twenty-four studies which had used positive reinforcement and/or feedback to improve safety-related behaviours in industry were examined[16]. The major finding was that in every published study positive reinforcement and/or feedback enhanced safe behaviour and/or reduced accidents. However, not all categories of behaviour improved, and examples were found where equipment design prevented the adoption of safe behaviours.

A.3.1.5 Behavioural Safety – A UK Example

Following year-on-year reductions in accidents, a UK cellophane manufacturing site employing over 500 staff retained a base level of behaviourally-caused accidents that resisted improvement.

At-risk behaviours were pinpointed by analysing the previous two years' accident records by departments, type of accident, place of injury on the body and time. Wherever possible, behavioural causes of accidents were identified (e.g. not wearing eye protection provided). Interviews with a sample of the workforce were carried out to verify the at-risk behaviours derived from accident analyses, which identified additional at-risk behaviours not evident from accident records.

Management briefings were held, and their specific assistance in supporting the programme was sought. Employee observers were recruited from the site, and each was provided with two days of theoretical and practical training.

The trained observers established a baseline of safe behaviour, and used group goal-setting meetings to establish and agree target levels of safe behaviour. Over a sixteen-week period, a

significant improvement in safe behaviour was found in nine of the fourteen departments involved. A 21% reduction in the plant's overall accident rate, and a 74% reduction in those accidents directly linked to the safe behaviours was noted, when pre- and post-programme accident rates were compared. Estimated annual savings due to reduced accidents costs and insurance premiums ranged from £180,00 to £360,000.

Table A1 Summary

Antecedents	• Communication of intention to change at-risk behaviours • Briefings for staff and management • Training of observers • Goal-setting
Pinpointing of **B**ehaviours	• Analysis of relevant at-risk behaviours • Direct observation of behaviour by trained observers
Consequences	• Weekly feedback on at-risk behaviour and improvements from observers , via display of graphical feedback charts • Management support and encouragement
Evaluation of effects	• Monitoring of changes in at-risk behaviour • Monitoring of accident rates
Outcome	• 21% reduction in the plant's overall accident rate • 74% reduction in those accidents directly linked to at-risk behaviours • Estimated annual savings ranged from £180,00 to £360,000.

This example used all three behaviour modification principles and the ABC model to successfully improve safety. The approach was relatively sophisticated, and included additional features identified by a previous HSE review of behavioural safety[2], for example goal-setting, as shown in Figure A.1 below.

A.3.1.6 UK Construction Industry

A two-phase behaviour modification programme was conducted on a number of UK construction sites to reduce accidents[17]. A construction-specific list of unsafe behaviours was prepared, based on accident and injury records and construction industry expertise. Independent, external observers were trained, and established a baseline measure of behavioural safety performance. At group goal-setting meetings, site staff set goals for improvement against baseline performance. Feedback of weekly behavioural safety performance was posted graphically at a highly-visible location. Significant increases in safe behaviour occurred, however no data on the knock-on effect on accident and injury rates was presented.

This piece of research was extended to examine the effects of management commitment and the use of internal company personnel to observe, facilitate goal-setting and provide graphical feedback. Similar improvements in safe behaviours were found, which were moderated by the degree of management commitment shown.

On those sites where management supported behavioural feedback; allowed workers to stop work to attend goal-setting sessions; attended and supported goal-setting sessions and allowed observers time to conduct observations, the safe behaviour improvements were markedly better.

A.3.1.7 Long-Term Evaluation of US Consulting Firm's Behaviour-Based Safety Interventions

A US safety-consulting firm recently published an evaluation of changes to injury rates across 73 sites where their firm had implemented behaviour-based safety interventions[18]. Over a third of these sites were in the petroleum and chemical industries. Each of the seventy-three interventions shared several common features, including development of a site-specific checklist of critical behaviours, training of employee observers, and provision of feedback to employees.

Taken as a whole, the 73 sites showed significant progressive reductions in injury rates from baseline levels over a five-year period. Alternative explanations for the improvement being due to other unmeasured organisational changes, the effect of the global trend in safety improvements, or the specific features of this consulting firm's approach cannot be entirely ruled out. However, it seems probable that a proportion of the reductions in injury rates are attributable to the generic principles underlying the application of behaviour modification to improve safety.

A.3.1.8 Australian Industrial Safety Behaviour Modification Trial

Many of the successful safety improvements reported in the behaviour modification literature have occurred when programmes are implemented by academic researchers or specialist consultants. In such circumstances, control over how rigorously the programme is implemented does not rest wholly with company employees. This may limit the effectiveness of company-driven schemes, when implemented under sub-optimal conditions by personnel subject to many other organisational demands.

An Australian study explored the effectiveness of behaviour modification programmes that were largely implemented by company personnel[19]. Nine programmes were implemented on different sites, each with the main aim of improving safe behaviour and housekeeping. Only three of the sites achieved improvements in both safe behaviour and housekeeping. A further three sites found improvements in housekeeping only. Further analyses[19] concluded that failures were not due to fundamental flaws in the techniques of behaviour modification, but aspects of site management behaviour and programme implementation. Specifically, those sites where the following nine aspects of management behaviour were present tended to be associated with effective behaviour modification programmes:

1. Active managerial involvement in safety
2. Delegation of authority for safety to employees
3. Briefing of all levels of the organisation
4. Consistency of management's current safety practices
5. Leadership by management to improve safety
6. Supervisors serving as role models
7. Personable communication
8. Priority given to safe production
9. Co-ordination between management and the research team.

A.3.1.9 Summary

Evidence exists from a range of industries on three continents that behaviour modification techniques can lead to safer behaviour, and reductions in accident / injury rates. As programme components have been combined in different ways across studies, how best to

combine programme components, and their relative importance became key research questions. Management's commitment to supporting programme implementation was also identified as a critical success factor, as was the organisation's readiness to implement a behavioural safety programme.

A.3.2 EFFECTS OF PROGRAMME COMPONENTS

The following studies sought to understand the relative contributions of behaviour modification programme components.

A.3.2.1 US Farm Machinery Manufacturing Plant

Due to concern about high accident rates, a behaviourally-based programme was instituted to (a) reduce accidents and (b) determine the relative contributions of the programme's principal components, namely (1) safety training (2) goal-setting and (3) feedback of results[20].

A behavioural checklist of safe/unsafe behaviours was developed, and trained observers established baseline behavioural safety performance. Training was then provided, which focused on teaching examples of safe/unsafe behaviour. Following completion of the training component, groups of employees were asked to endorse a management-defined 90% safe behaviour goal, and the goal was posted prominently. The final component was provision of graphical feedback during safety meetings on observed safe behaviour performance against the 90% goal.

Improvements in safe behaviours were noted following the introduction of each of the three components. The 90% goal was only attained once feedback was provided. In other words, goal setting plus training, and training alone, had positive effects on behavioural safety performance, but the addition of feedback resulted in a further increase. A corresponding decrease in overall and lost-time injury rates was observed following the programme's introduction.

A.3.2.2 US Automotive Industry

A US automobile manufacturing plant developed a similar programme to assess three components: (1) Altering antecedents only (e.g. training) (2) antecedents and feedback and (3) Antecedents, feedback and goal-setting[21]. An independent observer was used. Training alone did not produce any significant change in safe behaviour or accidents / injury rates. The introduction of group feedback via public posting of results led to measurably safer behaviour. When a 95% safe behaviour goal was set by a union representative, employees exceed the goal. In this study, it was concluded that safety training alone was not sufficient to change unsafe behaviour, whereas group feedback did lead to change, and this effect was enhanced by goal-setting.

A.3.2.3 US Retail Distribution Warehouse

Two similar studies were conducted by the US National Institute of Occupational Safety and Health[22]. Observation, training, group and individual feedback and goal-setting led to improvements in most categories of behaviour. These studies concluded that whilst their well-designed training component has produced measurably safer behaviour, the addition of goal-setting and feedback combined with informal management and peer support led to additional, enduring improvements.

A.3.2.4 Additional Programme Components

Other proprietary behaviour modification programmes[23], also emphasise the provision of face-to-face individual discussion and positive feedback at the time of observation. Observers are trained to elicit suggestions on how to improve safety, gain individual commitment to corrective actions and provide assurances of any management support required. Provision of immediate face-to-face feedback is another potentially important programme component, however its relative importance has not been systematically assessed.

A.3.3 IDENTIFICATION OF CRITICAL BEHAVIOURS: THE LITERATURE

A range of published examples of methodologically-sound behavioural safety research were reviewed to identify method(s) used to identify at-risk behaviours. Table A.2 below classified the methods into (a) **reactive methods**, based on accidents which have already occurred on-site, and (b) **proactive methods**, which prospectively assess the risks of behaviour causing an accident in the future by analysing hazards, tasks etc.

Table A2: Methods to identify critical at-risk behaviours

Method used to identify at-risk behaviour	Industry sector							
	Cellophane Manufacturing[24]	Bakery[25]	Machinery Manufacturing[20, 26]	Metal Fabrication[15]	Construction[17]	Car component manufacturer[21]	Distribution warehouse[22]	Offshore drilling rigs[27]
REACTIVE METHODS								
Analysis of site's past accident records	●	●	●	●	●	●		●
Analysis of past accident records by time of day	●							
Analysis of past accident records by department	●							
Analysis of past accident records by place of injury on body	●							
Analysis of past accident records of department with highest accident rate		●						
PROACTIVE METHODS								
Interviews with workforce to establish at-risk behaviours not identified by accident records	●			●				●
Survey of workforce to determine risk level of at-risk behaviours, to narrow down choice of at-risk behaviours				●				
Discussion with union and/or safety representatives						●		
Supervisory input to definition of at-risk behaviours	●	●	●	●	●			●
Consulting published sources of accident prevention and reduction			●	●				
Consulting tool and equipment manufacturers handbooks and recommendations				●			●	●
Consulting industry-sector-specific published journals and safety reports					●		●	●
Consulting national health and safety regulatory body publications					●			
Analyses of near-misses						●		
On-site observation of people at work							●	
Task / hazard analysis							●	●
Basing at-risk behaviours on company's newly-developed safety manual			●					

All but one example used reactive analyses of site accident data, and some extended this analysis by focusing on departments, time of day and place of injury on the body.

A range of proactive methods to identify at-risk behaviours were evident. All examples used at least one proactive method, the most frequently used being supervisory input. Importantly, some of these proactive methods identified behaviours which were critical in eliminating or reducing the hazard.

Some examples indicating a degree of integration with safety management systems were also found. These included basing at-risk behaviours on the company safety manual, analyses of near-misses, consulting handbooks for tools and equipment used on-site and task / hazard analysis. Several examples also described efforts being made to identify ***why*** an at-risk behaviour occurred, so that any root cause (e.g. poor equipment design) could be rectified, thus eliminating the hazard at source.

A.3.4 BEHAVIOURS THAT SUPPORT A POSITIVE SAFETY CULTURE

Safety culture has been described as the most important theoretical development in health and safety research in the last decade[28]. The relationship between behaviour and safety culture is complex. Theoretically, the behaviour is a component of the safety culture, but the behaviour of individuals at different levels within the organisation will influence the culture in different ways. This complexity is compounded by the lack of agreement between experts as to the definition of safety culture. The issue is further confused with concept of safety climate, which is often used interchangeably with safety culture.

In the absence of one agreed definition the following one appears to be accepted by most experts. Safety culture is "*the product of individual and group values, attitudes, perceptions, competencies, and patterns of behaviour that determine the commitment to and the style and proficiency of, an organisation's health and safety management"*[16]. Safety climate on the other hand has been described as "*the workforce's attitudes and perceptions at a given place and time. It is a snapshot of the state of safety providing an indicator of the underlying safety culture of an organisation"*[15].

Although there is a lack of published research specifying the behaviours required to support a positive safety culture, numerous studies[29] [30] [31] have attempted to link measurable safety culture factors, now usually called safety climate, to accident frequency. A clearer link between critical behaviours and a positive health and safety culture would therefore be useful.

A number of techniques have been employed to measure safety culture, the most common method is a self-completion questionnaire. Employees respond by indicating the extent to which they agree or disagree with a range of statements about safety e.g. "senior management demonstrate their commitment to safety". The data obtained from the questionnaires are analysed to identify factors or concepts that influence the level of safety within the organisation. Numerous research studies [30] [31] [32] have identified a range of organisational factors that are linked to safety performance. Although the majority of studies have developed their own instrument to measure safety climate a number of common factors have emerged. Recent reviews[32] [33] have identified the following six common themes in the studies reviewed:

- Management/ supervisor commitment to safety
- Safety systems
- Risk perception and self report risk taking
- Work pressure
- Competence
- Procedures and rules

The nature of safety climate measurement produces general organisational concepts, which are not directly tied to specific behaviours. This feature of safety climate research prevents the identification of specific behaviours associated with a positive safety culture, instead they identify general themes or factors. The general nature means that a range of behaviours could influence each safety climate factor. The specific behaviours required to promote a positive safety culture are likely to vary over time and between organisations. It is therefore necessary for an organisation to analyse the results of their safety climate surveys further in order to identify the specific behaviours required to promote or maintain a positive safety culture. In addition, safety climate is based on the perceptions of employees therefore it is important for an organisation to establish the specific behaviours that managers, supervisors, peers and individuals need to display to change employee perceptions.

Research evidence[7] suggests that behavioural safety programmes can enhance the safety climate of an organisation. For example, one behavioural safety study measured site safety climate before and after the programme was implemented. Over a one-year period, significant positive changes in the plant's safety climate occurred, suggesting the programme's impact extended beyond its initial focus on behaviour.

In contrast, other research[15] suggests that behavioural safety programmes are unlikely to succeed unless the organisation's safety culture is sufficiently mature. This suggests a two-way relationship between behavioural safety programmes and safety culture. This indicates that organisations need to consider the safety culture maturity of their organisation when selecting an implementing a behavioural safety intervention. In addition, it is likely that an effective behavioural safety intervention will enhance the safety culture of an organisation by changing patterns of behaviour and perceptions about the importance of safety and management commitment to safety.

A.4 LEADERSHIP STYLE AND BEHAVIOURS THAT ENHANCE SAFETY

The literature review did not identify any publications that systematically reviewed the effectiveness of behavioural safety programmes in changing management behaviours. The literature review did reveal four different ways, in which management behaviour is included in behavioural safety programmes. Table A.3 below describes how management behaviour is included, the intended effect and comments.

Table A.3: Promoting critical management behaviours

How management behaviour is included	Intended effect	Comments
Behavioural safety programme is extended beyond front-line staff, to encompass other work areas, including where managers work	Reduce at-risk behaviours associated with the hazards present in the managerial work environment	Relatively common feature of behavioural safety programmes. May include a set of at-risk behaviours developed for a low hazard office environment
Implementation of a behavioural safety programme[2] designed to train managers to personally use behaviour modification methods to improve safety	Managers personally use behaviour modification methods to influence employee behaviour. This also provides a visible demonstration of management commitment to safety. As a result, at-risk behaviour reduces.	Managers may have targets for the number of times they personally use behaviour modification methods to improve safety
Identification of management behaviours which support or hinder the success of behavioural safety programmes	Management display these behaviours, and help ensure programme success	For example, an Australian study[19] identified nine "managerial patterns" associated with effective behavioural safety programmes
Inclusion in behavioural safety programme of a feedback loop to the HSMS[2], which identifies system changes required.	The behavioural safety programme does not operate in isolation from HSMS, and systemic barriers or enablers to safe behaviour are addressed by management	The feedback loop would not typically express actions required in behavioural terms

At-risk behaviours for front-line employees are typically tightly-defined and frequently and readily observable. With the exception of the first example above, published studies have not

tightly-defined the safety critical managerial behaviours, or established exactly who and when to observe. Rather than relying on direct observation of management behaviour, they monitor the results of management behaviour (e.g. number of management tours completed, percentage of management actions completed within a given time frame).

In recent years, there has been an increasing recognition of the importance of safety leadership, specifically management commitment to safety. Although management commitment is recognised as an important element of an organisation's safety culture, there is limited research into the specific leadership style and behaviours that managers should display[34]. In addition to this, many research studies use the term 'management' to refer to a variety of occupational groups from senior management to front line supervisors[35]. The majority of published studies have focused on first or second line supervision. This is surprising given the importance placed on senior management in developing a positive safety culture[36]. Recently a limited number of research studies [6 23 35 37] have investigated the impact of leadership style of senior and middle managers on health and safety management. Studies that have investigated safety leadership behaviours have tended to focus on supervisors as opposed to more senior managers.

A.4.1 LEADERSHIP RESEARCH

A literature search revealed four publications describing studies that investigated the impact of managers' leadership styles on health and safety performance. These studies are summarised below.

A.4.1.1 Safety Implications of Offshore Managers' Leadership Style

Research is currently being conducted in the UK offshore oil and gas industry[35] to investigate the impact of leadership style on workforce self-reported willingness to take initiative in safety and compliance with safety rules. Leadership style was measured using the Multifactor Leadership Questionnaire (transformational, transactional and non-leadership)[38] and the Behaviour Description Questionnaire (consideration and initiating structure)[39]. Additional scales were developed to measure leader commitment to safety, leader/subordinate joint participation in safety activities and leader use of power. A self-completion questionnaire survey was conducted on six offshore installations. In total 231 responses were returned (70% response rate), which included responses from 10 site managers, 36 supervisors and 185 frontline staff.

The results revealed that leader self-report responses did not predict workforce safety initiative or compliance with safety rules. However, workforce ratings of site managers did predict worker self-report behaviour. This suggests that subordinate rating of leader behaviour could provide leaders with important feedback on their behaviour. Specifically worker's who reported higher leader commitment to safety and higher involvement in safety initiatives reported higher safety initiative behaviour. In addition, a transformational leadership style was predictive of safety initiative behaviour and consideration was predictive of rule compliance. This suggests that leaders should adopt a transformational as opposed to transactional leadership style and be more people focused (consideration) as opposed to task focused (initiating structure). A transformational leadership style involves attempting to motivate group members to go beyond their self-interest in order to achieve goals, by convincing them of the intrinsic work of the goal. Transactional leadership involves the exchange of rewards or threats to achieve compliance. The study also revealed differences in the impact of site managers and supervisors. Site managers had a greater influence on safety initiative while supervisors had a greater influence on rule compliance. This suggests that

senior managers have an important role to play in promoting health and safety in a general sense and supervisors have more impact on day-to-day safety arrangements.

A.4.1.2 Promoting Safety Behaviours through Transformational Leadership

Research suggests that a transformational leadership style motivates employees to achieve organisational goals[40]. . Leaders with a transformational leadership style attempt to motivate group members to go beyond self-interest in order to achieve goals, by convincing them of the intrinsic worth of the goal. A resent UK study[35] has investigated if a transformational leadership style motivates for employees who are not highly committed to safety to be more safety conscious and become more proactive. The authors concluded that, *"transformational leadership style was found to have a strong positive impact on safety compliance of individuals who were less committed to safety"* (p19). It is interesting to note that transformational leadership explained a relatively small amount of variance in safety compliance. This study also revealed that a transformational leadership style encourages employees with a narrow work orientation to become more proactive (i.e. more involved in safety initiatives). This study suggests that leaders should adopt a transformational leadership style to motivate employees to comply with safety rules and procedures and to be involved in safety initiatives.

A.4.1.3 Interaction Between Transformational Leadership and Safety Climate

The impact of transformational leadership on workgroup safety climate and accident rates was investigated[26] by surveying 351 industrial workers and then tracking first aid treatments for the following six months. The results revealed that transformational leadership was significantly correlated with climate perceptions while transactional leadership was not. In addition, structural equation modelling revealed that transactional leadership predicted safety climate, which in turn explained 25% of the variance in first aid accidents. This suggests that leaders can enhance their subordinates' safety of by adopting a transformational leadership style.

A.4.1.4 Supportive Leadership Style Promoting Safe Behaviour

A large (240 participants) longitudinal study[37] conducted over four years in an Australian hospital investigated the impact of conscientiousness and supportive leadership on safety compliance and participation through safety motivation. Regression analysis revealed that conscientiousness and supportive leadership had a positive impact on safety motivation, which in turn increased safety compliance. The study also revealed that supportive leadership did not influence safety participation. This suggests that leaders can increase the likelihood that subordinates comply with safety procedures by adopting a supportive leadership style.

A.4.1.5 Impact of the Quality of Leader-Member Communication on Safety

One of the important elements of an organisations health and safety climate is the perceived level of management commitment to safety. It has been argued that managers' commitment to safety influence employees' behaviour by giving them an implied signal to act in a safe manner. If this is the case then the quality and frequency of the social exchange between managers and employees is likely to influence their safety behaviour. An American study investigated the impact of perceived organisational support and leader member exchange on safety communication, safety commitment and accidents among 49 pairs of supervisors and group leaders (subordinate to supervisor) in a manufacturing plant. The group leaders

measured the quality of the leader member exchange and safety communication. The supervisors measured group leader safety commitment and accident involvement was established by reviewing company accident records a year after the survey.

A structural equation model was constructed to test the relationship between the quality of leader member exchanges, perceived organisational support, safety communication, safety commitment and accident involvement. The results indicated that the quality of the leader member exchanges influenced group leaders' safety communication, which in turn influenced their safety commitment that explained a significant amount of variance in accident involvement. In addition, the quality of leader member exchanges influenced the level of perceived organisational support, which also affected safety communication that in turn influenced safety commitment that explained a significant amount of variance in accident involvement. This suggests that improving the quality of exchanges between leaders and employees can enhance safety performance.

A.4.1.6 Conclusion

Three of the above investigated the impact of transformational versus transactional leadership on subordinate safety. Transformational leadership goes beyond the simple exchange of reward or punishment to produce desired behaviours used in transactional leadership. Leaders with a transformational leadership style attempt to motivate group members to go beyond self-interest in order to achieve goals, by convincing them of the intrinsic worth of the goal. In a safety context this style of leadership can motivate employees to comply with safety procedures which often require extra effort for what individuals often perceived to provide limited gain. All three studies found that transformational leadership had a positive impact on safety, while transactional leadership did not influence safety. This suggests that managers can enhance safety by adopting a transformational as opposed to transactional leadership style.

Two of the studies[35] [37] concluded that subordinates are more likely to comply with safety rules and procedures if their manager adopts a supportive or consideritive leadership style. This suggests that leaders should be more people focused than task focused if they wish to encourage employees to adhere to safety procedures. This finding could be linked to the important safety climate issue of balancing production against safety. It is possible that leaders who are more people focused than task focused are more effective at enabling their subordinates to prioritise safety over productivity.

The final study examined the importance of the quality of the exchanges between leaders and their subordinates. This study indicated that subordinates who had high quality exchanges communicated about safety more, were rated as more committed to safety and had fewer accidents. It is interesting to note that the scale used to measure the quality of the exchanges was similar to the scales used to measure consideration and supportive leadership styles. This may suggest that leaders who adopt a supportive leadership style are likely to have a better quality exchanges with subordinates, which will in turn improve safety.

It is also interesting to note the differential impact of senior versus middle managers. Research[35] suggests that senior managers influence levels of proactive safety behaviour while middle managers have greater influence over compliance with rules and procedures. It could therefore be suggested that senior managers role is to 'oil the wheels' and promote safety while middle managers have a more direct role in controlling subordinate safety behaviour. The following section describes studies that have investigated the behaviours supervisors or middle managers should display to manage safety effectively.

A.4.2 SAFETY LEADERSHIP BEHAVIOURS

As mentioned above the literature search did not reveal any research that identified the safety leadership behaviours that senior managers should adopt to promote safety within their organisation. This is surprising given the numerous studies that have concluded that senior management commitment is one of the most important elements of safety culture[1]. In addition, Flin et al[32], noted that it is unclear what level of management influences respondents perceptions of management commitment to safety, is it only senior management or does it include all levels of management above the respondent. In light of the lack of research investigating senior management behaviour, the following section will describe studies that have examined supervisor safety leadership behaviours.

Studies that have attempted to identify effective supervisory safety leadership behaviours have been classified into two groups: i) work force perceptions and ii) supervisors' self-report and observed behaviours.

A.4.2.1 Work Force Perceptions of Effective Safety Supervision

A Finnish study[41] conducted by Niskanen examined the safety environment of 193 road maintenance workers by means of self-administered questionnaire. The questionnaire contained 80 questions, of which 60 referred to 10 aspects of the safety environment, the remaining questions referred to demographic information. The following six items were designed to evaluate the supervisor's safety performance: (i) striving toward safe work habits; (ii) discussing accident risks with workers; (iii) effect of supervisors' attitudes on establishing safe work habits; (iv) effect of leadership methods on establishing safe work habits; (v) effect of supervisors' interest on establishing safe work habits; (vi) supervisors think that risk taking is part of the job. The respondents indicated that the supervisors' attitudes towards safety, the supervisors' leadership methods, discussions with the supervisor after the job was finished and the positive feedback provided by supervisors had an above average effect, to a great effect on the establishment of safe work habits. The results of a number of regression analysis indicated that respondents' perception of the attitudes of supervisors had a significant effect on the respondents': 1, own attitude ($p < 0.05$), 2, perception of feedback received ($p < .001$) and 3, importance of own professional skills ($p < 0.01$).

The above results suggest that respondents' felt that safe work habits and workers' safety attitudes were affected by the road supervisor's leadership methods, positive feedback by supervisors, supervisor's attitudes to safety and discussion with the supervisor after the job was completed. The regression analysis indicated that respondents' perceptions about their supervisors' attitudes to safety were related to the respondents' perceptions of the causes of accidents, the effect of feedback and the effect of knowledge and instruction. On the basis of these results the author suggests that supervisors should: (i) adopt a more supportive style of leadership, (ii) initiate discussions about safety to show their interest and (iii) increase the amount of positive feedback on safety issues after a job is finished.

Andriessen[42] investigated the factors that might influence safety motivation in the construction industry. The questionnaire used to measure motivation also attempted to measure the respondents' perception of their supervisor's leadership style and their perception of senior management's and supervisors' commitment to safety. The supervisor's leadership style was measured by the reformulating of a number of standard scales. The scales used were intended to measure: 1, openness; 2, participation; 3, pressure to produce; 4, rule formulating leadership; 5, organising. When these scales from the questionnaire were factor analysed only two dimensions emerged and these were labelled "organising leadership" and "open leadership". The author developed a model from the data using path analysis. This

model indicated that the perceived openness of the supervisor's leadership style and the respondents' perceptions of the safety attitude of senior management had a direct effect on the perceived safety norm of their supervisor. The perceived safety norm of their supervisor had a direct effect on the respondents' expectations regarding the reaction of the supervisor to safe or unsafe behaviour. The respondents' perceived safety attitudes of their supervisor also had a direct effect on their expectations regarding the probability of safety behaviour reducing accidents. These in turn explained a significant amount of the variance in respondents' self-reported carefulness and safety initiative. From this model, it was concluded that employees with supervisors who have an open style of management and demonstrate a positive attitude to safety are more likely to be highly motivated to behave safely and believe that this behaviour will help prevent accidents.

Safety culture within British Rail was investigated by interviewing workers from both safe and unsafe sections of track[43]. The sections were identified as either safe or unsafe based on the percentage of workers that had reported an accident in the previous three years. They found that when interviewees were questioned about the characteristics of 'safe' and 'unsafe' gangs, both safe and unsafe gangs identified the managers' attitude to safety and managerial performance as being important for effective safety management. It was suggested by the interviewees that managers of 'safe' gangs planned the work more carefully so that there was less time pressure and therefore less conflict between safety and production. They also suggested that they treated their staff more fairly and provided them with more information about work details. They reported that 'safe' section managers displayed a leadership style that made staff feel valued and informed with regard to work details, which the interviewee's felt gave staff a sense of loyalty to their section manager. The respondents also reported that they felt more comfortable with a section manager who exercised tight control over the work.

This study indicates that workers, at all levels within track maintenance in British Rail, are consistent in their perception of the factors that facilitate a safe working environment. The interviewee's perception that managers' abilities, leadership style and attitude to safety are important for a safe working environment is consistent with the findings of the studies presented above. It is interesting to note that managers had the same perceptions as workers because this suggests that managers of unsafe gangs were aware of what was required of them but either felt that they were effectively managing safety or were not motivated or able to perform as they felt was necessary. The former appears to be the case because Guest et al[43] also report that high accident sections were no more likely to perceive that their safety performance was poor. This suggests that providing feedback to managers of the relative position of their work group may be beneficial in improving the level of safety.

All the studies described above that have examined work force opinion about effective safety management could be affected by this problem of respondents presenting - for what ever reason - what they perceive to be the correct answer. The major shortcoming of the above research studies was the failure to link perceived supervisory behaviour to a variation in an objective measure of safety performance. Niskanen's and Andriessen's findings were based on the workers subjective evaluation of supervisor's performance and relating these evaluations to respondents' self-reported behaviour. It is therefore difficult to be confident that the results actually reflect the factors that are important in accident prevention, as they are relating one subjective perspective to another, with no objective measure. The study of safety culture in British Rail did identify safe and unsafe gangs but did not find differences between these groups in terms of their self-reports about effective safety management.

A.4.2.2 Supervisors' Self-Reported and Observed Behaviours

A study[44] carried out to identify the common factors in the safety programs of twelve companies that had succeeded in reducing their Lost Time Accident rate, revealed that some

supervisory behaviours were important. They found that supervisors in these companies frequently met with workers to discuss safety matters and were involved in the training of employees in safe work practices. In a similar study[45] to the above, the authors sent a questionnaire and visited the site of the five top performing companies in the USA in terms of the number of reported injury incidents to identify the factors that made them more effective. They found, in addition to other factors, that supervisors were: (i) considered part of the safety staff and spent significant amount of there time on safety matters, (ii) involved in the development of safety procedures, (iii) involved in safety inspections and accident investigations with workers and (iv) responsible for new employee safety training. A major weakness of both these studies is that they only looked at companies that had low accident rates, therefore the commonalties identified may be present in all companies, irrespective of the accident rate.

To determine the supervisory leadership behaviours that are most effective in managing safety, Simard and Marchand[46], investigated if supervisors in low accident manufacturing plants were more likely to use a participative style of management than supervisors in high accident plants. Initially, 258 plants with over seventy employees were selected by systematic random sampling from a population of 1428 plants divided among 20 manufacturing industries from Quebec, Canada. The sample was grouped into high and low accident plants on the basis of their accident rate relative their industry average. One hundred plants agreed to participate in the study.

The data were collected by site visits, a series of interviews and a battery of 13 standardised self-administered questionnaires. The sample included 1064 first-line supervisors. These supervisors were asked to report the frequency with which they were personally involved in a number of safety activities and how frequently their employees were involved in the same activities. These safety activities were; (i) inspections, (ii) safety analysis of critical tasks and working methods, (iii) accident investigation and (iv) training of new employees. The supervisor's level of participatory behaviour was measured by cross-tabulating his/her self reported statements about the frequency of his/her personal involvement in the above four safety activities and the frequency of his/her employees participation in the same activities. The final variable was constructed by aggregating at plant level the types of supervisory behaviour. This was done by selecting the behaviour that the majority of supervisors had been found to have. The plants were either coded as having hierarchical or participatory involvement.

They found a significant relationship between supervisory style and level of accidents, where low accident plants were positively correlated with participatory style of supervision and the hierarchical type was negatively related. Plant supervisory type was found to have a significant effect on plant occupational safety effectiveness with a partial correlation (R) of 0.17.

A study in the Finnish construction industry[47] examined the impact supervisors' management style on safety. The study was carried out on 16 construction sites in southern Finland, the sample included 15 site managers and 16 other foremen. The safety performance of the supervisor was calculated in two different ways: 1, the accident rate for each supervisor; 2, a safety checklist was developed determine the safety level of the sites. The accident rate for each supervisor was determined from the accident statistics for each work site compiled by the company for insurance purposes divided by the number of hours worked (excluding white collar workers). The safety checklist contained 18 items that were thought to be essential for describing the safety level of a construction worksite. Each item on the checklist was marked as either being correct, incorrect or not observed. If an item was observed as incorrect at any point during each sampling session the whole item was marked as incorrect for that item. A safety index was used to express the percentage of items performed safely at each site. The inter-rater reliability was found to be between 76% and 100%.

To establish supervisory behaviours they used the Operant Supervisory Taxonomy and Index (OSTI), which was developed by Komaki[48]. The OSTI contains seven main categories of supervisory behaviour these categories are further subdivided to allow specific behaviours to be classified. The seven categories are: 1, consequences (supervisor is indicating knowledge of the worker's performance); 2, monitoring (obtaining information on worker performance); 3, antecedents (providing instructions); 4, own performance; 5, work related; 6, not work related; 7, solitary. The procedure for observation involved a trained observer standing unobtrusively out of sight but within hearing distance of the foreman. Inter-rater reliability was established once for each supervisor, this revealed average inter-rater reliability of 90%.

The authors do not appear to have found significant differences between supervisors with high and low safety indices. Having said that the authors concluded that the supervisors' with the best safety indices:

1. Spent more time at the worksite;
2. Gave feedback more often to their workers;
3. Used more time to monitor performance;
4. Spent less time setting antecedents;
5. Spent more time communicating on non-work related issues;
6. Gave either positive or neutral feedback, while poorer performers gave more negative feedback;
7. Gave incentives to work safely more often;
8. Used a more participative management style in discussions.

These conclusions appear to be based on an examination of the mean scores of the above items for supervisors with high and low safety indices that were observed at a similar phase of construction. The authors have not reported any tests of significance, and it is therefore assumed that none were performed. While the direction of the mean differences between supervisors with high and low safety indices for the above items are in the direction that support the authors' conclusions the standard deviation for these items are large, in fact they are greater than the mean value in the majority of cases. This indicates that there is a large amount of variance in the data and this questions the amount of confidence that can be placed on the mean value, the median would have been informative. In short while the above differences are interesting, it not possible to be confident, in them due to the low sample size, lack of statistical testing and the large amount of variance in the data.

The authors also compared the observed behaviours of supervisors that ran their projects within budget for the last two years to those of other supervisors. They found significant differences at the 0.05 level, between the two groups, where supervisors who had a positive record spent more time: 1. monitoring performance; 2, referring to their own performance; 3, communicating on non-work related and 4, spent less time giving antecedents; 5. communicating on other work related topics. They concluded that the same skills were required for effective safety management as were required for effective economic management. This conclusion has to be taken with caution for a number of reasons, but primarily due to the lack of statistical testing of the differences between high and low safety performers.

A recent study[49] conducted in the UK offshore oil and gas industry used a multi method approach to identify the attributes required by first line supervisors to manage safety effectively. Initially behavioural interviews were conducted with 40 supervisors to establish how they managed the safety of their subordinates. Supervisors were classified as effective or less effective in managing safety on the basis of their subordinates self report risk taking behaviour and superior ratings of their performance. The interview data were analysed to identify differences between effective and less effective supervisors. This revealed eight

factors that separated effective from less effective supervisors. A second questionnaire study was conducted to validate the results of the first study. This study confirmed that four of the eight factors separated effective supervisors from less effective. The four factors were:

1. Visiting the worksite more than three times a shift
2. Involving subordinates in planning their work activities
3. Communicating about safety frequently
4. Valuing the contribution of their subordinates

A.4.3 SUMMARY

In the above review of the research has identified attitudes and behaviours that differentiate supervisors that have been effective the management of safety from those that have been less effective.

Table A4: Summary of the attributes of effective supervisors identified

Attributes of effective supervisors	Industry	Research studies
Work in collaboration with employees on safety related activities	Manufacturing	Simard and Marchand[46]
Plan work effectively to remove production and safety conflicts	Railway	Guest, Peccei and Thomas[43]
Involve employees in planning work activities	Offshore oil industry	Fleming[49]
Act in a respectful way towards workers and demonstrate that the contribution of work group members is valued	Railway Offshore oil industry	Guest, Peccei and Thomas [43] Fleming[49]
Communicating about safety regularly	Manufacturing companies/ Offshore oil industry	Smith et al[50] Fleming[49]
Being open with subordinates	Construction	Andressen[42]
Provide feedback on safety performance after the completion of a job	Road maintenance Construction	Niskanen[41] Mattila, Hyttinen and Rantanen[47]
Visit the worksite frequently	Coal mining Construction Offshore oil industry	Weyman[51] Mattila, Hyttinen and Rantanen [47] Fleming[49]

These studies have recommended behaviours and actions that supervisors should adopt to reduce accident involvement. Table A4 summarises the behaviours and actions these studies recommend that supervisors should adopt.

A.5 INTERVIEWS WITH BEHAVIOURAL OBSERVATION AND FEEDBACK PROVIDERS

To produce a comprehensive review of current practice in behavioural safety within the UK it was important to obtain the perspective of behavioural safety providers. In order to capture

their experience a telephone interview was conducted with a range of behavioural safety providers to obtain information about the:

- essential features of effective programmes
- barriers and enablers to effective implementation
- criteria used to establish that the organisation is ready to implement a behavioural modification programme.

A.5.1 METHOD

Behavioural safety providers were identified by reviewing safety publications and through the personal contacts of the author and the HSE project manager. In addition, providers and industry contacts were asked if they were aware of any providers not identified. In total ten providers were identified and contacted by letter, asking them to participate in the project. Although it is possible that some providers may not have been identified, it is likely that representative sample were included. Of the ten who were contacted nine agreed to participate in an interview. Only eight interviews were conducted, as one interview was cancelled due to the provider being unwell.

The telephone interview lasted approximately one hour. The interview schedule consisted of a series of open questions about behavioural safety programmes. The main themes included:

- Essential features of behavioural safety programmes
- Assessing readiness to implement a programme
- Methods to identify critical behaviours
- Management and supervisory behaviours
- Key enablers and barriers to successful programmes
- Integration with HSMS
- Relationship with safety culture

A.5.2 MAIN FEATURES OF A BEHAVIOURAL SAFETY PROGRAMME

Providers were asked to describe the essential features of a behavioural safety programme. Although the programmes offered by the providers differed, it is possible to group their activities under broader headings. Table A5 below summarises the main stages of a behavioural safety programme.

Table A5 Features of behavioural safety programmes

Essential feature	Mechanism
Assess readiness	Evaluate adequacy of systems and procedures to ensure they are mature.
	Expert judgement of readiness
	Assess level of management commitment to safety
	Conduct in-house behavioural readiness check, which involves interviewing staff about the safety culture and HSMS and management commitment
	Hold safety climate workshops
	SWOT analysis
	Ensure managers are willing to involve staff
Assess climate	Conduct safety attitude survey
Gain buy in from frontline staff	Involve them in designing the process
	Brief everybody on site

Table A5 Features of behavioural safety programmes

Essential feature	Mechanism
Give presentations to managers	Give presentation to all management staff
	Give presentation to senior managers
Select co-ordination team/ individual	Select cross section of staff and management
	Identify board level champion
Co-ordinator/ team training	Background to the process
	Identifying critical behaviours
	How to conduct observations
	How to give feedback
	How to analyse data
Identify critical behaviours	Review accident reports
	Develop list collaboratively with frontline staff
	Generic set of at risk behaviours
	Ask frontline staff to identify behaviours
	Consultant expert judgement
	Interview supervisors
	Desired behaviours specified in HSMS
	Risk analysis
	Audit results
Select observers	Ask for volunteers
Observer training	How conduct observations
	How to use checklist
	Interpersonal skills
	Evaluate ability to conduct observations
Assess inter-rater reliably	Two observers conduct observation on same individual and compare results
Conduct baseline observations	Observers conduct initial observations
Set improvement goals	Co-ordinator/ team set goals in participation with frontline staff
Conduct observations	Observe staff and complete check list
	Ask people why they are behaving in a specific way do not debate issue
	Challenge dangerous behaviours
	Self observation
	Targeted observation for infrequently performed activities
Collect and analyse observation data	Coordinator/ team review data and produce charts
	Coordinator/ team collate comments
	Coordinator/ team set improvement targets
Provide feedback to staff	Observers give face to face feedback at time of observation
	Graphical feedback of results are displayed
	Team feedback on the impact of system
	30 minute feedback session each week
Feedback results to senior management	Dependant on local circumstances
	Monthly feedback to management of % safe and level of management support
Review process	Measure quality of team meetings
	Measure level of management support
	Review process after 6 months to identify level of behaviour change
	Biannual external audit offered

A.5.3 ASSESSING READINESS TO IMPLEMENT A BEHAVIOURAL SAFETY PROGRAMME

All providers indicated that they assess the organisations level of readiness in some form or other. At a minimum, providers indicated that they used expert judgement, which was based on a site tour and interviews with managers and staff. At the other end of the scale, some providers had formal assessment processes, involving safety climate surveys, evaluation of the organisations systems and procedures, assessing management commitment and presence of skills. The methods used to assess level of readiness included, surveys, interviews with managers and frontline staff, group discussions, document analysis and site tours.

Although all providers assessed the organisation's readiness, there was less agreement about the existence of minimum requirements before implementing a behavioural safety process. Three of the providers interviewed stated that they would go ahead irrespective of the organisations readiness, as long as the management were committed to the process. They suggested that it is always possible to go ahead, but it is just more difficult. In contrast, other providers indicated that they would not go ahead if the organisation was not ready and they would recommend that they address the potential problems identified before introducing a behavioural safety programme. Interestingly, only one provider could think of an example where they recommended to an organisation that they should not proceed with an implementation at that point in time.

In general, the assessment of readiness appears to be used to identify problems that might be encountered during the process or to enable them to tailor the process the issues identified. This is an interesting finding as there is some research evidence to suggest that organisational readiness is one of the key factors that influences the likelihood of success.

A.5.4 METHODS USED TO IDENTIFY CRITICAL BEHAVIOURS

Providers varied in their approach to identifying the critical behaviours to be observed. Having said this, all providers reviewed previous accidents as a source of critical behaviours. In general, the results of this exercise are combined with other sources of information such as risk analysis, HSMS audits, input from frontline staff and supervisors and expert judgement. In fact, only two of the providers relied solely on accident analysis to identify critical behaviours.

Providers were also asked which method they found most effective for identifying critical behaviours. The preferred methods of providers varied widely, two indicated that accident analysis was most effective, two indicated expert judgement one indicated that shop floor input was critical and the remaining three providers indicated that it depends on the situation.

A.5.5 MANAGEMENT AND SUPERVISOR BEHAVIOURS

The majority of providers (63%) indicated that they included management behaviours in their programmes. The five providers that included management behaviours only included behaviours required to support the behavioural safety programme. Only one of the providers indicated that management behaviours should not be included as the programme was aimed at frontline staff. Although providers currently, only included behaviours that support the process they indicated that there was no reason why other management behaviours could not be included.

A.5.6 KEY ENABLERS TO SUCCESSFUL BEHAVIOURAL SAFETY PROGRAMMES

Providers were asked to identify the factors that facilitate the implementation and long-term success of a behavioural safety programme. Providers identified management commitment to the process as the single most important factor. In addition, half of providers indicated that it is important for middle management to understand the concept of behavioural safety and that they participate in and actively support the process.

It was also suggested that it is easier to implement a behavioural safety programme if workers are already actively involved in safety through safety committees or other mechanisms. The experience of the consultant and their ability to develop a programme, which meets the organisations needs, increased the likelihood of success. Adequate resources, (e.g. staff time to conduct observations) need to be available to the programme in order for it to succeed. The resources required for the programme need to be considered in planning workload levels for staff. A reasonable level of trust between management and staff and the absence of industrial relations issues also increase the likelihood of programme success. In addition, the long-term success is increased if something different or new is introduced on an annual basis to keep the programme fresh.

A.5.7 MAIN BARRIERS TO SUCCESSFUL BEHAVIOURAL SAFETY PROGRAMMES

The majority of barriers identified by providers were the absence of the enablers outlined above, for example a lack of management commitment. A lack of understanding of the level of resource required is also another major barrier as organisations find they cannot sustain the programme over an extended period.

One provider revealed that they were aware of a programme that failed because the co-ordinator rewrote the behavioural observations to meet their own ends. Although this is an isolated case, it does highlight the potential for a programme to deviate from the intended design over time, whether this happens deliberately or not it will limit the impact of the programme. Another provider highlighted the importance of not trying to manage hazards by behaviour modification, where those hazards are more effectively controlled by plant or equipment redesign.

A.5.8 INTEGRATION WITH HEALTH AND SAFETY MANAGEMENT SYSTEM (HSMS)

Seven of the eight providers interviewed indicated that behavioural safety programmes should be integrated with the organisation's HSMS. Although providers agreed that it should be integrated within an organisation's HSMS, there was less agreement about how this should be achieved. A number of providers suggested that a behavioural safety programme could be used to examine the extent to which the HSMS is being used in reality. It is also possible to establish why the system is not being used as proposed in the HSMS. The face to face observation and conversations can identify changes to the HSMS to increase the likelihood that people will comply with the requirements. In addition, the data produced from the behavioural observations could feed into the performance monitoring aspect of the HSMS. The increased employee involvement will enhance the HSMS by empowering the workforce to make suggested changes to the HSMS, which would increase effectiveness and compliance.

Box A.1: Impact of increased employee involvement

In one organisation the introduction of a behavioural safety programme also involved employees in conducting job audits. Employees conducted a job audit on compliance with the procedures for wearing the correct PPE when performing an operation with potential exposure to an irritant. The audit revealed a high level of non-compliance with the PPE requirements, which they investigated and identified some potential solutions. They identified the need for new personal protective equipment and a procedure describing how to put on and take off the personal protective equipment. They obtained management agreement for spending the money and implementing the process. Follow up audits revealed that this intervention had reduced workforce exposure to this irritant material.

Providers also argued that the introduction of behavioural safety programme would increase the effectiveness of other aspects of the HSMS for example accident investigation and risk assessment through participants increased understanding and consideration of behavioural aspects of the task.

One provider indicated that they recommended that a behavioural safety system should be integrated in every aspect of the HSMS including Policy, Organising, Planning and implementing, Measuring Performance, Audit.

In general, providers did not identify barriers to integrating behavioural safety programmes within the HSMS. One provider argued that it was not wise to integrate a behavioural system within the HSMS because workers would see it as a management system and not owned by them. Another provided indicated that integration could cause confusion between the some aspects of the HSMS e.g. audit and behavioural observations.

A.5.9 RELATIONSHIP WITH SAFETY CULTURE

In general, providers indicated that they felt that a behavioural safety programme would improve the safety culture of an organisation. In effect, an improved safety culture was viewed as a long-term indicator of a successful behaviour modification programme. A number of providers argued that behaviour is a subset of culture and therefore changing behaviour was directly changing the safety culture. In contrast, another provider indicated that behavioural change caused cognitive dissonance and therefore employee's attitudes changed to line up with their behaviour. The change in attitudes was in effect improved the culture.

One provider took a different perspective and argued that the culture of an organisation needed to have reached a certain (but unspecified) level of maturity before a behavioural programme could be implemented.

The responses to the questions about safety culture appear to reflect the general lack of agreement or clarity about safety culture among practitioners and the research community.

A.5.10 CONCLUSIONS

All the providers have their own specific approach to implementing a behavioural safety programmes. Having said this there was a large amount of overlap between the providers' programmes. This is not surprising as they are based on the same fundamental psychological research.

A.6 INDEPENDENT BEHAVIOUR MODIFICATION CASE STUDIES

It was recognised that information produced from interviews with behavioural safety programme providers would not give the complete picture of behavioural techniques within the UK, as many companies developed their own programmes. In addition, due to the nature of telephone interviews they limit the about of detail that can be provided about specific interventions. It was therefore decided that three case studies would be conducted to investigate the conditions required and features of effective behavioural safety programmes.

A.6.1 METHOD

The case study organisation were selected and contacted by the HSE project manager. The following criteria were used to select case studies:

1. example of best practice,
2. novel application of behavioural safety techniques,
3. information on potential barriers to successful implementation,
4. evidence of the impact of behavioural safety programmes on risk control,
5. application of behavioural safety within a low hazard environment.

The three case study organisations included a nuclear power company and two low hazard batch process companies. Each case study involved a site visit and interviewing at least four key stakeholders from the participating organisation. These stakeholders included a senior manager, a safety manager and two workforce representatives. In addition, relevant documentation, reports (e.g. safety climate surveys) and statistics (e.g. accident statistics) were reviewed where available to evaluate the effectiveness of the programme. Information about the resource requirements of the programmes was also sought. In one site, the behavioural programme, which was no longer in operation and therefore the aspects of this previous programme and reasons for its failure were investigated.

The data were collected during a one-day visit to each case study site carried out by the author. The site visits were conducted during April and May 2001. The interviews lasted approximately 45 minutes. The purpose of the interviews was to, firstly, to identify the aims and objectives of the behavioural intervention, how the programme was implemented, the impact of the programme on risk control and any lessons learned during the implementation of the programme.

A.6.2 CASE STUDY 1: PROMOTING CRITICAL MANAGEMENT BEHAVIOURS

This case study was conducted in a UK production site of an international chemical company. The UK site conducted a number of batch process operations to produce final and intermediate products. This organisation was selected because its behavioural safety process had been in place for sometime, the intervention focused on management behaviours and the safety manager is a recognised expert in behavioural safety. In addition, the intervention was a recognised success and had been rolled out across the company across the world.

In 1996, this site had reached the plateau in their accident rates and did not seem to be improving. They therefore conducted a Health and Safety audit through an external company. One benefit of conducting the audit was that it to enable the management team to benchmark themselves against the best in the industry. The audit suggested that management needed to focus upon health and safety leadership behaviours. Following this, they decided to introduce

a proprietary system to promote management conversations with front-line staff about safety. This system was given a title chosen by the company. To maintain anonymity it has been called 'Safe System' throughout this case study. Initially external consultants provided training for managers and safety staff. After this initial three day training, safety staff conducted training in-house. In total 400 members of staff or 20% of the workforce were trained in 'Safe System'. The system was designed so that managers and the safety committee at a local level own the system.

A.6.2.1 Aims and Objectives of Programme

The programme aimed to demonstrate management commitment to safety by getting managers to hold face-to-face conversations with frontline staff. In addition, it was proposed that, by visiting the worksite frequently, they would be able to identify and eliminate potential hazards. The ultimate aim of the programme was to reduce accident rates or more specifically increase the number of hours worked without a lost time accident.

A.6.2.2 Process

Although 'Safe System' is a relatively simple process, managers require specific skills to hold effective safety conversations. All managers at front line supervisor level and above were trained in how to hold face-to-face conversations with frontline staff. The training also included input on the importance of managers demonstrating their commitment to safety and causes of accidents. Managers agreed to conduct a number of safety conversations with their team members each month.

The numbers of conversations conducted are tracked at a local level and fed into the safety committee and summary statistics are given to the MD at the local site. When a manager conducts a 'Safe System', they go and visit the worksite, ask the worker about the task they are currently carrying out, identify any potential hazards, give them positive feedback on the safe behaviours that they are working to and highlight any unsafe behaviours. Through the discussion, they identify any actions or improvements required to remove any hazards identified, (e.g. engineering modification or a change in the behaviour of the member of staff). These actions are tracked and as many as possible are closed out at the time. All actions agreed are recorded on the 'Safe System' form. This form is then submitted into a local administrator, who enters the information into a database, which is accessible to all members of staff. Actions that are not closed out at the time are given a date for completion and this is monitored by the safety committee. The summary statistics are placed on a notice board identifying numbers of 'Safe Systems' conducted, actions completed, actions which have a target date for completion and outstanding actions.

A.6.2.3 Review

After six months of operation the 'Safe System' process was reviewed to establish its effectiveness. During this review, it was identified that the quality of the 'Safe System' audits being conducted was not satisfactory. An examination of the complete 'Safe System' forms indicated that a proportion of managers were not having conversations with the member of staff about safety. Following the review it was decided to provide retraining to all 'Safe System' auditors. This training involved the use of scenarios and role-play to give people practice in having conversations with staff about safety. Following the re-training the quality of the 'Safe System' audits improved. In addition, the number of 'Safe Systems' expected was reduced, to emphasise the importance of quality rather than quantity. The number of 'Safe Systems' that managers are expected to do varies across departments, so in some departments

they expect managers to do two per month, while in other departments it's one per month. In addition, the safety committee within departments monitors the action list, so that outstanding actions are tracked to ensure that managers are closing out actions within a realistic timeframe.

A.6.2.4 Impact on Safety Performance

The impact of 'Safe System' on the level of safety within the company is difficult to judge as there were other initiatives going on at the same time. The accident statistics indicate a significant improvement post-'Safe System'. For example, in 1996 the average hours worked before an accident was 100,000, while in 1999 it was 2 million hours, so there does appear to have been an improvement in the level of safety.

A.6.3 CASE STUDY 2: FAILURE OF A BEHAVIOURAL SAFETY PROGRAMME

This case study was conducted within one UK department of a large international organisation. This department produced product for other parts of the business and for external customers. This organisation's experience was selected to be the subject of a case study because they implemented a behavioural safety programme, which was stopped after two years.

A proprietary behavioural safety programme was introduced in 1996 following a sharp increase in lost time accident rates during the previous year. Senior management wanted to identify new safety techniques that could be used to address the increase in accident rates. One of the production managers had received some information from a behavioural safety programme provider and wanted to find out more. Representatives of the management went to a conference to learn about behavioural safety techniques. Through some further investigation, the company identified three potential behavioural safety providers. They met with each of the providers to listen to what their programmes entailed and, finally, selected one provider.

They selected this provider on the basis of their international experience in implementing behavioural safety programmes and the evidence they provided of successful interventions. A member of the management team and a safety advisor also went on a site visit to see this system in operation. They decided to implement this programme in one part of their UK operation, containing approximately 110 employees.

A.6.3.1 Implementation

Once the contract details were finalised the behavioural safety provider initiated the process by conducting a safety climate survey using a proprietary questionnaire. In addition, one of the organisation's consultants came on site for a day and interviewed front-line supervisory and management staff. The initial verbal feedback following the site interviews was very useful and identified distrust between management and staff. Front-line staff felt that safety issues were not being addressed effectively, but managers had the perspective that they were doing their best. The consultancy company provided a written report. This report focused exclusively on the results of the questionnaire data and did not include any of the results from the interviews conducted. In addition, the company felt that this report gave a very different impression than that of the verbal feedback provided by the consultant on the day he conducted the interviews. It was not clear to the company what the purpose of this survey was, as it did not seem to influence the implementation of the process and the results of the survey were not mentioned again.

Following the survey the provider asked the contact within the company to ask for volunteers to join the steering group. The company was not given guidance on the numbers of steering group participants or how to select the steering committee. In total eight members of staff volunteered to join the steering group. The steering group did not contain representatives from each section of the workforce, (e.g. no members of the nightshift volunteered). Once the steering group had been selected, the behavioural safety providers conducted one week's training for the steering committee. The steering committee members varied in their assessment of the quality of this training. Some committee members complained that it focused a lot on promoting the products of the particular provider. During the training the committee members analysed the accident data of the previous three years to identify common behaviours. Through this process, they identified 192 behaviours and condensed these down to 17 main behaviours that formed a checklist for their behavioural safety programme.

A.6.3.2 Behavioural Safety Process

The steering committee set a target for the number of observations they should conduct per month. They were not given any guidance as to what would be a realistic target. They set themselves a target of 20 observations per month per person, which they found impossible to meet. They then sought volunteers to assist them in reaching their target number of observations. Initially, 20 observers volunteered and they attended a two-day training session given by the provider. Even with the extra volunteers they found it difficult to achieve their original target of 160 observations per month (i.e. they did not increase the total target number of observations). Within two years, nearly 90% of the workforce had been trained as observers. However, even with this number of observers, it was difficult to reach the target number of observations set.

Initially, the workforce was hostile to the process, as many frontline staff felt that they were spying on their mates or that managers were absolving themselves of their responsibility for safety. The steering committee realised that the system would not succeed unless they gained the support of key influential members of staff who were critical of the system. It was therefore decided to ask these members of staff to join the steering group. Once these members of staff joined the steering group, the credibility of the programme increased. In addition, it appears that at the same time the focus of the behavioural safety programme seemed to shift away from behaviours towards hazard spotting and fixing staff problems and concerns.

At the end of the first year, the programme appeared to be an overwhelming success, as accident rates had dropped significantly. Managers and members of staff gave presentations about their success at industry and internal conferences. In hindsight, the effectiveness of the programme was questioned because, even though the accident rates had dropped to nearly zero in the first year, this may have been due to luck as historically the accident rates at this site varied widely due to the low staff numbers.

During the second year of the programme management support for the programme dwindled. This meant that there was greater difficulty in getting money for the engineering solutions identified by staff. In addition, the early fixes had been relatively cheap and the safety modifications required later were going to be more expensive. The programme appeared to lose momentum, due to a lack of money to resolve the issues identified during hazard spotting exercises. This meant that, when things were slow to change and people became disheartened.

As time passed, the number of observations dropped and the steering group responded by setting individual targets for each observer. This led observers to do their observations towards the end of the month. The quality of the observations was, therefore, questionable, as they were rushed in to meet the deadline. In fact, one steering committee member indicated that they questioned whether the observations were being conducted at all, as he would not witness an observation being conducted for months at a time. This conflicted with the number of observation sheets being submitted, which suggested that a large number of observations were being conducted and therefore he would have to seen someone conducting an observation regularly.

A.6.3.3 Programme Termination

In the second year, the accident rate returned to its previous level or even a bit higher. Due to the changes in the organisation of the company, it was decided to stop the programme. The steering committee did not agree with this decision, as they felt behavioural safety was a good idea. They were aware that the behavioural safety programme had problems and that it had become stagnant. It also appears that the steering group were unclear about how the process was to be applied and had lost the focus on the behavioural element.

It is unclear what impact stopping the programme had on the level of safety within the organisation. The accident rates of the department continued to fluctuate up and down. Stopping the programme had an impact on morale of some staff members and since then a number of the steering group members, have been unwilling to participate in health and safety initiatives. In contrast, a number of steering group members have become active participants in a safety committee structure, which was implemented following the stoppage of the behavioural safety programme.

In fact, the activities of the safety committee now seem very similar to the hazard spotting exercise being conducted by the behavioural safety steering group. The current safety committee system, which replaced the behavioural safety process, appears to be more representative, as it includes a cross section of the workforce, including nightshift staff. They are systematically working through each task conducted at the site and asking people about potential hazards and how these hazards could be removed. This information is combined with information from accident and risk data to identify potential hazards, which need to be more effectively controlled. The committee meets regularly and assigns members with actions to address hazards identified. The mechanical fixes provide evidence to staff that the committee is working and levels of involvement in safety seem to have increased.

A.6.3.4 Conclusions

There are a number of reasons why the behavioural safety programme was not successful. These include:

- Not involving the workforce involved in the process initially and therefore many staff were suspicious when it started.
- A lack of trust between management and staff
- Poor steering committee selection, which meant it was not representative and did not contain key influential members of staff
- Unrealistic target for the number of observations to be conducted
- The steering committee moved away from behavioural aspects of safety and focused more on physical hazards
- Lack of resources to fix the problems identified

- Lack of consistent management support
- The safety advisor now believes that the site was not ready to implement a behavioural safety programme

It is, therefore, likely that a behavioural approach was not appropriate and that resources targeted at addressing technical problems would have been more effective.

A.6.4 CASE STUDY 3: DEVELOPING AN IN HOUSE PROGRAMME

This case study was conducted within a large multi-site, multinational nuclear power organisation. This organisation was selected as a case study site because it had developed an in-house behavioural safety programme and they were using the data produced as a key safety indicator.

As this is a multi national organisation, a number of sites had implemented different behavioural safety programmes during the late 1990s. Two proprietary programmes were in operation on a number of different locations. These programmes differed in both approach and the nature of data collected. In 1998, it was decided that the organisation would harmonise their approach to behavioural safety by having one programme for all its operations. They also decided that they wanted to develop their own behavioural safety programme, as opposed to using either of the two proprietary programmes that were currently using.

The organisation therefore developed their own behavioural safety programme that could be adopted by all the various sites within their organisation. This had the advantage that there would be one database of all the observations conducted so that performance could be measured in a more systematic way. In addition, the company wanted to develop their own programme to increase their resourcefulness with regard to behavioural safety instead of relying on external consultants. In addition, they felt their own employees would be better placed to design a programme to meet their specific needs.

The new programme was designed around the fundamentals of behavioural safety and contained the standard elements of most behavioural safety programmes. The programme includes:

- peer-to-peer observations
- a checklist of behaviours
- face-to-face feedback to the individual observed at the time
- graphical feedback of the percentage safe / un-safe behaviours
- the reasons why the individual is behaving unsafely and to potential safety improvements are recorded.
- percentage of unsafe behaviours remedied at the time versus percentage put forward for further action is recorded.

In addition, each business group has a manager who acts as a sponsor for the process.

A.6.4.1 Implementation of the Behavioural Safety Programme

The programme was rolled out to each site systematically. The programme consists of a standard framework for implementation, which is adapted for local needs. The organisation's behavioural safety programme consists of four modules. Module one lasts approximately a month, and includes co-ordinator training, implementation planning and a safety climate

survey. The co-ordinator training includes an outline of the aims and objectives of the programme, and the underlying psychological principles behind behavioural safety. The co-ordinator training lasts four days. After the initial training there is the opportunity to modify the remaining parts of the training to fit local needs. In addition, the coordinators plan how the behavioural safety programme will be implemented and how it integrates with other health, safety and environment activities, and how it links with other safety roles.

Following the co-ordinator training a review of the site's safety culture is conducted in order to establish the suitability of the site to implement the behavioural safety programme. In addition, existing safety performance data such loss time and accidents are captured. Once module one is completed, there is a communication and awareness raising activity to make the workforce aware that the behavioural safety programme is going to be implemented within their site.

Module two is a management and union workshop where the process is explained to managers and union representatives, to ensure that they understand their role in the process. Module three is a team workshop where the process is explained to frontline staff. The workshop is designed for a team of 6 - 12 people, and involves the team leader and the team talking about misperception and behavioural safety. During the workshop, participants are asked to volunteer to become observers.

Module four is an observation workshop where volunteers are trained to conduct behaviour safety observations. Within two weeks of completing the observation training, employees are given a coaching session with the local co-ordinator and coaching continues at intermittent periods over the next few weeks. Module three and four plus the coaching all happen within a one month training cycle, so each department receives all its training within one month, including coaching.

A.6.4.2 Process

Once the observations have commenced, the observation data are collected and submitted centrally and entered into a bespoke database. This database allows the organisation to analyse trends of unsafe behaviour, links with potential accidents and incidents, highlight safety improvements and obstacles to working safely. The database can also conduct checks on the quality of observations and the number of observations conducted. The system provides reports at a number of different levels, for example, each co-ordinator can obtain a report broken down for their individual department or location. In addition, senior managers can look at a summary report for the entire organisation, and departmental managers can look at reports for their area or site.

Although there are no names on the behaviour observation forms, each observer is given an ID number and this needs to be put on their observation from. This enables the company to track the number of observations being conducted by specific observers. Only site co-ordinators can access the names of the observers to maintain confidentiality. When the system was rolled out to include the engineering and construction division, co-ordinators found it difficult to get contractor staff to put their numbers of the form. In order to get the system established the co-ordinators put their own ID number on the reports.

The overall results for the percentage safe and unsafe are fed back to participants at a site or department level on a regular basis. In addition, the organisation issues a behavioural safety newsletter on a quarterly basis, to communicate to staff about the programme across the entire organisation. There are also local behavioural safety newsletters, which promote local actions and feedback to staff about the results of the behavioural safety intervention and the impact on incident rates.

A.6.4.3 Impact on the Level of Risk Control

This organisation's safety performance has clearly improved following the introduction of the initial behavioural safety programmes and has further improved following the introduction of their own behavioural safety intervention. An examination of accident statistics revealed that after the implementation of the proprietary programmes the accident frequency rate was roughly half the accident rate of the early 1990s. Initial indications show that, following the introduction of their own behaviour safety programme the accident rate has halved again. In addition, numerous sites are currently reporting zero accidents for a considerable period.

A.6.4.4 Using Behavioural Safety Observation Data to Measure HSMS Performance

One of the benefits for the organisation in developing an in-house, company-wide behavioural safety programme was that they were able to develop a database that they could use to capture the behavioural observations across all their sites. The process has been running for approximately a year and a half, and within that time, they have collected 19,000 observations. This number will increase as time progresses, as the number of observers across the company increases. In fact, they estimate that they will be collecting 17,000 a year. All the observation sheets completed are sent to a central location for processing and are entered by three dedicated data processing employees. These three individuals enter in the number of safe/unsafe or unobserved responses for each behaviour. In addition, they read the reason why the individual was behaving in an unsafe manner. The written response is categorised into one of eight obstacles to safe working using an in-house coding system. In addition, they record the actions to be taken to prevent the unsafe behaviour recurring in the future. Three dedicated individuals are used to code all the data in order to achieve greater consistency in the coding process.

The database system produces eleven standard reports and each report can be broken down to the building level. This data is useful for the site manager to understand where they are at in terms of behavioural safety for the site. It is also possible for site managers to find out about the level of participation at their site, because the number of observations conducted are tracked. Also, by reading the reports submitted, it is possible to assess the quality of the data that has been submitted and the quality of the observations being conducted. This behavioural safety data is now one of the key indicators for the organisation. This clearly shows that behavioural safety can feed into the safety management system under measurement and review. In addition, the conversation with the person being observed identify barriers to safe behaviour, which can be resolved and thus improve the level of safety across the site.

A.6.4.5 Key Enablers to a Successful Behavioural Safety Programme

This organisation has identified a number of factors that increase the likelihood of a behavioural safety programme being successful. These include:

- a management team with a high level of behavioural awareness and involvement in safety before implementing the programme
- high status and effective safety committees
- clear evidence of the need to change, for example a site having an accident rate that is higher than the company average

- the site being ready to implement a behavioural safety programme by having technical safeguards in place and effective systems.

In addition, they also conduct a climate survey to ensure that the culture is suitable for the implementation of a behavioural safety programme.

The face-to-face discussion with the person about why they were behaving in a safe or unsafe way is one of the critical aspects of this behavioural safety programme. This conversation enables the company to understand why a person is behaving unsafely, which means that it is possible to remove barriers to behaving safely. The conversation also enables the observer to get agreement with the individual to change their behaviour.

This organisations experience of proprietary systems has led them to conclude that behavioural safety programmes should not be (top down) management driven or workforce driven (bottom up), but should be based on co-operation. They felt that both of their existing systems were limited because one was more of a top down approach and the other programme took a bottom up approach. They felt a balance between these two approaches was required.

A.6.4.6 Conclusions

This programme clearly demonstrates how the data collected through a behavioural safety programme can be used as one indicator of the state of safety within an organisation. In addition, the systematic collection of barriers to safety behaviour means that improvements implemented across the organisation instead of each site having to identify and solve the problem individually. The fact that the same system is used across the organisation means that managers at board level can get a deeper understanding of the state of health and safety risk control than they could from accident statistics alone. The success of the system to predict future accidents has heightened the importance of the behavioural data.

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